



DOCUMENT CONTROL

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This structure plan is prepared under the provisions of the Shire of Capel Local Planning Scheme No. 8.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

21 August 2024

Signed for and on behalf of the Western Australian Planning Commission:

An officer of the Commission duly authorised by the Commission pursuant to section 24 of the *Planning and Development Act 2005* for that purpose, in the presence of:

Witness:

Date: 26 August 2024

Date of Expiry: 26 August 2034

Table of Amendments

Amendment No.	Summary of the Amendment	Amendment Type	Date approved by the WAPC

Executive Summary

Planned Focus has been engaged to prepare a Structure Plan for the Greenpatch, Lots 9113, 9076, 8019 and (Pt) 9077 Maidment Parade, Dalyellup. The land is the last remaining area of the Dalyellup Beach Estate to be developed and the Structure Plan has gone through an extensive planning process to date to achieve this result.

The vision for the Structure Plan is to:

"Create an attractive residential precinct that sympathetically interfaces with established areas and completes the vegetation corridor that links the central lakes and parks with Regional Open Space to the north.

The subject land is within the Urban Development Zone and is affected by several Special Control Areas, with part of the subject land also affected by a Wastewater Treatment Plant Odour Buffer.

The Structure Plan was originally prepared in accordance with clause 5.10 of the Shire of Capel Town Planning Scheme No. 7, however a new Shire of Capel Scheme No.8 was gazetted on 17 July 2023. The new Scheme continues to require a Structure Plan to be prepared and approved.

This Structure Plan was originally advertised in February / March 2017 (report Version D December 2016, Version 1 Structure Plan layout). For continuity and transparency, this final Structure Plan report is based on the original Version D, however it has been updated as relevant to incorporate:

- The material advertised in January / February 2018 and considered by the Shire of Capel at its meeting on 26 April 2018 in the further report titled "Response to Submissions July 2017". This included Version 2 of the Structure Plan layout which reduced densities and added a new access from Hutt Drive.
- Version 3 of the Structure Plan layout, which reduced the development footprint and further reduced densities, and bushfire compliance commentary from JBS&G submitted to the Western Australian Planning Commission in the period after the Shire of Capel decision in April 2018.
- Updated technical references.
- Modifications requested by the Western Australian Planning Commission in its decision of July 2023.

The Structure Plan is summarised in *Table 1* on the following page:

Table 1: Summary

Item	Data	Structure Plan Ref (section no.)
Total area covered by the structure plan:	22.51 hectares	
Area of residential use proposed:	6.92 hectares ¹	
Total estimated lot yield:	162 residential lots	
Estimated number of dwellings:	162 dwellings	
Estimated residential site density:	23 dwellings per hectare ²	
Estimated population:	405 (based on average 2.5 persons per dwelling)	
Estimated area and percentage of public open space given over to: • Regional Open Space (indicative, subject to confirmation at subdivision stage)	3.9933 hectares	
District Open SpaceNeighbourhood ParksLocal Parks	0 hectares 6.2548 hectares / 1 park 0.4052 hectares /2 parks	
Estimated percentage of natural area:	10.6533 hectares / 47.32%	

¹ This figure reflects the total area proposed for residential land use (exclusive of areas of public open space, community purposes and road reserves and accesses), and does not represent the full extent of the development footprint necessary to implement the Structure Plan.

 $^{^2}$ Estimated residential site density relevant only to the area proposed for residential development (as per the above notation) and does not include the full extent of the development footprint.

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Appendix Three: Flora & Fauna Assessment

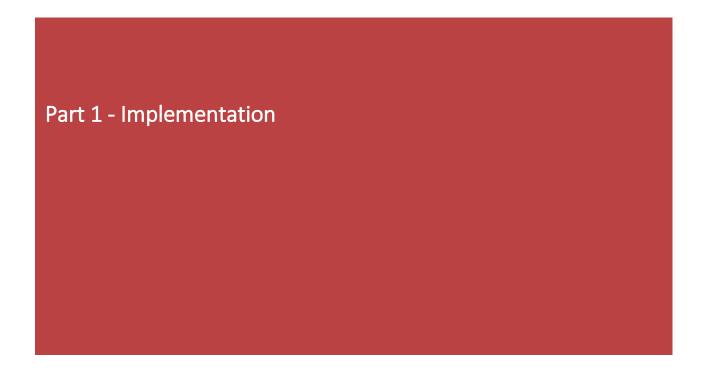
Appendix Four: Geotechnical Report

Appendix Five: Local Water Management Plan

Appendix Six: Bushfire Management Plan

Appendix Seven: Traffic Assessment

Appendix Eight: Detailed Site Investigation



1 Structure Plan Area

This Structure Plan applies to Lots 9111, 9076, 8019 and (Pt) 9077 Maidment Parade, Dalyellup, being the land shown in *Figure 1*, Structure Plan map.

2 Operation

This Structure Plan is in effect from the date stated on the cover and for a period of 10 years (or for any other period approved by the Western Australian Planning Commission).

3 Staging

Due to the topography of the site bulk earthworks for the entire development may be completed as part of the first stage and stabilised. The development will be implemented in stages, dependant on market conditions.

Staging will consider the provision of appropriate drainage basins and Bushfire Management plan principles and buffers. An indicative staging plan has been provided in Part 2 and will be finalised prior to subdivision.

4 Subdivision and development requirements

The Structure Plan outlines the Zones and Reserves applicable within the Structure Plan area, and these will guide future rezoning, subdivision, and development of the land.

4.1 Land use zones and reserves

Land Use Permissibility within the Structure Plan area shall generally be in accordance with the corresponding Zone or Reserve under the Scheme.

4.2 Density and development

- 4.2.1 Residential densities applicable to the Structure Plan area shall be those residential densities shown on the Structure Plan.
- 4.2.2 The Structure Plan shall provide for a minimum of 12 dwellings per site hectare at the subdivision approval stage.

4.3 Bushfire protection

Any application for subdivision approval over the Structure Plan area is to demonstrate how areas of public open space are to be developed to low threat standards in accordance with the recommendations of the bushfire management plan (Appendix Six). In this regard, a landscape concept plan is to be prepared and submitted with an application for subdivision approval which, in addition to bushfire mitigation measures, is to address ongoing management requirements of the Shire of Capel. The landscape concept plan shall inform the preparation and approval of a landscape management plan which is to be required as a condition of a subdivision approval.

An application for subdivision approval is to be accompanied by suitable information which clarifies appropriate implementation measures as part of subdivisional works to comply with State Planning Policy 3.7 - Planning in Bushfire Prone Areas and the Guidelines for Planning in Bushfire Prone Areas.

4.4 Management of environmental or landscape features

The structure plan seeks to optimise the retention of significant environmental and landscape features.

The proponent holds a conditional approval under Part 9 of the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) for the clearing of no more than 13.37 ha of native vegetation within a defined clearing footprint (refer Appendix Two, page 7).

A fauna survey is to be prepared and is to accompany an application for subdivision approval to determine the fauna species likely to be impacted by subdivisional works.

A fauna management plan will be required to be prepared and implemented prior to subdivisional works to minimise the impact of clearing and development on wildlife, to be required as a condition of subdivision approval.

Several trees have been identified within the structure plan area which have a diameter at breast height of greater than 50 centimetres. The structure plan seeks to optimise the retention of significant trees within road reserves and areas of public open space as part of subdivision design, site works and earthworks where viable.

Any application for subdivision approval over the structure plan area should identify significant trees which are proposed to be retained in road reserves and areas of public open space which are proposed to be retained as part of the subdivision design (refer Figure 5).

4.5 Decontamination and remediation

Lot 9113, which forms the western portion of the Structure Plan area, is classified as 'possibly contaminated - investigation required' under the *Contaminated Sites Act 2003 (WA)*.

Applications for subdivision approval over the affected land are to demonstrate the suitability of the land for its intended purpose. On advice of the Department of Water and Environmental Regulation, the WAPC may impose conditions of approval relating to site contamination and remediation if deemed necessary.

Prior to the creation of titles for new residential lots over the affected land, Lot 9113 must be appropriately reclassified under the *Contaminated Sites Act 2003* to a classification that is consistent with the intended residential use.

4.6 Urban Water Management Plan

The Structure Plan is supported by a Local Water Management Plan which has been approved by the Department of Water and Environmental Regulation (refer Appendix Five). Subdivision of the land is to be consistent with the principles and objectives of the approved Local Water Management Plan.

Urban Water Management Plan/s prepared for the Structure Plan are to be consistent with the approved Local Water Management Plan and are to address matters including (but not exclusive to) the identification of drainage basins having regard to landscape planting and the protection of remnant vegetation, acceptable use of groundwater for groundworks and potential household use and groundwater management and irrigation.

4.7 Bulk earthworks and extractive industry approval

Dependant on the potential removal of excess material associated with bulk earthworks to achieve subdivision within the Structure Plan area, a development application and licence for an Extractive Industry maybe required by the Shire of Capel.

4.8 Community purposes

The Structure Plan identifies land for Community Purposes. Alternative land use outcomes may be contemplated by the Western Australian Planning Commission at the time of subdivision approval. As noted in the Structure Plan map (Figure 1), this may include an extension of the adjacent Residential development and as demonstrated by Figure 2.

5 Local Development Plans

Local Development Plans are to address where relevant the following principles and issues:

- a) Orientation and design of built form and major openings to achieve passive surveillance of the street and or Public Open Space.
- b) Uniform fencing for lots directly abutting Public Open Space of appropriate height and character that achieves visual permeability and an appropriate parkland interface.
- c) Restriction of vehicle access.
- d) Garage location; and
- e) Setbacks.

6 Other requirements

The developer is to make satisfactory arrangements with the Shire of Capel to provide proportional contributions towards items of development infrastructure defined within the Shire of Capel Town Planning Scheme No. 8 for Development Contribution Area SCA2/ DCA2 – Dalyellup.

7 Additional information

Additional Information	Approval Stage	Consultation required
Staging Plan.	Subdivision or development application.	Shire of Capel/WAPC
Provision of a new MATV site including suitable arrangements for access, maintenance, and long-term ongoing management.	Subdivision or development application.	Shire of Capel/WAPC
Traffic assessment as required to support subdivision.	Subdivision or development application.	Shire of Capel
Landscape Concept Plan, demonstrating how the Asset Protection Zone will be classified as excluded in accordance with Australian Standard 3959.	Subdivision or development application.	Shire of Capel/WAPC
Landscape Management Plan.	Condition of subdivision approval	Shire of Capel/WAPC
Updated Bushfire Management Implementation table	Subdivision or development application	Shire of Capel/WAPC
Bushfire Management Plan implementation.	Condition of subdivision approval	Shire of Capel/WAPC
Urban Water Management Plan/s as required to support subdivision.	Condition of subdivision approval	Shire of Capel/Department of Water & Environmental Regulation
A Tree Retention Plan demonstrating significant trees (a diameter at breast height greater than 50cm) which are capable of retention in areas of public open space or road reserves.	Subdivision or development application.	Shire of Capel/WAPC
Provision of a constructed road access to the eastern boundary of Lot 9077.	Subdivision application and condition of subdivision approval.	Shire of Capel
Preparation of a Fauna Survey over the Structure Plan area.	Subdivision or development application	Department of Biodiversity, Conservation & Attractions/WAPC
Preparation, approval, and implementation of a Fauna Management Plan.	Condition of subdivision approval.	Department of Biodiversity, Conservation & Attractions/WAPC
Public Open Space schedule.	Condition of subdivision approval.	Shire of Capel/WAPC
Public Open Space Management Plan.	Condition of subdivision approval.	Shire of Capel/WAPC
Bulk Earthworks and Construction Management Plan.	Condition of subdivision approval	Shire of Capel/WAPC
Management of Mosquito breeding and ongoing management and maintenance.	Condition of subdivision approval	Shire of Capel

^{*} where Table 7 refers to 'subdivision or development application', this information is required to be provided or addressed as part of any application made to a decision-maker for approval to subdivide or develop land.



GREENPATCH STRUCTURE PLAN

GREENPATCH SITE - LOTS 9113, 9076, 8019 & Pt 9077 Maidment Parade, DALYELLUP



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1 Planning background

1.1 Introduction and purpose

The subject land is the last remaining parcel of undeveloped land in the north western corner of the Dalyellup Beach Estate.

Planning for this site has been extensive, and has particularly been subject to resolution of a number of design principal matters, as well as guidance on a number of external influencing factors including:

- Preservation of vegetation and habitat.
- Provision of open space assets.
- Bushfire risk.
- Delineation of the Water Corporation Wastewater Treatment Plant Buffer.
- Environmental assessments including with regards to impacts from the mineral waste disposal site.
- · Vehicle access and interface considerations with surrounding land; and
- Density and responding to site opportunities and limitations.

These matters have now been sufficiently progressed to enable preparation of this Structure Plan. This Structure Plan supersedes previously prepared concept Outline Development Plans.

1.2 Land Description

1.2.1 Location

The land is legally described as Lot 9113 on DP 426078, Lots 9076 and 8019 on DP 55511, and (Pt) Lot 9077 on DP 607016. Pt Lot 9077 is the accessway that dissects the site from Maidment Parade, known as Minninup Road, that provides access through to the balance of Lot 9077 that adjoins the western boundary of the subject land. Copies of Certificates of Title are provided at *Appendix One*.

1.2.2 Area and land use

The subject land is 22.51 ha in area (including the central accessway known as Pt Lot 9077) and has frontage to Norton Promenade, Hutt Drive and Maidment Parade in Dalyellup.

The land is presently undeveloped and comprises a mix of vegetated areas and open grassland. The western side of the land slopes up towards the west, whilst the eastern and northern sides are flatter.

There is the former sand quarry and Dalyellup Millenium Inorganic Chemical waste disposal facility adjoining to the west and a drainage basin within the southern portion. To the north of the subject land is Regional Open Space, and further away within this is a Wastewater Treatment Plant. There are established residential houses opposite in Hutt Drive and Maidment Parade.

The former sand quarry and Dalyellup waste disposal facility to the west is under rehabilitation. Although previously identified as future sporting fields with beach access, this is no longer proposed and this land is likely to remain as presently designated for endemic planting, falling within the Regional Open Space reservation and buffer to the Wastewater Treatment Plant.

2 Planning framework

2.1 Zoning and reservations

The subject land is within the Urban Development Zone of the Shire of Capel Local Planning Scheme No.8 (LPS8). The subject land is also within several Special Control Areas. These relate Development Contributions (SCA2/DCA2), Public Drinking Water (SCA7) and Regional Ecological Linkages (SCA8), with part of the subject land also within the Wastewater Treatment Plant Odour Buffer (SCA5) under the Greater Bunbury Region Scheme.

This Structure Plan was originally prepared in accordance with clause 5.10 of Shire of Capel Town Planning Scheme No. 7, which has since been revoked and replaced with LPS8 upon its gazettal on 17 July 2023. The requirement to prepare a Structure Plan for the land remains in LPS8 by virtue of the Urban Development zoning of the land.

The Structure Plan was originally prepared with regard to the *Planning and Development (Local Planning Schemes) Regulations 2015* that took effect on 19 October 2015 and the *Structure Plan Framework (August 2015)*. This includes the change from an Outline Development Plan to a Structure Plan.

Shire of Capel District Town Planning Scheme No.8

The site is zoned "Urban Development" under the Shire of Capel Local Planning Scheme (LPS8). The purpose of this zone is to designate land for future urban development and to provide a framework for the preparation and approval of a Structure Plan prior to subdivision and development. The zoning is intended to be flexible to overcome the inherent problems associated with the detailed zoning of land prior to lot boundaries being established for subdivision and development.

The Structure Plan represents a fundamental step in this process, delineating the basis for new development to progress within the subject land.

In relation to the Special Control Areas that apply under LPS8, and although introduced after the Structure Plan was prepared, it is considered these have still in effect been given due regard. For example, no residential development will occur with the Wastewater Treatment Plant Odour Buffer. The suitability of the land for residential purpose has been thoroughly explored, including from a contamination and environmental values perspective.

The land is subject to the requirements of Development Contributions Plan (SCA2/DCA2) which specifies the contributions required to be paid for new development as it occurs within Dalyellup, payable at subdivision stage.

2.2 Local planning influences

Dalyellup Beach Estate Local Structure Plan 2020

The Dalyellup Beach Estate Local Structure Plan (DBELSP) was endorsed by the Western Australian Planning Commission (WAPC) in May 1999 and applies to the western portion of Dalyellup, generally west of Dalyellup Boulevard. The Dalyellup Beach Estate is now substantially developed save for the Greenpatch and the final stages in the south western corner near to the Dalyellup Surf Club.

Various amendments have occurred to the DBELSP since it was originally prepared in 1999, culminating in Amendment No. 14 in November 2020.

In this plan, the subject land has remained identified as "Area for Further Investigation for Urban Land Use Options" with annotation stating "future urban land use options to have regard to odour buffer requirements". Since this annotation was applied, the odour buffer has been resolved and this is now defined by the Greater Bunbury Region Scheme and LPS8. The proposed Structure Plan area aligns to this.

The DBELSP identifies an indicative Community Purposes site within the Structure Plan area which is to be further investigated through detailed planning for the land. The intention of this was to provide for community facilities, co-located with the planned district sporting facility on Lot 9077 (Millennium Sports Precinct).

This Structure Plan responds to this, identifying land for a proposed Community Purpose facility, located along the western site boundary and adjacent to the Regional Open Space reservation.

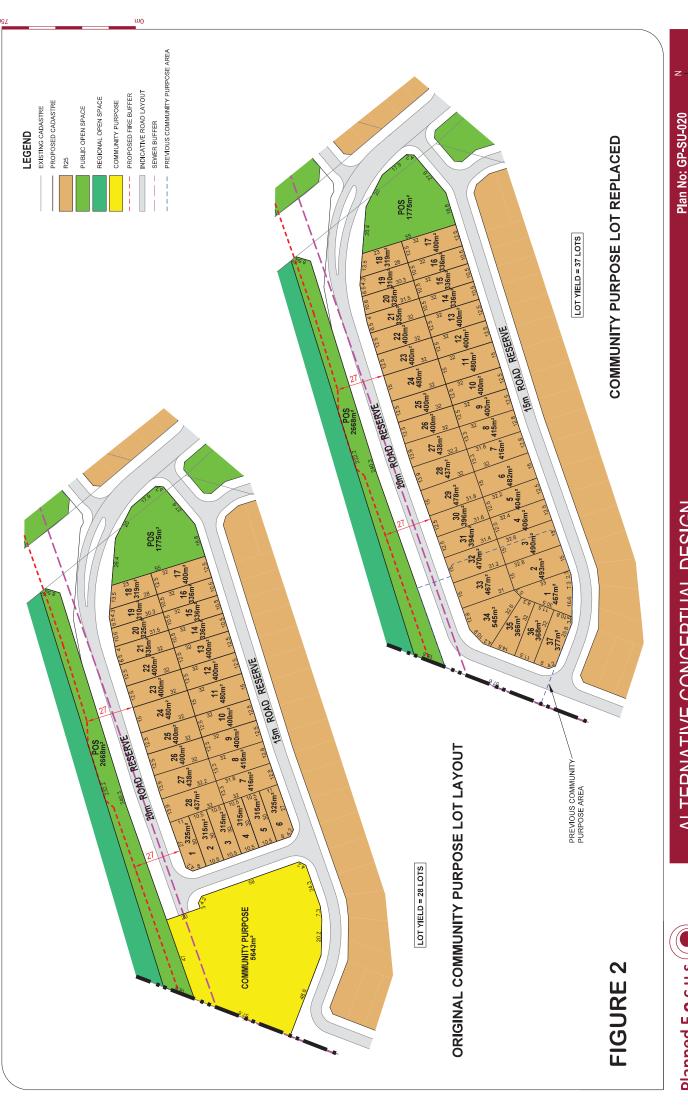
Since preparation of the Structure Plan, Lot 9077 has been deemed unsuitable for a sporting facility due to site contamination.

Provision of an alternative site for Community Purpose elsewhere in Dalyellup Beach, outside of the Greenpatch Structure Plan area, would be subject to discussion and a concluded agreement between the proponent and the Shire of Capel.

At the subdivision stage, the WAPC (in consultation with the Shire of Capel) may consider alternative zones/land uses, including Residential as an extension of the adjacent residential development to round off the proposed subdivisional pattern. This alternative land use scenario is demonstrated by Figure 2 and acknowledged by the Structure Plan map (refer Figure 1) and section 4.8 of Part One.

Shire of Capel Local Planning Strategy July 2023

The Western Australian Planning Commission approved the Shire of Capel Local Planning Strategy in hand with LPS8. Dalyellup is identified as a primary residential growth area within the Shire, with the subject land identified as future urban land abutting Regional Open Space to the north and west.



ALTERNATIVE CONCEPTUAL DESIGN

GREENPATCH SITE - LOTS 9113, 9076, 8019 & Pt 9077 Maidment Parade, DALYELLUP

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2.3 State and regional planning

Greater Bunbury Region Scheme and Strategy

The Greater Bunbury Region Scheme (GBRS) and Strategy (2011) are intended to guide urban and regional land use planning, growth and infrastructure delivery in the Greater Bunbury Sub-Region from 2011 to 2031 and beyond. The Strategy is particularly underpinned by themes of a compact and connected sub-region, advocating for increased residential densities that make more efficient use of liveable and well-designed urban areas.

Population targets are established within the Strategy, and Dalyellup is recognised as one of the large new residential areas within the region that will contribute to the achievement of this. Within these targets and goals however is also the inherent obligation to ensure that new development is sensitive to the environment, and preserving the characteristics that make the Greater Bunbury region unique.

The proposed Structure Plan delivers new residential development in a manner that is responsive to the opportunities and constraints of the subject land. Densities are achieved through appropriate location within the middle of the site, whilst interfaces with surrounding established residential development have been thoughtfully considered through the limitation of new vehicular access and the siting of low density lots.

Importantly, the GBRS reserves Regional Open Space, including prolifically along the coast to the Indian Ocean, stretching from Bunbury to the southern extent of the GBRS area. This includes but is much broader than the recently proclaimed Kalgalup Regional Park that now abuts the northern side of the subject land.

Bunbury Geographe Sub Regional Planning Strategy

This was adopted by the Western Australian Planning Commission in January 2022, superseding the former Greater Bunbury Strategy 2011. The Strategy identified the Bunbury Metropolitan Area, inclusive of Dalyellup, promoted as Western Australia's second city, and a major focus for population and employment growth.

With a horizon to 2050, the strategy plans for a step change in the magnitude of the sub-region's population and economy, in a manner that leverages the sub-regions strengths and maintains its uniqueness. This Structure Plan is considered to deliver on these aspirations, achieving residential growth balanced with environmental considerations, in a locality identified for growth.

South West Regional Planning and Infrastructure Framework

This was released in December 2015 and also provides strategic direction for future growth and development within the broader South West region. The document also outlines the infrastructure projects necessary to underpin and realise these aspirations.

Whilst this is a region level strategic document, the desire to create sustainable communities is fundamental. The document states that the WAPC will support the development of sustainable communities by:

- "1. Planning for settlements in the region to be truly liveable, with a strong sense of place, high quality of life and that are designed to be environmentally sustainable through:
- Promoting mixed use and higher density residential forms in appropriate locations and in major cities and towns.
- Facilitating high quality urban design that is sensitive to, and enhances the identity and character of the south-west's towns and settlements.
- Ensuring that new development reflects and enhances the natural, cultural, visual and built character of the local and regional landscape.

GREATER BUNBURY REGIONAL SCHEME

GREENPATCH SITE - LOTS 9113, 9076, 8019 & Pt 9077 Maidment Parade, DALYELLUP

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- Ensuring that new development reflects the south-west's climate and incorporates climate design principles, including orientation, siting, passive climate control, sustainable recycling, and efficient water management; and
- Retaining the characteristics that make settlements unique and give them their sense of place."

And

- "5. Building on existing communities with established infrastructure and services by supporting strategies and plans that:
- Identify and use vacant and under-used land for higher densities where these can be achieved without detriment to neighbourhood character or the natural environment and encourage carefully planned urban expansion."

The proposed Structure Plan has encapsulated these desires, delivering a mixed density of new housing opportunities within an established residential area, which at the same time has minimal negative impacts upon surrounding development and the natural environment.

State Planning Policy No.1: State Planning Framework

State Planning Policy No. 1 (SPP1) sets out the key principles for land use planning and development which apply throughout the State. It brings together existing regional policies and plans into an ordered hierarchy to guide decision making on land use and development. Local governments are required to have "due regard" to the provisions of state planning policies in the preparation of planning schemes and consideration of planning matters.

The Structure Plan is consistent with the primary aim and key principles of SPP1 and the relevant planning instruments which are incorporated into SPP No.1 by reference.

Liveable Neighbourhoods 2008 & Draft 2015 version

Liveable Neighbourhoods provides guidance to the design and assessment of subdivisions and structure plans. The principle aims of Liveable Neighbourhoods are to:

- "Provide for an urban structure of walkable neighbourhoods clustering to form towns to reduce car dependence;
- Ensure walkable neighbourhoods and access to services and facilities;
- Foster a sense of community;
- Provide an interconnected network of streets;
- Ensure active street land use interfaces;
- Facilitate mixed use urban development to provide a wide range of living, employment and leisure opportunities;
- Provide a variety of lot sizes and housing types;
- Provide an integrated approach to the design of open space and urban water management; and
- To maximise land use efficiency".

The Structure Plan has been designed with regards to contemporary subdivision practice. Regard was given to the original Liveable Neighbourhoods and remains consistent with the updated Draft 2015 version. Key features of Liveable Neighbourhoods reflected in the Structure Plan include:

- A range of low to medium density lot sizes, designed to respond to the topography. Medium
 density lots are located centrally within the site, adjoining open space areas, whilst the lowest
 density are at the interface with Hutt Drive.
- The subject land is within 1km of schools and local shops, and 1.5km from the Dalyellup district shopping centre and services. The land immediately abuts regional and local public open space and is less than 350m to the Indian Ocean. The site is well positioned to accommodate the densities proposed.
- 15 metre road widths and circulating roads that respond to the topography. The main entry road will be grade separated with an avenue feel to ensure a sense of entry into this stage of the Estate.
- Drainage requirements have been combined with open space and conservation obligations.
 Open space is extensive and provides additional separation from existing development in Maidment Parade.
- The area within the SCA4 buffer does not include residential development.
- Environmental and fire considerations have influenced the design of the Structure Plan, and separation of new development from established vegetation required to be retained.

2.4 Planning policies

Urban Landscape policy

This policy sets out policy requirements for landscaping in new urban areas. It will be applicable at subdivision stage and has been given regard in development of the Structure Plan. A requirement of the Structure Plan is for the preparation and approval of a Landscape Management Plan as a condition of subdivision approval. The plan should establish general principles for the development of public open space in context of measures identified in the Bushfire Management Plan.

2.5 Other planning influences

A substantial planning background has preceded and guided the development of the overall Dalyellup Beach Estate, at a State, regional and local level. The most pertinent planning background to the subject land is described above, however the following are also applicable and have been given regard in the preparation of this Structure Plan:

- State Planning Strategy 1997
- Bunbury- Wellington Region Plan and Greater Bunbury Structure Plan 1995
- Usher, Gelorup and Dalyellup District Structure Plan 1992

2.6 Pre lodgement consultation

Consultation has occurred with the Shire of Capel throughout the evolution of this plan.

3 Site conditions and constraints

The subject land represents the last pocket of undeveloped land in the north western portion of the Dalyellup Beach Estate. Whilst there is a desire for continuity with many of the design features from the remainder of the Estate, there is also opportunity to learn from these experiences and to capitalise upon what has worked well, and to respond to the features of this part of the Estate.

The subject land has edges that are clearly defined by:

- Regional open space (northern and western extent).
- Traditional residential (southern extent); and
- Ranch lifestyle lots (eastern extent).

These are key features driving the design response along with a number of other matters, listed as follows:

- The odour buffer from the wastewater treatment plant excludes residential development from the north western corner of the site.
- The access leg for the adjacent Lot 9077 divides the site into two halves.
- Each side of the Lot 9077 access leg has different characteristics, with the western side The site has linkages with existing regional and local open space areas and corridors that characterise the Dalyellup Beach Estate.
- Existing drainage and low-lying areas of the subject land connect directly with existing open space and drainage areas in surrounding land.
- Opportunity for vehicular access via both Hutt Drive and Maidment Parade.
- Parts of the site are elevated and steep, elsewhere is lower lying and flat.
- Parts of the site contain native vegetation and habitat for protected species.
- The site is identified as Bushfire Prone.
- Given topography and other site features, parts of the site are physically separate and distinct to surrounding established neighbourhoods.
- Effective fire management and vegetation retention are competing interests.
- There is opportunity to mirror existing residential development along Hutt Drive.
- There is opportunity to relocate the MATV site; and
- Ability to deliver various densities, establishing an individual character for this part of the Dalyellup Beach Estate.

These matters are visually represented in the Environmental Factors Plan at Figure 4.

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ENVIRONMENTAL FACTORS PLAN

GREENPATCH SITE - LOTS 9113, 9076, 8019 & Pt 9077 Maidment Parade, DALYELLUP



3.1 Biodiversity and natural area assets

The site has conditional clearing approval under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the clearing of no more than 13.37ha of native vegetation within the Structure Plan area. This includes a recently approved variation. A copy of this approval is provided at *Appendix Two*. This approval was informed by the Flora and Fauna assessment provided at *Appendix Three*.

This process has examined environmental impacts on listed threatened species, namely the Western Ringtail Possum (WRP) and the three black cockatoo species (Carnaby's Black Cockatoo, Forest Redtailed Black Cockatoo and Baudin's Black Cockatoo).

The design of the Structure Plan seeks to achieve a balance between efficient use of urban land and retention and creation of strategic vegetation and landscape linkages, that will also serve to preserve habitat, generally and for the identified threatened species.

Key recommendations from these assessments are:

- The proposal will necessitate the removal of native woodland vegetation potentially containing habitat for Western Ringtail Possums (WRP), Forest Red-tailed Black-Cockatoos (FRTBC), Baudin's Black- Cockatoos (BBC) and Carnaby's Black-Cockatoos (CBC). All four species are listed Threatened species under the EPBC Act and the Wildlife Conservation Act 1950 (WC Act).
- Replanting vegetation to replace habitat lost within the site creates fire management issues.
- Given the potential impacts of the proposal on black cockatoos and WRP, an offset is required to mitigate potential impacts to the species in accordance with the EPBC Act. In this regard, an offset site has been secured and necessary approvals for this are in place.

The plan at *Figure 5* identifies trees from the Environmental Factors plan in context of the Structure Plan layout.

Several trees have been identified within the Structure Plan area which have a diameter at breast height greater than 50 centimetres. Consistent with the aim of the Structure Plan to optimise the retention of significant environmental and landscape features (refer section 4.4), the Structure Plan seeks to encourage the retention of these significant trees in road reserves and areas of public open space through subdivision design where viable, having regard to factors including topography, tree condition and engineering design.

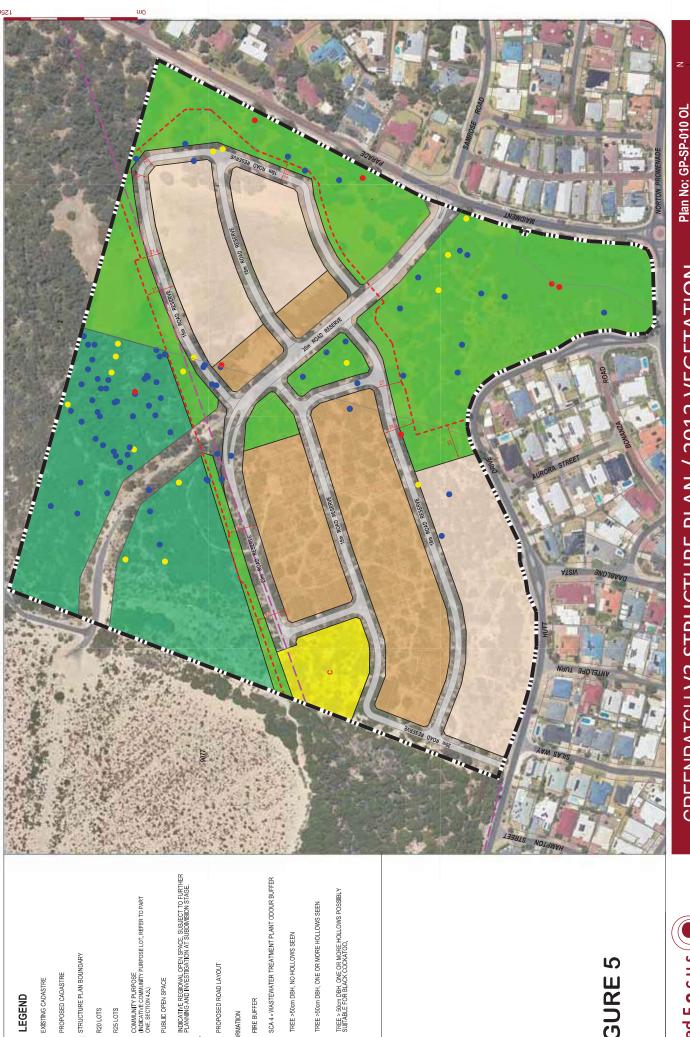
3.2 Landform, soils and water matters

The geology of the site is largely safety bay sand. There are swamp deposits in the eastern portion and sand in the north-west corner.

The topography of the site is RL 4.0m AHD in the low lying marshland in the north east, rising up to a maximum elevation of approximately RL 39.0 AHD on the western half. Some sections have a steep gradient of more than 20%, whilst other areas are relatively flat.

Galt has prepared a Geotechnical Report which also evaluates Acid Sulphate Soils and Groundwater. A copy of this is provided at *Appendix Four*.

This report concludes that from a geotechnical perspective, the site is capable of supporting a residential subdivision.



TREE >50cm DBH, NO HOLLOWS SEEN

PROPOSED ROAD LAYOUT

OTHER INFORMATION

PUBLIC OPEN SPACE

STRUCTURE PLAN BOUNDARY

EXISTING CADASTRE

LEGEND

GREENPATCH V3 STRUCTURE PLAN / 2012 VEGETATION

GREENPATCH SITE - LOTS 9113, 9076, 8019 & Pt 9077 Maidment Parade, DALYELLUP

Planned F o c u s (

FIGURE 5

Town planning & strategy

Whilst there is Acid Sulphate Soil detected in locations, this is manageable through targeted treatment. The remainder of the site is classified as non – Acid Sulphate Soil. An Acid Sulphate Management Plan may be required during the construction phase. In the event of dewatering, treatment of groundwater is unlikely to be required to correct PH levels.

There is an existing water management plan applicable to Dalyellup Beach Estate.

3.3 Local Water Management Strategy

JDA Consultant Hydrologists were engaged to prepare a Local Water Management Strategy (LWMS) for the site (October 2016) and version c of this strategy was approved in May 2017. This document builds on the Dalyellup Water Management Plan (JDA, 2010) which addresses water management issues across the Dalyellup Beach Estate. The area subject to this Structure Plan for the Greenpatch was not specifically considered as part of the Dalyellup Water Management Plan hence necessity for a new LWMS.

The LWMS provides an understanding of the existing surface water and superficial groundwater and provides advice on seasonal groundwater variation, water quality considerations and stormwater drainage issues. The LWMS provides a framework for the application of total water cycle management to the development and protection of environmental values.

The proposed water management system for the Structure Plan area is consistent with water sensitive design practices and meets key LWMS objectives and criteria, which are detailed in the approved strategy document.

It will consist of a pipe network and overland flow for the conveyance of stormwater runoff, and basins to infiltrate runoff from the proposed development. Basins are to be vegetated and landscaped and located within POS areas and designated landscape buffers.

Water quality management will be achieved through a treatment train approach including the application of non-structural controls to reduce nutrient input and structure controls for entrapment of nutrients through soil absorption and/or vegetation uptake. The principle of improving the water quality in comparison to existing water quality will be adopted for the structure plan area. Specific detail relating to water quality management for the site is detailed in the LWMS.

The proposed stormwater management system for the Structure Plan area is shown in Figure 15 of the LWMS and will consist of infiltration basins that have been designed to contain runoff from the 1% AEP (100 year ARI) storm event to a maximum depth of 1.2m. Basin inverts have been set 500mm above the estimated design groundwater level. Detailed explanation regarding Small, Minor and Major storm events can be reviewed within the LWMS.

A full copy of the approved Local Water Management Strategy is attached as *Appendix Five* noting further Urban Water Management plans will be necessitated to implement this overall strategy.

3.4 Bushfire hazard

The whole of the subject land is Bushfire Prone, as depicted in the Department of Fire and Emergency Services Map of Bush Fire Prone Areas. This compels a Bushfire Hazard Level assessment to be undertaken, and for management recommendations arising from this to be integrated into the Structure Plan.

To this effect, a Bushfire Management Plan (BMP) has been prepared and the recommendations have been incorporated into the Structure Plan. This initial report is provided at *Appendix Six*.

The BMP assesses the likely risk and Bushfire Attack Level (BAL) implications for proposed lots and makes a range of recommendations for implementation through the Structure Plan and future subdivision proposals. These address general risk management obligations as well as:

- A maximum BAL 29 rating being applied to any dwelling on future residential lots, with particular recommendations relevant to the north east corner of the developable area.
- Recommendations for vegetation management in asset protection zones; and
- Providing public road access to Hutt Drive.

Additional reviews of the BMP have been undertaken, including by Bushfire Prone Planning in June 2017 and by Strategen JBS&G in 2022 following evolution of the Structure Plan map. These reviews are provided at Appendix Six.

Implementation of bushfire mitigation measures (as updated) and the bushfire management plan will occur as part of subdivision of the land.

3.5 Heritage

There are no known, recognised heritage features within the subject land. The land is also not identified on the Aboriginal Cultural Heritage Inquiry System.

3.6 Coast and foreshores

Part of the subject land is described as being coastal in character however the subject land does not have direct coast frontage. Topography and development implications of being within a coastal environment have been taken into consideration within the Structure Plan. This particularly relates to the comprehensive environmental assessment that has occurred, as well as the earthworks and retaining that will be necessary in this part of the site, and the lot sizes and site layout that have been nominated for here.

3.7 Context and other land use constraints and opportunities

Possible Site Contamination

Adjoining the Greenpatch site to the west, and not part of the Structure Plan area, is a former sand quarry and the Dalyellup Millenium Waste Disposal Facility (balance area of Lot 9077 Deposited Plan 60716). This land is classified as remediated for restricted use and is limited to endemic bushland. Pt Lot 9077 (the internal accessway intersecting through the Structure Plan area) has also been classified as 'not contaminated- unrestricted use'.

In relation to the subject land, Lots 9076, 9113 and 8019 were classified as "possibly contaminated – investigation required" under the Contaminated Sites Act 2003 (WA) on 6 November 2020.

Following this, RPS Australia Pty Ltd prepared a Detailed Site Investigation (DSI) for this land dated 15 October 2021. A copy of this is provided in *Appendix Eleven*.

Subsequently, in November 2021 Lots 9076 and 8019 were classified as "not contaminated – unrestricted use" under the Contaminated Sites Act.

In relation to Lot 9113, a Remediation Action Plan (RAP) has been prepared by RPS, reviewed, and endorsed by the Contaminated Sites Auditor to address the impacted portion of Lot 9109, noting this is a discrete area to be remediated relative to the former Eastern Turning Circle area and not the whole lot.

Following completion of the remediation program RPS will prepare a Site Remediation Validation (SRV) report for review and endorsement by the Contaminated Sites Auditor. The Contaminated Sites Auditor will then prepare a Mandatory Auditors Report (MAR) for submission to the Department of Water and Environmental Regulation (DWER) confirming the extent and findings of the remediation program and making recommendations for reclassification of the site.

It is anticipated that the recommendation will be for reclassification as 'decontaminated'. This classification is defined by the DWER as:

The site has been remediated and is suitable for all uses. It does not pose a risk to the environment or human health.

4 Land use and subdivision requirements

4.1 Land use

The subject land provides opportunity to incorporate a range of housing products and residential densities, including medium densities, essentially given that it is largely physically separated from the adjoining established residential neighbourhoods, enjoys good amenity, and is immediately surrounded by tracts of open space.

As set out in Figure 1, R20 and R30 lots are proposed across the site. This approach is considered to provide a range of housing opportunities within this precinct that is appropriate to the site context, as well as complimenting and adding diversity when considered in context of the remainder of the Estate.

The subject land is well located and immediately accessible to open space, schools, public transport, and local and district level shopping facilities.

4.2 Community purpose

Consistent with the recommendations of the DBELSP, the Structure Plan provides land for a proposed community purpose site which was to be co-located with the (then) proposed district sporting facility at Lot 9077. Provision of an alternative site for Community Purpose elsewhere in Dalyellup Beach, outside of the Greenpatch Structure Plan area, would be subject to discussion and a concluded agreement between the proponent and the Shire of Capel.

At the subdivision stage, the WAPC (in consultation with the Shire of Capel) may consider alternative zones/land uses, including Residential as an extension of the adjacent residential development to round off the proposed subdivisional pattern. This alternative land use scenario is demonstrated by Figure 2 and acknowledged by the Structure Plan map (refer Figure 1) and section 4.8 of Part One.

4.3 Public Open space

Extensive public open space is proposed within this precinct, equating to 47% of the site area. Aside from meeting a need to avoid areas of the site within the odour buffer and environmental value, large areas of vegetation are to be retained. The areas of open space proposed within the clearing footprint may present some opportunity to retain further trees.

The Structure Plan aims where possible through future Landscape Management to retain and protect the existing vegetation for the purpose of amenity and habitat for the listed threatened species. Working with the existing vegetation and incorporating usable functions, including drainage, within these areas, rather than manipulating the areas to create an active, curated space for users.

A range of planting options are available to satisfy BMP requirements at the interface with roads and lots. A Landscape Management Plan will be implemented at subdivision stage, to be informed by a landscape concept plan which is to be prepared and submitted with an application for subdivision approval over the Structure Plan area.

The developer also intends to incorporate street planting, including species that are favoured by the black cockatoo and western ringtail possum. The street planting will result in an improvement in the local habitat and improve connectivity between the 7.57 hectares of vegetation proposed to be retained.

It is intended that the two smaller areas of POS central to the development will be, where slope allows, used for active Public Open Space, with the larger POS areas located on the outer boundaries to remain largely 'as is' and act as a buffer to the adjoining properties, noting some of this is already cleared in the understorey. Where POS adjoins the residential cells there will be careful plant selection with the Shire to ensure ongoing management in accordance with the BMP.

As identified in the Local Water Management Strategy, infiltration basins will be required within POS areas, sensitively designed to avoid vegetation to be retained.

The Structure Plan identifies an area for indicative Regional Open Space in the north-eastern section of the land. Future tenure, reservation and management options for this land is to be further investigated and explored at the subdivision stage.

4.4 Movement networks

A Transport Study has been prepared and this is provided at *Appendix Nine*. This study is supported by a further Traffic Note undertaken by Shawmac. These studies conclude that:

"The proposed street network will provide an acceptable range of choices for travel and ensure that traffic volumes on individual streets can be kept below threshold levels to ensure the amenity of the area is preserved and safe movement options exist for pedestrians, cyclists and local traffic".

Other key conclusions include:

- The traffic generation and distribution exercise undertaken to quantify the traffic impact of the site indicate that site will have minimal impact on the function of the adjacent network.
- A review of the pedestrian and cycle facilities indicate that the extension of the internal
 footpath network will be required to provide connections to the bus stop located within
 Norton Parade and that separate on-road cycle facilities may be required for Road 1, Road 4
 and Maidment Parade to facilitate access to the adjacent recreational facility.
- The trip volumes per day are generated based on planning codes and land use type and have been derived from the ITE Guide, thus the predicted weekday flows generated within the site and sporting fields along Road 1 onto Maidment Parade is expected to be 1,751 vpd.
- Traffic Hierarchy based on 2015 daily volumes indicates that the midblock cross section for Maidment Parade is a Neighbourhood Connector A and that Road 1 is an Access Street A and as such may require the addition of a median/traffic calming to control traffic movements.
- Traffic projections to 2031 for Maidment Parade indicate that it will continue to operate as a Neighbourhood Connector A once Dalyellup is at full development.

4.5 Infrastructure coordination, servicing, and staging

The site will be connected to appropriate services to ensure suitable disposal of wastewater, water supply and power supply. These services are located adjacent to the site and will be extended as appropriate.

Due to the topography of the site bulk earthworks for the entire development are likely to be completed as part of the first stage and stabilised.

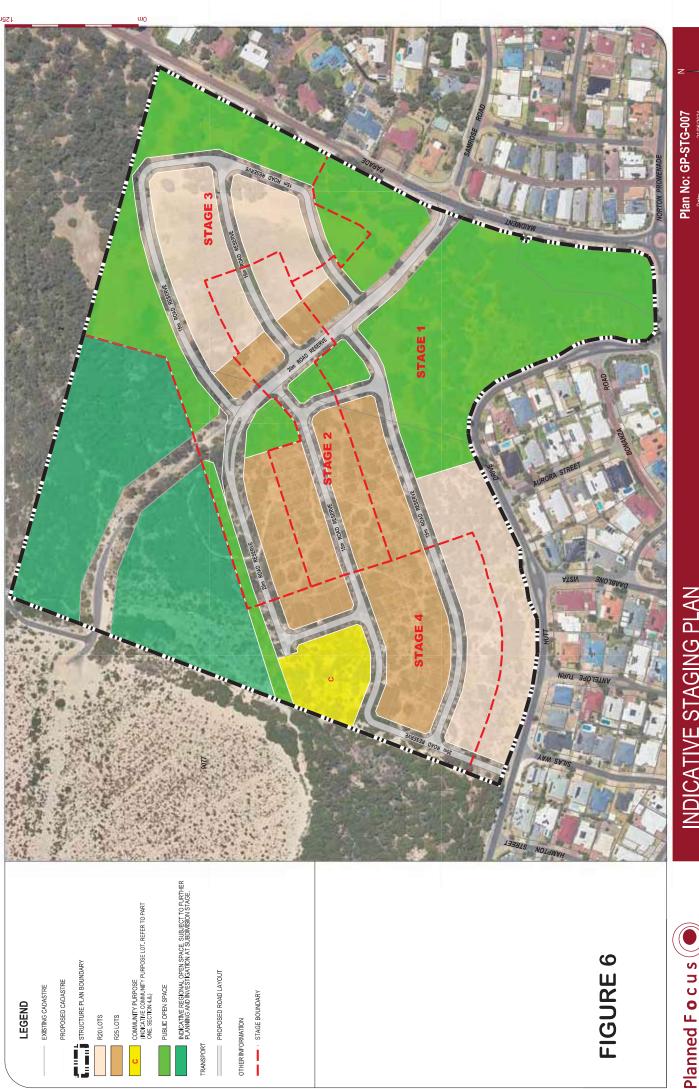
The development will be staged over 4-6 stages, dependant on market conditions. An indicative staging plan has been provided as *Figure 6* and will be finalised prior to subdivision.

4.6 Developer contribution arrangements

The subject land is within SCA2/DCA2 which requires a contribution to be paid at subdivision stage.

4.7 Other requirements

The Structure Plan sets out the desired future outcome for the subject land and enables the new development of this stage to be undertaken in stages. The Structure Plan requires all relevant recommendations from the various studies and investigations that have been undertaken to be realised as development proceeds.



INDICATIVE STAGING PLAN

GREENPATCH SITE - LOTS 9113, 9076, 8019 & Pt 9077 Maidment Parade, DALYELLUP



Town planning & strategy

Technical Appendices

Appendix One: Certificates of Title

TITLE NUMBER

AUSTRALIA

Volume

Folio 377

2696

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

WESTERN



LAND DESCRIPTION:

LOT 9076 ON DEPOSITED PLAN 55511

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

HOUSING AUTHORITY OF 99 PLAIN STREET, EAST PERTH

(AF K653100) REGISTERED 23/7/2008

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

EASEMENT BENEFIT SEE TRANSFER 2756/1912. REGISTERED 10/1/1912. T2756/1912 1.

2. H598929 EASEMENT BENEFIT AS TO THE PORTION OF LAND FORMERLY COMPRISED IN VOL 2516

FOL 780 ONLY - SEE INSTRUMENT H598929. REGISTERED 16/11/2000.

A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Warning:

Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE------END OF CERTIFICATE

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP55511

PREVIOUS TITLE: 2516-780, 2656-245

PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.

LOCAL GOVERNMENT AUTHORITY: SHIRE OF CAPEL

RESPONSIBLE AGENCY: DEPARTMENT OF COMMUNITIES (SSHC)



RECORD OF CERTIFICATE OF **CROWN LAND TITLE**

UNDER THE TRANSFER OF LAND ACT 1893 AND THE LAND ADMINISTRATION ACT 1997

The undermentioned land is Crown land in the name of the STATE OF WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.



LAND DESCRIPTION:

LOT 8019 ON DEPOSITED PLAN 55511

STATUS ORDER AND PRIMARY INTEREST HOLDER:

(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE UNDER MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: SHIRE OF CAPEL OF PO BOX 369, CAPEL

(XE L420915) REGISTERED 7/9/2010

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

T2756/1912 EASEMENT BENEFIT SEE TRANSFER 2756/1912. REGISTERED 10/1/1912. 1.

RESERVE 50692 FOR THE PURPOSE OF DRAINAGE REGISTERED 7/9/2010. 2. L420914

MANAGEMENT ORDER. CONTAINS CONDITIONS TO BE OBSERVED. REGISTERED L420915

7/9/2010.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.

Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF CROWN LAND TITLE-----

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP55511 PREVIOUS TITLE: 2656-245

PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.

LOCAL GOVERNMENT AUTHORITY: SHIRE OF CAPEL

RESPONSIBLE AGENCY: DEPARTMENT OF PLANNING, LANDS AND HERITAGE (SLSD)

CORRESPONDENCE FILE 00649-2010-01RO NOTE 1: L420914

WESTERN AUSTRALIA

TITLE NUMBER

Volume

Folio

2717

207

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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LAND DESCRIPTION:

LOT 9077 ON DEPOSITED PLAN 60716

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

CRISTAL PIGMENT AUSTRALIA LTD OF LOT 4 OLD COAST ROAD, AUSTRALIND

(T M667801) REGISTERED 12/6/2014

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. T2756/1912 EASEMENT BENEFIT REGISTERED 10/1/1912.

2. H598929 EASEMENT BURDEN SEE SKETCH ON DEPOSITED PLAN 60716, REGISTERED 16/11/2000.

J066925 EASEMENT H598929 PARTIALLY SURRENDERED. AS TO THE LAND IN VOLUME 2210

FOLIO 558 ONLY. REGISTERED 28/10/2004.

3. M379789 NOTIFICATION. ENVIRONMENTAL PROTECTION ACT 1986. REGISTERED 22/8/2013.

4. N989531 MEMORIAL. CONTAMINATED SITES ACT 2003 AS TO PORTION ONLY - SEE DEPOSITED

PLAN 412592 REGISTERED 19/9/2018.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.

Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP60716

PREVIOUS TITLE: 1894-495, 2696-378

PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.

LOCAL GOVERNMENT AUTHORITY: SHIRE OF CAPEL

WESTERN AUSTRALIA

TITLE NUMBER

Volume

Folio

4044

640

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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LAND DESCRIPTION:

LOT 9113 ON DEPOSITED PLAN 426078

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

HOUSING AUTHORITY OF 5 NEWMAN COURT FREMANTLE WA 6160

(AF P646393) REGISTERED 6/12/2023

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. H598929 EASEMENT BENEFIT FOR TELEVISION CABLING PURPOSES - SEE DEPOSITED PLAN 426078 AND INSTRUMENT H598929 REGISTERED 16/11/2000.

2. P053528 MEMORIAL. CONTAMINATED SITES ACT 2003 AS TO PORTION ONLY- SEE DEPOSITED PLAN 426078 REGISTERED 24/2/2022.

3. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR DRAINAGE/IRRIGATION/WATER SUPPLY/SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 426078 AS CREATED ON DEPOSITED PLAN 424136

Warning:

A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP426078
PREVIOUS TITLE: 4024-178

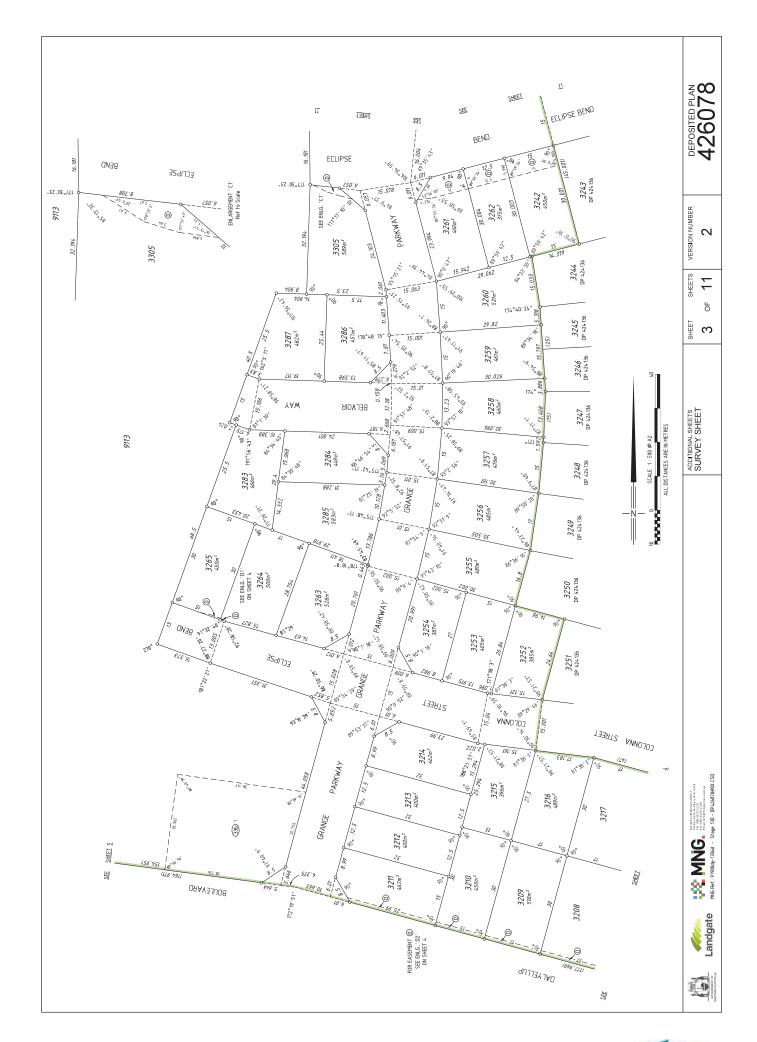
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.

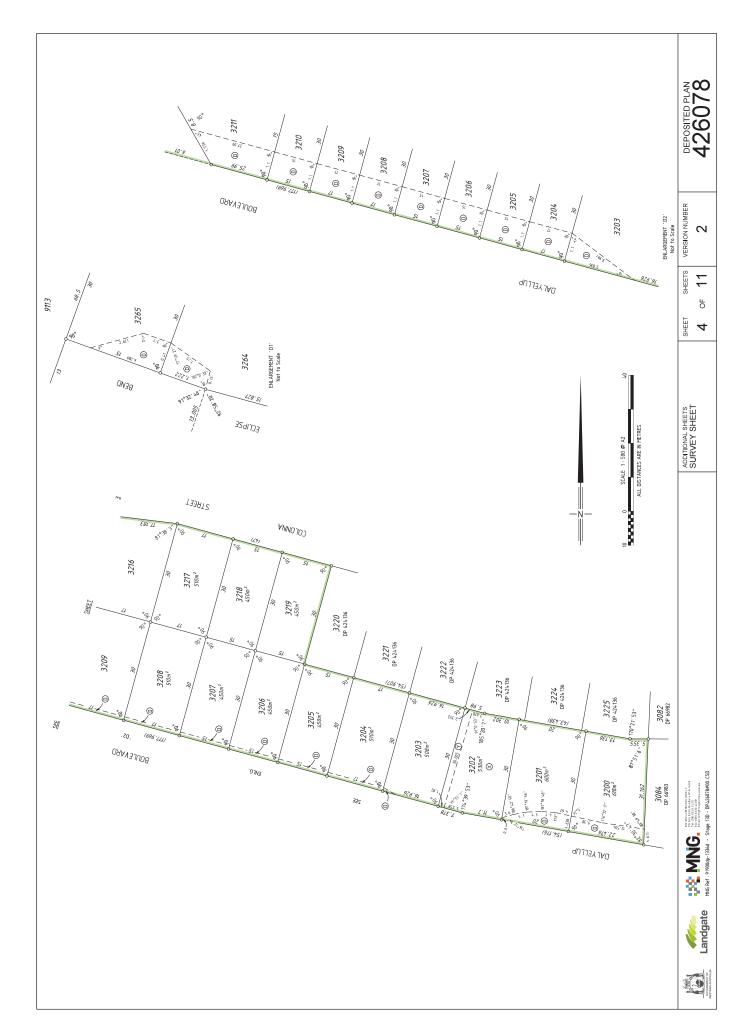
LOCAL GOVERNMENT AUTHORITY: SHIRE OF CAPEL

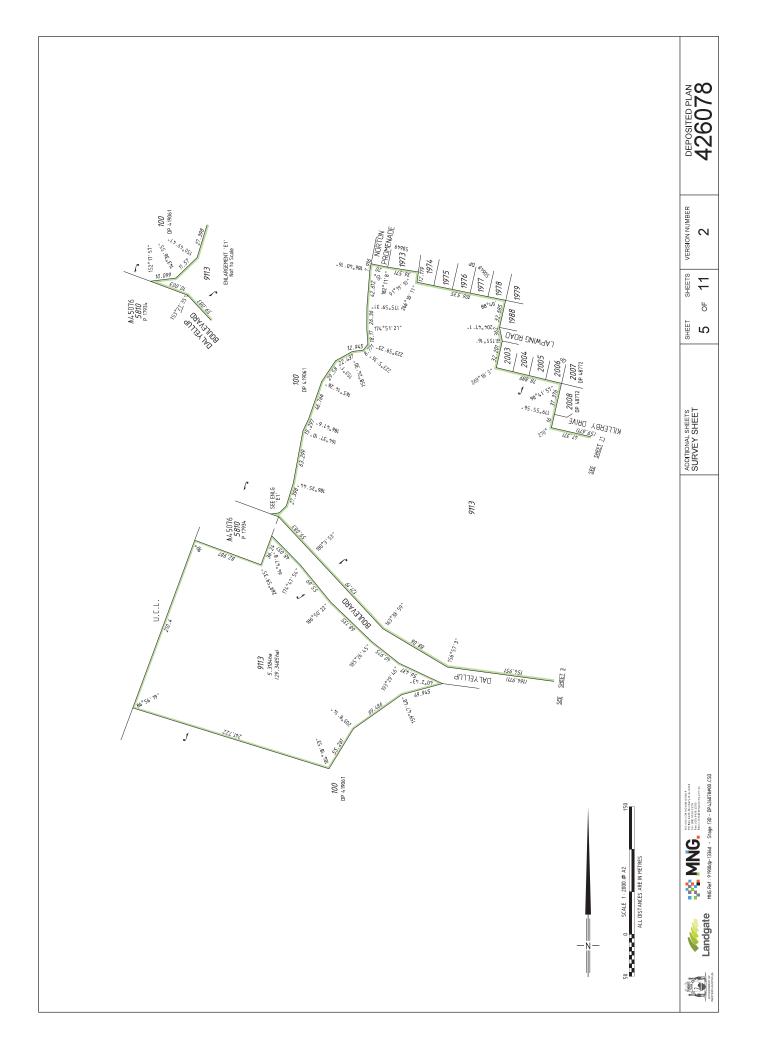
RESPONSIBLE AGENCY: DEPARTMENT OF COMMUNITIES (SSHC)

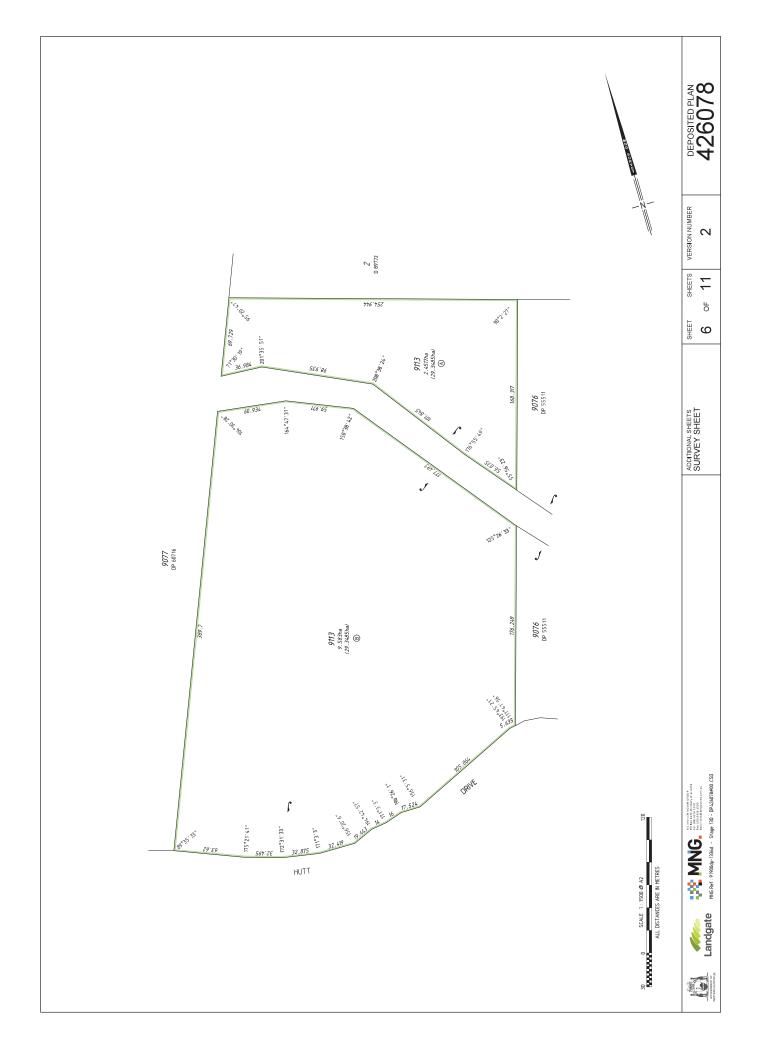
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Extendition of the Control of Seculation of Secul 05-Dec-2023 6.12.2023 Western Australian Planning Commission 6 12 2023 Date Date Date Date SEC 168(1)(2), 165, 152 OF THE P&D ACT SEC 136D, 129BA OF THE TLA Inspector of Plans and Surveys / Authorised Land Officer Department of Planning, Lands and Heritage 4.08.2023 Deposited Plan Shire of Capel Subdivision Freehold Dalvellup 161366 Delegated under S. 16 P&D Act 2005 1946 Locality & Local Government Landgate For Inspector of Plans and Surveys E. Milewska In Order For Dealings 97 lenta Planning Approval Plan Information Plan Approved Local Government Planning Authority Plan Heading Examination Plan Purpose Tenure Type Đ Plan Type Examined Reference Locality

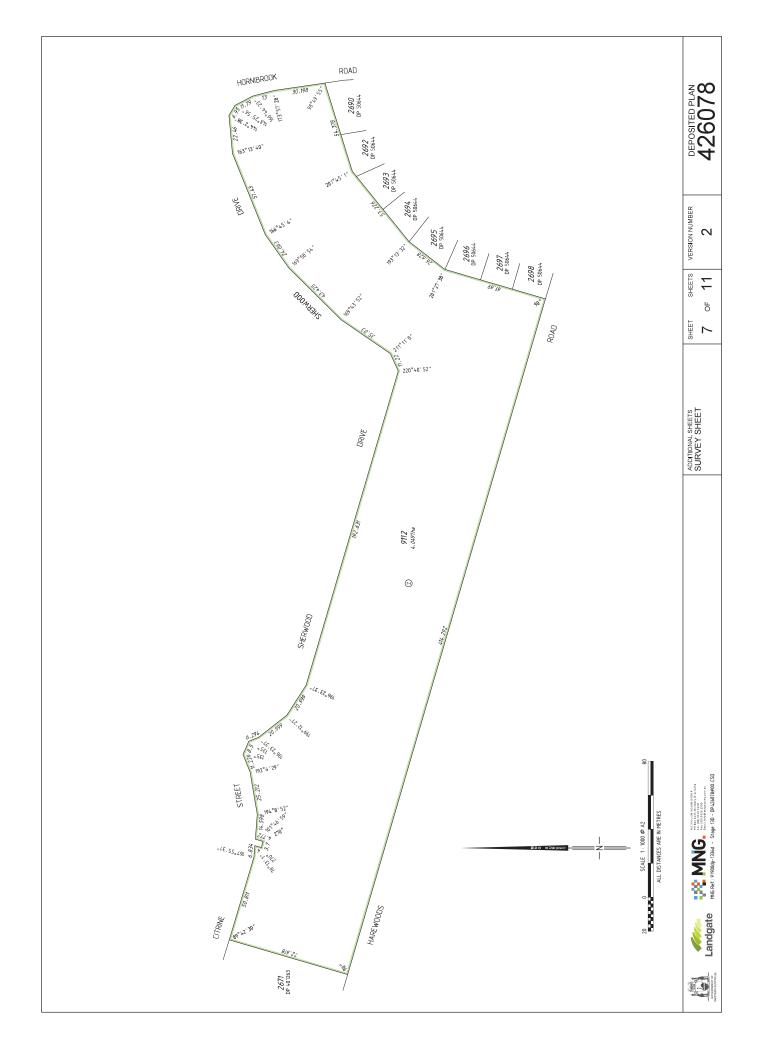


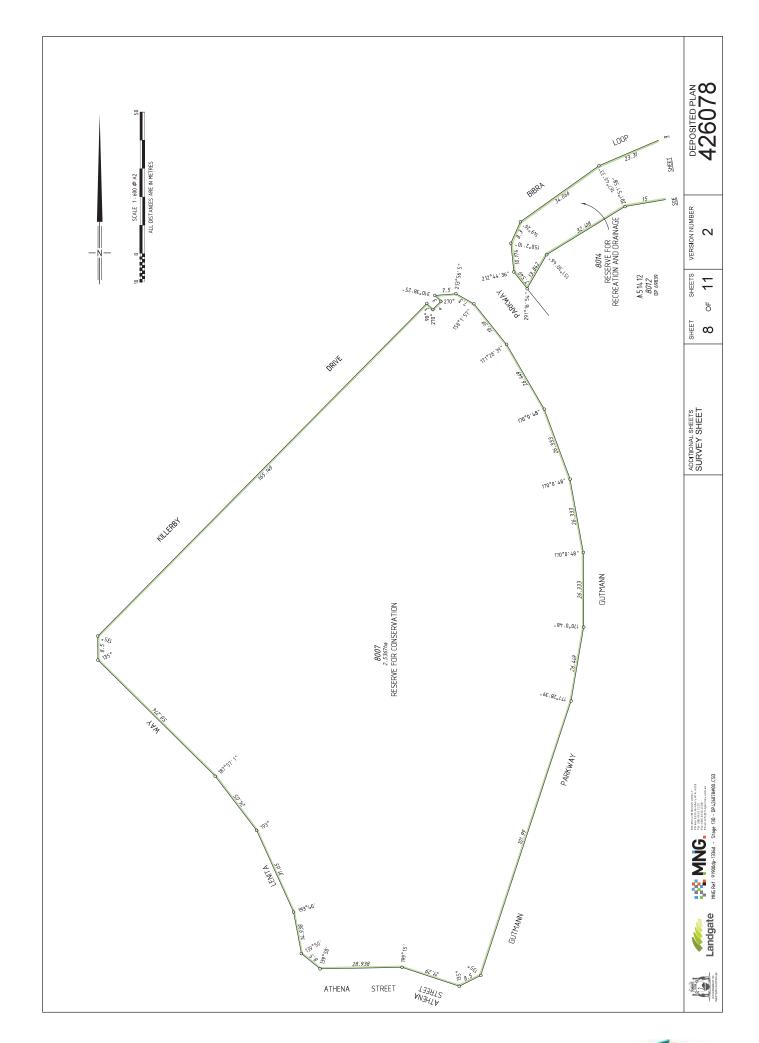


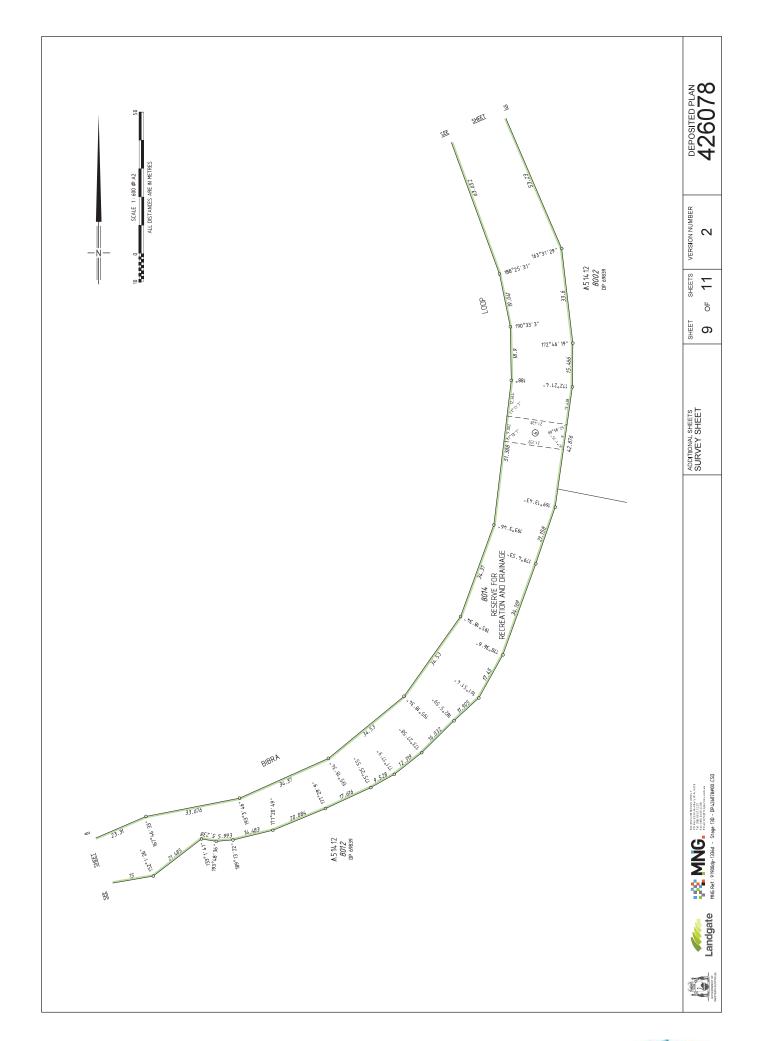


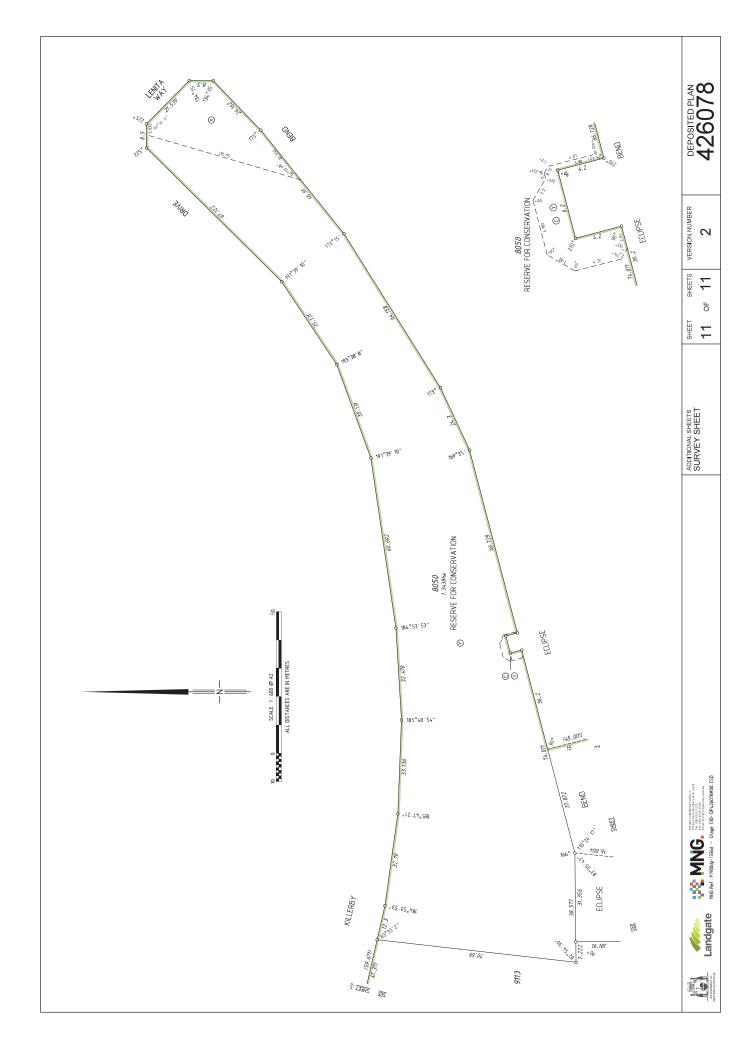


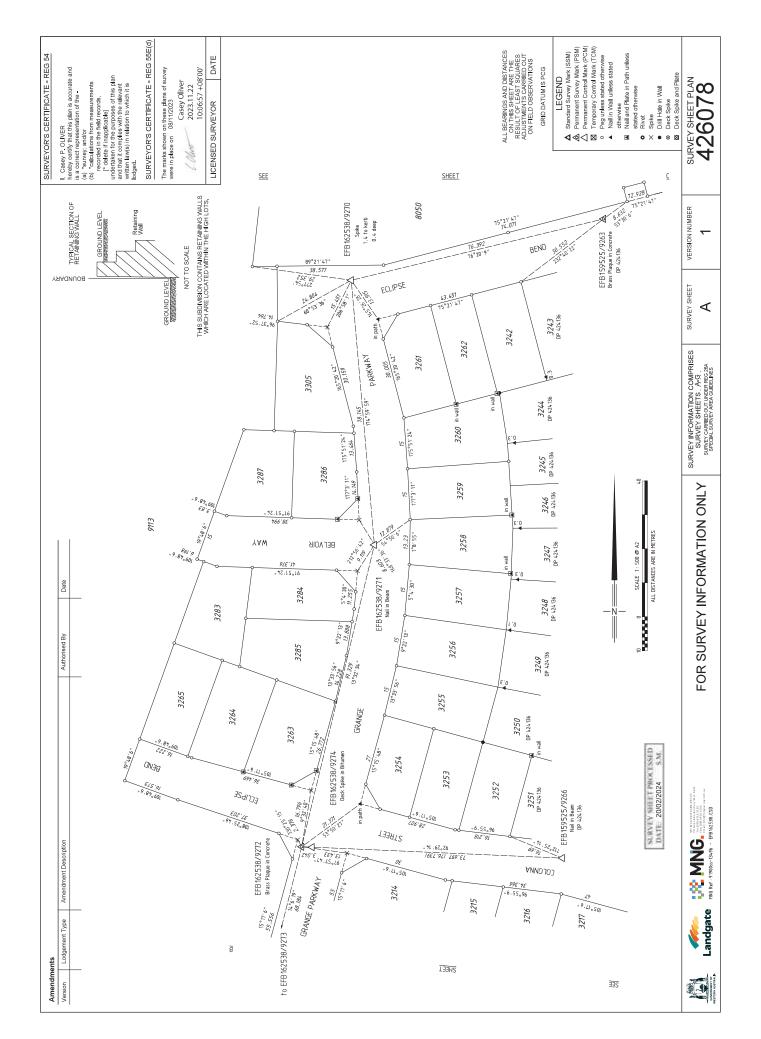


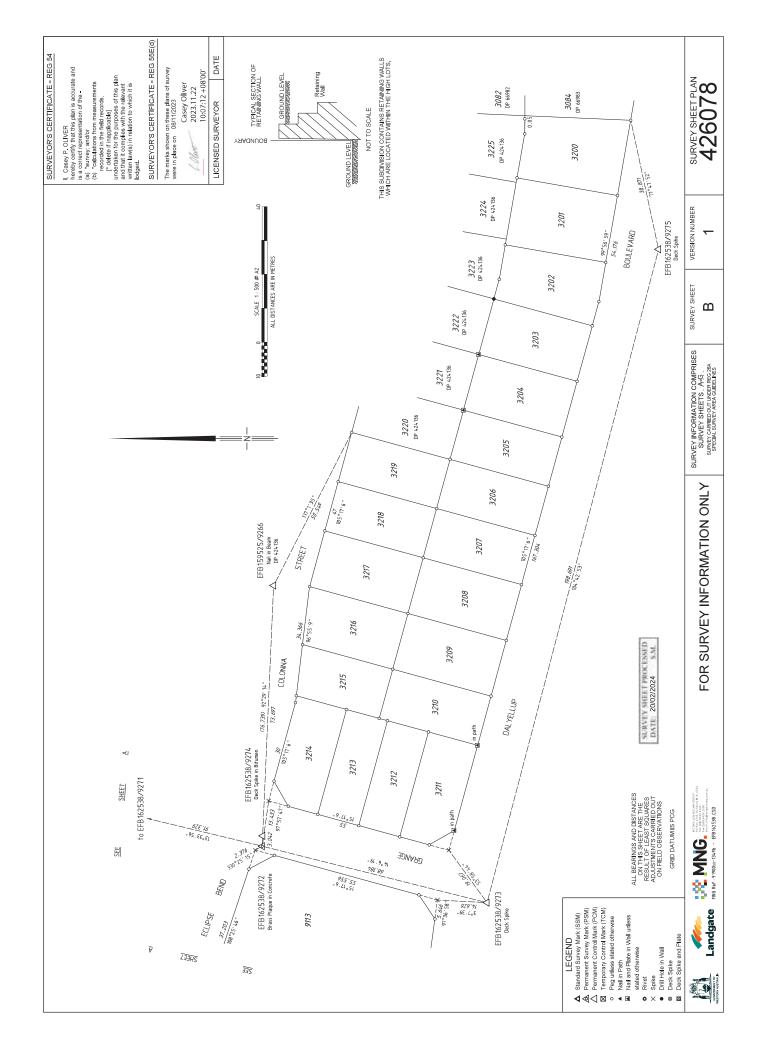


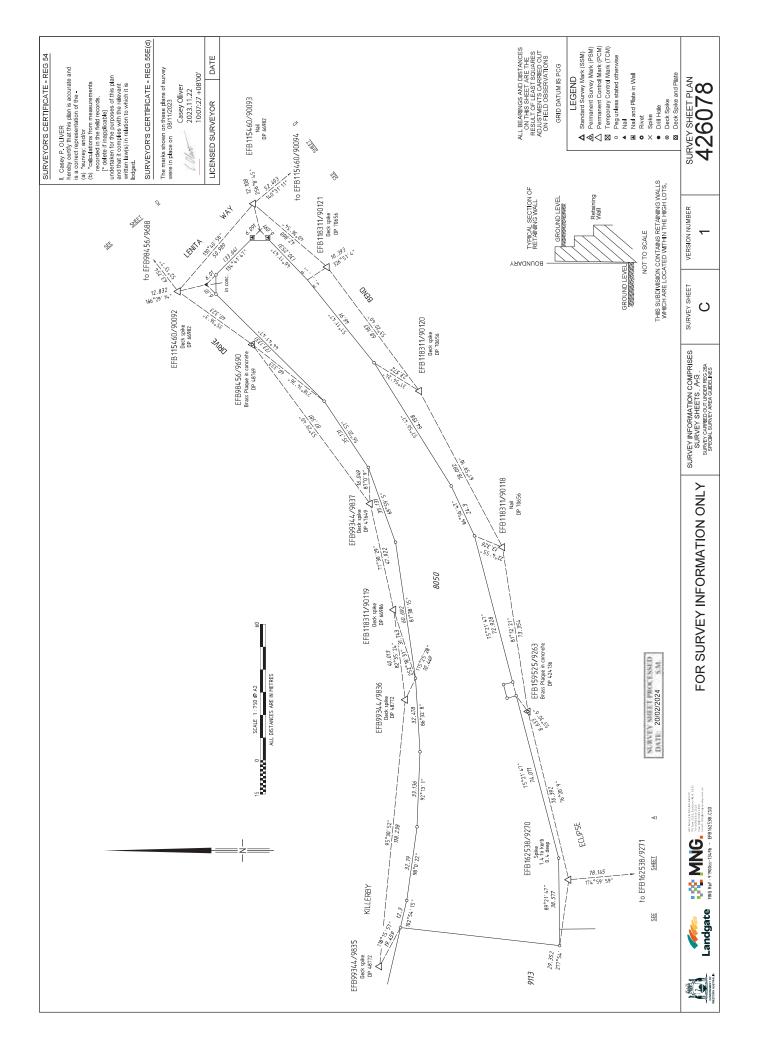


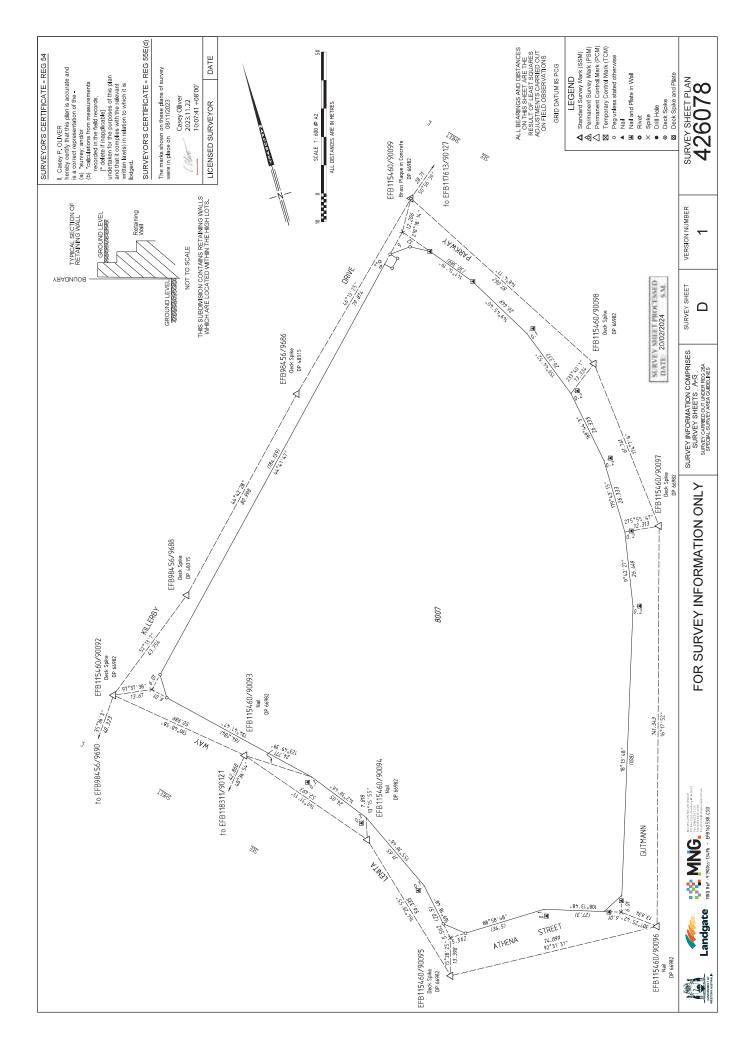


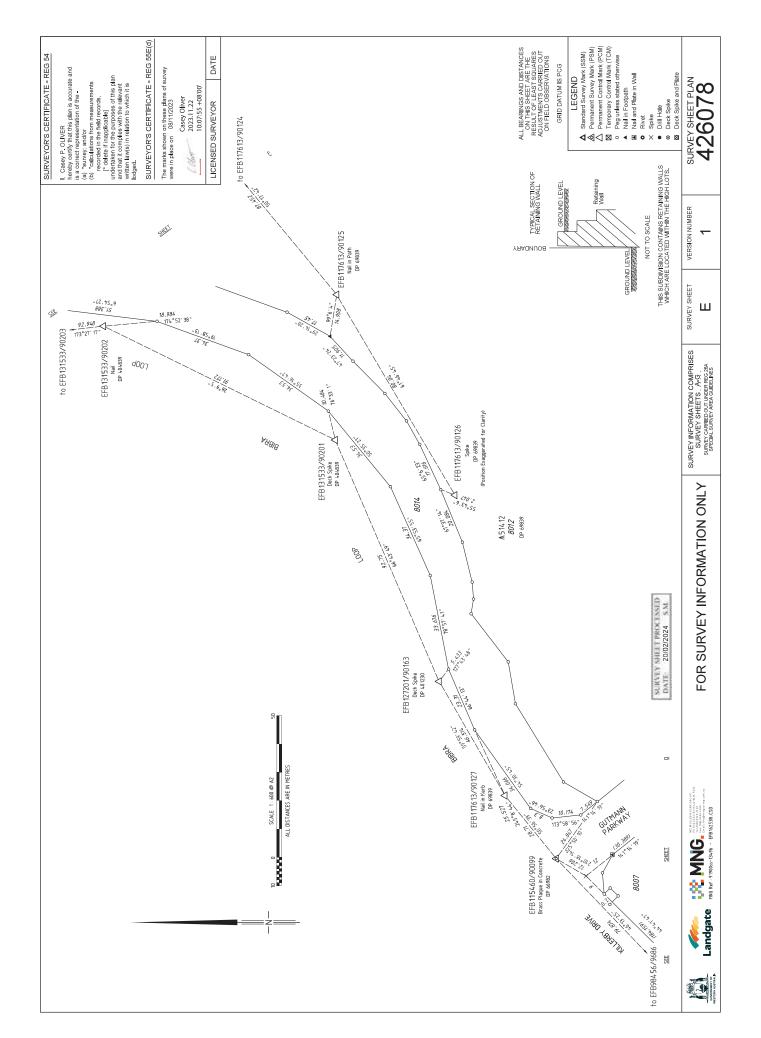


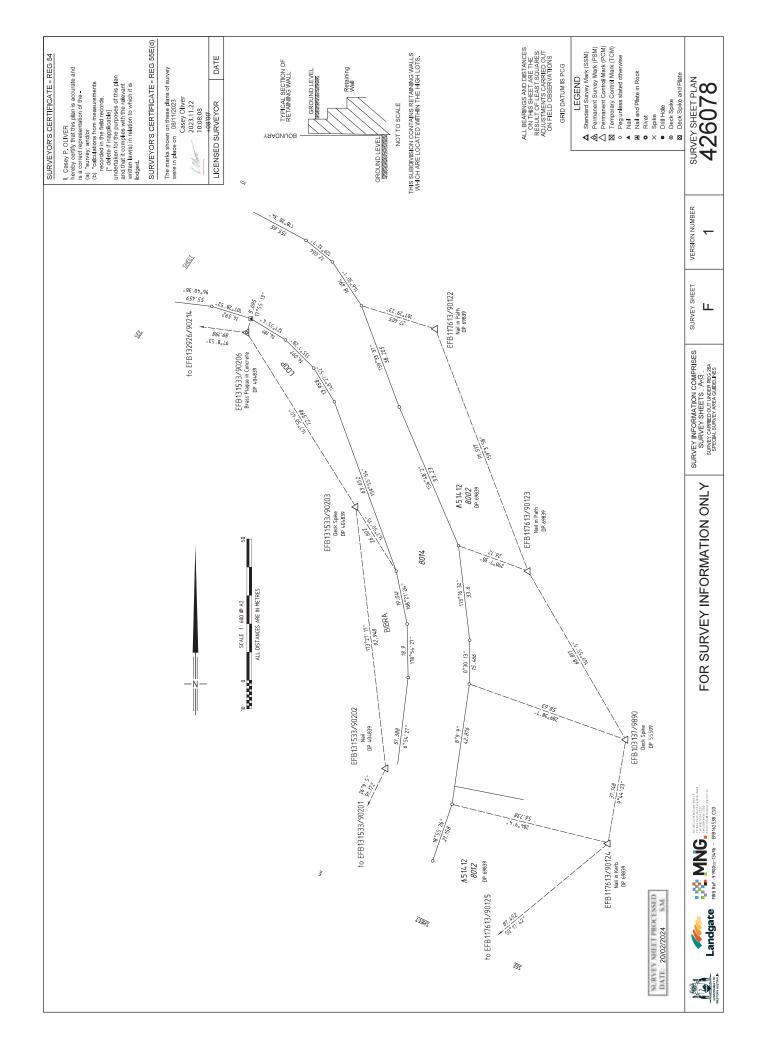


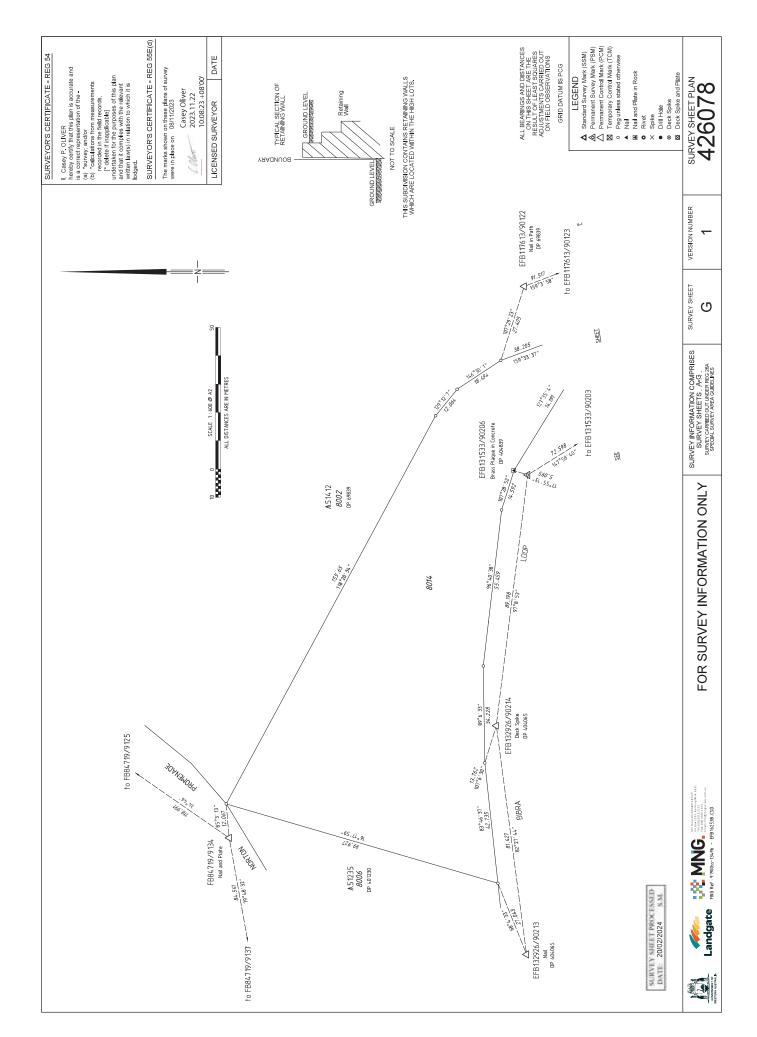




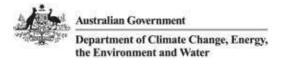








Appendix Two: EPBC Approval



EPBC 2007/3361

Mr Darren Walsh Executive Director JBS&G Australia Pty Ltd Level 9 Allendale Square, 77 St Georges Terrace, Perth WA

Dalyellup Beach Estate – Greenpatch Subdivision, Bunbury, Western Australia (EPBC 2007/3361)

Dear Mr Walsh

Thank you for your letter dated 17 April 2023, and subsequent correspondence and discussions with the department, requesting a variation to conditions attached to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval EPBC 2007/3361.

Officers of this department have reviewed the variation request and briefed me. As delegate of the Minister for the Environment and Water, I have varied the EPBC Act approval EPBC 2007/3361 under section 143(1)(c) of the EPBC Act. The action must now be taken in accordance with the varied conditions specified in the variation notification, which has been attached for your information.

As you are aware, the department has an active monitoring program which includes monitoring inspections, desktop document reviews and audits. Please ensure that you maintain accurate records of all activities associated with, or relevant to, the conditions of approval so that they can be made available to the department on request.

Should you require any further information please contact Robin Nielsen at PostApprovals@dcceew.qov.au.

Yours sincerely

Rachel Short

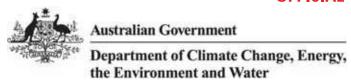
Branch Head

Environment Assessments (Vic, Tas) and Post Approvals Branch

Nature Positive Regulation Division

13 March 2024

Attach: Variation Notice



Variation of conditions attached to approval

Dalyellup Beach Estate – Greenpatch subdivision, Bunbury, Western Australia (EPBC 2007/3361)

This decision to vary conditions of approval is made under section 143 of the *Environment Protection* and *Biodiversity Conservation Act 1999* (EPBC Act).

Approved action

approval holder	Names:	Satterley Property Group Pty Ltd
	ACN:	009 054 979
approved action	Clear native vegetation and develop the "Greenpatch" residential subdivision within the Dalyellup Beach Estate approximately 7 km south of Bunbury in the Shire of Capel, Western Australia [See EPBC Act referral 2007/3361].	
Variation		
variation of	The variat	ion is:
conditions attached to approval	Delete conditions 1 and 2 attached to the approval and substitute with the conditions specified in the table below.	
	Add new conditions 2A and 2AA specified in the table below.	
	Add new definitions of Clearing footprint , Construction , Environmental Management Plan Guidelines , EPBC Environmental Offsets Policy , and Offset Area specified in the table below.	
		e definition of Western Australian Department of Biodiversity , tion and Attractions.
	Delete At t table belo	tachment A and substitute with the conditions specified in the w.
date of effect	This variat	tion has effect on the date this instrument is signed.
Person authorised to m	ake decision	
name and position	Rachel Sh	ort
	Branch He	ead
	Environm	ent Assessments (Vic & Tas) and Post Approvals
signature	Poll	She
date of decision	13 March	2024

DCCEEW.gov.au

Date of decision	Conditions attached to approval	
As varied on the date this instrument was signed	1.For the protection of the EPBC Act listed Black Cockatoos and Western Ringtail Possum the person taking the action must not clear more than 11.76 ha within the clearing footprint. The person taking the action must not clear outside the clearing footprint.	
As varied on the date this instrument was signed	2.To offset residual significant impacts to Black Cockatoos and Western Ringtail Possum , prior to the commencement of the action , the person taking the action must submit to the department for approval by the Minister an Offset Management Plan which must:	
	 i. document the extent and condition of Black Cockatoo habitat and Western Ringtail Possum habitat in the offset area; ii. include a detailed description and map clearly defining the location and boundary of the offset area, accompanied by the offset attributes and shapefiles; iii. specify achievable goals and timeframes for the ongoing maintenance and improvement of Black Cockatoo habitat and Western Ringtail Possum habitat in the offset area; 	
	habitat in the offset area; iv. specify the management activities to be implemented in the offset area and their timing, to achieve the specified goals in the specified timeframes. In particular the following should be addressed: a. include milestones and completion criteria, and triggers and corrective actions to be implemented if milestones and completion criteria are not met; b. identify the risks associated with invasion by declared weeds from the potential on-site developments and measures to manage that risk; c. delineation and access control to the site; d. weed and pathogen management e. waste management; f. fauna and pest management; g. bushfire management; h. identify any hollow-bearing trees that would be removed during site development and outline compensatory measures for any loss hollow-bearing trees; i. details of monitoring and reporting methods and timing; v. provide details of how the offset area will be protected in perpetuity consistent with the EPBC Environmental Offsets Policy, including details of its intended long-term manager, and funding arrangements (if required); and	
	vi. be consistent with the Environmental Management Plan Guidelines.The person taking the action must not commence the action until the OMP has been approved by the Minister.	
	The person taking the action must commence implementing the Offset Management Plan as soon as it is approved by the Minister and must continue to implement the approved Offset Management Plan until the department has acknowledged that it has received evidence that the offset area is protected in perpetuity, and that the long-term manager specified in the approved Offset Management Plan has	

Date of decision	Conditions attached to approval	
	committed to implement the approved Offset Management Plan at least until the expiry date of this approval.	
As varied on the date this instrument was signed	2A. If the offset area does not protect at least 23 ha of Black Cockatoo habitat and at least 21.5 ha of Western Ringtail Possum habitat of equivalent or better habitat than the impacted area, the person taking the action must, within 12 months of the commencement of the action, submit to the department for approval by the Minister , a Supplementary Offset Management Plan to offset habitat impacted by the Action consistent with the EPBC Environmental Offsets Policy such that the total impact of the action as specified in condition 1 is fully offset.	
	If direct offsets are proposed, the Supplementary Offset Management Plan must meet the requirements of the Environmental Offsets Policy and the Environmental Management Plan Guidelines to the satisfaction of the Minister . The Supplementary Offset Management Plan must include:	
	i. Detailed information on the residual impacts to protected matters that will be compensated for by the supplementary offset (Note: the offset comprises the securement of the offset site and the habitat condition improvements to be achieved at the offset site). This must include the area(s) of habitat for protected matters and its condition and quality at all locations impacted by the Action which the supplementary offset is to address.	
	ii. The relevant protected matters and a reference to the EPBC Act approval conditions to which the Supplementary Offset Management Plan refers.	
	iii. Detailed baseline information on the areas of habitat, their condition, and the presence (or not) of the protected matters on the supplementary offset.	
	iv. Commitments to achievable ecological benefits at the supplementary offset and the timeframes in which they will be achieved.	
	v. A table summarising all commitments to achieve the ecological benefits for protected matters at the offset site and a reference to where each commitment is detailed in the Offset Management Plan.	
	Reporting and review mechanisms to inform the department annually regarding compliance with the management and environmental outcome commitments, and attainment and maintenance of the ecological benefits specified in the Supplementary Offset Management Plan.	
	vii. An assessment of risks to achieving the ecological benefit(s) and what risk management measures and/or strategies will be applied to address these.	
	viii. A monitoring program, which must specify:	
	 a. measurable performance indicators and the timeframes for their achievement to gauge attainment of the ecological benefit(s) for the protected matters; 	
	b. trigger values for corrective actions; and	
	c. the proposed timing (including season/time of day/frequency) methods and effort, and an explanation of how these will be effective for this purpose, of monitoring to detect trigger values, changes in the performance indicators and to gather evidence that effectively	

Date of decision	Conditions attached to approval	
	demonstrates actual progress towards, attainment of and maintenance of the ecological benefits for the protected matters.	
	ix. Corrective actions to be implemented to ensure ecological benefits for the protected matters are achieved or maintained if trigger values are reached or performance indicators not achieved in the specified timeframes.	
	x. Links to relevant referenced plans or conditions of approval (including state/territory approval conditions), and	
	xi. How the supplementary offset will be protected and the ecological benefits maintained in perpetuity consistent with the EPBC Environmental Offsets Policy.	
As varied on the date this instrument was signed	2AA. If a Supplementary Offset Management Plan is required under condition 2A, and has not been approved by the Minister in writing from 18 months after the commencement of the action , the person taking the action must not undertake any further clearing or construction within the clearing footprint until the Minister has approved the Supplementary Offset Management Plan in writing.	
Variation dated 27/6/2022	3. The approval holder must notify the Department in writing of the date of commencement of the action within 10 business days after the date of the commencement of the action .	
Variation dated 27/6/2022	4. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval and make them available upon request to the Department .	
	Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act. Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.	
Variation dated 27/6/2022	5.The approval holder must prepare a compliance report for each 12-month period following the date of commencement of the action , or otherwise in accordance with an annual date that has been agreed to in writing by the Minister . The approval holder must:	
	a. publish each compliance report on the website within 60 business days following the relevant 12 month period,	
	 b. notify the Department by email that a compliance report has been published on the website and provide the weblink for the compliance report within 5 business days of the date of publication 	
	c. keep all compliance reports publicly available on the website until this approval expires,	
	d. exclude or redact sensitive ecological data from compliance reports published on the website , and	
	e. where any sensitive ecological data has been excluded from the version published, submit the full compliance report to the Department within 5 business days of publication.	
	Note: Compliance reports may be published on the Department's website.	

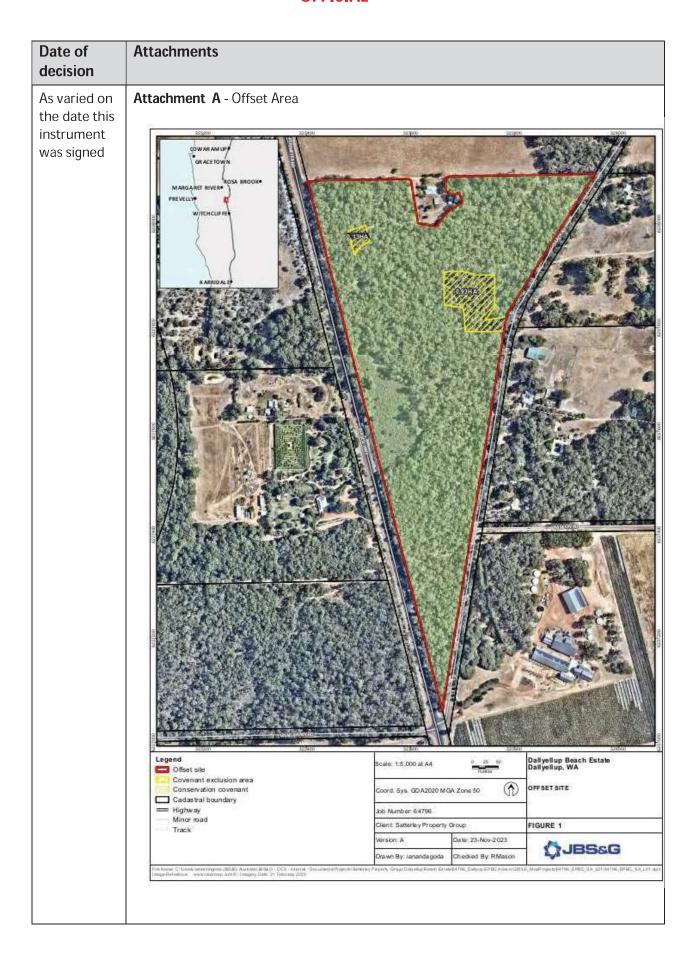
Date of decision	Conditions attached to approval	
Variation dated 27/6/2022	6.The approval holder must notify the Department in writing of any incident or non-compliance with the conditions. The notification must be given as soon as practicable, and no later than 2 business days after becoming aware of the incident or non-compliance. The notification must specify:	
	a. any condition which is or may be in breach,	
	b. a short description of the incident and/or non-compliance,	
	c. the location (including co-ordinates), date, and time of the incident and/or non-compliance. In the event the exact information cannot be provided, provide the best information available.	
Variation dated 27/6/2022	7.The approval holder must provide to the Department the details of any incident or non-compliance with the conditions as soon as practicable and no later than 10 business days after becoming aware of the incident or non-compliance, specifying:	
	a. any corrective action or investigation which the approval holder has already taken or intends to take in the immediate future,	
	b. the potential impacts of the incident or non-compliance,	
	c. the method and timing of any remedial action that will be undertaken by the approval holder.	
Variation dated 27/6/2022	8.If, at any time after eight (8) years from the date of this approval, the person taking the action has not substantially commenced the action, then the person taking the action must not substantially commence the action without the written agreement of the Minister .	
Variation dated 27/6/2022	9. Within 30 days after the completion of the action , the approval holder must notify the Department in writing and provide completion data .	

Date of approval	Definitions
Original Dated 29/6/2017	Black Cockatoo/s means the EPBC Act listed Carnaby's Black-Cockatoo (Calyptorhynchus latirostris), Baudin's Black-Cockatoo (Calyptorhynchus baudinii) and Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso)
Original Dated 29/6/2017	Black Cockatoo habitat includes foraging and potential breeding habitat as defined in the EPBC Act Referral Guidelines for three species of Western Australian black cockatoos: Carnaby's Black-Cockatoo (<i>Calyptorhynchus latirostris</i>). (Endangered) Baudin's Black Cockatoo (<i>Calyptorhynchus baudinii</i>) (Vulnerable) and Forest Red-tailed Black-Cockatoo (<i>Calyptorhynchus banksii naso</i>) (Vulnerable) (October 2012)
Variation dated 27/6/2022	Business day means a day that is not a Saturday, a Sunday or a public holiday in the state or territory of the action.
Original Dated 29/6/2017	Clearance, clear or clearing means the cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting or burning of native vegetation.

Date of approval	Definitions		
As varied on the date this instrument was signed	Clearing footprint is the 13.38 ha area to be developed within the "Greenpatch" residential subdivision, within the Dalyellup Beach Estate approximately 7 km south of Bunbury in the Shire of Capel, Western Australia, which is labelled as 'Clearing footprint' and marked with a purple perimeter line in Attachment B.		
Variation dated 27/6/2022	Commence the action, commenced the action or commencement of the action means the first instance of any specified activity associated with the action including clearing and construction of infrastructure. Commencement of the action does not include minor physical disturbance necessary to:		
	 i. undertake pre-clearance surveys or monitoring programs ii. install signage and /or temporary fencing to prevent unapproved use of the project area iii. protect environmental and property assets from fire, weeds and pests, including installation of temporary fencing, and use of existing surface access tracks 		
	install temporary site facilities for persons undertaking precommencement activities so long as these are located where they have no impact on the protected matters .		
Variation dated 27/6/2022	Completion of the action means the date on which all specified activities associated with the action have permanently ceased		
Variation	Compliance reports means written reports:		
dated 27/6/2022	 i. providing accurate and complete details of compliance, incidents, and non-compliance with the conditions and the plans ii. consistent with the Department's Annual Compliance Report Guidelines (2014) iii. include a shapefile of any clearance of any protected matters, or their habitat, undertaken within the relevant 12 month period iv. annexing a schedule of all plans prepared and in existence in relation to the conditions during the relevant 12 month period 		
As varied on	Construction means:		
the date this instrument was signed	a) any work which involves breaking of the ground (including pile driving) or bulk earthworks,		
	b) the laying of pipes and other prefabricated materials in the ground; and		
	c) any associated excavation work.		
	Construction does not include the installation of temporary fences and signage.		
Variation dated 27/6/2022	Department means the Australian Government Department or any other agency administering the EPBC Act.		
As varied on the date this instrument was signed	Environmental Management Plan Guidelines means the Environmental Management Plan Guidelines 2014 published on the Department's website.		

Date of approval	Definitions
As varied on the date this instrument was signed	EPBC Environmental Offsets Policy means the <i>Environment Protection and Biodiversity Conservation Act 1999</i> Environmental Offsets Policy October 2012 published on the Department's website.
Original Dated 29/6/2017	EPBC Act is the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth).
Variation dated 27/6/2022	Incident means any event which has the potential to, or does, impact on one or more protected matter(s)
Variation dated 27/6/2022	Minister means the Australian Government Minister administering the EPBC Act including any delegate thereof.
As varied on the date this instrument was signed	Offset area means the land at 9931 Bussell Highway, Margaret River, Western Australia, represented in Attachment A by the area enclosed by the red line designated as the 'Boundary'
Original Dated 29/6/2017	Offset attributes means electronic files including '.xis' files and ESRI shapefiles containing '.shp', '.shx' and '.dbf' files capturing the relevant attributes of the offset area, including the EPBC Act reference number, the physical address of the offset area, coordinates of the boundary points in decimal degrees, the EPBC Act protected matters that the offset area compensates for, any additional EPBC Act protected matters benefiting from the offset and the size of the offset area (in hectares).
Original Dated 29/6/2017	Person taking the action is the person to whom the approval is granted, or to whom the approval is transferred under section 145B of the EPBC Act.
Variation dated 27/6/2022	Protected matter means a matter protected under a controlling provision in Part 3 of the EPBC Act for which this approval has effect.
Variation dated 27/6/2022	Sensitive ecological data means data as defined in the Australian Government Department of the Environment (2016) Sensitive Ecological Data – Access and Management Policy V1.0
Variation dated 27/6/2022	Shapefile means location and attribute information of the action provided in an Esri shapefile format. Shapefiles must contain '.shp', '.shx', '.dbf' files and a '.prj' file that specifies the projection/geographic coordinate system used. Shapefiles must also include an '.xml' metadata file that describes the shapefile for discovery and identification purposes.
Variation dated 27/6/2022	Website means a set of related web pages located under a single domain name attributed to the approval holder and available to the public.
As varied on the date this instrument was signed	REVOKED - Western Australian Department of Biodiversity, Conservation and Attractions

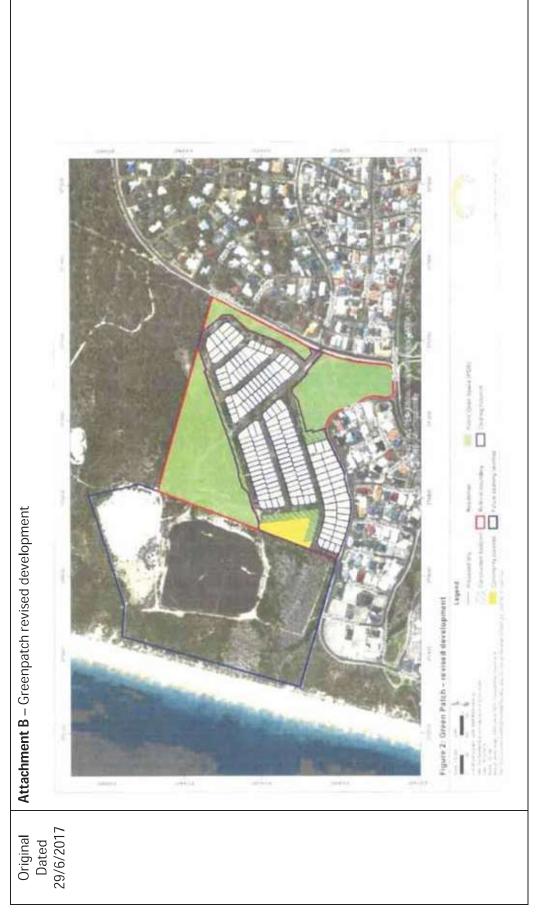
Date of approval	Definitions
Original Dated 29/6/2017	Western Ringtail Possum is the EPBC Act listed Western Ringtail Possum (<i>Pseudocheirus occidentalis</i>).
Original Dated 29/6/2017	Western Ringtail Possum habitat includes supporting or core habitat as defined in the Significant impact guidelines for the vulnerable western ringtail possum (<i>Pseudocheirus occidentalis</i>) in the southern Swan Coastal Plain, WA (2009) and explained in the Background Paper to the EPBC Act Policy Statement 3. 10: Significant impact guidelines for the vulnerable western ringtail/ possum (<i>Pseudocheirus occidentalis</i>) in the southern Swan Coastal Plain, WA (2009).





Australian Government

Department of Climate Change, Energy, the Environment and Water



DCCEEW.gov.au John Gorton Building - King Edward Terrace, Parkes ACT 2600 Australia GPO Box 3090 Canberra ACT 2601 ABN: 63 573 932 849 NOT 571 v2.2

Appendix Three: Flora & Fauna Assessment



Simon Banks Assistant Secretary West Assessment Branch Department of the Environment GPO BOX 787 CANBERRA CITY, ACT 2601

Your reference: 2007/3361
Our reference: SPG15011.01

Dear Simon,

EPBC 2007/3361: DALLYELLUP BEACH ESTATE – GREENPATCH SUBDIVISION, BUNBURY, WESTERN AUSTRALIA – PRELIMINARY DOCUMENTATION

I refer to your letter of 5 January 2015 to Mitchell Dodson from Satterley Property Group (SPG) in relation to the Dallyellup Beach Estate Greenpatch subdivision (EPBC 2007/3361) (the proposed action). A letter response to the 'stop the clock' notice was provided to the Department of the Environment (DotE) on 18 December 2014. On 5 January 2015 the delegate of the Minister for the Environment (Minister) determined that the project (proposed action) was a controlled action, on the basis of the potential and likely impacts on listed threatened species, namely Western Ringtail Possum (WRP) and the three black cockatoo species (Carnaby's Black Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo).

A response to each additional item requested is provided in the following sections:

1. Details on revegetation proposed to be undertaken on the site. Please include the location of the area to be revegetated, methods to revegetate, timeframes, success criteria, management of key threats, monitoring, land tenure details and legal mechanisms proposed to protect these areas in the future

SPG originally proposed to revegetate approximately 1.37 ha of vegetation within the project area of a degraded nature. After further consideration of the subdivision design, namely fire management requirements, SPG no longer propose to undertake any revegetation within the project area, however will ensure vegetation within POS areas is retained in its current form, which provides habitat for the listed threatened species.

Due to the proximity of the residential lots to areas of retained vegetation within POS, further revegetation is not proposed as this would increase the density of vegetation within these areas, in turn increasing the fire risk associated with the residential development.

SPG will plant street trees, comprising suitable species that will include known black cockatoo foraging species (including but not limited to those detailed in Department of Parks and Wildlife *Plants used by Carnaby's Black Cockatoo*, Groom 2011) and WRP habitat trees within the proposal area which will assist in providing potential black cockatoo foraging habitat.

The proposed planting of street trees will result in an improvement in the local habitat and improve connectivity between the 7.57 ha of vegetation proposed to be retained, comprising both black cockatoo foraging and potential breeding and WRP habitat within POS, as presented in Attachment 1. In addition, a total of 75 potential habitat trees will be retained within retained vegetation areas that will continue to provide potential habitat to black cockatoos.

Streetscaping utilising Black Cockatoo and WRP habitat species will assist in maintaining ecological linkages with the surrounding Dalyellup development, including large areas of WRP and Black Cockatoo habitat providing significant habitat for both species. The retention of interconnected areas of vegetation within the Dalyellup residential development has been demonstrated to provide a benefit for WRP. Biannual monitoring of numbers and distribution throughout Stages 12, 13, 14 and 16, including day and nocturnal surveys indicate that WRP numbers are either not impacted or are enhanced by residential development. Recent monitoring has demonstrated a significant increase in WRP numbers for Stages 14 and 16, with number sustained for 12 months. Monitoring results for Stages 12 and 13 demonstrates that current WRP numbers are more consistent than pre-development and are consistently maintained at the higher numbers recorded pre-development.

Streetscapes will be developed following weed control and site preparation activities as required. Following planting of streetscapes, trees will be maintained, including watering and use of tree guards as required and opportunistic monitoring.

Key threats to streetscapes and the proposed management approach is detailed in Table 1.

Table 1: Key threats to streetscape success and proposed management approaches

Key threat	Proposed management approach
Disturbance/removal of seedlings/trees as a result of fauna feeding within the proposal area.	Installation of tree guards as required to prevent fauna accessing the streetscape areas, including rabbits, kangaroos etc.
Disturbance to streetscapes resulting from unauthorised access in the streetscape	Installation of fencing as required within the development area to prevent access by unauthorised personnel.
area.	Erection of signage to inform community members of streetscape works being undertaken.
Erosion resulting in impacts to the streetscapes.	Undertake landscaping to minimise potential for erosion, including ripping and mounding activities.
	Landscaping will also consider drainage requirements to prevent erosion caused by water.

Whilst revegetation is not proposed, 7.57 ha of vegetation is proposed to be retained within the proposal area. The proposal area is currently zoned 'Urban' under the Greater Bunbury Region Scheme (2012). POS will be ceded to the City of Bunbury for management and protection in perpetuity as 'conservation', consistent with retained vegetation and conservation POS in the larger Dalyellup area.

- 2. Details of how the residual impacts of the proposed action on listed threatened species are proposed to be offset, including:
- (a) location and size of any proposed offset sites(s)
- (b) type and condition of vegetation onsite
- (c) the amount (in hectares) and quality of suitable WRP habitat and black cockatoo foraging, roosting and breeding habitat on the offset site
- (d) current tenure arrangements (including zoning and ownership)
- (e) legal mechanisms proposed to protect these areas in the future

- (f) the risk of damage, degradation or destruction to any proposed offset sites in the absence of any formal protection and/or management
- (g) any plans to maintain or enhance the quality or extent of suitable WRP and black cockatoo habitat present on-site over a specified time period
- (h) the amount of funding proposed to purchase the offset site(s) and any additional funding for the rehabilitation and/or ongoing management of the proposed offset site(s) for a specified time period

Proposed land acquisition offsets

The proposed action was determined a controlled action by DotE, requiring EPBC Act assessment through 'preliminary documentation' due to the potential impacts on the following threatened species protected under the EPBC Act:

- Western Ringtail Possum (Endangered)
- Carnaby's Black-Cockatoo (Endangered)
- Forest Red-tailed Black-Cockatoo (Vulnerable)
- Baudin's Black-Cockatoo (Vulnerable).

Impacts to the four species as a result of the proposed clearing of 11.77 ha of vegetation are expected to be as follows:

- 8.33 ha of black cockatoo potential foraging and/or breeding habitat for all three species
 of black cockatoo (Carnaby's Black-Cockatoo, Forest Red-tailed Black-Cockatoo and
 Baudin's Black-Cockatoo), including Agonis flexuosa dominated shrubland providing
 limited foraging value and Agonis flexuosa and Eucalyptus gomphocephala open
 woodland providing limited foraging and potential suitable breeding habitat
- 27 potential black cockatoo habitat trees, with the same number of hollow bearing trees impacted
- 8.33 ha of potential WRP habitat predominately *Agonis flexuosa* dominated shrubland, providing limited interconnected canopy areas.

SPG has utilised the Offset Assessment Guide (DotE 2012) in order to determine the offset package required to account for loss of black cockatoo and WRP habitat. The Offset Assessment Guide (DotE 2012) was used to calculate direct offsets required, comprising land acquisition. An area of 22.12 ha has been determined as the area required for acquisition to offset the loss of black cockatoo and WRP habitat.

The project area is considered to be potential habitat for all three species of black cockatoo. Carnaby's Black Cockatoo has the highest level of protection (EPBC Act 'Endangered') therefore; this value has been input into the Offset Assessment Guide (DotE 2012), a conservative approach, in order to calculate the required offset. Table 2 provides offset calculator values for impacts to black cockatoo species.

Table 2: Land acquisition offset: black cockatoo – offset calculator values

Attribute	Value	Justification		
Impact calculator				
Area of habitat (ha)	8.33	The proposed action will result in the clearance of 11.77 ha of vegetation. Of this area, approximately 8.33 ha of potential black cockatoo foraging and/or potential breeding habitat will be cleared, comprising the following vegetation communities:		
		open woodland of Agonis flexuosa and Banksia attenuata		
		open woodland of Agonis flexuosa and Eucalyptus gomphocephala over a shrubland dominated by Diplolaena dampieri		
		open woodland of Eucalyptus gomphocephala and Agonis flexuosa over a herbland dominated by Lepidosperma gladiatum		
		 shrubland dominated by Diplolaena dampieri and Jacksonia furcellata and Acanthocarpus preissii with scattered Agonis flexuosa 		
		low open woodland of Agonis flexuosa over an open sedgeland dominated by Lepidosperma gladiatum and Juncus pauciflorus.		
Quality	6	Of the 8.33 ha of vegetation to be cleared, approximately 5.08 ha is considered good quality habitat for Black Cockatoos. This 5.08 ha portion of the proposal area includes potential suitable foraging and breeding habitat associated with <i>Banksia attenuata</i> and <i>Eucalyptus gomphocephala</i> species, however also includes some areas of limited foraging potential associated with <i>Agonis flexuosa</i> .		
		An average habitat quality score of 6 (foraging and potential breeding) has been assigned for this portion of the proposal area.		
		A total of 3.25 ha of black cockatoo habitat is considered of marginal foraging and/or breeding habitat as this area comprises sparse shrublands interspersed with degraded understorey with scattered <i>Agonis flexuosa</i> , therefore an average habitat quality score of 2 has been assigned.		
		In addition a total of 27 potential Black Cockatoo habitat trees will be cleared as part of the development.		
		Based on the 'good quality' and 'marginal quality' areas described above, a total average quality score of 4 has been determined, based on the average of the 6 and 2 habitat quality scores associated with the 8.33 ha area to be cleared. However, the quality score has been increased to 6 for the purpose of this assessment, based on the area of each vegetation community impacted (5.08 ha versus 3.25 ha) and number of habitat trees to be disturbed.		
Offset calculator				
Start area (ha)	22.12	A 22.12 ha offset area is located in Margaret River.		
Time over which loss is averted (years)	20	The offset site will be protected in perpetuity.		
Risk of loss without offset (%)	35%	The offset site is zoned 'General Agriculture' in accordance with the Shire of Augusta-Margaret River Local Planning Scheme No. 1. The 'General Agriculture' zoning provides for a broad range of agricultural activities, including some intensive agriculture, horticultural and viticulture activities. If this site was not acquired for the purpose of offset there would be no formal protection mechanisms or active conservation management (i.e. weed control, fire management and access management). There would also be a clear risk that the site could be developed for future agricultural purposes, given the location of the site, south of the development front of housing in the Margaret River region.		
Risk of loss with offset (%)	5%	Formal protection of the offset site will ensure that the risk of loss is minimised as much as possible.		
Confidence in result (%)	90%	Protection mechanisms, once established, will provide a higher level of certainty that the offset will be conserved and enhanced through active management.		
Time until ecological benefit (years)	1	The ecological benefit of the offset is likely to be realised immediately as the property is currently owned by Coastview Nominees Pty Limited as Freehold and subject to ongoing management, including inspections, fence maintenance and fire management.		

Attribute	Value	Justification
Start quality (1-10)	8	The proposed offset site is comprised of Jarrah-Marri forest, providing foraging, breeding and roosting habitat for CBC, BBC and FRTBC. Species throughout the midstorey and understorey consist of:
		Banksia grandis Applia flavora
		Agonis flexuosa Agonis collings
		Acacia saligna Vantharibasa prainsii
		Xanthorrhoea preissii
		Hakea spp. Cravillas and
		Grevillea spp. An assessment of the prepared effect site was undertaken to
		An assessment of the proposed offset site was undertaken to determine the number of significant trees, with a diameter at breast height (DBH) of greater than 500 mm. In addition trees with hollows of greater than 100 mm were noted. Of the 22.12 ha, a 2 ha transect was surveyed which identified 73 potentially significant trees (DBH > 500 mm), of which 59 were identified as <i>Corymbia calophylla</i> and 14 trees were identified as <i>Eucalyptus marginata</i> ; both of which are species known to provide breeding habitat for black cockatoos. A total of 31 trees contained at least one visible hollow considered large enough to be suitable for nesting black cockatoos. The density of significant trees within the surrounding proposed offset site was observed to be comparable to that within the survey area. It is therefore reasonable to assume that the remaining area comprising the offset site will include well in excess of 27 significant trees, to offset the loss of 27 trees within the proposal area. A copy of the black cockatoo and WRP habitat survey is provided in Attachment 2.
Future quality without offset (1-10)	7	Without ongoing management the future quality of the site is likely to be reduced by one habitat quality score through the risk of unauthorised access spreading weeds and dieback and causing disturbance, or loss of vegetation through inappropriate fire management. These degradation processes will be expected to continue over time leading to progressive loss of habitat value and foraging resources on-site.
Future quality with offset (1-10)	8	Formal protection of the offset and provision of capped funds to DPaW to engage in active management of the offset site will reduce degrading processes and maintain a high habitat quality at the site.
Confidence in result	90%	Proposed management options provide a high level of certainty that the offset will be conserved, averting the level of loss that would likely occur should no formal protection measures be implemented.
TOTAL offset calculator values	100.89%	

Table 3 provides offset calculator values for impacts to the WRP.

Table 3: Land acquisition offset: Western Ringtail Possum – offset calculator values

Attribute	Value	Justification
Impact calculator		
Area of habitat (ha)	8.33	The proposed action will result in the clearance of 11.77 ha of vegetation. Of this area, approximately 8.33 ha of potential WRP habitat will be cleared, comprising the following vegetation communities:
		open woodland of Agonis flexuosa and Banksia attenuata
		open woodland of Agonis flexuosa and Eucalyptus gomphocephala over a shrubland dominated by Diplolaena dampieri
		open woodland of Eucalyptus gomphocephala and Agonis flexuosa over a herbland dominated by Lepidosperma gladiatum
		shrubland dominated by Diplolaena dampieri and Jacksonia furcellata and Acanthocarpus preissii with scattered Agonis flexuosa
		low open woodland of Agonis flexuosa over an open sedgeland dominated by Lepidosperma gladiatum and Juncus pauciflorus.
Quality	5	Of the 8.33 ha of vegetation to be cleared, approximately 5.08 ha is considered good quality habitat for the WRP. This area was determined to be good quality for the purpose of this assessment, given the location within the project area adjacent to other <i>Agonis</i> woodland areas. The area does however comprise open <i>Agonis</i> woodland which is not usually considered 'good quality' WRP habitat due to the open canopy and resultant increased threat from a range of factors, consistent with definitions outlined in <i>the Significant impact guidelines for the vulnerable western ringtail possum in the southern Swan Coastal Plain, WA</i> (DEWHA 2009). On this basis, a habitat quality score of 5 has been assigned for this portion of the proposal area.
		A total of 3.25 ha of WRP habitat is considered of marginal habitat quality as these areas comprise scattered <i>Agonis flexuosa</i> , therefore an average habitat quality score of 2 has been assigned.
		Based on the 'good quality' and 'marginal quality' areas described above, a total average quality score of 4 (3.5 rounded up to 4) has been determined, based on the average of the 6 and 2 habitat quality scores associated with the 8.33 ha area to be cleared. However, given that a larger portion of the habitat is of good quality WRP habitat (5.08 ha versus 3.25 ha), a quality value of 5 has been applied.
Offset calculator		
Start area (ha)	22.12	A 22.12 ha offset area is located in Margaret River.
Time over which loss is averted (years)	20	The offset site will be protected in perpetuity.
Risk of loss without offset (%)	35%	If this site was not acquired for the purpose of offset there would be no formal protection mechanisms or active conservation management (i.e. weed control, fire management and access management). There would also be a clear risk that the site could be developed for future agricultural purposes, given the location of the site, south of the development front of housing in the Margaret River region.
Risk of loss with offset (%)	5%	Formal protection of the offset site will ensure that the risk of loss is minimised as much as possible.
Confidence in result (%)	90%	Protection mechanisms, once established, will provide a higher level of certainty that the offset will be conserved and enhanced through active management.
Time until ecological benefit (years)	1	The ecological benefit of the offset is likely to be realised immediately as the property is currently owned by Coastview Nominees Pty Limited as Freehold and subject to ongoing management, including inspections, fence maintenance and fire management.

Attribute	Value	Justification
Start quality (1-10)	8	A WRP habitat assessment of the proposed offset site was undertaken to determine the value of the habitat and the sites adequacy in offsetting the loss of WRP habitat from the proposal area (Attachment 2). Of the 22.12 ha, a 2 ha transect was surveyed. The proposed offset site is comprised of Jarrah-Marri forest over peppermint and other small trees/shrubs, providing a suitable food source for the WRP.
		While peppermints are the favoured food source of the species and were generally restricted to dense patches within the survey area the presence of a continuous canopy of Jarrah-Marri, in addition to the peppermint patches will provide moderate-good quality habitat for WRP.
		Vegetation within forested areas of the proposed offset site was observed to be contiguous with that of the survey area (a 2 ha transect within the offset site). As such, it can be inferred that 22.12 ha of the proposed offset site (forested areas) contains moderate-good quality habitat for WRP.
		The proposed offset site is located adjacent to a WRP release site managed by DPaW. The location of these sites adjacent to each other will provide additional interconnected WRP habitat and assist in successful relocation of WRP individuals in the area.
Future quality without offset (1-10)	7	Without ongoing management the future quality of the site is likely to be reduced by one habitat quality score through the risk of unauthorised access spreading weeds and dieback and causing disturbance, or loss of vegetation through inappropriate fire management. These degradation processes will be expected to continue over time leading to progressive loss of habitat value and foraging resources on-site.
Future quality with offset (1-10)	8	Formal protection of the offset and provision of capped funds to DPaW to engage in active management of the offset site will reduce degrading processes and maintain a high habitat quality at the site.
Confidence in result	90%	Proposed management options provide a high level of certainty that the offset will be conserved, averting the level of loss that would likely occur should no formal protection measures be implemented.
TOTAL offset calculator values	141.23%	

Based on the above offset calculations, the proposed 22.12 ha offset site will adequately offset the loss of 8.33 ha of black cockatoo and WRP habitat. The combined offset package will meet the 100% offset target (100.89% or 141.23% required in the Offset Assessment Guide (DotE 2012).

3. Detail on how any proposed offset site aligns with the principles of the EPBC Act Offset Policy (2012)

Offset details and offsets policy

SPG propose to offset the loss of black cockatoo and WRP through provision of a 27.5 ha land acquisition offset site near Margaret River (location figure provided in Attachment 2). The site, 9931 Bussell Highway, Margaret River is bound to the west by Bussell Highway, to the east by Darch Road, and is located approximately 3 kilometres southwest of the Margaret River townsite.

A total area of 5.38 ha of the site comprises wetland vegetation, which does not provide suitable habitat for black cockatoos and WRP and has therefore not been considered when determining offset calculations, presented in Table 2 and Table 3.

The remaining 22.12 ha portion of the site comprises Jarrah-Marri forest, providing suitable foraging, breeding and roosting habitat for all three species of Threatened black cockatoos and WRP, as detailed in Attachment 2.

The proposed offset site has been assessed in accordance with the EPBC Act Offset Policy and summarised in Table 4 below.

Table 4: Land acquisition offset details

Offset details	Response		
Current tenure arrangements (including zoning and ownership) and legal mechanisms proposed to protect these areas in the future	The proposed offset site is zoned 'General Agriculture' within the Augusta Margaret River Town Planning Scheme, currently owned by SPG. Ownership of the land will be transferred to DPaW for conservation in perpetuity as a Nature Reserve, following transfer of funds by SPG.		
	Ongoing maintenance of the property will be undertaken by DPaW following handover of the land.		
The risk of damage, degradation or destruction to any proposed offset sites in the absence of any formal protection and/or management	In the absence of formal protection the proposed offset site may be developed for agricultural purposes, consistent with other land parcels south of Margaret River. If the site was not developed, there is the potential the site could be degraded as a result of unauthorised access and edge effects.		
	Maintenance of the site by DPaW following transfer would reduce the risk of unauthorised access and edge effects by ensuring management measures are maintained, for example fence maintenance.		
Any plans to maintain or enhance the quality or extent of suitable WRP and black cockatoo habitat present on-site over a specified time period	The proposed offset site comprises an area of high quality habitat for Black Cockatoos and WRPs, therefore no additional revegetation or enhancement is deemed to be required, outside of routine maintenance, including fencing.		
	The offset site is located adjacent to a DPaW WRP release location. The site is therefore considered to support these activities and provide additional habitat that would not be threatened by potential development.		
The amount of funding proposed to purchase	The cost of the offset site is expected to be \$360,000 + GST.		
the offset site(s) and any additional funding for the rehabilitation and/or ongoing management of the proposed offset site(s) for a specified time period	SPG would also provide approximately \$10 000 to assist in ongoing management including maintenance of fencing.		

When assessed against key provisions of the Department's EPBC Act Environmental Offsets Policy (DotE 2012), the proposed offsets address the key offset requirements as shown in Table 5 below.

Table 5: Comparison of black cockatoo offset requirements with proposed offsets

Offset requirements	Proposed offsets		
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environmental that is protected by national environmental laws and affected by the proposed action	The proposed offset will result in an improved overall conservation outcome for the black cockatoos and WRPs, ensuring protection and enhancement of key habitat for all four species.		
Suitable offsets must be built around direct offsets but may include other compensatory measures	The upfront management actions proposed will directly improve the protection, management and long term viability of black cockatoo and WRP habitat within the offset site and Margaret River area i.e. this is a direct offset.		
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	The offsets proposed are consistent with DotE policy and the offset calculator in relation to the level of statutory protection that applies to listed black cockatoo species and WRPs.		
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	The extent of habitat to be subject to improved management and maintenance as a result of the offsets will be proportionate to the residual impacts on habitat within the proposal area. The proposed action will result in the clearing of approximately 8.33 ha of potential foraging and breeding habitat for all three species of black cockatoo and WRP. The proposed offset site will be approximately 22.12 ha in size; of a size and scale proportionate to the residual impacts on the protected matter. The offset package provides for greater than 90% of the impact offset as identified through the offset calculator.		

Offset requirements	Proposed offsets		
Suitable offsets must effectively account for and manage the risk of the offset not succeeding	The risk of the offset option not fulfilling the aims for which it is designed is considered to be very low and a confidence level of 90% has been used in the offset calculator. The offset property will be managed in perpetuity by DPaW and will ensure that the offset measures undertaken are enduring in terms of their improvement of the habitat values.		
Suitable offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	The proposed offsets package for black cockatoos and the WRP is to satisfy the requirements of the Commonwealth EPBC Act only.		
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	The proposed offsets will be managed by DPaW consistent with management measures implemented for Nature Reserve's within WA.		
Suitable offsets must have transparent governance arrangements, including being able to be readily measured, monitored, audited and enforced	Performance for the improvement of the direct offset habitat is readily measurable through the development of a baseline position and ongoing monitoring and reporting in terms of improvements being undertaken. This can be readily undertaken in an audited manner and enforced through conditions which can be applied to the approval decision.		

Conclusion

The offset package proposed, including acquisition of a 22.12 ha Jarrah-Marri and peppermint forest site in Margaret River is considered to offset the loss of 8.33 ha of black cockatoo and WRP habitat. The proposed offset package exceeds the 100% offset target, required by the Offset Assessment Guideline (DotE 2012).

Yours sincerely

Dale Newsome SENIOR PRINCIPAL

11 February 2016

Enclosure: Attachment 1 – Green Patch – revised developed and flora and vegetation

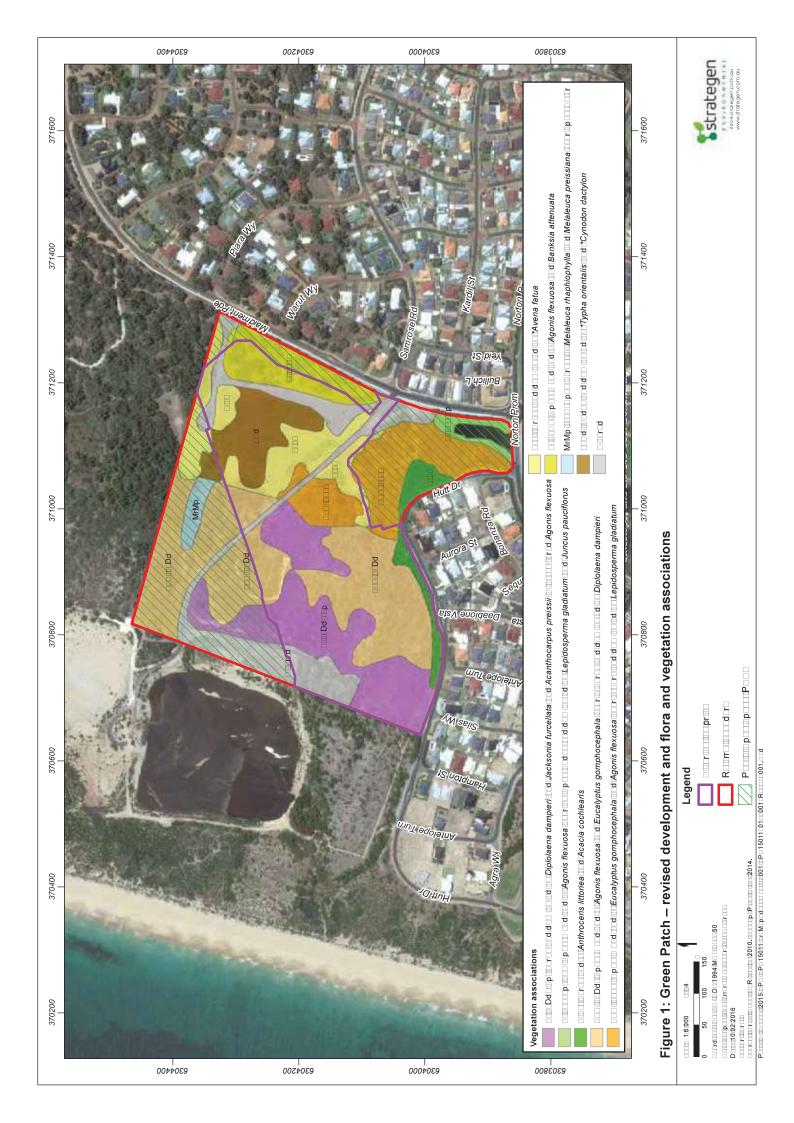
associations

Attachment 2 - 9931 Bussell Highway, Margaret River: Black cockatoo and

Western Ringtail Possum habitat survey

cc: Mitchell Dodson

Attachment 1
Green Patch – revised developed and flora and vegetation associations



Attachment 2
9931 Bussell Highway, Margaret River:
Black cockatoo and Western Ringtail
Possum habitat survey



9931 Bussell Highway, Margaret River

Black cockatoo and Western Ringtail Possum habitat survey

Prepared for Satterley Property Group by Strategen

February 2016



9931 Bussell Highway, Margaret River

Black cockatoo and Western Ringtail Possum habitat survey

Strategen is a trading name of Strategen Environmental Consultants Pty Ltd Level 1, 50 Subiaco Square Road Subiaco WA 6008 ACN: 056 190 419

February 2016

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consulting Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

Client: Satterley Property Group

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Figure 1: Location of the proposed offset site

3

1. Introduction

Satterley Property Group (SPG) is currently seeking to develop the Greenpatch residential subdivision within the Dalyellup Beach Estate in Bunbury Western Australia (the proposal). The proposal will necessitate the removal of native woodland vegetation potentially containing habitat for Western Ringtail Possums (WRP), Forest Red-tailed Black-Cockatoos (FRTBC), Baudin's Black-Cockatoos (BBC) and Carnaby's Black-Cockatoos (CBC). All four species are listed Threatened species under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Wildlife Conservation Act 1950* (WC Act).

Impacts to the four species as a result of the proposed clearing of 11.77 ha of vegetation are expected to be as follows:

- 8.33 ha of black cockatoo potential foraging and/or breeding habitat for all three species of black cockatoo (Carnaby's Black-Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Black-Cockatoo), including approximately 4.03 ha of *Agonis flexuosa* dominated shrubland providing limited foraging value and 4.30 ha of *Agonis flexuosa* and *Eucalyptus gomphocephala* open woodland providing limited foraging and potential suitable breeding habitat
- 27 potential black cockatoo habitat trees, with same number of hollow bearing trees impacted
- 8.33 ha of potential WRP habitat predominately Agonis flexuosa dominated shrubland, providing limited interconnected canopy areas.

Given the potential impacts of the proposal on black cockatoos and WRP, an offset will be required to mitigate potential impacts to the species in accordance with the EPBC Act. SPG own a 27.5 ha site in Margaret River that supports approximately 22.12 ha of Jarrah-Marri forest and 5.38 ha of wetland vegetation (the proposed offset site). On the basis of an Environmental Appraisal undertaken by Coffey (2008), the vegetation on site is considered to provide habitat for black cockatoos and potentially WRP.

SPG commissioned Strategen to undertake a black cockatoo habitat assessment within the proposed offset site to identify potential habitat values present within the site for the three black cockatoo species. The habitat assessment combines both a vegetation assessment as well as a significant tree assessment. The potential habitat value of vegetation within the proposed offset site for WRP was also determined during the assessment.

1.1 Description of the survey area

The proposed offset site is located at 9931 Bussell Highway, Margaret River, in the shire of Augusta-Margaret River. The site is bound to the west by Bussell Highway, to the east by Darch Road, and is located approximately 3 kilometres southwest of the Margaret River townsite (Figure 1). The proposed offset site contains approximately 22.12 ha of Jarrah-Marri forest vegetation which is likely to provide suitable foraging, breeding and roosting habitat for all three species of Threatened black cockatoos and potential habitat for WRP.

1.2 Foraging and breeding habits of black cockatoos

Carnaby's Black-Cockatoos feed on the seeds of a variety of native and introduced plant species and insect larvae (DotE 2015). Food plants generally occur within kwongan heath vegetation and genera range from *Banksia, Dryandra, Hakea* and *Grevillea*. The birds are also known to eat Marri seeds in more woodland areas. These black cockatoos have also adapted to feeding on exotic species such as pines and cape lilac and some weeds such as wild radish and wild geranium (DotE 2015). CBCs usually breed between July and December in the hollows of live or dead eucalypts, primarily in Salmon Gum and Wandoo (Johnstone 2010a). Hollows are usually at least 2 m above ground, sometimes over 10 m and the depth of the hollow varies from 0.25 m to 6 m (DotE 2015).



Forest Red-tailed Black-Cockatoos depend primarily on Marri and Jarrah trees for both foraging and nesting. The seeds of both eucalypts are the favoured food source of the birds and hollows within live or dead individual trees are utilised for nesting purposes (Johnstone and Kirkby 1999). Breeding varies between years and occurs at times of Jarrah and Marri fruiting. These black cockatoos breed in woodland or forest, but may also breed in former woodland or forest that has been reduced to isolated trees (DotE 2015).

Baudin's Black-Cockatoos primarily occur in eucalypt forests and forage at all strata levels within the forests with a tendency to favour areas containing Marri (Johnstone and Kirkby 2008, DotE 2015). Breeding generally occurs in the Jarrah, Marri and Karri forests of the southwest of Western Australia in areas averaging more than 750 mm of rainfall annually (DotE 2015). As with the other two species of Threatened black cockatoos in Western Australia, breeding habitat also occurs in former woodland or forest that has been reduced to isolated trees (DotE 2015).

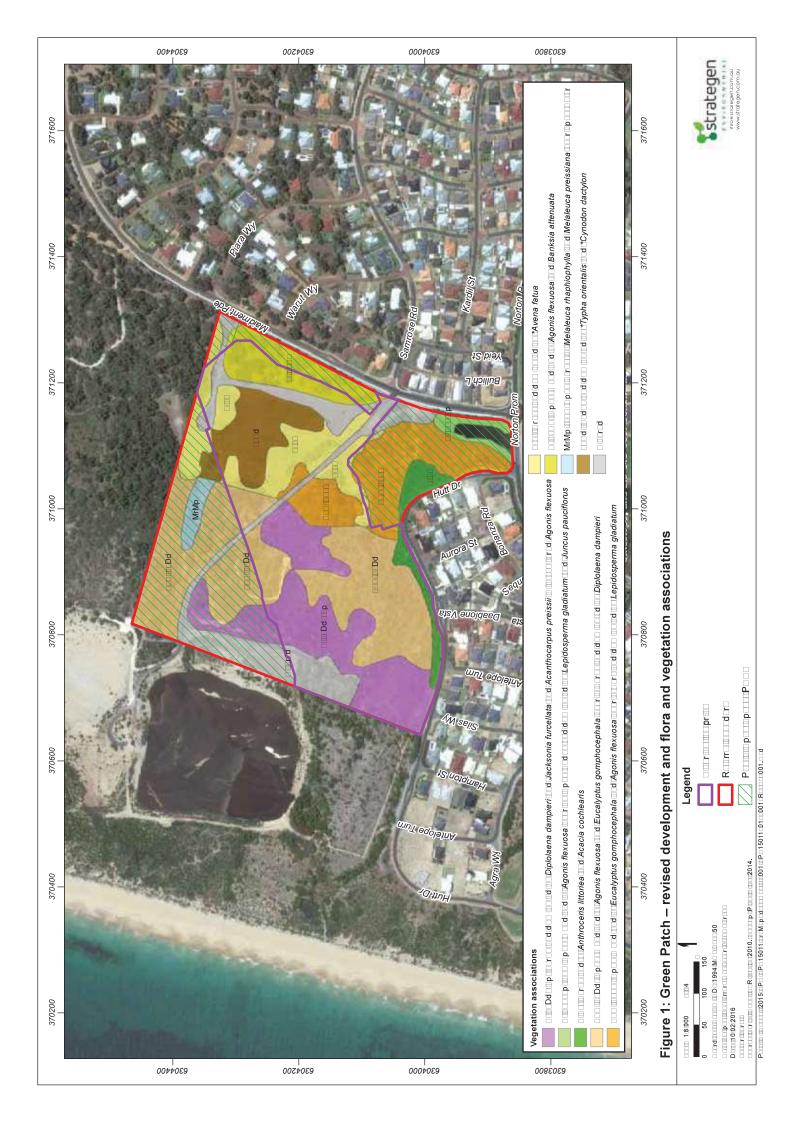
1.3 Western Ringtail Possums

Western Ringtail Possums occur within woodland and forest areas within the southwest of Western Australia (DotE 2015). Parks and Wildlife (2014) notes the species as occurring in the following habitats:

- stands of myrtaceous trees (usually peppermints [Agonis flexuosa]) on the Swan Coastal Plain
- · Jarrah, Marri, Karri and Wandoo forests near the Manjimup area
- coastal heath, eucalypt woodlands/forests, peppermint woodlands and myrtaceous heaths/shrublands on the south coast near Albany
- remnant patches of riparian vegetation within pine and blue-gum plantations.

Breeding timing is dependent on the distribution of the species. Coastal populations tend to have a year-round breeding period, with peaks noted in April – July and September – November (Jones et al. 1994). Breeding within inland populations tends to be more discrete, with majority of births occurring in May and June with a smaller breeding peak occurring from October – November (Wayne et al. 2005).





Methods

2.1 Site assessment

The proposed offset site was inspected on 13 March 2015 by Daniel Panickar (BSc Hons.). The inspection included:

- a vegetation assessment to identify potential black cockatoo and WRP habitat
- a significant tree assessment to identify any trees with the potential to be utilised by black cockatoos for breeding.

The proposed offset site was assessed by means of a continuous transect measuring 2 km as displayed in Figure 1. A 10 m wide survey corridor was established on the right hand side of the transect, resulting in a total survey area of 2 ha which was traversed on foot.

2.1.1 Vegetation assessment

Tree species with the potential to provide foraging and/or breeding habitat for black cockatoos were recorded within the survey area. Following the assessment, a foraging value based on the presence and quantity of tree species providing potential foraging habitat for black cockatoos was assigned to the proposed offset site.

Similarly, vegetation with the potential to provide habitat for WRP was noted within the survey area. Following the assessment, a habitat value based on the presence and quantity of tree species providing potential habitat for WRP was assigned to the proposed offset site.

2.1.2 Significant tree assessment

A significant tree assessment for black cockatoos was undertaken within the survey area. Significant trees are defined as trees of suitable species with a diameter at breast height (DBH) greater than 500 mm (> 300 mm for salmon gum and wandoo) (DSEWPaC [now DotE] 2012). Tree species which are considered to be potential breeding or roosting trees are outlined in Table 1. Trees with a DBH greater than 500 mm (or >300 mm for salmon gum and wandoo) are large enough to potentially contain hollows suitable for nesting black cockatoos, or have the potential to develop suitable hollows over the next 50 years. Trees of this size may also be large enough to provide roosting habitat. The locations of such trees within the survey area were recorded using a Global Positioning System (GPS) device. In addition to the location and DBH, the species of each tree was also recorded.



Table 1: Black cockatoo potential breeding tree species (Groom 2011, DSEWPaC 2012)

Scientific name	Common name	Breeding	Roosting
Corymbia calophylla	Marri	Yes	Yes
Corymbia maculata	Spotted Gum		Yes
Eucalyptus accedens	Powderbark	Yes	
Eucalyptus camaldulensis	River Red Gum		Yes
Eucalyptus citriodora	Lemon Scented Gum		Yes
Eucalyptus diversicolor	Karri	Yes	
Eucalyptus globulus	Tasmania B l ue Gum		Yes
Eucalyptus gomphocephala	Tuart	Yes	Yes
Eucalyptus grandis	Flooded Gum, Rose Gum		Yes
Eucalyptus longicornis	Red Morrell	Yes	
Eucalyptus loxophleba	York Gum	Yes	
Eucalyptus marginata	Jarrah	Yes	Yes
Eucalyptus megacarpa	Bullich	Yes	Yes
Eucalyptus occidentalis	Swamp Yate	Yes	
Eucalyptus patens	Blackbutt	Yes	Yes
Eucalyptus robusta	Swamp Mahogany		Yes
Eucalyptus rudis	Flooded Gum	Yes	Yes
Eucalyptus salmonophloia	Salmon Gum	Yes	
Eucalyptus salubris	Gimlet	Yes	
Eucalyptus wandoo	Wandoo	Yes	Yes
Pinus pinaster	Pinaster, Maritime Pine		Yes
Pinus radiata	Monterey, Radiata Pine		Yes



3. Results and discussion

3.1 Black cockatoo and WRP presence

No black cockatoos or WRP were observed within the survey area at the time of assessment.

3.2 Vegetation assessment

Vegetation within the proposed offset site is comprised of 22.12 ha of Jarrah-Marri forest (Plate 1) and 5.38 ha of *Taxandria* dominated wetland (Plate 2). The survey area (2 ha) only traversed forested areas of the proposed offset site as these were considered to be the only areas providing potential habitat for black cockatoos and WRP.

3.2.1 Black cockatoos

The survey area is comprised of Jarrah-Marri forest (Plate 1, Plate 3) which is considered to provide foraging, breeding and roosting habitat for CBC, BBC and FRTBC Groom 2011, Johnstone 2010b; 2010c). Species throughout the midstorey and understorey of the survey area consisted of:

- Banksia grandis
- Agonis flexuosa
- Acacia saligna
- Xanthorrhoea preissii
- Hakea spp.
- Grevillea spp.

These species are all considered to provide foraging habitat for black cockatoos (refer to Table 2) and were present in medium to high densities throughout the survey area.

Table 2: Flora species considered as providing foraging habitat for black cockatoos

Species	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black- Cockatoo	
Acacia saligna	Groom (2011)			
Agonis flexuosa (peppermint)	Groom (2011)			
Banksia grandis	Groom (2011)	Johnstone et al. (2011)		
Corymbia calophylla (Marri)	Groom (2011)	Johnstone et al. (2011)	Johnstone et al. (2011)	
Eucalyptus marginata (Jarrah)	Groom (2011)	Johnstone et al. (2011)	Johnstone et al. (2011)	
Hakea amplexicaulis Groom (2011)			Lee et al. (2003)	
Grevillea spp.	Species not identified in the species	field – black cockatoos known to	o forage on several <i>Grevillea</i>	
Xanthorrhoea preissii	Groom (2011)	Johnstone et al. (2011)		

Based on the results of the vegetation assessment, the survey area is considered to contain excellent quality foraging habitat for all three species of Threatened black cockatoos.

Vegetation within forested areas of the proposed offset site was observed to be contiguous with that of the survey area. As such, it can be inferred that 22.12 ha of the proposed offset site (forested areas) contains excellent quality foraging habitat for all three species of Threatened black cockatoos.





Plate 1: Jarrah-Marri forest within the proposed offset site



Plate 2: Taxandria dominated wetland within the proposed offset site



Plate 3: Jarrah-Marri forest within the proposed offset site

3.2.2 Western Ringtail Possums

The vegetation composition of the survey area (i.e. Jarrah-Marri over peppermint and other small trees/shrubs) provides a suitable food source for WRP (DotE 2015). While peppermints are the favoured food source of the species and were generally restricted to dense patches within the survey area (Plate 4); the presence of a continuous canopy of Jarrah-Marri, in addition to the peppermint patches will provide moderate-good quality habitat for WRP.

Vegetation within forested areas of the proposed offset site was observed to be contiguous with that of the survey area. As such, it can be inferred that 22.12 ha of the proposed offset site (forested areas) contains moderate-good quality habitat for WRP.

Additionally, a WRP release site is located directly adjacent (east) to the proposed offset site. This release site extends from the northern boundary of Watershed winery to the east of the proposed offset site to Rosa Brook Road, approximately 1 km to the north. The proximity of the release site to the proposed offset site increases the value of vegetation contained within the proposed offset site due to the likelihood of WRP utilising the proposed offset site as habitat.





Plate 4: Dense peppermint (Agonis flexuosa) patches within the proposed offset site

3.3 Significant tree assessment

'Breeding habitat' for black cockatoos is defined in DSEWPaC (2012) as trees of species known to support breeding (Table 1) within the range of the species which either have a suitable nest hollow or are of a suitable DBH to develop a nest hollow (> 300 mm for salmon gum and wandoo, and >500 mm for other species). These trees are known as significant trees. Significant trees which contain hollows that have an entrance diameter of more than 100 mm are suitable for use by black cockatoos (Whitford 2001). In general, hollows of sufficient size to support black-cockatoos do not form until trees are at least 230 years old, and the majority of nests are found in 300-500 year old trees (Johnstone 2006).

A total of 73 potentially significant trees (with DBH >500 mm) were recorded in the survey area (Table 3; Figure 1). A total of 59 trees were identified as *Corymbia calophylla* and 14 trees were identified as *Eucalyptus marginata;* both of which species are known to provide breeding habitat for black cockatoos (refer to Table 1). A total of 31 trees contained at least one visible hollow considered large enough to be suitable for nesting black cockatoos.

The density of significant trees within the surrounding proposed offset site was observed to be similar to that within the survey area.

No evidence of roosting or breeding was noted within the survey area at the time of assessment.



Table 3: Significant trees recorded in the survey area

Tree	Species	DBH (mm)	Suitable hollow(s) visible	Notes
1	C. calophylla	85	No	
2	C. calophylla	140	Yes	
3	C. calophylla	80	No	
4	C. calophylla	98	Yes	
5	C. calophylla	103	Yes	Dead tree
6	C. calophylla	118	Yes	
7	C. calophylla	98	No	
8	C. calophylla	86	No	
9	C. calophylla	135	Yes	
_10	C. calophylla	116	Yes	
11	C. calophylla	53	Yes	
12	C. calophylla	78	No	
_13	C. calophylla	63	No	
14	C. calophylla	151	No	
15	C. calophylla	71	No	
_16	C. calophylla	82	No	
_17	C. calophylla	76	No	
18	C. calophylla	50	No	
19	E. marginata	68	No	
20	C. calophylla	83	Yes	
21	C. calophylla	98	No	
22	C. calophylla	89	No	
23	C. calophylla	67	No	
24	C. calophylla	102	Yes	
25	C. calophylla	92	Yes	
26	C. calophylla	102	No	
27	C. calophylla	69	No	
28	C. calophylla	65	No	
29	C. calophylla	121	Yes	
30	C. calophylla	96	Yes	
31	C. calophylla	88	Yes	
32	C. calophylla	92	Yes	
33	E. marginata	50	No	
34	C. calophylla	56	No	
35	C. calophylla	63	Yes	
36	E. marginata	72	No	
37	E. marginata	73	Yes	
38	C. calophylla	65	No	
39	C. calophylla	72	No	
40	E. marginata	78	Yes	
41	C. calophylla	68	Yes	
42	C. calophylla	61	No	
43	C. calophylla	52	No	
44	C. calophylla	71	No	
45	C. calophylla	72	Yes	
46	C. calophylla	71	No	
47	C. calophylla	55	No	
48	C. calophylla	60	No	



Tree	Species	DBH (mm)	Suitable hollow(s) visible	Notes
49	C. calophylla	50	No	
50	C. calophylla	63	Yes	
51	C. calophylla	76	Yes	
52	C. calophylla	72	Yes	
53	E. marginata	62	Yes	
54	C. calophylla	73	Yes	
55	C. calophylla	50	No	
56	E. marginata	50	No	
57	C. calophylla	110	Yes	
58	C. calophylla	50	No	
59	E. marginata	62	No	
60	E. marginata	58	No	
61	C. calophylla	94	Yes	
62	E. marginata	50	No	
63	E. marginata	54	No	
64	C. calophylla	110	No	
65	E. marginata	63	Yes	
66	C. calophylla	78	Yes	
67	C. calophylla	52	No	
68	E. marginata	107	Yes	Dead tree
69	E. marginata	56	No	
70	C. calophylla	145	Yes	
71	C. calophylla	72	No	
72	C. calophylla	80	Yes	
73	C. calophylla	116	No	

4. Conclusion

The survey area contains suitable foraging and potential breeding habitat for Carnaby's Black Cockatoos, Baudin's Black Cockatoos and Forest Red-tailed Black Cockatoos as well as habitat for Western Ringtail Possums.

A total of 73 potentially significant trees were recorded within the survey area which could potentially be used by black cockatoos for roosting or breeding purposes in the future. Thirty-one of these trees contain hollows which are of suitable size for use by black cockatoos during breeding season. The survey area and surrounding forested areas within the proposed offset site contain excellent quality foraging habitat for black cockatoos due to the composition of the Jarrah-Marri forest vegetation contained within. This forest vegetation type contains several flora species considered to provide foraging habitat for black cockatoos. Based on this assessment, the proposed offset site contains 22.12 ha of excellent quality foraging habitat for black cockatoos.

The vegetation composition of the survey area (i.e. Jarrah-Marri over peppermint and other small trees/shrubs) also provides a suitable food source for WRP. The presence of a continuous canopy of Jarrah-Marri, in addition to dense patches of peppermint (*Agonis flexuosa*) trees provides moderate-good quality habitat for WRP. Based on this assessment, it can be inferred that 22.12 ha of the proposed offset site contains moderate-good quality habitat for WRP. Additionally, the location of a WRP release site to the east of the proposed offset site will increase the value of vegetation contained within the proposed offset site due to the likelihood of WRP utilising the proposed offset site as habitat.



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Appendix Four: Geotechnical Report



Report on

GEOTECHNICAL, PRELIMINARY ACID SULFATE SOIL AND GROUNDWATER STUDY PROPOSED RESIDENTIAL SUBDIVISION DALYELLUP BEACH ESTATE LOTS 9090 & 9076, DALYELLUP

Submitted to:

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Figure 1: Site and Location Plan

Figure 2: Site Classifications



APPENDICES

APPENDIX A: SITE PHOTOGRAPHS

APPENDIX B: BOREHOLE REPORTS

APPENDIX C: GROUNDWATER MONITORING LOGS

APPENDIX D: PENETROMETER TEST RESULTS

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APPENDIX H: UNDERSTANDING YOUR REPORT



1. INTRODUCTION

This report presents the outcomes of Galt Geotechnics' (Galt's) geotechnical, preliminary acid sulfate soil (ASS) and groundwater study for the proposed Dalyellup Beach Estate residential subdivision of Lot 9090 and 9076 ("the site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

The study was requested by Ian Cocker of Calibre Consulting (Aust) Pty Ltd on behalf of Satterley Property Group and authorised in an email dated 4 January 2016.

This report supersedes the draft report (report reference: J1601005 001 R Rev0 DRAFT dated 9 February 2016) and incorporates the ASS and groundwater studies.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Based on the supplied information, the site has an irregular shape and covers approximately 22 ha. It is bounded by Maidment Parade to the east and Hutt Drive to the south. There is bushland along the other boundaries.

The site comprises mostly dense bushland covering undulating sand dunes with a lower-lying grassed marshland present in part of the northeast. Minninup Road cuts through the middle of the site from the southeast to a loop in the northwest leading to an existing communication tower. The majority of the western part of the site comprises undulating sand dunes.

The current ground level is understood to vary from about RL 4.0 m AHD in the low-lying marshland in the northeast, rising up to a maximum elevation of about RL 39.0 m AHD on the western half of the site.

There is a small dam along the northern boundary towards the eastern side of the site. A drainage course runs from Maidment Parade along the northern side of Minninup Road.

A small amount of flytipped waste was present on the site at the time of fieldwork.

We understand that about half the site is to be subdivided into 176 residential lots and associated roads with the remainder of the site to be public open space (POS). The proposed earthworks plan provided shows that earthworks comprise up to 15 m of cut in the middle of the site and up to 3 m of fill, mainly in the northeast part. Total cut to fill will be 250,000 m³ with some 75,000 m³ excess material to be removed from site.

Over the north eastern part, a gravity sewer will be between 1.5 m and 4.0 m below finished level. Over the remainder of the site, the sewer will be about 2 m below finished level.

Level differences between lots will be accommodated by mass retaining walls (presumably limestone block walls). The maximum retained height will be of the order of 5 m in the southwest part of the development.

3. PROJECT OBJECTIVES

The objectives of the study were to:

Geotechnical

- ♦□ assess subsurface soil and groundwater conditions across the site;
- ♦□ provide recommendations on suitable footing systems for the proposed development;
- ❖□ provide a site classification(s) in accordance with AS 2870-2011 "Residential Slabs and Footings";
- ❖□ provide recommendations and geotechnical design parameters for earth retaining structures;
- ♦□ recommend appropriate site preparation procedures including compaction criteria;



- ♦□ assess the excavatability of the soil and rock in the areas of deep cut and along the alignment of the proposed deep sewer;
- ♦□ advise on the re-use of excavated material as fill;
- lacktriangleright assess the permeability of the soils at the site for potential on-site disposal of stormwater by infiltration; and
- ♦ provide a subgrade California bearing ratio (CBR) value for pavement thickness design by others.

Environmental

- ♦□ provide a preliminary ASS assessment; and
- ♦ provide a groundwater assessment for the proposed sewer installation.

4. FIELDWORK

Fieldwork was carried out from 18 to 21 January 2016 and comprised:

- ❖□ cutting access tracks and vegetation clearing to the test hole locations;
- ♦ drilling of boreholes at twenty five locations as follows:
 - o□ cut areas (BH01 to BH14, excluding BH03) extending to depths of between 2.0 m and 10.0 m;
 - o□ fill areas (BH15 to BH20) extending to a depth of 2.7 m in each instance;
 - o deep sewer control line (BH21 to BH26) extending to depths of between 3.0 m and 6.0 m (generally at least 1 m below invert level);
- ♦ □ drilling of three hand auger boreholes (HA01 to HA03) extending to depths of between 1.0 m and 1.3 m;
- ♦□ collection soil samples at 0.25 m intervals until the termination of each deep sewer and hand auger borehole;
- ♦ installation of three standpipe for groundwater sampling at the site;
- ❖□ collection of groundwater samples from the onsite standpipe;
- testing with a Perth sand penetrometer at twelve locations (PSP01 to PSP12) in areas of proposed shallow fill /cut, extending to a depth of 0.9 m in each instance; and
- ♦☐ infiltration tests using the 'inverse auger hole' technique at five locations (P01 to P05), at a depth of about 0.72 m to 0.75 m below existing surface.

Note: BH03 was not carried out due to access constraints on the site.

General

A geotechnical engineer and an environmental scientist from Galt located the test positions, supervised vegetation and track clearing, observed the drilling, logged the soils encountered, conducted the penetrometer and infiltration testing, and collected samples for inspection and possible laboratory testing.

The approximate test locations are shown on Figure 1, Site and Location Plan and details are summarised in Table A1, Summary of Tests, at the end of the text. Photographs of the site are presented in Appendix A, Site Photographs.

Boreholes

Geotechnical boreholes were drilled with an Eziprobe utility-mounted drill rig using solid auger and percussion drilling techniques.

Hand augered boreholes were drilled using an 80 mm diameter hand auger.

Standpipes (40 mm slotted PVC casing with gravel packs) were installed in boreholes BH21/MW01, BH23/MW02 and BH26/MW03.

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Borehole reports are presented in Appendix B, Borehole Reports along with a method of soil description and a list of explanatory notes and abbreviations used in the reports. A photograph of the spoil recovered from each borehole is included with each borehole report.

Soil Sampling

Soil samples were collected in accordance with the following Australian Standards and guidelines:

- ♦□ AS 4482.1 (2005) Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil Part I Non Volatile and Semi Volatile Compounds; and
- ◆□ Department of Environment Regulation (DER) (2015) Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes.

Samples for field testing were collected using dedicated nitrile gloves and placed in laboratory-supplied plastic clip lock sample bags. The plastic clip lock sample bags were placed in an ice chilled cooler until field testing (pH_F and pH_{FOX}) was conducted.

At the conclusion of fieldwork and field testing, selected soil samples were couriered to the laboratory with adequate packing and ice to ensure that they arrived intact and at the appropriate temperature to ensure sample preservation.

Acid Sulfate Soil Field Testing

Soil samples were tested for pH before (pH_F) and after (pH_{FOX}) rapid oxidation with hydrogen peroxide (H_2O_2). The field tests were undertaken to provide an indication of soil types likely to have the potential to generate acidity as a result of oxidation during earthworks.

Test results are included in Table A2, Acid Sulfate Soil Results Table, at the end of the text.

Groundwater Sampling

Groundwater samples were collected from groundwater monitoring wells (BH21/MW01, BH23/MW02 and BH26/MW03). Groundwater sampling was undertaken in accordance with the following Australian Standards:

- ♦□ AS 5667.1:1998 Water Quality Sampling. Part I Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples; and
- ♦ AS 5667.11:1998 Water Quality Sampling. Part II Guidance on the Sampling of Groundwater.

Representative groundwater samples for laboratory analysis were recovered on 3 February 2016. Measurements of field parameters, including temperature, pH, electrical conductivity (EC), reduction oxidation (redox) potential and dissolved oxygen (DO) were taken every two minutes using a calibrated water quality meter until stabilisation of parameters was achieved.

Recovery of groundwater samples was undertaken utilising a low-flow pump. A minimum of 20 L from each well was purged before monitoring and field testing to remove any stagnant water from the well installation process. All groundwater purged from the bores was carefully disposed into the ground in the vicinity of the monitoring bore it was extracted from at a rate that did not result in unsightly or nuisance conditions. New nitrile, disposable gloves were used at each monitoring well location.

Groundwater samples were collected directly from the pump into appropriately preserved and labelled, laboratory supplied bottles and filled to zero headspace. Samples that required field filtering were collected using a single use, sterile, catheter tip syringe which connects directly to an in-line, single-use 0.45 µm filter.



All samples were stored on ice in an esky, prior to submission to the laboratory for analysis. All groundwater samples were couriered to the laboratory at the conclusion of the fieldwork, with adequate packing and ice to ensure that they arrived intact and at the appropriate temperature to ensure sample preservation.

Groundwater monitoring field sheets are presented in Appendix C, Groundwater Monitoring Field Sheets.

Perth Sand Penetrometer Tests

Perth sand penetrometer (PSP) tests were carried out in accordance with AS 1289.6.3.3 although to a greater depth than the 0.45 m covered by the standard. Tests were carried out adjacent to selected boreholes in areas of proposed shallow fill/cut. The results of the PSP testing are presented in Appendix D, Penetrometer Test Results.

Infiltration Testing

Infiltration testing was carried out at five locations (P01 to P05) using the method described by Cocks². The results of the infiltration testing are presented in Appendix E, Infiltration Test Results and summarised in Table 1: Summary of Permeability Test Results.

Minimum Unsaturated Permeability, k (m/day) Test Description Pipe Embedment (m) Location Test 1 Test 2 Test 3 P01/BH17 SAND 0.72 6.1 6.5 6.2 SAND P02/BH08 0.74 >15 >15 >15 P03/BH20 SAND 0.72 >15 >15 >15 P04/BH12 SAND 0.72 >15 >15 >15 P05/BH02 SAND 0.75 >15 14.3 14.9

Table 1: Summary of Infiltration Test Results

Note:

- 1. The minimum unsaturated permeabilities were generally recorded towards the end of test, with pressure head varying between 0.1 m and 0.185 m.
- 2. The test method is not considered accurate for permeabilities higher than about 15 m / day.

5. LABORATORY TESTING

5.1 Geotechnical

Laboratory testing on soil samples is being undertaken by Mining & Civil Geotest in their NATA accredited laboratory and comprised determination of:

- ♦□ particle size distribution on five samples;
- ♦□ Atterberg limits and linear shrinkage on two samples; and
- ♦☐ organic content on three samples.

Laboratory test results along with the test methods followed will be included in Appendix F, Geotechnical Laboratory Test Results and summarised in Table 2, Summary of Laboratory Test Results in the final report.

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Cocks, G (2007), "Disposal of Stormwater Runoff by Soakage in Perth Western Australia", Journal and News of the Australian Geomechanics Society, Volume 42 No. 3, pp 101-114



Table 2: Summary of Laboratory Test Results

Test Pit	Depth (m)	% Gravel	% Sand	% Fines	LL (%)	PI (%)	LS (%)	OC (%)
BH06	3.0 – 4.0	0	99	1	-	-	-	-
BH17	1.5 – 1.8	0	92	8	-	-	-	3.1
BH18	0.2 – 0.5	1	44	55	50	14	5.0	-
BH19	0.2 – 0.5	3	69	28	59	16	7.0	9.6
BH21	0.0 – 0.75	0	95	5	-	-	-	2.8

NOTES: LL: Liquid Limit

PI: Plasticity Index

LS: Linear Shrinkage

OC: Organic content

5.2 Environmental

Laboratory analysis was undertaken on selected soil samples collected from the boreholes. Analysis was undertaken using the chromium reducible sulfur (CRS) method which provides acid base accounting and quantification of potential acid generation. The selection of samples for laboratory analysis was based on soil types encountered and the results of field testing.

All groundwater samples were scheduled for a suite of analysis consistent with the Department of Environment Regulation (DER) (2015) *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* guideline document. The suite included total and dissolved metals, acidity, alkalinity, nutrients, anions and cations.

Analysis of soil and groundwater samples was undertaken by Eurofins in their NATA accredited laboratory. Laboratory certificates of analysis are presented in Appendix G, Environmental Laboratory Test Results.

6. SITE CONDITIONS

6.1 Geology

The Bunbury-Burekup sheet of the 1:50,000 scale Urban Geology series map indicates that the area is underlain by the following geological units:

♦☐ Bulk of site: SAFETY BAY SAND — calcareous quartz sand dunes;

♦☐ Eastern part: SWAMP DEPOSITS — mainly peaty sand; and

♦□ Northeast corner: SAND derived from TAMALA LIMESTONE

The findings of our investigation are in accordance with the geology mapping.

6.2 Subsurface Conditions

Based on the material encountered within the boreholes, the site can be broadly divided into three typical areas, as shown on Figure 2, Site Classifications. The typical soil profiles for the three areas generally comprise:

Area 1 – Western Half of Site (Safety Bay Sand)

♦ SAND (SP), fine to medium grained, sub-angular to sub-rounded, pale grey becoming white, trace (~3%) organics and rootlets generally in the top 0.1 m to 0.3 m, localised trace fine grained shell fragments, dry becoming moist, generally medium dense to dense, locally loose in the top 0.5 m, present from the surface extending to the maximum depth of investigation of 10.0 m.



Area 2 - Eastern Boundary of Site (Sand derived from Tamala Limestone)

♦ SAND (SP), fine to coarse grained, sub-angular to sub-rounded, grey brown becoming yellow brown, trace (~3%) organic fines and rootlets in the 0.2 m to 0.3 m, moist to wet, generally medium dense to dense, present from the surface, extending to depths of between 2.7 m and 6.0 m.

<u>Area 3 – Low-lying Marshland (Swamp Deposits)</u>

- ◆□ Peaty Silty SAND/Peaty SAND/Sandy CLAY, fine to medium grained sand, 20% to 60% low plasticity clay/high liquid limit silt fines, 5% to 10% organics, dark grey/pale grey, sandy clay is possibly uncontrolled fill material, moist to wet, soft to firm, present from the surface, extending to depths of between 0.7 m and 1.0 m; overlying
- ♦☐ SAND (SP), fine to coarse grained, sub-angular to sub-rounded, grey brown becoming yellow brown, trace non-plastic fines, moist to wet, extending to depths of between 2.7 m and 3.0 m.

6.3 Groundwater

We are not aware of any publicly available groundwater information for this area. Groundwater was encountered within the boreholes at the following depths:

- ♦ Area 1 encountered within two boreholes (BH15 and BH21) at depths of 2.2 m and 4.23 m below ground level, respectively. These locations were on the far east side of Area 1, bordering the marshland;
- ♦ Area 2 encountered within six boreholes (BH17, BH20 and BH23 to BH26) at depths of between 1.7 m and 2.95 m below ground level;
- ♦ Area 3 encountered within four boreholes (BH16, BH18, BH19 and BH22) at depths of between 0.9 m and 1.5 m below ground level.

Note: Fieldwork was carried out in the middle of summer; however, the Bunbury region received heavy rainfall during the period of the fieldwork.

7. GEOTECHNICAL ASSESSMENT

7.1 Site Classification

We consider that the site is geotechnically capable of supporting the proposed residential subdivision.

The site classification is based on AS 2870-2011 "Residential Slabs and Footings" which defines the site classes as given in Table 3.

Table 3: Summary of Site Classifications (AS 2870-2011)

Class	Description	Characteristic Surface Movement (y _s)
А	Most sand and rock site with little or no ground movement from moisture change	Not Defined (typically <5 mm)
S	Slightly reactive clay sites with only slight ground movement from moisture changes	0 – 20 mm
M	Moderately reactive clay sites, which may experience moderate ground movements from moisture change	20 – 40 mm
H1	Highly reactive sites, which may experience high ground movements from moisture change	40 – 60 mm

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Class	Description	Characteristic Surface Movement (y _s)
H2	Highly reactive sites, which may experience very high ground movements from moisture change	60 – 75 mm
E	Extremely reactive sites, which may experience extreme ground movements from moisture change	>75 mm
Р	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise	Not Defined

We consider that the site classifications shown in Figure 2, Site Classifications, are appropriate for the site, <u>provided</u> the standard site preparation measures outlined in Section 7.3 are followed (excluding detailed remediation of the <u>swamp deposits</u>).

Site classifications considered appropriate are:

- ♦□ "Class A" for Area 1 and Area 2; and
- ♦☐ "Class P" for Area 3, due to the presence of soft peaty and clayey swamp deposits.

We consider improvement of the "Class P" area to "Class S" is possible with remediation/ground improvement (see Section 7.3).

Alternatively, we consider improvement of the "Class P" area to "Class A" is possible with over-excavation and removal of all clayey and peaty material, and replacement with imported approved fill.

7.2 Shallow Footings

Provided that the site preparation measures given in Section 7.3 are completed, we consider that proposed residential structures may be founded on shallow footings constructed in accordance with the requirements of AS 2870-2011 for the appropriate site classification as outlined in Section 7.1 (maximum bearing pressure of 100 kPa).

7.3 Site Preparation

7.3.1 General

The site preparation measures outlined below are aimed at improvement of the site in preparation for construction of the structures including on-ground slabs, shallow footings, retaining walls and pavements.

- ♦ Remove all fly-tipped rubbish from the site.
- ❖□ Strip vegetation from the site including grubbing out of tree roots.
- $\bullet \Box$ Remove or treat clayey and peaty material (Swamp Deposits) within Area 3 (see Section 7.3.2).
- ❖□ Strip and stockpile topsoil from the site for potential re-use in non-structural applications or for possible blending with clean sand. We recommend a 100 mm topsoil strip or as otherwise necessary to remove all significant organic material from the soil (locally up to 300 mm strip may be required).
- ◆□ Compact ground surface to achieve the level of compaction specified in Section 7.4 to a minimum depth of 0.9 m below surface. Note: Where there is more than 1 m of bulk fill to be placed over the in-situ sand, the depth of compaction can be reduced to 0.45 m.
- ♦ Where fill is required to raise site surface levels, approved fill must be used (refer to Section 7.5), placed and compacted in layers of no greater than 300 mm loose thickness.

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7.3.2 Treatment of Swamp Deposits (Area 3)

We consider two remediation options are available for the swamp deposits present in Area 3, depending on the desired site classification. Additionally, the costs of implementing either of the two remediation options will potentially vary greatly and we recommend a detailed cost analysis is undertaken to determine the most favourable treatment.

Class A – Remove and Replace Peaty and Clayey Material

- ♦ Over-excavate and stockpile all peaty and clayey material present in the marshland;
- ◆□ Compact ground surface to achieve the level of compaction specified in Section 7.4 to a minimum depth of 0.9 m below surface. Note: Where there is more than 1 m of bulk fill to be placed over the in-situ sand, the depth of compaction can be reduced to 0.45 m.
- ♦ Where fill is required to raise site surface levels, approved fill must be used (refer to Section 7.5), placed and compacted in layers of no greater than 300 mm loose thickness.

It should be noted that due to the high water level in this area, compaction of the underlying clean sand is likely to be difficult to achieve and dewatering may be required. Additionally, the material to be over-excavated will require treatment before it can be re-used or disposed of.

Potentially, this peaty and clayey material could be re-used once treated as non-structural fill in POS areas or screened and blended to create a deep bulk fill to be utilised where at least 3.0 m of clean sand fill is present overlying the blended fill.

Class S - Treatment of Peaty and Clayey Material In-situ

- ◆□ Use lime or cement stabilisation to treat the peaty and clayey material in-situ (Note: the test holes indicate a maximum depth of about 1.0 m but deeper areas may be present).
- ♦ Proof-compact the exposed surface. Any areas rutting or heaving during compaction will need to be over-excavated and replaced.
- ♦ Where fill is required to raise site surface levels, approved fill must be used (refer to Section 7.5), placed and compacted in layers of no greater than 300 mm loose thickness.

This method will minimise or avoid the removal of potentially ASS material and limit the amount of dewatering required to achieve compaction. However, care will need to be taken to ensure that the entire extents of the *in-situ* material is treated, since we still anticipate long-term settlements of the order of 15-20 mm will be likely following remediation and failure to consistently treat all material could lead to long term differential settlement issues and release of methane gas as organics decompose over time.

Prior to earthworks, trials must be carried out to confirm the procedures to be adopted and the amount of additives to be used.

7.4 Compaction

Approved granular fill and the *in situ* sands must be compacted using suitable compaction equipment to achieve a dry density ratio (DDR) of at least 95% MMDD (maximum modified dry density) as determined in accordance with AS 1289.5.2.1 at a moisture content within 2% of optimum moisture content (OMC).

If sand is used as fill and a Perth sand penetrometer (PSP) is used for compaction control, we consider the following minimum blow counts will demonstrate that the sand has been compacted to the required DDR:



♦ 0-150 mm: SET
 ♦ 150-450 mm: 8
 ♦ 450-750 mm: 10
 ♦ 750-1050 mm: 12

If difficulties are experienced in achieving the required blow count, a site-specific PSP correlation should be carried out to determine the PSP blow count correlating to a DDR of 95% MMDD. The correlation must:

- ♦□ be done on site;
- ♦□ use the nuclear density gauge (NDG) to determine density at a minimum of 5 points with varying density to a depth of 300 mm below surface;
- ♦ use a calibrated PSP to determine the PSP blow count from 150 mm to 450 mm at each of the NDG test points; and
- ♦□ be plotted on a chart of PSP blow count vs DDR.

Over-excavation and replacement of loose materials must be done where the minimum dry density ratio cannot be achieved.

Fill must be placed in horizontal layers of not greater than 0.3 m loose thickness. Each layer must be compacted by suitable compaction equipment and carefully controlled to ensure even compaction over the full area and depth of each layer.

Care will need to be taken when compacting in the vicinity of existing structures. This is particularly important if vibratory compaction is being carried out. Tynan (1973)³ provides assistance with the selection of compaction equipment for use adjacent to structures.

After compaction, verify that the required level of compaction has been achieved by testing to a minimum depth of 0.9 m:

- ♦□ on each lift of fill on a 20 m grid;
- ♦□ at each spread footing location;
- ◆□ at 5 m centres along gravity retaining wall footings and strip footings (where present); and
- ❖□ at 10 m centres below on-ground slabs and pavements.

7.5 Approved Fill

Imported granular fill must comply with the material requirements as stated in AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments".

Generally, the *in-situ* sand present at the site is suitable for re-use as inert structural fill. However, any organic-rich sand (including the nominal 100 mm topsoil strip and clayey or peaty material within the marshland) or sand containing significant proportions of fines (material less than 0.075 mm in size) must not be used unless suitably screened and blended with clean sand.

Additionally, we consider that the sand (excluding topsoil) present at the site is suitable for re-use as bedding material (Zone A), pipe side support (Zone B) and backfill above pipe (Zone C) for the proposed sewer, in accordance with Water Corporation specifications.

Where doubt exists, a geotechnical engineer must be engaged to inspect and approve the use of potential fill materials.

Galt Geotechnics Pty Ltd

³ Tynan (1973) Ground Vibration and Damage Effects on Buildings, Australia Road Research Board, Special Report No. 11.



7.6 Earth Retaining Structures

Retaining structures may be designed in accordance with AS 4678-2002 "Earth-Retaining Structures". We recommend that all retaining walls at the site be backfilled with free-draining fill, e.g. sand (either site-derived or imported free draining sand fill with less than 5% fines).

For the design of retaining structures, the following parameters are considered appropriate for *in situ* medium dense sand and compacted sand backfill:

- $\bullet \Box$ angle of internal friction, ϕ = 36°;
- $\bullet \square$ coefficient of active earth pressure $K_a = 0.26$;
- ♦ coefficient of passive earth pressure $K_p = 3.85$;
- \clubsuit at rest coefficient of earth pressure $K_0 = 0.41$;
- ♦ bulk density: 18 kN/m³; and
- ♦□ buoyant density (below watertable): 8 kN/m³.

Compaction plant can augment the lateral earth pressure acting on retaining walls. Hand operated compaction equipment is recommended within 2 m of any retaining walls to minimise compaction pressures.

It is important to note that some ground movement is to be expected behind any soil retaining system, including gravity retaining walls.

The design of any high retaining walls (>1.0 m) must be reviewed by a geotechnical engineer. Prepared footing excavations for retaining walls must be carefully assessed prior to construction.

7.7 Excavatability

Based on the soil profile encountered, we expect that excavations on site will be readily achievable to depths of at least 10 m using conventional earthmoving equipment (i.e. with a 10 tonne or larger excavator).

Excavations in sand are prone to instability particularly below the water table. Above the water table, we recommend batter angles no steeper than 1V:2H for temporary slopes and 1V:3H for permanent slopes where no external restraint is provided to the slope. Even at these slope angles, rilling and erosion of the slope may occur. Where steeper slopes are required, temporary or permanent slope retention must be employed.

Temporary slopes up to 1V:1.5H can be considered where:

- ♦□ No surcharge (machinery, stockpiles, etc) is present at the crest of the slope.
- ♦ The maximum slope height is 2 m.
- \blacklozenge Groundwater is at least 1 m below the toe of the slope (this may require dewatering in places).

A geotechnical engineer must be consulted where there is any doubt regarding the stability or safety of unsupported excavations.



7.8 Stormwater Disposal

The results of the infiltration tests carried out at five locations are presented in Appendix E, Infiltration Test Results. The minimum measured permeabilities recorded were between 6.1 m/day (P01) and 27.5 m/day (P02).

We consider that the *in-situ* sands and sand fill at the site are suitable for the disposal of stormwater by infiltration by means of soak wells. Notwithstanding the results of the permeability testing, we recommend a design value of permeability (k) not greater than 5 m/day for the in-situ sand and sand fill to allow for the variability in materials and reduced permeability as a consequence of:

- ❖□ densification of sand during site preparation works;
- ♦□ natural variation in sands; and
- ♦□ clogging of the sand around soak wells and soakage basins over time with fines.

Soak wells should be placed outside a line of 1V:2H extending below the edge of the nearest footing, subject to local council regulations. Discharge from soak wells has been known to promote densification of loose sandy soils, leading to settlements of footings and slabs. Soak wells should be carefully wrapped with geotextile to prevent migration of sand and fines into the soak well.

7.9 Pavement Design

Where the site preparation measures outline in Section 7.3 have been completed (i.e. pavement subgrades comprise at least 0.5 m of compacted *in-situ* sand or sand backfill), pavement thickness design may be undertaken assuming a subgrade California bearing ratio, CBR of 12 %.

8. ENVIRONMENTAL ASSESSMENT

8.1 Assessment Criteria

8.1.1 Field Testing

In most cases, field pH values (pHF) of <4 indicate the presence of actual acid sulfate soils (AASS), thus indicating acids in the soil profile have oxidised.

The presence of unoxidised acids or potential acid sulfate soil (PASS) is indicated if:

- ❖□ a strong reaction with hydrogen peroxide is observed;
- $\bullet \Box$ the pH_{FOX} is at least 1 pH unit below pH_F; or
- \blacklozenge the pH_{FOX} is <3 and one or both of the above conditions apply.

8.1.2 Laboratory Testing - Soil

The texture based net acidity action criteria presented in the DER (2015) *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* guideline document specifies a value of **0.03** %**S** based on sandy soils encountered across the site. As such, this value has been adopted for the assessment of net acidity in soils across the site.



8.1.3 Laboratory Testing - Groundwater

Groundwater analytical results have been compared with assessment criteria outlined in the following guideline documents:

- ♦ National Environmental Protection Council (NEPC) (2013) National Environmental Protection (Assessment of Site Contamination) Measure; and
- ♦□ DER (2014) Assessment and Management of Contaminated Sites.

The specific groundwater criteria adopted from these documents are as follows:

- ♦□ drinking water;
- ♦ freshwater; and
- ♦□ non-potable use of groundwater (NPUG).

8.2 Field Testing Results

Field testing results are presented in Table A2, (located at the end of the text) and are summarised below.

- \blacklozenge Field pH_F test results for all soil samples ranged from 7.0 (HA01/0.75) to 8.9 (BH23/0.75).
- ♦ Field pH_{FOX} test results were lower, ranging from 1.7 (BH22/2.25) to 8.5 (BH23/1.0).
- ◆□ Differences between pH_F and pH_{FOX} levels in individual soil samples ranged from 0.0 (BH23/1.0) to 5.6 (BH22/2.25).
- ◆□ During oxidation, 62 of the 107 samples field tested displayed a low reaction, 36 samples displayed a moderate reaction, 3 samples displayed a high reaction, 1 samples displayed an extreme reaction and 5 samples displayed a volcanic reaction.

8.3 Laboratory Analysis

Soil analytical results using the CRS method are presented in Table A2 and are summarised below.

- ◆□ Titratable actual acidity (TAA) values were below the laboratory limit of reporting (LOR) (<0.02 %S) at all locations</p>
- ♦ CRS values ranged from below the laboratory LOR (<0.005 %S) to 0.74 %S (HA02/1.25).</p>
- ♦ Net acidity values ranged from <0.02 %S (a number of locations) 0.74 %S (HA02/1.25) exceeding the adopted criterion of 0.03 %S at three locations.

8.4 Summary

The investigation has confirmed that PASS is present within the sites boundary. Levels of net acidity exceeded the action criterion of 0.03 %S at three locations at the site (BH22/2.25 m, HA01/0.0 m and HA02/1.25 m). These locations are within the area identified as PASS on Figure 1. The exceedances were identified in soils characterised as:

- ◆□ SAND (SP), fine to medium grained, sub-angular to sub-rounded, pale grey;
- ❖□ Peaty/ sandy CLAY, 50-60% low plasticity fines, fine grained sand, dark brown-black, with some silt; and
- ♦☐ SAND (SP), fine to coarse grained, sub-angular to sub-rounded, grey-brown, trace non-plastic fines, and trace organics.



Two treatment options have been provided for the material within Area 3 (as outlined on Figure 2) with these options comprising either excavation or in-situ treatment (see Section 7.3.2). We note that both options with require disturbance of ASS material and as such, a site-specific acid sulfate soil management plan (ASSMP) is required once a treatment strategy has been decided upon. Irrespective of the above, an ASSMP is required for any soil disturbance within the area identified as PASS on Figure 1.

Soils excavated from the remainder of the site are classified as non-acid sulfate soils (NASS on Figure 1) and will not require any further treatment or management.

9. GROUNDWATER INVESTIGATION RESULTS

9.1 Field Parameters

Groundwater field parameters are presented in Table 4 and are discussed below.

- ♦ pH values ranged from 6.65 (MW02) to 6.90 (MW03) with all values within the recommended range of 6.5 to 8.5.
- ♦□ Electrical conductivity ranged from 774 μS/cm (MW03) to 1184 μS/cm (MW01).
- ♦☐ Dissolved oxygen concentrations ranged from 0.16 mg/L (MW02) to 4.26 mg/L (MW03).
- ♦□ Redox potential values ranged from -110.2mV (MW03) to -25.6 (MW02).

	Table 4. G	irounuwate	ei rieiu ra	iailleteis		
	Depth to Groundwater (mBGL)	Temperature (°C)	Hd	Electrical Conductivity (μS/cm)	Dissolved Oxygen (mg/L)	Redox Potential (mV)
Sample ID						
BH21/MW01	4.51	17.9	6.71	1184	1.10	-106.2
BH23/MW02	0.59	20.4	6.65	1114	0.16	-25.6
BH26/MW03	1.96	21.3	6.90	774	4.26	-110.2

Table 4: Groundwater Field Parameters

9.2 Analytical Results

Groundwater analytical results are presented in Table 5 and Table 6 and are discussed below.

- ♦ Dissolved arsenic concentrations ranged from 0.033 mg/L (MW01 and MW03) to 0.003 exceeded the drinking water and the freshwater assessment criteria at two locations (MW01 and MW03).
- ◆□ Total iron concentrations ranged from 0.89 mg/L (MW02) to 14 mg/L (MW01), exceeding the NPUG criterion of 0.3 mg/L at all locations.
- ♦ Ammonia concentrations ranged from 0.02 mg/L (MW02) to 0.53 mg/L (MW02), exceeding the NPUG criterion of 0.5 mg/L at one locations (MW01).
- ❖□ Remaining heavy metals and nutrient concentrations were either below the laboratory LOR and/or conformed to the adopted criteria at all locations.



- ♦□ Concentrations of acidity (as CaCO₃) ranged from less than the laboratory LOR (<10 mg/L) (MW01 and MW03) to 10 mg/L (MW02) indicating that the groundwater generally contains low levels of inherent acidity.
- ♦ Concentrations of alkalinity ranged from 250 mg/L (MW03) to 380 mg/L (MW02), indicating that the groundwater has sufficient self-buffering capacity.

Table 5: Groundwater Analysis Results - Metals

	Aluminium - Total (mg/L)	Aluminium – Dissolved (mg/L)	Arsenic - Dissolved (mg/L)	Cadmium - Dissolved (mg/L)	Chromium (VI) - Dissolved (mg/L)	Iron - Total (mg/L)	Iron – Dissolved (mg/L)	Manganese - Dissolved (mg/L)	Nickel - Dissolved (mg/L)	Selenium – total (mg/L)	Zinc - Dissolved (mg/L)
Drinking Water	-	-	0.01	0.002	0.05	-	-	0.5	0.02	0.01	-
Freshwater	-	0.055	0.013	0.0002	0.001	-	-	1.9	0.011	0.005	0.008
NPUG	-	0.2	0.1	0.02	0.5	0.3	-	5	0.2	0.1	3
Sample ID											
BH21/MW01	1.5	<0.005	0.033	<0.0002	<0.001	14	12	0.067	<0.001	<0.001	<0.001
BH23/MW02	0.25	<0.005	0.003	<0.0002	<0.001	0.89	0.57	0.020	<0.001	<0.001	<0.001
BH26/MW03	1.2	<0.005	0.033	<0.0002	<0.001	2.0	1.4	0.024	<0.001	<0.001	<0.001

Table 6: Groundwater Analysis Results - Nutrients

	Acidity (mg/L)	Ammonia - as NH ₃ (mg/L)	Chloride (mg/L)	Phosphorous – as P (mg/L)	Sulfate – as S (mg/L)	Alkalinity (mg/L)	Nitrate and Nitrite (mg/L)	Total Kjeldahl Nitrogen (mg/l)	Total Nitrogen (mg/L)
Drinking Water	-	-	-	-	500	-	50	-	50
Freshwater	-	-	-	-	-	-	-	-	-
NPUG	-	0.5	250	-	1000	-	500	-	-
Sample ID									
BH21/MW01	<10	0.53	230	0.14	19	340	<0.05	2.2	2.2
BH23/MW02	10	0.02	130	<0.05	27	380	3.8	<0.2	3.8
BH26/MW03	<10	0.21	96	<0.05	16	250	<0.05	0.7	0.7

9.3 Summary

Groundwater was encountered at depths ranging from 0.59 m (BH26/MW02) to 4.51 m (BH23/MW01) (during the groundwater monitoring event), with pH values within the recommended range of 6.5 to 8.5 at all locations.

Low levels of inherent acidity and elevated levels of alkalinity in groundwater across the site indicate the aquifer is likely to have sufficient self-buffering capacity to maintain stable pH conditions in the event dewatering works are required.



10. CONCLUSIONS AND RECOMMENDATIONS

ASS treatment and management will be required across a portion of the site identified as PASS (as outlined on Figure 1). Two treatment options have been provided for the material within Area 3 (as outlined on Figure 2) with these options comprising either excavation or in-situ treatment. We note that both options with require disturbance of ASS material and as such, a site-specific ASSMP is required once a treatment strategy has been decided upon. Irrespective of the above, an ASSMP is required for any soil disturbance within the area identified as PASS on Figure 1.

Soils excavated from the remainder of the site are classified as non-acid sulfate soils (NASS on Figure 1) and will not require any further treatment or management.

In the event of dewatering, treatment of groundwater to correct pH levels is unlikely to be required, however we recommend that a monitoring program be implemented (in accordance with a site specific management plan) to ensure that the local aquifer is not adversely impacted by dewatering and the treatment of PASS.

11. CLOSURE

We draw your attention to Appendix H of this report, Understanding Your Report. The information provided within is intended to inform you as to what your realistic expectations of this report should be. Guidance is also provided on how to minimise risks associated with groundworks for this project. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

GALT GEOTECHNICS PTY LTD

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James Harris

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Tables



Table A1: Summary of Tests

Test Name	Test Depth (m)	Depth to Groundwater (m)	Reason for Termination	Stratigraphy
BH01	2.0	GNE ¹	Target depth	SAND
BH02	2.0	GNE	Target depth	SAND
BH03			Test not car	ried out due to access constraints
BH04	10.0	GNE	Target depth	
BH05	2.5	GNE	Target depth	
BH06	7.2	GNE	Target depth	
BH07	10.0	GNE	Target depth	
BH08	2.0	GNE	Target depth	
BH09	6.0	GNE	Target depth	
BH10	4.5	GNE	Target depth	CAND
BH11	4.2	GNE	Target depth	SAND
BH12	2.0	GNE	Target depth	
BH13	3.5	GNE	Target depth	
BH14	2.7	GNE	Target depth	
BH15	2.7	2.2	Target depth	
BH16	2.7	0.9	Target depth	
BH17	2.7	2.65	Target depth	
BH18	2.7	1.5	Target depth	Sandy CLAY overlying Peaty SAND overlying SAND
BH19	2.7	1.5	Target depth	Peaty Clayey SAND overlying SAND
BH20	2.7	2	Target depth	SAND
BH21	6.0	4.23	Target depth	SAND
BH22	3.0	1	Target depth	Sandy CLAY overlying SAND
BH23	4.5	1.7	Target depth	
BH24	3.0	2.95	Target depth	SAND
BH25	3.0	2.55	Target depth	SAND
BH26	4.5	1.9	Target depth	

NOTES 1. GNE – groundwater not encountered



Table A2: Acid Sulfate Soil Results Table

		Table A2: Acid Field Observations	Suitate	Soli Kesu	its lable		Lab pH		С	RS		uo
Samp	ole ID	Soil Description	βĘ	pH _{fox}	pH _f -	Reaction Rate	pH Kcl	TAA	ScR	ANCE	Net Acidity	ASS Classification
Location	Depth/ mBGL	Join Description	pH units	pH units	pH units	LMHXV	pH units	%S	%S	%S	%S	ASS (
		Assessment Criteria	4	4	1	NV	NV	0.03	0.03	NV	0.03	NV
	0.00		7.5	6.0	1.5	М						
	0.25		7.7	6.3	1.4	М						
	0.50		7.9	6.6	1.3	М						
	0.75		7.8	6.6	1.2	М						
	1.00		7.8	6.7	1.1	М						
	1.25		7.7	6.7	1.0	М						
	1.50		7.7	6.9	0.8	М						
	1.75		7.8	6.8	1.0	М						
	2.00	SAND: fine to medium grained, sub-angular to sub-	7.9	6.5	1.4	М						
BH21	2.25	rounded, grey brown, with some non-plastic fines, trace	8.0	7.0	1.0	М						
	2.50	organics	8.0	7.0	1.0	М						
	2.75		8.6	6.7	1.9	L						
	3.00		8.5	6.7	1.8	L						
	3.25		8.5	6.8	1.7	L						
	3.50	_	8.7	6.7	2.0	L	9.8	<0.02	<0.005	11	<0.02	NASS
	3.75	_	8.6	6.8	1.8	L						
	4.00	_	8.6	6.8	1.8	L						
	4.25	_	8.6	6.8	1.8	L						
	4.50		8.7	6.8	1.9	L						
	0.00		8.1	7.1	1.0	M						
	0.25		7.8	6.9	0.9	M						
	0.50	Sandy CLAY: low plasticity, grey, fine grained sand, trace		6.9	0.8	M					• • • •	
	0.75	organics / rootlets	7.7 7.8	6.9	0.9	L					•••	
	1.00	-	7.6	6.9	0.3							
			7.7			L						
DUDD	1.25	_		6.5	1.2	L						
BH22	1.50		7.5	2.6	4.9	M						
	1.75		7.5	2.2	5.3	M						
	2.00	SAND: fine to medium grained, sub-angular to sub-	7.4	1.9	5.5	М						
	2.25	rounded, pale grey	7.3	1.7	5.6	М	6.5	<0.02	0.41	0.02	0.41	PASS
	2.50		7.3	1.8	5.5	М						
	2.75		7.2	1.9	5.3	L						
	3.00		7.2	4.6	2.6	L						
	0.00		7.8	6.8	1.0	М						
	0.25		7.8	7.1	0.7	L						
	0.50		7.9 8.9	7.0	0.9	L						
	0.75			7.7	1.2	L						
	1.00		8.5	8.5	0.0	L						
	1.25	SAND: fine to coarse grained, sub-angular to sub-	8.8	7.3	1.5	L	9.6	<0.02	<0.005	3.1	<0.02	NASS
BH23	1.50	rounded, dark grey / grey, trace organic fines, with	8.2	6.9	1.3	L						
	1.75	some non plastic fines	7.9	6.8	1.1	L						
	2.00		7.7	6.9	0.8	L						
	2.25	1		6.8	0.7	L						
	2.50		7.4	6.6	0.8	L						
	2.75		7.6	6.8	0.8	L						
	3.00		7.5	6.6	0.9	L						



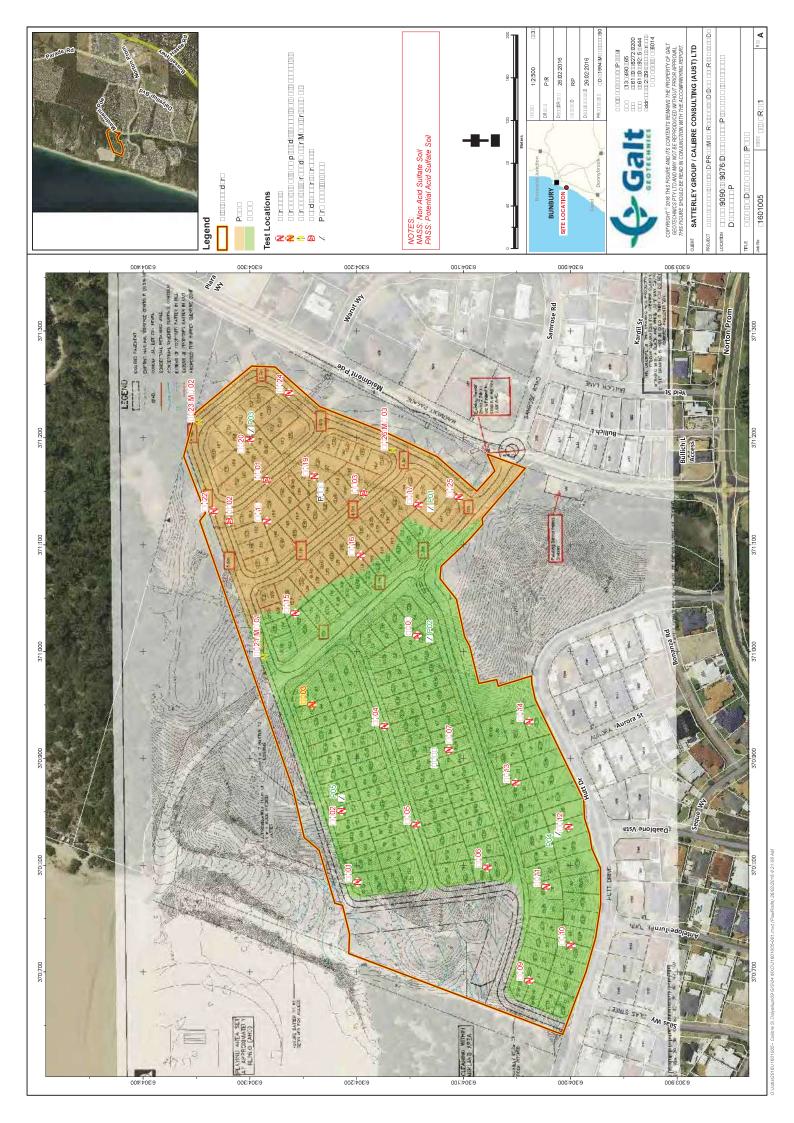
		Field Observations					Lab pH		С	RS		tion
Samp	ole ID	Soil Description	pHę	pH _{fox}	pH _f -	Reaction Rate	рН ка	TAA	San	ANCE	Net Acidity	ASS Classification
Location	Depth/ mBGL	Jon Description	pH units	pH units	pH units	LMHXV	pH units	%S	%S	%S	%S	ASS (
		Assessment Criteria	4	4	1	NV	NV	0.03	0.03	NV	0.03	NV
	0.00		7.4	6.0	1.4	М						
	0.25		7.5	6.2	1.3	L						
	0.50		7.5	6.3	1.2	L						
	0.75		7.5	6.0	1.5	L						
	1.00		7.4	6.0	1.4	L						
	1.25	SAND: fine to coarse grained, sub-angular to sub-	7.7	6.1	1.6	L						
BH24	1.50	rounded, grey brown, with some non - plastic fines, trace organics	7.8	6.1	1.7	L	6.7	<0.02	<0.005	0.04	<0.02	NASS
	1.75	trace organies	7.7	6.5	1.2	L						
	2.00		7.5	6.1	1.4	L						
	2.25		7.6	6.0	1.6	L						
	2.50		7.3	6.3	1.0	L						
	2.75		7.4	6.8	0.6	L						
	3.00		7.7	6.8	0.9	L						
	0.00		7.7	6.0	1.7	М	8.8	<0.02	<0.005	0.54	<0.02	NASS
	0.25		7.8	6.3	1.5	М						
	0.50		7.8	6.4	1.4	М						
	0.75		7.8	5.6	2.2	М						
	1.00		7.4	5.4	2.0	М						
	1.25	SAND: fine to coarse grained, sub-angular to sub-	7.4	5.9	1.5	L						
BH25	1.50	rounded, grey, with some non-plastic fines, trace organics	8	6.5	1.5	L						
	1.75	0. 54.1105	7.9	7.2	0.7	L						
	2.00		8.0	6.7	1.3	L						
	2.25		8.0	6.8	1.2	L						
	2.50		8.1	6.8	1.3	L						
	2.75		8.0	6.8	1.2	L						• • •
	3.00		8.0	6.8	1.2	L						
	0.00		7.7	6.7	1.0	М						
	0.25		7.7	6.2	1.5	M					• • •	
	0.50		7.6	6.1	1.5	Н						
	0.75		7.6	6.0	1.6	M	7.1	<0.02	<0.005	0.08	<0.02	NASS
	1.00		7.8	6.3	1.5	M						• • •
	1.25		7.9	7.0	0.9	M						
	1.50		7.9	7.0	0.9	L					•••	• • •
	1.75		7.8	6.8	1.0	L					• • • •	
DUDG	2.00	SAND: fine to coarse grained, sub-angular to sub-	7.9	6.9	1.0	L						
BH26	2.25	rounded, grey, with some low plasticity fines, trace organics	7.8	7.0	0.8	L					•••	• • •
	2.50	Š	7.7	6.9	0.8	L						
	2.75		7.9	6.8	1.1	L					•••	• • •
	3.00		7.5	6.2	1.3	L					•••	
	3.25		7.9	6.7	1.2	L						
	3.50		7.7	6.4	1.3	L						
	3.75		7.6	6.3	1.3	L						
	4.00		7.5	6.3	1.2	L						
	4.25		7.5	6.3	1.2	L					• • • •	
	4.50		7.5	6.5	1.0	L						

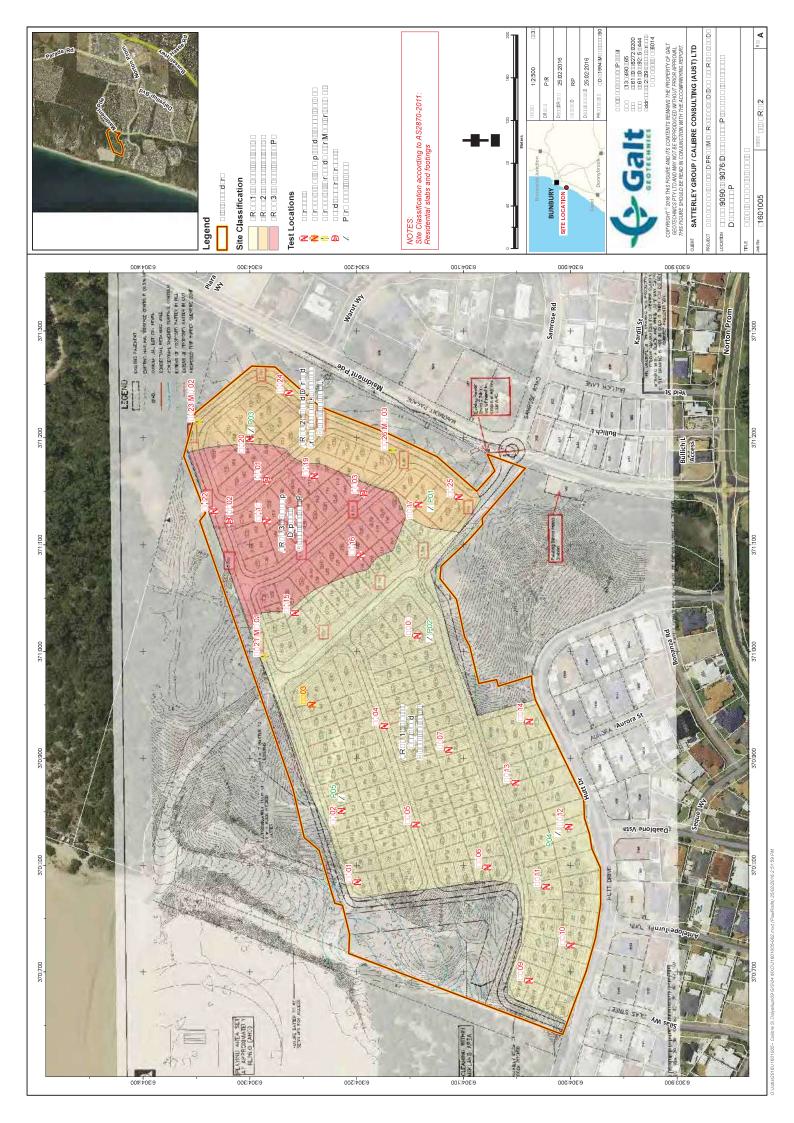


		Field Observations					Lab pH		C	RS		tion
Samp	ole ID	Soil Description		pH _{fox}	pHf -	Reaction Rate	рН ка	TAA	SGR	ANCE	Net Acidity	ASS Classification
Location	Depth/ mBGL		pH units	pH units	pH units	LMHXV	pH units	%S	%S	%S	%S	ASS
Assessment Criteria				4	1	NV	NV	0.03	0.03	NV	0.03	NV
	0.00		7.8	5.9	1.9	V	8.4	<0.02	<0.039	9.1	0.039	PASS
	0.25	Peaty/Sandy CLAY: 50-60% low plasticity fines, fine grained sand, dark brown-black, with some silt	7.6	6.5	1.1	V						
	0.50	granica saila, aark brown black, with some site	7.1	6.4	0.7	V						
HA01	0.75	Peaty SAND: fine to medium grained, sub-angular to sub-rounded, dark grey-black, 10-15% organics	7.0	5.9	1.1	М						
	1.00	SAND: fine to coarse grained, sub-angular to sub-	7.1	5.6	1.5	L	8.3	<0.02	<0.005	0.04	<0.0.2	NASS
	1.25	rounded, grey/black/brown, trace non-plastic fines, trace organics	7.2	5.7	1.5	М						
	0.00		8.3	6.5	1.8	Н	5.8	<0.02	0.022	15	0.022	NASS
	0.25	Peaty/Silty CLAY: 50-60% low plasticity fines, brown, 10- 15% organics, with some silt	8.2	6.6	1.6	V						
	0.50	20/0 0/04/11/05/110 01/0	8.0	6.4	1.6	М						
HA02	0.75	Peaty SAND: fine to coarse grained, sub-angular to sub-	7.4	6.0	1.4	V						
	1.00	rounded, dark brown, 5-10% organics	7.1	6.1	1.0	М						
	1.25	SAND: fine to coarse grained, sub-angular to sub- rounded, grey-brown, trace non-plastic fines, trace organics		3.1	4.1	х	7.6	<0.02	0.74	0.07	0.74	PASS
	0.00	Peaty/Sandy CLAY: fine to coarse grained, sub-angular	7.6	5.7	1.9	Н						
	0.25 0.50	to sub-rounded, brown, low plasticity fines, with some silt fines	7.5	5.5	2.0	М	6.8	<0.02	<0.005	0.16	<0.02	NASS
HA03		Peaty SAND: fine to coarse grained, sub-angular to sub-	7.6	5.9	1.7	L						
	0.75	rounded, dark brown, 5-10% organics	7.3	5.5	1.8	L						
	1.00	SAND: fine to coarse grained, sub-angular to sub-rounded, brown/grey/black, with some non-plastic fines	7.4	4.8	2.6	L	6.7	<0.02	0.008	0.02	0.008	NASS



Figures







Appendix A: Site Photographs





Photograph 1: Looking east from BH01



Photograph 2: Track clearing in marshland near BH19





Photograph 3: Drill rig at BH11



Photograph 4: Drainage course running along Minninup Road





Photograph 5: Looking northeast from BH16



Photograph 6: Small amounts of flytipped waste



Appendix B: Borehole Reports

METHOD OF SOIL DESCRIPTION BOREHOLE AND TEST PIT REPORTS



GRAPHIC LOG & UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) SYMBOLS

Graphic	USCS	Soil Name
		FILL (various types)
000		COBBLES
QÇ		BOULDERS
0000	GP	GRAVEL (poorly graded)
,,,,,	GW	GRAVEL (well graded)
0000	GC	Clayey GRAVEL
	SP	SAND (poorly graded)
	sw	SAND (well graded)
	SC	Clayey SAND

1303/311	VIBOL3	
Graphic	USCS	Soil Name
× · · · × · · · · · · · · · · · · · · ·	SM	Silty SAND
11 ×	ML	SILT (low liquid limit)
× × × × ×	МН	SILT (high liquid limit)
	CL	CLAY (low plasticity)
:====: :====:	CI	CLAY (medium plasticity)
;==== ;====	СН	CLAY (high plasticity)
77 77 7 7 77 77 77 77 7	OL	Organic SILT (low liquid limit)
10000	ОН	Organic SILT (high liquid limit)
III.	Pt	PEAT

RESISTANCE TO EXCAVATION

Symbol	Term	Description
VE	Very easy	
Е	Easy	
F	Firm	
Н	Hard	
VH	Very hard	

All resistances are relative to the selected method of excavation

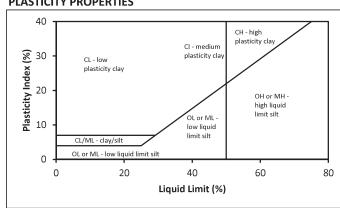
SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil descriptions are based on AS1726-1993, Appendix A. Material properties are assessed in the field by visual/tactile methods in combination with field testing techniques (where used).

PARTICLE SIZE

Soil	Name	Particle Size (mm)
BOU	LDERS	>200
COE	BLES	63 to 200
	Coarse	20 to 63
GRAVEL	Medium	6 to 20
	Fine	2 to 6
	Coarse	0.6 to 2.0
SAND	Medium	0.2 to 0.6
	Fine	0.075 to 0.2
FINES	SILT	0.002 to 0.075
FINES	CLAY	<0.002





MOISTURE CONDITION AS1726-1993

Symbol	Term	Description			
D	D Dry Sands and gravels are free flowing. Clays and silts may be brittle or friable and powdery.				
М	M Moist Soils are darker than in the dry condition and may feel cool. Sands and gravels tend to cohere.				
W	Wet	Soils exude free water. Sands and gravels tend to cohere.			

CONSISTENCY AND DENSITY

		Undrained Shear		DCP blows
Symbol Term		Strength (kPa)	SPT "N"	per 100 mm
VS Very Soft		0 to 12	0 to 2	<1
S Soft		12 to 25	2 to 4	<1
F Firm		25 to 50	4 to 8	1 to 2
St Stiff		50 to 100	8 to 15	3 to 4
VSt Very Stiff		100 to 200	15 to 30	5 to 10
H Hard		>200	>30	>10

AS1726-1993 and HB160-2006

		Density		DCP blows	PSP Blows
Symbol	SymbolTermVLVery Loose		SPT "N"	per 100 mm	per 300 mm
VL			0 to 4	<1	0 to 2
L	Loose	15 to 35	4 to 10	1 to 2	2 to 6
MD	MD Medium Dense		10 to 30 30 to 50	2 to 3	6 to 8
D Dense		65 to 85		4 to 8	8 to 15
VD	Very Dense	>85	>50	>8	>15
Note: PSP	correlations only	valid to 45	0 mm den	th	

Consistency and density may also be inferred from excavation performance and material behaviour.

EXPLANATORY NOTES TO BE READ WITH BOREHOLE AND TEST PIT REPORTS



AC	Air Core	Е	Excavator	PQ3	PQ3 Core Barrel
AD/T	Auger Drilling with TC-Bit	EH	Excavator with Hammer	PT	Push Tube
AD/V	Auger Drilling with V-Bit	HA	Hand Auger	R	Ripper
AT	Air Track	HMLC	HMLC Core Barrel	RR	Rock Roller
В	Bulldozer Blade	HQ3	HQ3 Core Barrel	SON	Sonic Rig
ВН	Backhoe Bucket	N	Natural Exposure	SPT	Driven SPT
CT	Cable Tool	NMLC	NMLC Core Barrel	WB	Washbore
DT	Diatube	PP	Push Probe	Χ	Existing Excavation

SUPPORT

PENETRATION EFFORT (RELATIVE TO THE EQUIPMENT USED)

VE	Very Easy	Ε	Easy	F	Firm
Н	Hard	VH	Very Hard		

WATER

*/ \ _ \				
	Water Inflow	•	Water Level	
◀	Water Loss (complete)			

Water Loss (partial)

SAMPLIF	NG AND TESTING		
В	Bulk Disturbed Sample	Р	Piston Sample
BLK	Block Sample	PBT	Plate Bearing Test
С	Core Sample	U	Undisturbed Push-in Sample
CBR	CBR Mould Sample		U50: 50 mm diameter
D	Small Disturbed Sample	SPT	Standard Penetration Test
ES	Environmental Soil Sample		Example: 3, 4, 5 N=9
EW	Environmental Water Sample		3,4,5: Blows per 150 mm
G	Gas Sample		N=9: Blows per 300 mm after
HP	Hand Penetrometer		150 mm seating interval
LB	Large Bulk Disturbed Sample	VS	Vane Shear; P = Peak
M	Mazier Type Sample		R = Remoulded (kPa)
MC	Moisture Content Sample	W	Water Sample

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)
$$= \frac{CRL}{TCL} \times 100$$
SCR = Solid Core Recovery (%)
$$= \frac{CCR}{TCL} \times 100$$
RQD = Rock Quality Designation (%)
$$= \frac{ALC > 100}{TCL} \times 100$$

RQD = Rock Quality Designation (%)
$$= \frac{ALC > 100}{TCL} \times 100$$

TCL	Length of Core Run
CRL	Recovered Length of Core

ALC>100 Total Length of Axial Lengths of Core Greater than 100 mm Long



Date:

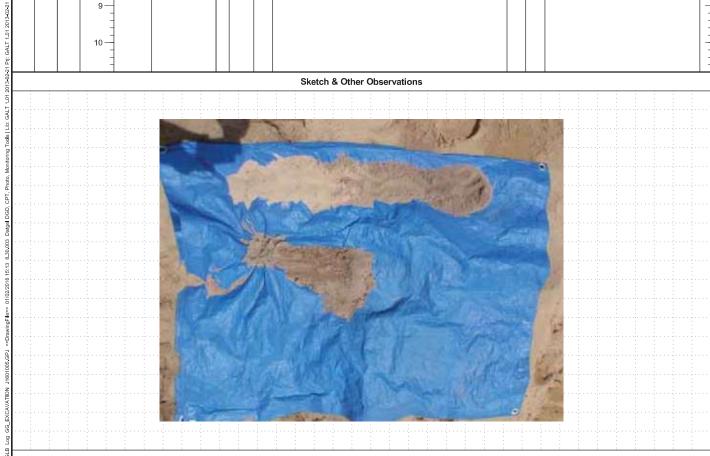
Sheet 1 OF 1 19/01/2016

Contractor: SFB Drilling Job Number: J1601005 Client: Drill Rig: Eziprobe Satterley Group

Logged: JΗ Project: Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Location: Dalyellup Beach Estate - Lots 9090 & 9076

Checked By: RP

		Drilling							Field Material Desc	riptio	on		1
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	
ZZZT PJ. GALL TAJI ZDISHZZT DTZZ			1 — 3 — 3 — 3 — 4 — 5 — 6 — 6 — 9 — 9 — 10 — 10 — 10 — 10 — 10 — 10 —					SP	SAND: fine to medium grained, sub-angular to sub-rounded, white / pale grey, trace rootlets, trace organic fines Hole terminated at 2.00 m Target depth Groundwater not encountered	D	D		
2013-	Sketch & Other Observations												



Comments:



Sheet 1 OF 1

Contractor: SFB Drilling 19/01/2016 Job Number: J1601005 Date: Client: Drill Rig: Eziprobe Satterley Group Logged: JΗ

Project: Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Location:

Dalyellup Beach Estate - Lots 9090 & 9076 Checked By: RP

	Drillin	g		Sampling				Field Material Desc			
METHOD PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT22		0 — 1 — 1 — 2 — 3 — 4 — 5 — 5 — 7 — 7 — 9 — 1 — 1 0 —					SP	SAND: fine to medium grained, sub-angular to sub-rounded, pale grey becoming white, trace organic fines in top 200 mm Hole terminated at 2.00 m Target depth Groundwater not encountered	D	D	
								Sketch & Other Observations			·



Comments:



Sheet 1 OF 1

Contractor: SFB Drilling 19/01/2016 Job Number: J1601005 Date: Client: Drill Rig: Eziprobe Satterley Group Logged: JΗ

Project: Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Location: Dalyellup Beach Estate - Lots 9090 & 9076

Checked By: RP

Drilling	Sampling		Field Material Desc		
METHOD PENETRATION RESISTANCE WATER WATER (metres)	SAMPLE OR FIELD TEST OF SECONCERED GRAPHIC	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
0 —		SP	SAND: fine to medium grained, sub-angular to sub-rounded, pale grey becoming white, trace non-plastic fines in top 1000 mm, trace rootlets in top 500 mm, trace shell fragments	D	
7 — 10 — - 10 —			Hole terminated at 10.00 m	М	
			Target depth Groundwater not encountered		



Comments:



Sheet 1 OF 1

Job Number: J1601005 Client: Satterley Group

Project: Proposed Residential Subdivision

Location: Dalyellup Beach Estate - Lots 9090 & 9076 Contractor: SFB Drilling Drill Rig: Eziprobe

Inclination: -90°

19/01/2016 Date:

Logged: JΗ Checked Date: 29/01/2016

Checked By: RP

		Drillin	ıg		Sampling				Field Material Desc				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	
DT22			1 - 2					SP	SAND: fine to medium grained, sub-angular to sub-rounded, pale grey becoming white	D	MD D	2.00-2.50: Localised pocket of high organic content (inferred broken down root)	
Z1 PJ; GALT 1.01 2013-02-21			3 — 4 — 5 — 7 — 7 — 9 — 10 — 10 — 10 — 10 — 10 — 10 — 10						Hole terminated at 2.50 m Target depth Groundwater not encountered				
8									Sketch & Other Observations				



Comments:



Sheet 1 OF 1

Job Number: J1601005
Client: Satterley Group

Project: Proposed Residential Subdivision
Location: Dalyellup Beach Estate - Lots 9090 & 9076

Contractor: SFB Drilling
Drill Rig: Eziprobe

Inclination: -90°

Date: 19/01/2016

Logged: JH Checked Date: 29/01/2016

Checked By: RP

SAMPLE OR PRICE OR PR	Drilling	Sampling	Field Material Desc	
SAND: fine to medium grained, sub-angular to sub-rounded, white / pale gray, trace order, trace organic fines in top 500 mm, trace rootlets in top 200 mm B(BH06-01) B(BH06-01) SP B(BH06-01) Hole terminated at 7,20 m Target depth Groundwater not encountered		RECOVERED GRAPHIC LOG USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	STRUCTURE AND ADDITIONAL ADDITIONAL OBSERVATIONS OBSERVATIONS
Sketch & Other Observations	0 — — — — — — — — — — — — — — — — — — —	B(BH06-01) SP	SAND: fine to medium grained, sub-angular to sub-rounded, white / pale grey, trace rootlets, trace organic fines in top 500 mm, trace rootlets in top 200 mm Hole terminated at 7.20 m Target depth Groundwater not encountered	
Sketch & Other Observations			Sketch & Other Observations	



Comments:



Sheet 1 OF 1

Job Number: J1601005
Client: Satterley Group

Project: Proposed Residential Subdivision
Location: Dalyellup Beach Estate - Lots 9090 & 9076

Contractor: SFB Drilling
Drill Rig: Eziprobe
Inclination: -90°

Date: 19/01/2016 **Logged:** JH

Logged:JHChecked Date:29/01/2016Checked By:RP

	Drillin	g		Sampling				Field Material Des	cription	
PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	APHIC G	JSCS SYMB	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION CONSISTENCY DENSITY	OBSERVATIONS

SAND: fine to medium grained, sub-angular to sub-rounded, gray becoming while, trace organic fines in top 1000 mm. 1 -		Z M M	PENE RESIS	WAT	DEP' (metr	<i>DEPTH</i> RL	REC	GRA	USC		MOR	CON	OBSERVATIONS
8— 9— 10— Hole terminated at 10.00 m					2—					SAND: fine to medium grained, sub-angular to sub-rounded, grey becoming white, trace organic fines in top 1000 mm, trace rootlets in top 500 mm	D		
Target depth Groundwater not encountered	LT 1.01 2013-02-21	ADIV			6— 7— 8— 9—				SP		М		
1	-21 Prj: G				_					Target depth Groundwater not encountered			

Sketch & Other Observations



Comments:



Sheet 1 OF 1

19/01/2016 Job Number: J1601005 Contractor: SFB Drilling Date: Drill Rig: Client: Eziprobe Satterley Group Logged: JΗ

Project: Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Location: Dalyellup Beach Estate - Lots 9090 & 9076

Checked By: RP

		Orillin	g		Sampling				Field Material Desc	criptio	on	
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			F-0						SAND: fine to medium grained, sub-angular to sub-rounded, grey becoming pale grey, trace organics with some non-plastic fines	М	- 1	
22			1 =					SP	non-plastic fines			
DT22			1-					SP		D		
			=						Hole terminated at 2.00 m Target depth Groundwater not encountered			
			3—						Groundwater not encountered			
			=									
			4 —									
			=									
			5 —									
			=									
			6—									
			=									
			7—									
			. =									
			8—									
			9—									
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			10									
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									Sketch & Other Observations			-: : : : : : : : : : : : : : : : : : :
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Sheet 1 OF 1

 Job Number:
 J1601005
 Contractor:
 SFB Drilling
 Date:
 19/01/2016

 Client:
 Satterley Group
 Drill Rig:
 Eziprobe
 Logged:
 JH

Project:Proposed Residential SubdivisionInclination:-90°Checked Date:29/01/2016Location:Dalyellup Beach Estate - Lots 9090 & 9076Checked By:RP

Drilling		Sampling			Field Material Desc			
METHOD PENETRATION RESISTANCE WATER	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	907	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
D122	0 —		1	· · · · · · · · · · · · · · · · · · ·	SAND: fine to medium grained, sub-angular to sub-rounded, grey becoming white, trace organic fines in top approximately 700 mm, trace rootlets in top 1000 mm Hole terminated at 6.00 m Target depth Groundwater not encountered	M	D	1
					Sketch & Other Observations			•
	1				Sketch & Other Observations			



Comments:



Sheet 1 OF 1

Job Number: J1601005 Client: Satterley Group

Project: Proposed Residential Subdivision

Location: Dalyellup Beach Estate - Lots 9090 & 9076 Contractor: SFB Drilling Drill Rig: Eziprobe

Inclination: -90°

19/01/2016 Date:

Logged: JΗ Checked Date: 29/01/2016

RP

Checked By:

DT22 METHOD PENETRATION RESISTANCE WATER WATER THOD TH	SAMPLE OR FIELD TEST	GRAPHIC GRAPHIC LOG WSCS SYMBOL CS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION SAND: fine to medium grained, sub-angular to sub-rounded, pale grey becoming white, trace non-plastic fines in top 200 mm, trace rootlets in top 100 mm, trace shell fragments	MOISTURE	D CONSISTENCY	STRUCTURE AND ADDITIONAL OBSERVATIONS
2— 2— 3— 4—			SAND: fine to medium grained, sub-angular to sub-rounded, pale grey becoming white, trace non-plastic fines in top 200 mm, trace rootlets in top 100 mm, trace shell fragments	D		
5— 6— 7— 8— 9— 10—			Hole terminated at 4.50 m Target depth Groundwater not encountered			
	1	ı	Sketch & Other Observations			<u> </u>



Comments:



Sheet 1 OF 1

Contractor: SFB Drilling 19/01/2016 Job Number: J1601005 Date: Client: Drill Rig: Eziprobe Satterley Group Logged: JΗ

Project: Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Location: Dalyellup Beach Estate - Lots 9090 & 9076

Checked By: RP

	Sampling	I	Field Material Desc	riptic	n	
METHOD PENETRATION RESISTANCE WATER DEPTH (metres)	SAMPLE OR FIELD TEST OO OU WILLIAM	GRAPHIC LOG USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
0 — 1 — 2 — 2 — 3 — 3 — 4 — 4 — 4 — 4 — 4 — 4 — 4 — 4	B(BH11-01)		SAND: fine to medium grained, sub-angular to sub-rounded, pale grey becoming white, trace non-plastic fines in top 200 mm, trace fine grained shell fragments Hole terminated at 4.20 m Target depth	M D		
5 — 6 — 7 — 8 — 9 — 10 — 10 — 10 — 10 — 10 — 10 — 10			Target depth Groundwater not encountered			



Comments:



Sheet 1 OF 1

Job Number: J1601005 Client: Satterley Group

Project: Proposed Residential Subdivision Location:

Dalyellup Beach Estate - Lots 9090 & 9076

Contractor: SFB Drilling Drill Rig:

Eziprobe Inclination: -90°

Date:

19/01/2016

Logged: JΗ Checked Date: 29/01/2016

Checked By: RP

Drilling	Sampling			Field Material Desc			
METHOD PENETRATION RESISTANCE WATER DEPTH (metres)	SAMPLE OR FIELD TEST	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
0			SP	SAND: fine to medium grained, sub-angular to sub-rounded, grey becoming white, trace organic fines in top 1000 mm, trace rootlets in top 100 mm	D	MD	1.00-2.00: Small root
3 — 3 — 3 — 3 — 3 — 3 — 3 — 3 — 3 — 3 —				Hole terminated at 2.00 m Target depth Groundwater not encountered			
				Sketch & Other Observations			



Comments:



Sheet 1 OF 1

Job Number: J1601005
Client: Satterley Group

Project:Proposed Residential SubdivisionLocation:Dalyellup Beach Estate - Lots 9090 & 9076

Contractor: SFB Drilling Drill Rig: Eziprobe

Inclination: -90°

Date: 19/01/2016

Logged: JH Checked Date: 29/01/2016

Checked By: RP

	ı	Drillin	g		Sampling				Field Material Desc			
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V			1					SP	SAND: fine to medium grained, sub-angular to sub-rounded, pale grey becoming white, trace non-plastic fines in top 500 mm, trace rootlets in top 1000 mm	D	L MD -	
			4 —						Hole terminated at 3.50 m Target depth Groundwater not encountered			
			_			_	<u> </u>		Sketch & Other Observations			



Comments:



Sheet 1 OF 1

Contractor: SFB Drilling 19/01/2016 Job Number: J1601005 Date: Client: Drill Rig: Eziprobe Satterley Group Logged: JΗ

Project: Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Location: Dalyellup Beach Estate - Lots 9090 & 9076

Checked By: RP

		Drillin	g		Sampling					Description			
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	
DT22			1—					SP	SAND: fine to medium grained, sub-angular to sub-rounded, pale grey becoming white, trace non-plastic fines in top 100 mm	D	MD D		
			3 — 4 — 5 — 6 — 7 — 9 — 10 — 10 — 10 — 10 — 10 — 10 — 10						Hole terminated at 2.70 m Target depth Groundwater not encountered				
			1			_		<u> </u>	Sketch & Other Observations				



Comments:



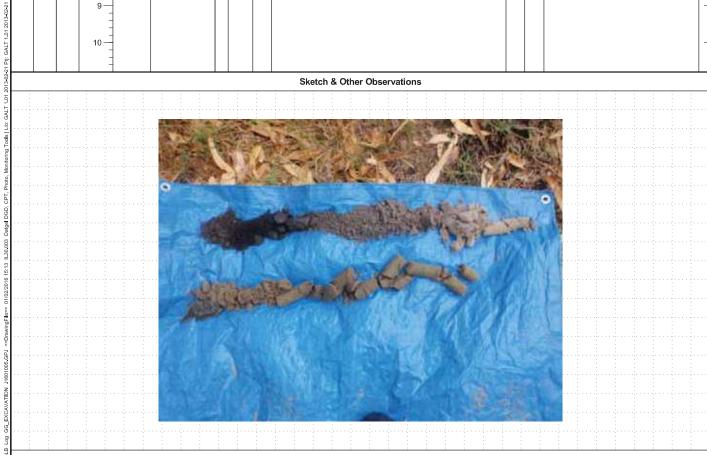
Sheet 1 OF 1

Contractor: SFB Drilling 19/01/2016 Job Number: J1601005 Date: Client: Drill Rig: Eziprobe Satterley Group Logged: JΗ

Project: Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Location:

Dalyellup Beach Estate - Lots 9090 & 9076 Checked By: RP

	I	Drillin	g		Sampling				Field Material Descr			
МЕТНОВ	PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT22		_	0					SP	SAND: fine to medium grained, sub-angular to sub-rounded, dark grey, trace organics fines (approximately 4 %) with some non-plastic fines At 0.4 m, becoming pale grey, no organics / fines	M	D	
			3 — 4 — 5 — 6 — 7 — 9 — 10 — 10 — 10 — 10 — 10 — 10 — 10						Hole terminated at 2.70 m Target depth Groundwater encountered at 2.2 m			
									Sketch & Other Observations			
								_				



Comments:



Project:

BOREHOLE: BH16

Sheet 1 OF 1

Job Number: J1601005 Client: Satterley Group

Proposed Residential Subdivision

Location: Dalyellup Beach Estate - Lots 9090 & 9076 Contractor: SFB Drilling Drill Rig:

Eziprobe Inclination: -90°

19/01/2016 Date:

Logged: JΗ Checked Date: 29/01/2016

RP

Checked By:

	-	Orillin	g		Sampling				Field Material Desc			
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT22		Y	0					SP	SAND: fine to medium grained, sub-angular to sub-rounded, grey, with some low plasticity dry fines, trace organics At 0.4 m, becoming pale grey to pale brown, no fines	W		-
ET TJ ONET INT EXCONENT			3 — 4 — 5 — 6 — 7 — 8 — 9 — 10 — 10 — 10 — 10 — 10 — 10 — 10						Hole terminated at 2.70 m Target depth Groundwater encountered at 0.9 m			

Sketch & Other Observations



Comments:



Sheet 1 OF 1

Job Number: J1601005 Client: Satterley Group

Project: Proposed Residential Subdivision

Location:

Dalyellup Beach Estate - Lots 9090 & 9076

Contractor: SFB Drilling Drill Rig:

Eziprobe Inclination: -90°

Date:

Checked By:

19/01/2016

RP

Logged: JΗ Checked Date: 29/01/2016

Drill	ling		Sampling							
METHOD PENETRATION RESISTANCE WATER		<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT22	1		B(BH17-01)			SP	SAND: fine to medium grained, sub-angular to sub-rounded, grey / dark grey, trace to some organic fines Becoming pale grey / pale brown, no organic fines	M	MD	
	3						Hole terminated at 2.70 m Target depth Groundwater not encountered			

Sketch & Other Observations



Comments:



Sheet 1 OF 1

Job Number: J1601005 Client:

Satterley Group Project: Proposed Residential Subdivision

Location: Dalyellup Beach Estate - Lots 9090 & 9076 Contractor: SFB Drilling Drill Rig:

Eziprobe Inclination: -90°

19/01/2016 Date:

Logged: JΗ Checked Date: 29/01/2016

RP

Checked By:

SAMPLE OR FIELD TEST OPEN SAMPLE OR THE OPEN SA	F	ı	Drillin	ıg		Sampling				Field Material Desc	riptio	on	
B(BH18-01) CL Sandy CLAY / Clayey SAND: fine to medium grained sand, by plasticity fines, brown becoming pale grey M S	METHOD	PENETRATION RESISTANCE	WATER		<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
Target depth Groundwater encountered at 1.5 m	DT22		_	1		B(BH18-01)			SP	Peaty SAND: fine to medium grained, dark grey with 10 - 15 % organics	М		-
	Z PIĘ GALI 1 MJ 2015-02-21			4 — 5 — 6 — 7 — 8 — 9 — 9 — 9 — 9						Target depth			

Sketch & Other Observations



Comments:



Sheet 1 OF 1 19/01/2016

JΗ

 Job Number:
 J1601005
 Contractor:
 SFB Drilling
 Date:

 Client:
 Satterley Group
 Drill Rig:
 Eziprobe
 Logge

Client:Satterley GroupDrill Rig:EziprobeLogged:Project:Proposed Residential SubdivisionInclination:-90°Checked DischargedLocation:Dalyellup Beach Estate - Lots 9090 & 9076Checked Bit

Checked Date: 29/01/2016 **Checked By**: RP

	, I	Drillin	g		Sampling Field Material Description							
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0 -		B(BH19-01)	T	` <u>\'''</u> .	sc	Peaty Clayey SAND: fine to medium grained, dark grey, 15 - 20 % low plasticity fines, 10 - 15% organics	М	S-F	
DT22		_	1-						SAND: fine to coarse grained, sub-angular to sub-rounded, brown becoming yellow brown	\vdash		
		=	2—					SP		w		
			3— 3— 4— 5—						Hole terminated at 2.70 m Target depth Groundwater encountered at 1.5 m			
			6 — 7 — 8 — 8 —									
			9									
					; ; ;	-			Sketch & Other Observations			
									Sketch & Other Observations			



Comments:



Sheet 1 OF 1 19/01/2016

JΗ

Contractor: SFB Drilling Job Number: J1601005 Date: Client: Drill Rig: Eziprobe Satterley Group Logged:

Project: Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Location: Dalyellup Beach Estate - Lots 9090 & 9076

Checked By: RP

		Drillin	g		Sampling	mpling Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT22		_	1 — 2 — -					SP	SAND: fine to medium grained, sub-angular to sub-rounded, grey, trace to some organic fines Becoming pale grey to pale brown, no organic fines	М	D	
			3 — 4 — 5 — 6 — 7 — 8 — 9 — 10 — 10 — 10 — 10 — 10 — 10 — 10						Hole terminated at 2.70 m Target depth Groundwater encountered at 2 m			
							<u> </u>		Sketch & Other Observations			
									Sketch & Other Observations			



Comments:

Contractor: Location: Satterley Group Proposed Residential Subdivision Job Number: J1601005
Client: Satterley Gro
Project: Proposed Re

Galt

SFB Drilling Dalyellup Beach Estate - Lots 9090 & 9076

Drill Rig: Eziprobe **Inclination:** -90°

 Date:
 19/01/2016

 Logged:
 JH

 Checked Date:
 29/01/2016

 Checked By:
 RP

		STRUCTURE AND ADDITIONAL OBSERVATIONS	40 mm Standpipe and gravel pack installed (MW01)			
		Ass Classification	NASS			
		Net Acidity (%S)	<0.02			
	Environmental Sampling	pH CHANGE				
	vironmenta	DHFOX PHF 675 750 8.25				
	En	SAMPLE	BH21/0.00 BH21/0.25 BH21/0.25 BH21/1.05 BH21/1.00 BH21/1.50 BH21/2.00 BH21/2.50 BH21/2.50 BH21/2.50 BH21/3.25 BH21/3.25 BH21/3.25 BH21/3.25 BH21/3.25 BH21/3.25 BH21/3.25	BH21/4.25 BH21/4.50	su	
		DENSILLA CONSISTENCY CONDITION			ervatio	
		MOISTURE CONDITION			r Obs	
	Field Material Description	SOIL/ROCK MATERIAL DESCRIPTION		Hole terminated at 6.00 m Target depth Groundwater encountered at 4.23 m	Sketch & Other Observations	
		NSCS SAWBOF	. · · · · · · · · · · · · · · · · · · ·			
		RECOVERED 6RAPHIC	· · · · · · · · · · · · · · · · · · ·			
	Sampling	SAMPLE OR FIELD TEST	B(BH21-01)			
	Drilling	DEPTH CEGETGE CEPTH RL	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
	Drill	ABTAW				
		METHOD PENETRATION RESISTANCE	AH			The same and the same and the same
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Satterley Group Proposed Residential Subdivision Job Number: J1601005
Client: Satterley Gro
Project: Proposed Re

METHOD

D352

Galt

Dalyellup Beach Estate - Lots 9090 & 9076 SFB Drilling Contractor: S

Drill Rig: Eziprobe **Inclination:** -90°

 Date:
 19/01/2016

 Logged:
 JH

 Checked Date:
 29/01/2016

 Checked By:
 RP

		STRUCTURE AND ADDITIONAL OBSERVATIONS			
		esA Classification	PASS		
		Net Acidity (%S)	0.41		
	Environmental Sampling	pH CHANGE			
	menta	-> pHF			
	nviron	~ рнгох			
	ш	SAMPLE	BH22/0.00 BH22/0.25 BH22/0.50 BH22/1.00 BH22/1.25 BH22/1.50 BH22/1.50 BH22/2.25 BH22/2.25 BH22/2.25 BH22/2.30	ns	
ľ		DENSILA CONSISTENCY	ω	ervatio	
		MOISTURE	Σ >	r Obse	
	Field Material Description	SOIL/ROCK MATERIAL DESCRIPTION	Sandy CLAY: low plasticity, grey, fine grained sand, trace organics / rootlets SAND: fine to medium grained, sub-angular to sub-rounded, pale grey Becoming brown Hole terminated at 3.00 m Target depth Groundwater encountered at 1 m	Sketch & Other Observations	
		NSCS SAWBOL	고 88		
		GRAPHIC LOG			
		KECONEKED			
	Sampling	SAMPLE OR FIELD TEST			
-		<i>DEPTH</i> RL			
	6	(metres) DEPTH	0 - 2 & 4 & 0 - 8 & 0 - 1		
	Drilling	MATER HT930			
		PENETRATION RESISTANCE			



19/01/2016

SFB Drilling Contractor: Location:

Proposed Residential Subdivision

Project:

Client:

Satterley Group

Job Number: J1601005

Calt Calt

Dalyellup Beach Estate - Lots 9090 & 9076

Drill Rig: Eziprobe **Inclination:** -90°

Logged:

Checked Date:

29/01/2016 RP Checked By:

STRUCTURE AND ADDITIONAL OBSERVATIONS

40 mm Standpipe and gravel pack installed

NASS

Σ

SAND: fine to coarse grained, sub-angular to sub-rounded, dark grey agrey, trace organic fines, with some non plastic fines

Becoming yellow brown

SP

D352

<0.02

≥

BH23/0.00 BH23/0.25 BH23/0.25 BH23/0.75 BH23/1.00 BH23/1.50 BH23/1.50 BH23/2.75 BH23/2.75 BH23/2.75 BH23/2.75 BH23/2.75 BH23/2.75 BH23/3.75 BH23/3.75

Hole terminated at 4.50 m Target depth Groundwater encountered at 1.7 m

Sketch & Other Observations

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

Comments:

(MW02)

Net Acidity (%S)

PH CHANGE

PHFOX 6.75 7.50 8.25

SAMPLE

DENSILLA CONDITION MOISTENCY MOISTUN

SOIL/ROCK MATERIAL DESCRIPTION

NSCS SAMBOF GRAPHIC LOG KECONEKED

SAMPLE OR FIELD TEST

DEPTH RL

(metres)

ABTAW

PENETRATION RESISTANCE METHOD

Sampling

Drilling

Field Material Description

Environmental Sampling

BOREHOLE: BH24 Sheet 1 OF 1

Satterley Group Proposed Residential Subdivision Job Number: J1601005 Client: Project:

PENETRATION RESISTANCE MATER

METHOD

D352

Galt

Dalyellup Beach Estate - Lots 9090 & 9076 SFB Drilling Contractor: Location:

Drill Rig: Eziprobe **Inclination:** -90°

 Date:
 19/01/2016

 Logged:
 JH

 Checked Date:
 29/01/2016

 Checked By:
 RP

		STRUCTURE AND ADDITIONAL OBSERVATIONS		
		seA Classification	NASS	
		Net Acidity (%S)	<0.02	
	Sampling	−− PH CHANGE ∞−		
	Environmental Sampling	ХОЭНӨ & - 5 - ЭНФ & -		
	ㅁ	SAMPLE	BH24/0.00 BH24/0.25 BH24/0.25 BH24/0.50 BH24/1.00 BH24/1.05 BH24/1.25 BH24/2.25 BH24/2.25 BH24/2.25 BH24/2.25 BH24/2.25 BH24/2.25 BH24/2.25	ns
		DENSILLA CONSISTENCY		ervation
		MOISTURE CONDITION	<u>v</u>	r Obse
	Field Material Description	SOIL/ROCK MATERIAL DESCRIPTION	SAND: fine to coarse grained, sub-angular to sub-rounded, grey brown, with some non - plastic fines, trace organics At 0.25 m, becoming yellow brown, no fines Hole terminated at 3.00 m Target depth Groundwater encountered at 2.95 m	Sketch & Other Observations
		Nece Sambor	Sp At Hooley	
		COG CRAPHIC		
		KECONEKED		
	Sampling	SAMPLE OR FIELD TEST		
		<i>DEPTH</i> RL		
$\ $	β	(metres)	0	
$\ $	Drilling	A3TAW HTG3Q		
П		KESISTANCE		1





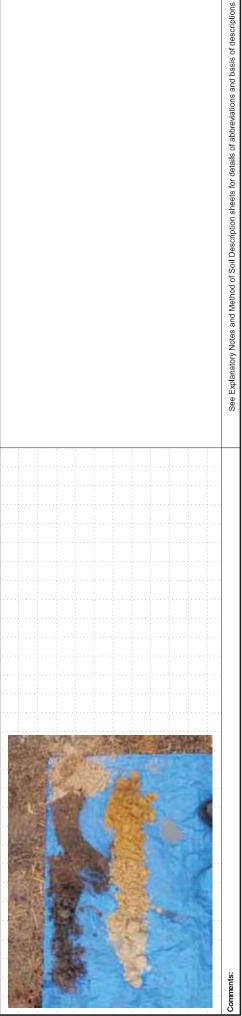
SFB Drilling Contractor: Location: Proposed Residential Subdivision

Dalyellup Beach Estate - Lots 9090 & 9076

29/01/2016 RP 19/01/2016 Checked Date: Logged: **Drill Rig:** Eziprobe **Inclination:** -90°

Checked By:

STRUCTURE AND ADDITIONAL OBSERVATIONS NASS <0.02 Net Acidity (%S) **Environmental Sampling** ⊳ bH CHANGE ∃Hd **DHFOX** SAMPLE BH25/0.00 BH25/0.25 BH25/0.25 BH25/0.75 BH25/1.75 BH25/1.35 BH25/1.35 BH25/1.75 BH25/2.56 BH25/2.25 Sketch & Other Observations DENSILLA CONDITION MOISTURE ≥ (≥ Σ SAND: fine to coarse grained, sub-angular to sub-rounded, grey, with some non-plastic fines, trace organics SOIL/ROCK MATERIAL DESCRIPTION Field Material Description Hole terminated at 3.00 m Target depth Groundwater encountered at 2.55 m - - - - - - - Becoming pale brown SP NSCS SAMBOR GRAPHIC LOG KECONEKED SAMPLE OR FIELD TEST Sampling DEPTH RL (metres) Drilling ABTAW





PENETRATION RESISTANCE METHOD

Satterley Group

Client:

Job Number: J1601005

Calt

D352

19/01/2016

SFB Drilling Contractor: Location: Proposed Residential Subdivision Satterley Group Job Number: J1601005

Project: Client:

Galt Galt

Dalyellup Beach Estate - Lots 9090 & 9076

Drill Rig: Eziprobe **Inclination:** -90°

Logged: Date:

29/01/2016 RP Checked Date: Checked By:

40 mm Standpipe and gravel pack installed STRUCTURE AND ADDITIONAL OBSERVATIONS (MW03) NASS <0.02 Net Acidity (%S) Environmental Sampling ⊳ bH CHANGE Hd 5 S PHFOX SAMPLE BH26/0.00 BH26/0.25 BH26/0.25 BH26/0.75 BH26/1.00 BH26/1.50 BH26/1.25 BH26/2.25 BH26/2.25 BH26/2.25 BH26/2.25 BH26/3.25 BH26/4.25 BH26/4.25 Sketch & Other Observations DENSILLA CONDITION MOISTURE **≥**jo ≥ SOIL/ROCK MATERIAL DESCRIPTION Field Material Description Hole terminated at 4.50 m Target depth Groundwater encountered at 1.95 m SP NSCS SAMBOR GRAPHIC LOG KECONEKED SAMPLE OR FIELD TEST Sampling DEPTH RL (metres) Drilling **A**3TAW PENETRATION RESISTANCE METHOD D352

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	の記憶を見るのに近							原為,以	S TONE	
	A CONTRACTOR AND A CONT				がはない。			原人、以外		
	を記録するのはない				THE REAL PROPERTY.			国人、以前		



HAND AUGER BOREHOLE: HA01

03/02/2016 MC STRUCTURE AND ADDITIONAL OBSERVATIONS Checked Date: Checked By: Logged: Date: : Surface grasses 0.00 Net Acidity (%S) Environmental Sampling ⊳ pH CHANGE 9HFOX 5.75 6.50 7.25 Diameter: 75 mm Inclination: -90° SAMPLE Operator: HA01/0.75 HA01/0.25 HA01/1.25 DENSILLA CONDITION MOISTENCY MOISTUN Σ ≥ Dalyellup Beach Estate - Lots 9090 & 9076 Peaty SAND: fine to medium grained, sub-angular to sub-rounded, dark grey-black, 10-15% organics Peaty/Sandy CLAY: 50-60% low plasticity fines, fine grained sand, dark brown-black, with some silt SAND: fine to coarse grained, sub-angular to sub-rounded, grey/black/brown, trace non-plastic fines, trace organics SOIL/ROCK MATERIAL DESCRIPTION Field Material Description Hole terminated at 1.30 m Hole collapse Groundwater encountered at 0.5 m Location: SP NSCS SAMBOR GRAPHIC 200 1 KECONEKED Proposed Residential Subdivision SAMPLE OR FIELD TEST Sampling Satterley Group DEPTH RL Job Number: J1601005 (meţres) 1.0 1.5 0.5 Drilling ABTAW Project: Client: PENETRATION RESISTANCE ш

METHOD

suo				
Sketch & Other Observations				
		1/2		1

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

Comments:

HAND AUGER BOREHOLE: HA02 Sheet 1 OF 1

Dalyellup Beach Estate - Lots 9090 & 9076 Location:

Satterley Group Proposed Residential Subdivision Job Number: J1601005
Client: Satterley Gro
Project: Proposed Re

Galt Galt

Operator: Inclination: -90° Diameter: 75 mm

03/02/2016 MC Date: Logged: Checked Date: Checked By:

		STRUCTURE AND ADDITIONAL OBSERVATIONS	0.00 : Surface grasses		
		Ass Classification	P ASS		
		(8%) (%S)	47.0		
	Sampling	ph CHANGE			
	Environmental Sampling	XOFHQ 4-6-6-6-6-6-6-6-6-7-5-7-7-7-7-7-7-7-7-7-7			
	Ē	SAMPLE	HA02/0.25 HA02/0.75 HA02/1.25	ns	
		DENSILL CONDITION	- >	ervatio	
		CONDITION WOISTURE	ganics, , dark , , dark , , , , , , , , , , , , , , , , , , ,	Sketch & Other Observations	
	Field Material Description	SOIL/ROCK MATERIAL DESCRIPTION	Peaty/Silty CLAY: 50-60% low plasticity fines, brown, 10-15% organics, with some silt Becoming grey Peaty SAND: fine to coarse grained, sub-angular to sub-rounded, dark brown, 5-10% organics SAND: fine to coarse grained, sub-angular to sub-rounded, grey-brown, trace non-plastic fines, trace organics Hole terminated at 1.30 m Hole terminated at 1.30 m Hole collapse Groundwater encountered at 0.5 m	Sketch &	
		NSCS SAWBOL	φ ₀		
		FOG GEVENIC BECONEBED			
	Sampling	SAMPLE OR FIELD TEST	d d		
		DEPTH RL			
	ing	(metres) DEPTH	0.0 1. 1. 0.5 1. 0.0	0.7	
	Drilling	ЯЭТАМ			
		METHOD PENETRATION RESISTANCE	AH m		
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HAND AUGER BOREHOLE: HA03

Location: Satterley Group Proposed Residential Subdivision Job Number: J1601005
Client: Satterley Gro
Project: Proposed Re

METHOD

Dalyellup Beach Estate - Lots 9090 & 9076

Operator: Inclination: -90° Diameter: 75 mm

03/02/2016 MC Date: Logged: Checked Date: Checked By:

		STRUCTURE AND ADDITIONAL OBSERVATIONS	0.00 : Surface grasses				
		Ass Classification	NASS				
		Net Acidity (%S)	<0.02				
	Sampling	- ph CHANGE					
	Environmental Sampling	−o pHFOX - a - ¬ pHF		=====	 		
	En	SAMPLE	HA03/0.25	HA03/0.75			ns
		DENSILA CONSISTENCY CONDITION					ervatio
		MOISTURE CONDITION	γ,	>			r Obs
	Field Material Description	SOIL/ROCK MATERIAL DESCRIPTION	Peaty/Sandy CLAY: fine to coarse grained, sub-angular to sub-rounded, brown, low plasticity fines, with some silt fines	Peaty SAND: fine to coarse grained, sub-angular to sub-rounded, dark brown, 5-10% organics	SAND: fine to coarse grained, sub-angular to sub-rounded, brown/grey/black, with some non-plastic fines	Hole terminated at 1.00 m Hole collapse Groundwater encountered at 0.4 m	Sketch & Other Observations
		NSCS SAMBOF			SP		
		LOG GRAPHIC		· i) · i			
	Sampling	SAMPLE OR REPLET TEST OO	ED	Ē		- CD	
ľ		DEPTH RL					
	βL	(metres) DEPTH	0.0	0.5		5	2
	Drilling	A3TAW HT93Q		<u> </u>			•
		PENETRATION RESISTANCE		ш			
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- 60	AL.	200			NO.			923	17.5	M
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100	ш	$b(x^{\prime\prime})$	100	W.			ZAS	87	4.7	16
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. 80	III.	-		8.		Sale.				V.
83			12	18	\sim 1		200	-		52
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	u_{L}	100		100		VIII)				4
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	1	- 14	S.,	100				680	MIN.	3
			5	M		á		丰		Š,

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

GALT Comments: ΑH



GROUNDWATER MONITORING BORE: MW01

Sheet 1 OF 1

Job Number: J1601005 Client: Satterley Group

Project: Proposed Residential Subdivision
Location: Dalyellup Beach Estate - Lots 9090 & 9076

Contractor: SFB Drilling **Drill Rig:** Eziprobe

Inclination: -90°

9

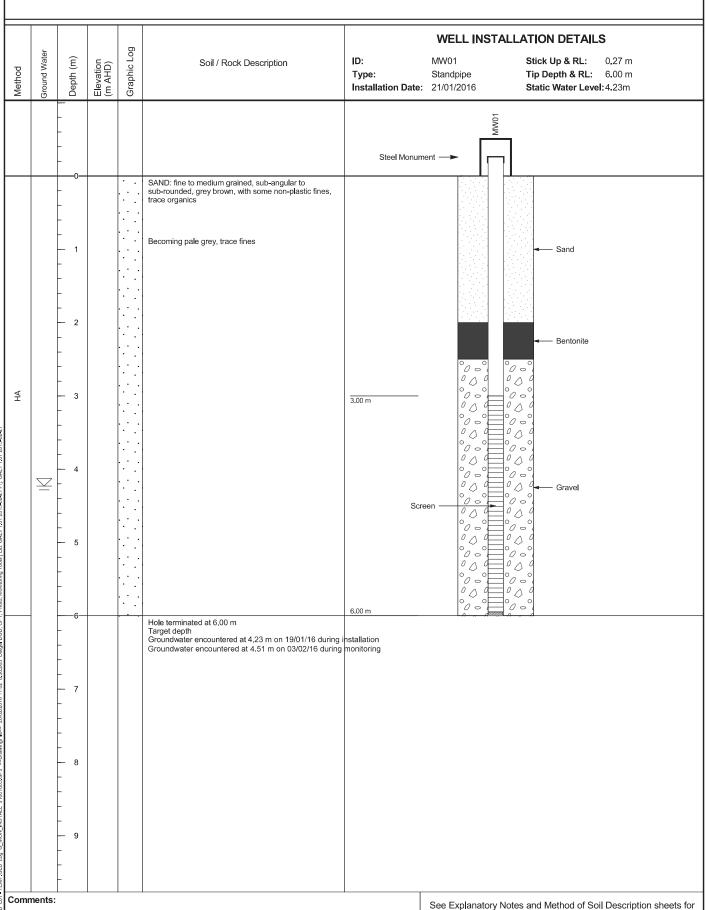
19/01/2016

Logged: JH Checked Date: 29/01/2016

Date:

details of abbreviations and basis of descriptions

Checked By: RP





GROUNDWATER MONITORING BORE: MW02

Sheet 1 OF 1

Job Number: J1601005 Client: Satterley Group

Project: Proposed Residential Subdivision
Location: Dalyellup Beach Estate - Lots 9090 & 9076

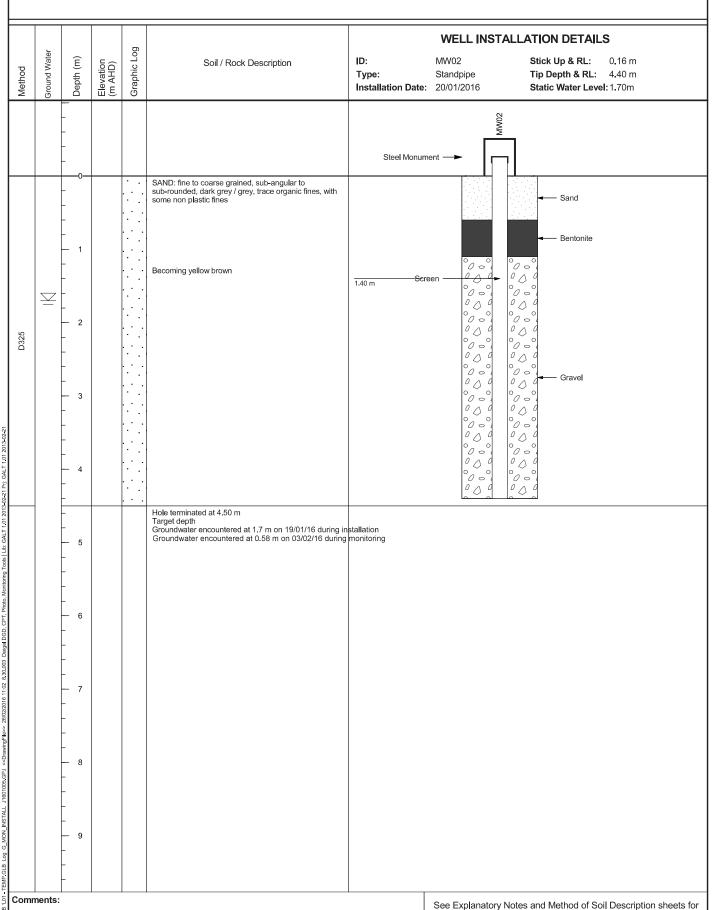
Contractor: SFB Drilling **Drill Rig:** Eziprobe

Inclination: -90°

Date: 19/01/2016 **Logged:** JH

Checked Date: 29/01/2016 Checked By: RP

details of abbreviations and basis of descriptions





GROUNDWATER MONITORING BORE: MW03

Sheet 1 OF 1

Job Number: J1601005 Client: Satterley Group

Comments:

Project: Proposed Residential Subdivision
Location: Dalyellup Beach Estate - Lots 9090 & 9076

Contractor: SFB Drilling Drill Rig: Eziprobe

Inclination: -90°

ing

19/01/2016

JΗ

Checked Date: 29/01/2016 Checked By: RP

Date:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

Logged:

	_			g		WELL INSTALLATION DETAILS
Method	Ground Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description	ID: MW03 Stick Up & RL: 0.70 m Type: Standpipe Tip Depth & RL: 3.10 m Installation Date: 20/01/2016 Static Water Level: 1.95m
		- - -				Steel Monument —➤
		0 - -			SAND: fine to coarse grained, sub-angular to sub-rounded, grey, with some low plasticity fines, trace organics	0.50 m Sand
		- 1 -			Becoming yellow brown	Bentonite
D3Z3	\geq	- - - 2				Screen O O O O O O O O O O O O O O O O O O
á		- - - 3				3.10 m
		- - -				
		- 4 - -			Hole terminated at 4.50 m	
		- - 5 -			Target depth Groundwater encountered at 1.95 m on 19/01/16 during Groundwater encountered at 1.96 m on 03/02/16 during	installation monitoring
		- - - 6				
		- - -				
		- 7 - -				
		- - 8 -				
		- - - 9				
		_				



Appendix C: Groundwater Monitoring Field Sheets

GROUNDWATER FIELD PARAMETERS



DALYELLUP Job Number: JILO 1 005 3.2.16 Site:

Monitoring Well: MWO Depth To Water (mTOC):

4.78 Sampling Method:

Purge Method: 20C

Flow Rate (L/mln):

Pipe Stick-up (m):

0.27

Time Sampled:

ر ≥

Field Rep:

Flow Cell Used: (V) N

TATAL I COME

								そので、 までは、 ここのと	7
bservations	SWL (m)	Volume	Cond (mS/cm)	Ho	Temp	DO (mg/L)	DO (% sat)	Redox (mV)	_
くさ		2	8211	6.65	17.9	0.95	(0.0)	77.6	_
		5	1169	6.65	17.9	1.68	7.17	-78.	
		ه.	6911	59.3	6.61	1.72	8-21	1361	
		1	c.					2	-

Colours 6 1169 6.64 179 1.22 12.8 Colours 8 1175 6.67 17.9 1.06 11.0 Colours 12 1183 6.70 17.9 1.06 11.4 Clour 14 1184 6.71 17.9 1.10 12.4								
90-1 6-67 17-9 1-06 90-0 6-71 17-9 1-06 1181 6-71 17-9 1-06 1181 1184 11-10	Cydounic	2	69/1	59.2	6.11	1.72	8-21	136-
90.1 6.61 17.9 0.48 1811 5.10 07.9 89.1 5.10		<i>>></i>	2611	111	17.9			1 3
01.1 6.67 17.9 0.98 18.0 6.71 17.9 4811 41 11.06 11.18 6.71 17.9 4811 411 51	3	0	6/17	10.0	1 1	90.7	11:0	1.8.
90-1 6-L1 11-9 h8/1 h1		0)	1811	6.67	17.9	86.0	10.3	- (00.3
01.1 6.71 17.4 1.10	Leconing	2)	2811	6.70	6.6	1.06	5.11	7.70/-
	CLOOK	ካ/	1184	11.9	17.9	0/:/	17.6	- 106.9
								3
					•			
							7.00	
					77-77-7			

ACAD: 0.25

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Purge Method: 25C	Flow Rate (L/min):	Pipe Stick-up (m): 0.16	Flow Cell Used : (9/N	FOTAL LENGT 2. EST
Mus	51.0	CF		
Monitoring Well:	Depth To Water (mTOC):	Sampling Method:	Time Sampled:	
2.2:16	31601005	phyeun	mc	
Date:	Job Number:	Site:	Field Rep:	•

						A Particular	No. 10. co.	Baden Cash
SWL (m) Volume Cond (mS/cm)		Cond (ms/cn	-	Ł	Temp	DO (mg/L)	DO (% sat)	Kedox (mv)
2 1102	2 1102	1102		6.92	20.5	55.0	6.3	-24.7
۲ //۵۶	4 1105	1105		6.74	20.4	8).0	2.0	1.02-
51113	6 1113	1113		6.67	5.0%	0.76	6.9	-18.5
8 1113	8 1113	1113		99.9	20.4	7).0	9-1	. 22-1
(0 1113		1113		6.65	100	0		1.52-
11/1	11 1/14	1/14		59.9	20.4	9).0	8.1	-25.6

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AUK: 1-43

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GROUNDWATER FIELD PARAMETERS



Sampling Method: Depth To Water (mTOC): Time Sampled: Job Number: 31601005 Site: CALYCLUP Date: 9.1-10

Field Rep: M.C.

Monitoring Well: MAJOS

3.66 レガ

Purge Method: 200

0.70 Flow Rate (L/min): Pipe Stick-up (m):

Flow Cell Used: (Y) N

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							1	j
Observations	SWL (m)	Volume	Cond (ms/cm)	Hq	Temp	DO (mg/l)	DO (% sat)	Redox (mV)
clas		2	769	and of	21.3	6.56	13.7	0.611-
and to bid		5	773	7.01		5.92	66.6	-117.5
tow was		و	773	1.0.1	21.3		0.09	-117.2
O de Avenue		8	274	7.00		Vi	6.95	-116.5
		٥	774	96.9	21.3	n. 70	8-25	-110.5
		7)	774	16.9	21.3	78.17	0.65	-111.3
		ד	ncc	06.9	21.3	4.25	46.3	118.7
		. The state of the						
								Z ₁
79.78								

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ACD: 0:17



Appendix D: Penetrometer Test Results

PERTH SAND PENETROMETER FIELD TEST DATA (AS 1289.6.3.3)

Client:Satterley GroupJob No: J1601005Project:Proposed Residential SubdivisionDate: 19/01/2016

Location: Dalyellup Beach Estate - Lots 9090 & 9076 Engineer: JH



Test No:	PSP01	PSP02	PSP03	PSP04	PSP05	PSP06	PSP07
Location:	BH01	BH02	BH05	вн09	BH10	BH11	BH12
Depth (mm)		N° o	f Penetrometer	Blows per 150	mm Depth Inte	rval	
0-150	-	-	-	-	-	-	-
150-300	4	2	2	2	2	2	2
300-450	2	3	3	3	3	3	2
450-600	5	4	4	3	4	4	3
600-750	6	6	5	4	5	4	3
750-900	8	6	6	5	6	4	4

Test No:	PSP08	PSP09	PSP10	PSP11	PSP12		
Location:	BH13	BH14	BH15	BH17	BH20		
Depth (mm)		N° o	f Penetrometer	Blows per 150	mm Depth Inte	rval	-
0-150	-	-	-	-	-		
150-300	2	4	1	3	6		
300-450	3	5	2	3	8		
450-600	3	5	7	4	10		
600-750	4	7	10	3	10		
750-900	5	8	5	3	10		

Test No:						
Location:						
Depth (mm)	N° o	f Penetrometer	Blows per 150	mm Depth Inte	rval	-
0-150						
150-300						
300-450						
450-600						
600-750						
750-900						

Test No:						
Location:						
Depth (mm)	N° o	f Penetrometer	Blows per 150	mm Depth Inte	rval	
0-150						
150-300						
300-450						
450-600						
600-750						
750-900						

Perth Sand Penetrometer tests done in accordance with AS 1289.6.3.3 (except blow counts are reported per 150 mm, rather than 300 mm) HB: Hammer bounce (refusal)

0 = Penetration due to hammer weight only

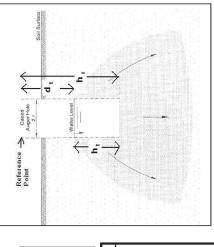
R: Refusal



Appendix E: Infiltration Test Results

Permeability Calculation - Inverse Auger Hole Method

	i cillicabillity calcalation mixeloc Aagel Hole memod			2	50150			
Galt Geotechnics		Spreadsheet author:	et author:	ORW	17-Oct-09	REFERENCE	REFERENCE: Cocks, G. Disposal of	Disposal of
Job No:	Job No: J1601005					Stormwater R	Runoff by Soal	Stormwater Runoff by Soakage in Perth
Client:	Client: Satterley Group			_	-	Western Aust	Western Australia, Journal and News of the Australian Geomechanics Society	and News of
Site:	Site: Dalyellup Beach Estate		log ₁₀ (h ₀ +	∵r) – log	$\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_1 + \frac{1}{2}r)$ Volume 42 No 3 September 2007,	Volume 42 No	o 3 Septembe	er 2007,
<u>Location:</u>	Location: Lots 9090 & 9076	K = 1.15r -		7	7	pp101-114		
Calc by: JH	JH 25-Jan-16			0 1 — 1				
BH Name:	BH Name: P01/BH17	Parameter	Parameter Description				Value	Units
Test Depth: 0.72	0.72 m	¥	Permeability				X	s/w
Spreadshe	preadsheet Legend	L	radius of test hole	t hole		\	0.04 m	Е
	Required input	ţ	time since start of measurement	art of mea	surement		X	S
	Calculated field	ہ	reference point height above base	int height	above base		0.77	Е
	Comment field	ģ	depth from r	eference p	depth from reference point to water at time t	at time t	\bigvee	E
\bigvee	Field not used	<u>ב</u>	Water column height at time t	ın height a	t time t	<u>/\</u>	\bigvee	E
	Fixed field	$h_{\!\scriptscriptstyle 0}$	h _t at t=0				\bigvee	Ε



	Soil Surface				
	200				
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\geq		ے۔		7	
	-×				
Cased Auger Hole 2 r		Water Level			
Aug C		Wate			
↓ ,				\subseteq	
nce			-	<	
Reference Point					
8 9					
	8				

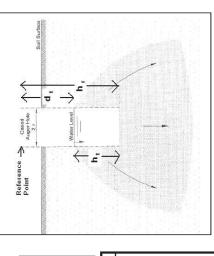
	K (m/day)	\bigvee	13.4	12.7	10.8	10.1	9.6	0.6	8.8	8.2	6.7	7.6	7.4	7.1	6 <u>'</u> 9	6.7	6.5		8.8
	K (m/s)	\bigvee	1.6E-04	1.5E-04	1.3E-04	1.2E-04	1.1E-04	1.0E-04	1.0E-04	9.5E-05	9.1E-05	8.8E-05	8.6E-05	8.2E-05	7.9E-05	7.7E-05	7.5E-05		1.0E-04
	h _t (m)	0.57	0.485	0.42	0.385	0.35	0.32	0.295	0.27	0.255	0.24	0.225	0.21	0.2	0.19	0.18	0.17		AVERAGE
	(m) ^м p	0.2	0.285	0.35	0.385	0.42	0.45	0.475	0.5	0.515	0.53	0.545	0.56	0.57	0.58	0.59	9.0		
est Z	t (s)	0	20	4	09	8	100	120	140	160	180	200	220	240	260	280	300		

	day)	\bigvee	3	2	5	ω.	0	9	_	.7	23	_	<u>б</u>	ω.	4	4	.5		Ľ
	K (m/day)	Ň	14.3	12.2	10.5	9.8	9.0	8	80	7	7.3	7.	9	6.8	6.4	6.4	9.		α Σ
	K (m/s)	\mathbb{N}	1.7E-04	1.4E-04	1.2E-04	1.1E-04	1.0E-04	9.9E-05	9.4E-05	8.9E-05	8.5E-05	8.2E-05	8.0E-05	7.8E-05	7.4E-05	7.4E-05	7.2E-05		9 8F-05
	h _t (m)	0.57	0.48	0.425	0.39	0.355	0.33	0.305	0.285	0.27	0.255	0.24	0.225	0.21	0.205	0.19	0.18		AVFRAGE
	d _w (m)	0.2	0.29	0.345	0.38	0.415	0.44	0.465	0.485	0.5	0.515	0.53	0.545	0.56	0.565	0.58	0.59		
Test 3	t (s)	0	20	40	09	80	100	120	140	160	180	200	220	240	260	280	300		
																			_

	ı/day)	V	14.3	12.2	10.8	0.1	9.5	80.	ღ.	7.8	5.	4.	7.1	6.8	6.4	6.2	6.1		0
	K (m/day	\mathbb{A})—			- 1			_										ļ
	K (m/s)	\mathbb{X}	1.7E-04	1.4E-04	1.3E-04	1.2E-04	1.1E-04	1.0E-04	9.7E-05	9.1E-05	8.7E-05	8.6E-05	8.2E-05	7.8E-05	7 4E-05	7.2E-05	7.0E-05		4 0 0 0 4
	h _t (m)	0.57	0.48	0.425	0.385	0.35	0.32	0.3	0.28	0.265	0.25	0.23	0.22	0.21	0.205	0.195	0.185		70407/14
	d _w (m)	0.2	0.29	0.345	0.385	0.42	0.45	0.47	0.49	0.505	0.52	0.54	0.55	0.56	0.565	0.575	0.585		
Test 1	t (s)	0	20	40	09	80	100	120	140	160	180	200	220	240	260	280	300		



	- 1						
Galt Geotechnics	Spreadsheet author:	et author:	ORW	ORW 17-Oct-09	REFERENCE: Cocks, G. Disposal of	of	
<u>Job No:</u> J1601005					Stormwater Runoff by Soakage in Perth	Perth	
Client: Satterley Group			_	_	Western Australia, Journal and News of the Australian Geomechanics Society	vs of	
Site: Dalyellup Beach Estate		log ₁₀ (h ₀ +	-رىڭ	$_{10}(h_{t} + \frac{1}{2}r)$	$\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)$ Volume 42 No 3 September 2007,		
Location: Lots 9090 & 9076	K = 1.15r		7	7	pp101-114		
<u>Calc by:</u> JH 25-Jan-16			0 1 — 1			1	
BH Name: P02/BH08	Parameter	Parameter Description	_		Value Units	Г	
Test Depth: 0.74 m	¥	Permeability			s/w		
Spreadsheet Legend	_	radius of test hole	st hole		0.04 m		
Required input	4	time since start of measurement	tart of mea	surement	No.		
Calculated field	ہ ۔	reference po	oint height	reference point height above base	0.77 m		
Comment field	ڻ ٽ	depth from r	eference p	depth from reference point to water at time t	at time t		
Field not used	ٹ	Water column height at time	nn height a	t time t			
Fixed field	٦	h, at t=0				_	



t (s)	0	20	40	09	80 100				
K (m/s) K (m/day)	$\backslash\!\!\!\!/$	41.4	37.9	32.6	31.0				
K (m/s)	\bigvee	4.8E-04	4.4E-04	3.8E-04	3.6E-04				
h _t (m)	0.57	0.345	0.225	0.17	0.12				
\neg									

0.2 0.425 0.545 0.6 0.65

<mark>0</mark> 2 4 8 8

t (s)

Test 2

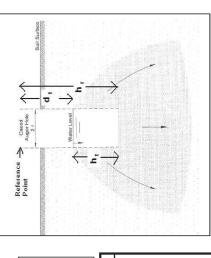
	K (m/day)	\setminus	36.8	33.7	30.4	28.2	27.5	31.3
	K (m/s)	\setminus	4.3E-04	3.9E-04	3.5E-04	3.3E-04	3.2E-04	3.6E-04
	h _t (m)	0.57	0.365	0.25	0.185	0.14	0.1	AVERAGE
	(m) [^] p	0.2	0.405	0.52	0.585	0.63	0.67	
Test 3	t (s)	0	20	40	09	80	100	
								 _

	K (m/day)	\bigvee	52.8	44.6	38.5			ļ	45.3
	K (m/s)	$\backslash\!$	6.1E-04	5.2E-04	4.5E-04			- 1	5.2E-04
	h _t (m)	0.57	0.3	0.19	0.135				AVERAGE
	(m) ^м p	0.2	0.47	0.58	0.635				
Test 1	t (s)	0	20	40	09				

K (m/day)	\setminus	52.8	44.6	38.5	45.3
(s/ш) y	\setminus	6.1E-04	5.2E-04	4.5E-04	5.2E-04
h _t (m)	0.57	0.3	0.19	0.135	AVERAGE
(w) [^] p	0.2	0.47	0.58	0.635	
t (s)	0	20	40	09	



				50::0::				
Galt Geotechnics	Spreadsheet author:	et author:	ORW	17-Oct-09	REFERENCE: Cocks, G. Disposal of	Socks, G. D	isposal of	Refe Poin
Job No: J1601005					Stormwater Runoff by Soakage in Perth	off by Soak	age in Perth	
Client: Satterley Group				-	The Australian Geomechanics Society	<i>lia</i> , Journal (and News of	
Site: Dalyellup Beach Estate		$\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_1 + \frac{1}{2}r)$ Volume 42 No 3 September 2007,	- r) – log	$^{10}(h_t + \frac{1}{2}r)$	Volume 42 No 3	September	r 2007,	
Location: Lots 9090 & 9076	K = 1.15r		,	7	pp101-114			
<u>Calc by:</u> JH 25-Jan-16			$1-1^{\circ}$					
BH Name: P03/BH20	Parameter	Parameter Description			Va	Value	Units	
Test Depth: 0.72 m	소	Permeability			/ \ 	Ž	s/w	
Spreadsheet Legend	L	radius of test hole	hole			0.04 m	٤	
Required input	4	time since start of measurement	art of mea	surement	/\	Ÿ	S	
Calculated field	ت ۔	reference point height above base	nt height	above base		0.77 m	E	
Comment field	ڻ ن	depth from reference point to water at time t	ference p	oint to water	at time t	Ž	E	
Field not used	ځ	Water column height at time t	n height a	t time t	\triangle	$\sqrt{}$	E	
Fixed field	h_0	h _t at t=0			\triangle	Ž	E	



t (s)	0	30	09	8	120	
K (m/s) K (m/day)	\bigvee	26.1	24.7	21.7	21.8	
K (m/s)	\bigvee	3.0E-04	2.9E-04	2.5E-04	2.5E-04	
h _t (m)	0.57	0.355	0.23	0.17	0.11	

0.2 0.415 0.54 0.6 0.6

0 0 0 0 1 1 2 0 0 0 1 1 2 0 0 0 1 1 2 0 0 0 1

t (s) Test 2

	K (m/day)	\bigvee	23.8	22.5	20.7	20.7					21.9
	K (m/s)	$\backslash\!\!\!\!/$	2.8E-04	2.6E-04	2.4E-04	2.4E-04					2.5E-04
	h _t (m)	0.57	0.37	0.25	0.18	0.12					AVERAGE
	(m) ^м p	0.2	0.4	0.52	0.59	0.65					
Test 3	t (s)	0	30	09	06	120					
,											_

	K (m/s) K (m/day)	\bigvee	31.7	26.5	22.8	21.8	25.7
	K (m/s)	\bigvee	3.7E-04	3.1E-04	2.6E-04	2.5E-04	3 0F-04
	h _t (m)	0.57	0.32	0.215	0.16	0.11	AVERAGE
	(m) [^] p	0.2	0.45	0.555	0.61	99.0	
Test 1	t (s)	0	30	09	06	120	

K (m/s) K (m/day)	\bigvee	31.7	26.5	22.8	21.8	25.7
K (m/s)	\bigvee	3.7E-04	3.1E-04	2.6E-04	2.5E-04	3.0E-04
h _t (m)	0.57	0.32	0.215	0.16	0.11	AVERAGE
d _w (m)	0.2	0.45	0.555	0.61	0.66	
t (s)	0	30	09	06	120	



Galt Geotechnics	Spreadsheet author:	-	ORW	17-Oct-09	REFERENC	REFERENCE: Cocks, G. Disposal of	Disposal of	
Job No: J1601005					Stormwater	Runoff by Soa	Stormwater Runoff by Soakage in Perth	
Client: Satterley Group				_	Western Au.	Western Australia, Journal and News of the Australian Geomechanics Society	Western Australia, Journal and News of the Australian Geomechanics Society	
Site: Dalyellup Beach Estate		$\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_1 + \frac{1}{2}r)$ Volume 42 No 3 September 2007,	∵r) – log	$ _{10}(h_t + \frac{1}{2}r) $	Volume 42 l	No 3 Septemb	er 2007,	
Location: Lots 9090 & 9076	K = 1.15r		,	7	pp101-114			
<u>Calc by:</u> JH 25-Jan-16			0 l — l					
BH Name: P04/BH12	Parameter	Parameter Description				Value	Units	
Test Depth: 0.72 m	소	Permeability				\mathbb{N}	s/ш	
Spreadsheet Legend	L	radius of test hole	t hole			0.04 m	E	
Required input	ţ	time since start of measurement	art of mea	surement		\bigvee	s	
Calculated field	h _r	reference point height above base	int height	above base		0.77	E	
Comment field	ģ	depth from re	eference p	depth from reference point to water at time t	at time t	\bigvee	Е	
Field not used	ځ	Water column height at time t	n height a	it time t		\bigvee	E	
Fixed field	h _o	h _t at t=0				\bigvee	E	

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Test 2

K (m/s) K (m/day)

h_t (m)

d_w (m)

Test 1 t (s) 28.4 23.6 20.7 20.7

3.3E-04 2.7E-04 2.4E-04 2.4E-04

0.57 0.34 0.24 0.18

0.2 0.43 0.53 0.59 0.65

K (m/s) K (m/day)	\bigvee	25.3	21.4	18.5	16.7	20.5
K (m/s)	\bigvee	2.9E-04	2.5E-04	2.1E-04	1.9E-04	2.4E-04
h _t (m)	0.57	0.36	0.26	0.205	0.165	AVERAGE
d _w (m)	0.2	0.41	0.51	0.565	0.605	
t (s)	0	30	09	06	120	

K (m/day)	\bigvee	23.8	20.9	18.1	16.7								19.9
K (m/s)	$\backslash\!\!\!\!/$	2.8E-04	2.4E-04	2.1E-04	1.9E-04								2.3E-04
h _t (m)	0.57	0.37	0.265	0.21	0.165								AVERAGE
d _w (m)	0.2	0.4	0.505	0.56	0.605								
t (s)	0	30	09	06	120								
													•
	(m) [^] p	d _w (m) h _t (m) 0.2 0.57	d _w (m) h _t (m) 0.2 0.57 0.4 0.37	d _w (m) h _t (m) 0.2 0.57 0.4 0.37 0.505 0.265	0.2 0.57 0.4 0.37 0.505 0.265 0.56 0.21	d _w (m) h _t (m) 0.2 0.57 0.4 0.37 0.505 0.265 0.56 0.21 0.605 0.165	dw (m) h _t (m) 0.2 0.57 0.4 0.37 0.505 0.265 0.56 0.21 0.605 0.165	dw (m) h _t (m) 0.2 0.2 0.4 0.505 0.265 0.56 0.265 0.605 0.165	d _w (m) h _t (m) 0.2 0.2 0.4 0.57 0.505 0.505 0.056 0.005	dw (m) h ₁ (m) 0.2 0.2 0.4 0.57 0.40 0.505 0.605 0.165	d _w (m) h _t (m) 0.2 0.2 0.4 0.57 0.56 0.56 0.265 0.056 0.0165	dw (m) h _t (m) 0.2 0.2 0.4 0.505 0.505 0.265 0.021 0.605 0.165	d _w (m) h _t (m) 0.2 0.2 0.4 0.57 0.505 0.505 0.265 0.056 0.0165

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Galt Geo	Galt Geotechnics	Spreadsheet author:	t author:	ORW	ORW 17-Oct-09	REFERENC	REFERENCE: Cocks, G. Disposal of	l of	Refere Point
Job No:	<u>Job No:</u> J1601005					Stormwater	Stormwater Runoff by Soakage in Perth	Perth	
Client:	Client: Satterley Group			_	_	western Aus the Australia	West <i>ern Australia</i> , Journal and News of the Australian Geomechanics Society	ews of	
Site	Site: Dalyellup Beach Estate		log ₁₀ (h ₀ +	∵r) – log	$ _{10}(h_t + \frac{1}{2}r) $	Volume 42 N	$\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_1 + \frac{1}{2}r)$ Volume 42 No 3 September 2007,		
Location:	Location: Lots 9090 & 9076	K = 1.15r		7	7	pp101-114			
Calc by: JH	JH 25-Jan-16			0 1 — 1					
BH Name:	BH Name: P05/BH02	Parameter	Parameter Description	_			Value Units		
Test Depth: 0.75	0.75 m	¥	Permeability				s/w		
Spreadsh	Spreadsheet Legend	_	radius of test hole	st hole			0.04 m		1
	Required input	ţ	time since start of measurement	tart of mea	surement		Ň		\
	Calculated field	ئے	reference po	oint height	reference point height above base		0.77 m		
	Comment field	ģ	depth from r	eference p	depth from reference point to water at time t	at time t	E		
\bigvee	Field not used	Ť	Water column height at time t	nn height a	it time t		E		
	Fixed field	h_0	h _t at t=0				E		

Test 2

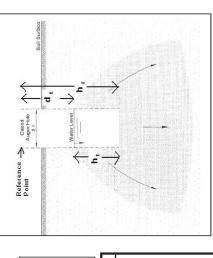
K (m/s) K (m/day)

Test 1 t (s) 28.4 22.5 19.4 17.1 16.1

3.3E-04 2.6E-04 2.2E-04 2.0E-04 1.9E-04

h_t (m) 0.57 0.34 0.25 0.195 0.16

dw (m)
0.2
0.43
0.52
0.575
0.675



K (m/s) K (m/day)	\bigvee	20.2	17.2	16.5	14.9	14.3	16.6
K (m/s)	$\backslash\!\!\!\!/$	2.3E-04	2.0E-04	1.9E-04	1.7E-04	1.7E-04	1.9F-04
h _t (m)	0.57	0.395	0.305	0.23	0.19	0.15	AVERAGE
(m) ^м p	0.2	0.375	0.465	0.54	0.58	0.62	
t (s)	0	30	09	06	120	150	

	K (m/day)	\bigvee	18.9	16.7	16.5	14.9	15.0	16.4
	K (m/s)	\bigvee	2.2E-04	1.9E-04	1.9E-04	1.7E-04	1.7E-04	1.9E-04
	h _t (m)	0.57	0.405	0.31	0.23	0.19	0.14	AVERAGE
	d _w (m)	0.2	0.365	0.46	0.54	0.58	0.63	
Test 3	t (s)	0	30	09	06	120	150	

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Appendix F: Geotechnical Laboratory Test Results

Particle Size Distribution



unit1/1 Pusey Road, Jandakot, WA 6164 Ph (08) 9414 8022 Fax (08) 9414 8011

Email: kevin@mcgeotest.com.au

Client:

GALT Geotechnics

Project: Satterley Group - Proposed Residential Subdivision

Location: Lot 9090 & 9076 Dalyellup Beach Estate

Job No: 60083

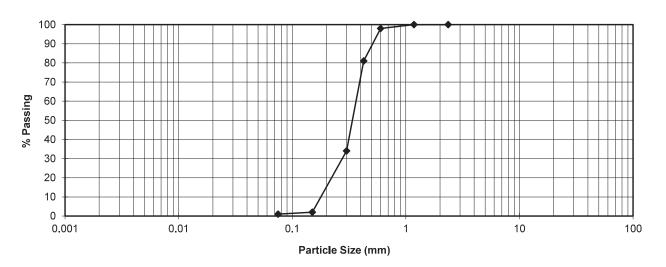
Report No: 60083-P16/245

Sample No: P16/245 Issue Date: 02-Feb-16

Sample Location: BH06

Sample Depth(m): 3.0 - 4.0

Test Request: J1601005



SIEVE ANALYSIS AS 1289.3.6.1

DIE I E III II E I DI	0 110 1 2 07 10
Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	98
0.425	81
0.300	34
0.150	2
0.075	1

Client Address: Unit 2, 39 Flynn St, Wembley, WA, 6014

Sampling Procedure: Tested as received



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Particle Size Distribution



unit1/1 Pusey Road, Jandakot, WA 6164 Ph (08) 9414 8022 Fax (08) 9414 8011

Email: kevin@mcgeotest.com.au

Client:

GALT Geotechnics

Project: Satterley Group - Proposed Residential Subdivision

Location: Lot 9090 & 9076 Dalyellup Beach Estate

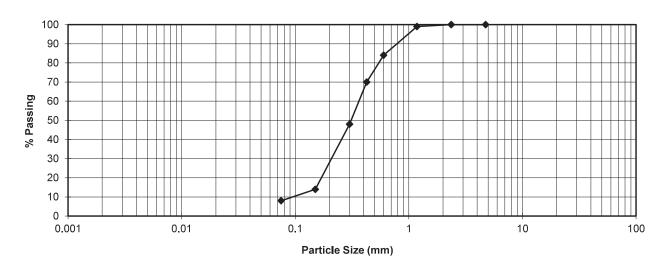
Job No: 60083

Report No: 60083-P16/246

Sample No: P16/246 Issue Date: 02-Feb-16

Sample Location: BH17
Sample Depth(m): 1.5 - 1.8

Test Request: J1601005



SIEVE ANALYSIS AS 1289.3.6.1

015 15 11 11 11 15 1 01	
Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	100
1.18	99
0.600	84
0.425	70
0.300	48
0.150	14
0.075	8

Client Address: Unit 2, 39 Flynn St, Wembley, WA, 6014

Sampling Procedure: Tested as received



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Particle Size Distribution & Plasticity Index tests



Mining & Civil **Geotest Pty Ltd**

unit1/1 Pusey Road, Jandakot, WA 6164 Ph (08) 9414 8022 Fax (08) 9414 8011

Email: kevin@mcgeotest.com.au

GALT Geotechnics Client: Satterley Group - Proposed Residential Subdivision Project:

Lot 9090 & 9076 Dalyellup Beach Estate Location:

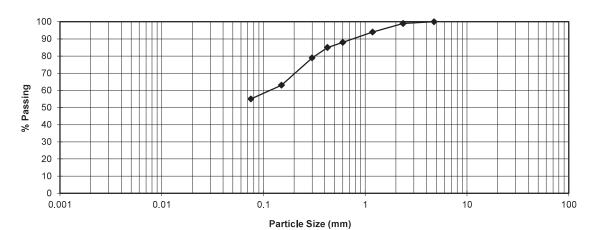
Job No: 60083

60083-P16/247 Report No:

Sample No: P16/247 **Issue Date:** 02-Feb-16

Sample Location: BH18 0.2 - 0.5Sample Depth(m):

J1601005 **Test Request:**



SIEVE	ANALYSIS	AS 1289.3.6.1	

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	99
1.18	94
0.600	88
0.425	85
0.300	79
0.150	63
0.075	55

Plasticity index tests

I lasticity much tests		
AS 1289		
Liquid limit 3.1.1	50	%
Plastic limit 3.2.1	36	%
Plasticity index 3.3.1	14	%
Linear shrinkage 3.4.1	5.0	%

Cracked

Curled

Client Address: Unit 2, 39 Flynn St, Wembley, WA, 6014

Sampling Procedure: Tested as received



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Particle Size Distribution & Plasticity Index tests



Mining & Civil **Geotest Pty Ltd**

unit1/1 Pusey Road, Jandakot, WA 6164 Ph (08) 9414 8022 Fax (08) 9414 8011

Email: kevin@mcgeotest.com.au

GALT Geotechnics Client: Satterley Group - Proposed Residential Subdivision Project:

Lot 9090 & 9076 Dalyellup Beach Estate Location:

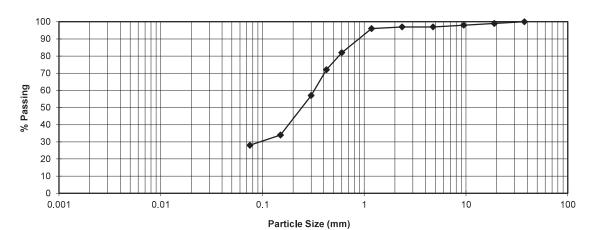
Job No: 60083

Report No: 60083-P16/248

Sample No: P16/248 **Issue Date:** 02-Feb-16

Sample Location: BH19 0.2 - 0.5Sample Depth(m):

J1601005 **Test Request:**



SIEVE ANALYS	IS AS 1289.3.6.1	Plasticity index tests		
Sieve Size (mm)	% Passing	AS 1289		
75.0		Liquid limit 3.1.1	59	%
37.5	100	Plastic limit 3.2.1	43	%
19.0	99	Plasticity index 3.3.1	16	%
9.5	98	Linear shrinkage 3.4.1	7.0	%
4.75	97			
2.36	97	Cracked		
1.18	96			
0.600	82	Curled	1	
0.425	72			
0.300	57			
0.150	34			
0.075	28			

Client Address: Unit 2, 39 Flynn St, Wembley, WA, 6014

Sampling Procedure: Tested as received



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Particle Size Distribution



unit1/1 Pusey Road, Jandakot, WA 6164 Ph (08) 9414 8022 Fax (08) 9414 8011

Email: kevin@mcgeotest.com.au

Client:

GALT Geotechnics

Project: Satterley Group - Proposed Residential Subdivision

Location: Lot 9090 & 9076 Dalyellup Beach Estate

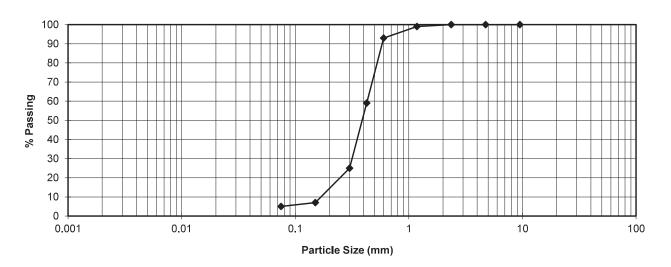
Job No: 60083

Report No: 60083-P16/249

Sample No: P16/249 Issue Date: 02-Feb-16

Sample Location: BH21 Sample Depth(m): 0.0 - 0.75

Test Request: J1601005



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	100
2.36	100
1.18	99
0.600	93
0.425	59
0.300	25
0.150	7
0.075	5

Client Address: Unit 2, 39 Flynn St, Wembley, WA, 6014

Sampling Procedure: Tested as received



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Approved signature

Kevin Jones

AS PSDPI May 2009



Organic content of Soils ASTM: D 2974-07a Test Method C

Mining & Civil
Geotest Pty Ltd

Ph (08) 9414 8022 Fax (08) 9414 8011 Job No: 60083

Email kevin@mcgeotest.com.au Report No: 60083-P16/246-249

Unit 1/1 Pusey Road, JANDAKOT WA 6164 Date of issue: 02-Feb-16

Client:GALT GeotechnicsDate tested:27-Jan-16Project:Satterley Group - Proposed Residential SubdivisionTested by:P.CulvertsonLocation:Lot 9090 & 9076 Dalyellup Beach EstateChecked:S.Davies

Sample Number	Sample Identification	Ash content %	Organic content %
P16/246	BH17 1.5 - 1.8m	96.9	3.1
P16/248	BH19 0.2 - 0.5m	90.4	9.6
P16/249	BH21 0.0 - 0.75m	97.2	2.8
Tested as received	Furnace temperature 440°c		

Client Address: Unit 2, 39 Flynn St, Wembley, WA, 6014

Kun in ask

Approved Signature Kevin Jones



Appendix G: Environmental Laboratory Test Results



Galt Environment P/L 2/39 Flynn St Wembley WA 6014 ilac-mra



Certificate of Analysis

NATA Accredited Accreditation Number 1261 Site Number 1254

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: Michael Carmichael

Report488191-SProject nameDALYELLUPProject IDJ1601005Received DateFeb 08, 2016

Client Sample ID			BH21/3.5	BH22/2.25	BH23/1.25	BH24/1.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins mgt Sample No.			M16-Fe06067	M16-Fe06068	M16-Fe06069	M16-Fe06070
Date Sampled			Feb 04, 2016	Feb 04, 2016	Feb 04, 2016	Feb 04, 2016
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	9.8	6.5	9.6	6.7
Acid trail - Titratable Actual Acidity	2	mol H+/t	< 2	< 2	< 2	< 2
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur ^{S04}	0.005	% S	< 0.005	0.41	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	260	< 3	< 3
Sulfur - KCI Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCI Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite ^{S02}	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	35	0.07	9.8	0.14
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	6900	15	2000	28
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt) ^{S03}	0.02	% S	11	0.02	3.1	0.04
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	0.39	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	250	< 10	< 10
Liming Rate ^{S01}	1	kg CaCO3/t	< 1	18	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	2.1	18	8.5	3.1



Client Sample ID			BH25/0.0	BH26/0.75	HA01/0.0	HA01/1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins mgt Sample No.			M16-Fe06071	M16-Fe06072	M16-Fe06073	M16-Fe06074
Date Sampled			Feb 04, 2016	Feb 04, 2016	Feb 04, 2016	Feb 04, 2016
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	8.8	7.1	8.4	8.3
Acid trail - Titratable Actual Acidity	2	mol H+/t	< 2	< 2	< 2	< 2
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur ^{S04}	0.005	% S	< 0.005	< 0.005	0.039	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	25	< 3
Sulfur - KCI Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCI Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite ^{S02}	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	1.7	0.24	28	0.13
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	340	48	5700	26
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt) ^{S03}	0.02	% S	0.54	0.08	9.1	0.04
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10	< 10
Liming Rate ^{S01}	1	kg CaCO3/t	< 1	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	17	13	40	19

Client Sample ID Sample Matrix			HA02/0.0 Soil	HA02/1.25 Soil	HA03/0.25 Soil	HA03/1.0 Soil
Eurofins mgt Sample No.			M16-Fe06075	M16-Fe06076	M16-Fe06077	M16-Fe06078
Date Sampled			Feb 04, 2016	Feb 04, 2016	Feb 04, 2016	Feb 04, 2016
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	8.5	7.6	6.8	6.7
Acid trail - Titratable Actual Acidity	2	mol H+/t	< 2	< 2	< 2	< 2
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur ^{S04}	0.005	% S	0.022	0.74	< 0.005	0.008
Chromium Reducible Sulfur -acidity units	3	mol H+/t	14	460	< 3	5.0
Sulfur - KCI Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCI Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite ^{S02}	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	46	0.21	0.51	0.06
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	9200	42	100	12
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt) ^{S03}	0.02	% S	15	0.07	0.16	0.02
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	0.69	< 0.02	< 0.02



Client Sample ID			HA02/0.0	HA02/1.25	HA03/0.25	HA03/1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins mgt Sample No.			M16-Fe06075	M16-Fe06076	M16-Fe06077	M16-Fe06078
Date Sampled			Feb 04, 2016	Feb 04, 2016	Feb 04, 2016	Feb 04, 2016
Test/Reference	LOR	Unit				
Chromium Suite						
Net Acidity (Acidity Units)	10	mol H+/t	< 10	430	< 10	< 10
Liming Rate ^{S01}	1	kg CaCO3/t	< 1	32	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	55	24	23	20



Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

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

Description	Testing Site	Extracted	Holding Time
Chromium Suite			
Chromium Suite	Brisbane	Feb 10, 2016	6 Week
- Method: LTM-GEN-7070			
Extraneous Material	Brisbane	Feb 10, 2016	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Feb 08, 2016	14 Day

⁻ Method: LTM-GEN-7080 Moisture

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Received:

J1601005 488191

Order No.: Report #: Phone: Fax:

Galt Environment P/L

Company Name:

Address:

2/39 Flynn St

DALYELLUP

Project Name:

Project ID:

J1601005

WA 6014

Wembley

Feb 8, 2016 8:37 AM

Priority: Contact Name: Due:

Michael Carmichael Feb 15, 2016 5 Day

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail

Chromium Suite

Moisture Set

ASS Groundwater Quality Suite - WA Department of Environment and

Melbourne Laboratory - NATA Site # 1254 & 14271

Laboratory where analysis is conducted

Brisbane Laboratory - NATA Site # 20794

External Laboratory

Sydney Laboratory - NATA Site # 18217

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LAB ID

Matrix

Sampling Time

Sample Date

Sample ID

Feb 04, 2016 Feb 04, 2016 Feb 04, 2016

> MW02 MW03

MW01

M16-Fe06063 M16-Fe06064

Water Water

Water

Water Soil Soil Soil Soil

Feb 04, 2016

Feb 04, 2016 Feb 04, 2016 Feb 04, 2016 Feb 04, 2016

BH22/2.25 BH23/1.25 BH24/1.5

BH25/0.0

BH21/3.5

OC1

Feb 04, 2016

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M16-Fe06065

× × M16-Fe06068 M16-Fe06069 M16-Fe06066 M16-Fe06067

× × M16-Fe06070 M16-Fe06071 666

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J1601005 488191

Order No.: Report #: Phone: Fax:

Galt Environment P/L

Company Name:

Address:

2/39 Flynn St

DALYELLUP

Project Name: Project ID:

11601005

WA 6014

Wembley

Michael Carmichael Feb 15, 2016 5 Day Priority: Contact Name: Due:

Feb 8, 2016 8:37 AM

Received:

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail

Moisture Set Chromium Suite

ASS Groundwater Quality Suite - WA Department of Environment and

Melbourne Laboratory - NATA Site # 1254 & 14271

Laboratory where analysis is conducted

Brisbane Laboratory - NATA Site # 20794

Sydney Laboratory - NATA Site # 18217

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M16-Fe06073

M16-Fe06072

Soil Soil Soil Soil Soil Soil

> Feb 04, 2016 Feb 04, 2016 Feb 04, 2016 Feb 04, 2016

Feb 04, 2016

BH26/0.75

HA01/1.0

HA02/0.0

HA01/0.0

External Laboratory

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M16-Fe06074 M16-Fe06075 M16-Fe06076

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M16-Fe06077

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M16-Fe06078

Feb 04, 2016

HA02/1.25 HA03/0.25 Feb 04, 2016

HA03/1.0

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Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

NTU: Nephelometric Turbidity Units

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

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

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

Units

 mg/kg: milligrams per Kilogram
 mg/l: milligrams per litre

 ug/l: micrograms per litre
 ppm: Parts per million

 ppb: Parts per billion
 %: Percentage

org/100ml: Organisms per 100 millilitres

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

Terms

Dry Where a moisture has been determined on a solid sample the result is expressed on a dry basis.

LOR Limit of Reporting.

SPIKE Addition of the analyte to the sample and reported as percentage recovery.

RPD Relative Percent Difference between two Duplicate pieces of analysis.

LCS Laboratory Control Sample - reported as percent recovery
CRM Certified Reference Material - reported as percent recovery

Method Blank In the case of solid samples these are performed on laboratory certified clean sands.

In the case of water samples these are performed on de-ionised water.

Surr - Surrogate The addition of a like compound to the analyte target and reported as percentage recovery.

Duplicate A second piece of analysis from the same sample and reported in the same units as the result to show comparison.

Batch Duplicate A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.

Batch SPIKE Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.

USEPA United States Environmental Protection Agency

APHA American Public Health Association

ASLP Australian Standard Leaching Procedure (AS4439.3)

TCLP Toxicity Characteristic Leaching Procedure

COC Chain of Custody

SRA Sample Receipt Advice

CP Client Parent - QC was performed on samples pertaining to this report

NCP Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within

TEQ Toxic Equivalency Quotient

QC - Acceptance Criteria

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

Results <10 times the LOR : No Limit

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

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

Surrogate Recoveries: Recoveries must lie between 50-150% - Phenols 20-130%.

QC Data General Comments

- 1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
- 2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
- 3. Organochlorine Pesticide analysis where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
- 4. Organochlorine Pesticide analysis where reporting Spike data. Toxaphene is not added to the Spike.
- Total Recoverable Hydrocarbons where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported
 in the C10-C14 cell of the Report.
- 6. pH and Free Chlorine analysed in the laboratory Analysis on this test must begin within 30 minutes of sampling. Therefore laboratory analysis is unlikely to be completed within holding time.

 Analysis will begin as soon as possible after sample receipt.
- 7. Recovery Data (Spikes & Surrogates) where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
- 8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
- 9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
- 10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Report Number: 488191-S



Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery									
Chromium Suite									
Chromium Reducible Sulfur			%	103			70-130	Pass	
Acid Neutralising Capacity (ANCbt)			%	98			70-130	Pass	
Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	M16-Fe06067	CP	%	2.1	2.1	1.0	30%	Pass	
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	M16-Fe06070	CP	pH Units	6.7	6.7	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	M16-Fe06070	CP	mol H+/t	< 2	< 2	<1	30%	Pass	
sulfidic - TAA equiv. S% pyrite	M16-Fe06070	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	M16-Fe06070	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	M16-Fe06070	СР	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCI Extractable	M16-Fe06070	CP	% S	n/a	n/a	n/a	30%	Pass	
HCI Extractable Sulfur	M16-Fe06070	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	M16-Fe06070	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	M16-Fe06070	СР	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	M16-Fe06070	СР	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	M16-Fe06070	CP	%CaCO3	0.14	0.14	<1	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	M16-Fe06070	СР	% S	0.04	0.04	<1	30%	Pass	
ANC Fineness Factor	M16-Fe06070	CP	factor	1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	M16-Fe06070	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (Acidity Units)	M16-Fe06070	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming Rate	M16-Fe06070	СР	kg CaCO3/t	< 1	< 1	<1	30%	Pass	



Comments

Sample Integrity

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

Qualifier Codes/Comments

Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'

S01

S02 Retained Acidity is Reported when the pHKCl is less than pH 4.5

S03 Acid Neutralising Capacity is only required if the pHKCI if greater than or equal to pH 6.5 S04 Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised By

Natalie Krasselt Analytical Services Manager Bryan Wilson Senior Analyst-Metal (QLD) Richard Corner Senior Analyst-Inorganic (QLD)



Glenn Jackson

National Operations Manager

Final report - this Report replaces any previously issued Report

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

Uncertainty data is available on request

Eurofins | mgt shall not be liable for loss, cost, damages or expenses incurred by the client, or any other person or company, resulting from the use of any information or interpretation given in this report. In no case shall Eurofins | mgt be liable for consequential damages including, but not limited to, lost profits, damages for failure to meet deadlines and lost production arising from this report. This document shall not be reproduced except in full and relates only to the items tested. Unless indicated otherwise, the tests were performed on the samples as received.

Report Number: 488191-S



Galt Environment P/L 2/39 Flynn St Wembley WA 6014





Certificate of Analysis

NATA Accredited Accreditation Number 1261 Site Number 1254

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: Michael Carmichael

Report488191-WProject nameDALYELLUPProject IDJ1601005Received DateFeb 08, 2016

Client Sample ID			MW01	MW02	MW03	QC1	
Sample Matrix			Water	Water	Water	Water	
Eurofins mgt Sample No.			M16-Fe06063	M16-Fe06064	M16-Fe06065	M16-Fe06066	
Date Sampled			Feb 04, 2016	Feb 04, 2016	Feb 04, 2016	Feb 04, 2016	
Test/Reference	LOR	Unit					
Acidity (as CaCO3)	10	mg/L	< 10	10	< 10	12	
Ammonia (as N)	0.01	mg/L	0.53	0.02	0.21	< 0.01	
Chloride	1	mg/L	230	130	96	130	
Conductivity (at 25°C)	1	uS/cm	1400	1200	850	1200	
Nitrate & Nitrite (as N)	0.05	mg/L	< 0.05	3.8	< 0.05	3.6	
рН	0.1	pH Units	8.1	8.3	8.4	8.3	
Phosphate total (as P)	0.05	mg/L	0.14	< 0.05	< 0.05	< 0.05	
Phosphorus filterable reactive (as P)	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	
Sulphate (as S)	5	mg/L	19	27	16	27	
Total Dissolved Solids	10	mg/L	770	740	480	700	
Total Kjeldahl Nitrogen (as N)	0.2	mg/L	2.2	< 0.2	0.7	0.2	
Total Nitrogen (as N)	0.2	mg/L	2.2	3.8	0.7	3.8	
Alkalinity (speciated)							
Total Alkalinity (as CaCO3)	20	mg/L	340	380	250	380	
Heavy Metals							
Aluminium	0.05	mg/L	1.5	0.25	1.2	0.14	
Aluminium (filtered)	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	
Arsenic (filtered)	0.001	mg/L	0.033	0.003	0.033	0.003	
Cadmium (filtered)	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	
Chromium (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	
Iron	0.05	mg/L	14	0.89	2.0	0.65	
Iron (filtered)	0.05	mg/L	12	0.57	1.4	0.53	
Manganese (filtered)	0.005	mg/L	0.067	0.020	0.024	0.019	
Nickel (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	
Selenium (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	
Zinc (fi l tered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	
Alkali Metals							
Sodium	0.5	mg/L	170	99	76	99	



Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

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

Description	Testing Site	Extracted	Holding Time
ASS Groundwater Quality Suite - WA Department of Environment and Conservation	n		
Acidity (as CaCO3)	Melbourne	Feb 08, 2016	14 Day
- Method: APHA 2310 Acidity			
Ammonia (as N)	Melbourne	Feb 09, 2016	28 Day
- Method: APHA 4500-NH3 Ammonia Nitrogen by FIA			
Chloride	Melbourne	Feb 09, 2016	28 Day
- Method: MGT 1100A			
Conductivity (at 25°C)	Melbourne	Feb 08, 2016	28 Day
- Method: LTM-INO-4030			
pH	Melbourne	Feb 08, 2016	0 Hours
- Method: LTM-GEN-7090 pH in water by ISE			
Phosphate total (as P)	Melbourne	Feb 08, 2016	28 Day
- Method: APHA 4500-P E. Phosphorous			
Phosphorus filterable reactive (as P)	Melbourne	Feb 09, 2016	2 Day
- Method: APHA 4500-P Phosphate (filterable reactive)			
Sulphate (as S)	Melbourne	Feb 09, 2016	28 Day
- Method: In house MGT1110A (SO4 by Discrete Analyser)			
Total Dissolved Solids	Melbourne	Feb 08, 2016	7 Day
- Method: APHA 2540C Total Dissolved Solids			
Alkalinity (speciated)	Melbourne	Feb 08, 2016	14 Day
- Method: APHA 2320 Alkalinity by Titration			
Heavy Metals	Melbourne	Feb 10, 2016	180 Day
- Method: LTM-MET-3040 Metals in Waters by ICP-MS			
Acid Sulphate Metals : Metals M9 filtered	Melbourne	Feb 10, 2016	180 Day
- Method: LTM-MET-3040 Metals in Waters by ICP-MS			
Alkali Metals	Melbourne	Feb 08, 2016	180 Day
- Method: USEPA 6010 Alkali Metals			
Total Nitrogen Set (as N)			
Nitrate & Nitrite (as N)	Melbourne	Feb 09, 2016	28 Day
- Method: APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA			
Total Kjeldahl Nitrogen (as N)	Melbourne	Feb 09, 2016	7 Day
- Method: APHA 4500 TKN			

Report Number: 488191-W

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Order No.: Report #: Phone: Fax:

Galt Environment P/L

Company Name:

Address:

2/39 Flynn St

DALYELLUP

Project Name:

Project ID:

11601005

WA 6014

Wembley

Priority: Contact Name:

Feb 8, 2016 8:37 AM

Received:

Due:

Michael Carmichael

Feb 15, 2016 5 Day

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail

Moisture Set

Chromium Suite

ASS Groundwater Quality Suite - WA Department of Environment and

×

Sydney Laboratory - NATA Site # 18217

Brisbane Laboratory - NATA Site # 20794

Melbourne Laboratory - NATA Site # 1254 & 14271

Laboratory where analysis is conducted

Sample Date

External Laboratory Sample ID

Sampling Time

Water Feb 04, 2016

Feb 04, 2016

Feb 04, 2016

MW02 MW03

MW01

Water Water Water Soil Soil Soil Feb 04, 2016 Feb 04, 2016 Feb 04, 2016 Feb 04, 2016

× × × × ×

> M16-Fe06068 M16-Fe06069

M16-Fe06065

M16-Fe06066 M16-Fe06067

M16-Fe06063 M16-Fe06064

LAB ID

Matrix

M16-Fe06070

Soil

Feb 04, 2016 Feb 04, 2016

BH25/0.0

BH22/2.25 BH23/1.25 BH24/1.5

BH21/3.5

OC1

M16-Fe06071

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Received: Due:

J1601005 488191

Order No.: Report #: Phone: Fax:

Galt Environment P/L

Company Name:

Address:

2/39 Flynn St

DALYELLUP

Project Name: Project ID:

11601005

WA 6014

Wembley

Feb 8, 2016 8:37 AM

Michael Carmichael Feb 15, 2016 5 Day Priority: Contact Name:

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail

Moisture Set Chromium Suite

ASS Groundwater Quality Suite - WA Department of Environment and

Melbourne Laboratory - NATA Site # 1254 & 14271

Laboratory where analysis is conducted

Brisbane Laboratory - NATA Site # 20794

Sydney Laboratory - NATA Site # 18217

M16-Fe06072

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×

M16-Fe06073

Soil Soil Soil Soil Soil Soil

> Feb 04, 2016 Feb 04, 2016 Feb 04, 2016 Feb 04, 2016

Feb 04, 2016

BH26/0.75

HA01/1.0

HA02/0.0

HA01/0.0

External Laboratory

× ×

×

M16-Fe06074

M16-Fe06077 M16-Fe06075 M16-Fe06076

Feb 04, 2016

HA02/1.25 HA03/0.25 Feb 04, 2016

HA03/1.0

× M16-Fe06078

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Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

NTU: Nephelometric Turbidity Units

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

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

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

Units

 mg/kg: milligrams per Kilogram
 mg/l: milligrams per litre

 ug/l: micrograms per litre
 ppm: Parts per million

 ppb: Parts per billion
 %: Percentage

org/100ml: Organisms per 100 millilitres

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

Terms

Dry Where a moisture has been determined on a solid sample the result is expressed on a dry basis.

LOR Limit of Reporting.

SPIKE Addition of the analyte to the sample and reported as percentage recovery.

RPD Relative Percent Difference between two Duplicate pieces of analysis.

LCS Laboratory Control Sample - reported as percent recovery
CRM Certified Reference Material - reported as percent recovery

Method Blank In the case of solid samples these are performed on laboratory certified clean sands.

In the case of water samples these are performed on de-ionised water.

Surr - Surrogate The addition of a like compound to the analyte target and reported as percentage recovery.

Duplicate A second piece of analysis from the same sample and reported in the same units as the result to show comparison.

Batch Duplicate A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.

Batch SPIKE Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.

USEPA United States Environmental Protection Agency

APHA American Public Health Association

ASLP Australian Standard Leaching Procedure (AS4439.3)

TCLP Toxicity Characteristic Leaching Procedure

COC Chain of Custody

SRA Sample Receipt Advice

CP Client Parent - QC was performed on samples pertaining to this report

NCP Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within

TEQ Toxic Equivalency Quotient

QC - Acceptance Criteria

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

Results <10 times the LOR : No Limit

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

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

Surrogate Recoveries: Recoveries must lie between 50-150% - Phenols 20-130%.

QC Data General Comments

- 1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
- 2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
- 3. Organochlorine Pesticide analysis where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
- 4. Organochlorine Pesticide analysis where reporting Spike data. Toxaphene is not added to the Spike.
- Total Recoverable Hydrocarbons where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported
 in the C10-C14 cell of the Report.
- 6. pH and Free Chlorine analysed in the laboratory Analysis on this test must begin within 30 minutes of sampling. Therefore laboratory analysis is unlikely to be completed within holding time.

 Analysis will begin as soon as possible after sample receipt.
- 7. Recovery Data (Spikes & Surrogates) where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
- 8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
- 9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
- 10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Report Number: 488191-W



Quality Control Results

Test	Units	Result 1	Acceptance Limits	Pass Limits	Qualifying Code
Method Blank					
Acidity (as CaCO3)	mg/L	< 10	10	Pass	
Ammonia (as N)	mg/L	< 0.01	0.01	Pass	
Chloride	mg/L	< 1	1	Pass	
Nitrate & Nitrite (as N)	mg/L	< 0.05	0.05	Pass	
Phosphate total (as P)	mg/L	< 0.05	0.05	Pass	
Phosphorus filterable reactive (as P)	mg/L	< 0.05	0.05	Pass	
Sulphate (as S)	mg/L	< 5	5	Pass	
Total Dissolved Solids	mg/L	< 10	10	Pass	
Total Kjeldahl Nitrogen (as N)	mg/L	< 0.2	0.2	Pass	
Method Blank			·		
Alkalinity (speciated)					
Total Alkalinity (as CaCO3)	mg/L	< 20	20	Pass	
Method Blank		'			
Heavy Metals					
Aluminium	mg/L	< 0.05	0.05	Pass	
Aluminium (filtered)	mg/L	< 0.05	0.05	Pass	
Arsenic (filtered)	mg/L	< 0.001	0.001	Pass	
Cadmium (filtered)	mg/L	< 0.0002	0.0002	Pass	
Chromium (filtered)	mg/L	< 0.0002	0.001	Pass	
Iron	mg/L	< 0.05	0.05	Pass	
Iron (filtered)	mg/L	< 0.05	0.05	Pass	
, , , , , , , , , , , , , , , , , , ,		< 0.005	0.005	Pass	
Manganese (filtered)	mg/L				
Nickel (filtered)	mg/L	< 0.001	0.001	Pass	
Selenium (filtered)	mg/L	< 0.001	0.001	Pass	
Zinc (filtered)	mg/L	< 0.001	0.001	Pass	
Method Blank					
Alkali Metals		.05			
Sodium	mg/L	< 0.5	0.5	Pass	
LCS - % Recovery		105			
Acidity (as CaCO3)	%	105	70-130	Pass	
Ammonia (as N)	%	91	70-130	Pass	
Chloride	%	106	70-130	Pass	
Nitrate & Nitrite (as N)	%	94	70-130	Pass	
Phosphate total (as P)	%	87	70-130	Pass	
Sulphate (as S)	%	99	70-130	Pass	
Total Kjeldahl Nitrogen (as N)	%	106	70-130	Pass	
LCS - % Recovery					
Alkalinity (speciated)					
Total Alkalinity (as CaCO3)	%	94	70-130	Pass	
LCS - % Recovery					
Heavy Metals					
Aluminium	%	91	80-120	Pass	
Aluminium (filtered)	%	91	80-120	Pass	
Arsenic (filtered)	%	94	80-120	Pass	
Cadmium (filtered)	%	95	80-120	Pass	
Chromium (filtered)	%	90	80-120	Pass	
Iron	%	88	80-120	Pass	
Iron (filtered)	%	88	80-120	Pass	
Manganese (filtered)	%	90	80-120	Pass	
Nickel (filtered)	%	89	80-120	Pass	
Selenium (filtered)	%	98	80-120	Pass	



Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Zinc (filtered)			%	91			80-120	Pass	Oode
LCS - % Recovery			70				1 00 120	1 400	
Alkali Metals							I		
Sodium			%	89			70-130	Pass	
Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
				Result 1					
Ammonia (as N)	M16-Fe05956	NCP	%	95			70-130	Pass	
Nitrate & Nitrite (as N)	M16-Fe05956	NCP	%	97			70-130	Pass	
Phosphate total (as P)	M16-Fe07227	NCP	%	100			70-130	Pass	
Total Kjeldahl Nitrogen (as N)	S16-Fe07568	NCP	%	107			70-130	Pass	
Spike - % Recovery									
Alkalinity (speciated)				Result 1					
Total Alkalinity (as CaCO3)	M16-Fe05992	NCP	%	86			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic (filtered)	M16-Fe06063	СР	%	84			70-130	Pass	
Cadmium (filtered)	M16-Fe06063	СР	%	89			70-130	Pass	
Chromium (filtered)	M16-Fe06063	СР	%	86			70-130	Pass	
Manganese (filtered)	M16-Fe07642	NCP	%	88			70-130	Pass	
Nickel (filtered)	M16-Fe06063	СР	%	82			70-130	Pass	
Selenium (filtered)	M16-Fe06063	СР	%	89			70-130	Pass	
Zinc (filtered)	M16-Fe06063	СР	%	87			70-130	Pass	
Spike - % Recovery							<u>'</u>		
Alkali Metals				Result 1					
Sodium	M16-Fe05758	NCP	%	106			70-130	Pass	
Spike - % Recovery							<u>'</u>		
Heavy Metals				Result 1					
Iron (filtered)	M16-Fe07642	NCP	%	87			70-130	Pass	
Spike - % Recovery	111101001012	1101	70				10 100	1 400	
- The state of the				Result 1			I		
Chloride	M16-Fe06065	СР	%	100			70-130	Pass	
Phosphorus filterable reactive (as P)	M16-Fe06065	CP	%	98			70-130	Pass	
Sulphate (as S)	M16-Fe06065	CP	%	102			70-130	Pass	
Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate		,							
				Result 1	Result 2	RPD			
Acidity (as CaCO3)	M16-Fe06063	СР	mg/L	< 10	< 10	<1	30%	Pass	
Ammonia (as N)	M16-Fe05956	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Conductivity (at 25°C)	M16-Fe06063	СР	uS/cm	1400	1400	<1	30%	Pass	
Nitrate & Nitrite (as N)	M16-Fe05956	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
pH	M16-Fe06063	СР	pH Units	8.1	8.2	pass	30%	Pass	
Phosphate total (as P)	M16-Fe07227	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Total Dissolved Solids	M16-Fe06059	NCP	mg/L	3300	3300	2.0	30%	Pass	
Total Kjeldahl Nitrogen (as N)	S16-Fe07568	NCP	mg/L	2.3	1.8	26	30%	Pass	
Duplicate									
Alkalinity (speciated)				Result 1	Result 2	RPD			
Total Alkalinity (as CaCO3)	M16-Fe06063	СР	mg/L	340	340	<1	30%	Pass	



Duplicate				I					
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	M16-Fe06057	NCP	mg/L	3.6	4.3	19	30%	Pass	
Aluminium (filtered)	M16-Fe06063	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Arsenic (filtered)	M16-Fe06063	CP	mg/L	0.033	0.030	8.0	30%	Pass	
Cadmium (filtered)	M16-Fe06063	CP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium (filtered)	M16-Fe06063	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Iron	M16-Fe10561	NCP	mg/L	19	20	7.0	30%	Pass	
Iron (filtered)	M16-Fe06063	СР	mg/L	12	12	2.0	30%	Pass	
Manganese (filtered)	M16-Fe06063	СР	mg/L	0.067	0.061	9.0	30%	Pass	
Nickel (filtered)	M16-Fe06063	СР	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Selenium (filtered)	M16-Fe06063	СР	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc (filtered)	M16-Fe06063	СР	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Duplicate									
Alkali Metals				Result 1	Result 2	RPD			
Sodium	M16-Fe05758	NCP	mg/L	880	910	3.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Chloride	M16-Fe06065	СР	mg/L	96	95	1.6	30%	Pass	
Phosphorus filterable reactive (as P)	M16-Fe06065	СР	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Sulphate (as S)	M16-Fe06065	СР	mg/L	16	16	3.0	30%	Pass	



Comments

Sample Integrity

Custody Seals Intact (if used)N/AAttempt to Chill was evidentYesSample correctly preservedYesAppropriate sample containers have been usedYesSample containers for volatile analysis received with minimal headspaceYesSamples received within HoldingTimeYesSome samples have been subcontractedNo

Authorised By

 Natalie Krasselt
 Analytical Services Manager

 Emily Rosenberg
 Senior Analyst-Metal (VIC)

 Huong Le
 Senior Analyst-Inorganic (VIC)



Glenn Jackson

National Operations Manager

Final report - this Report replaces any previously issued Report

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

Uncertainty data is available on request

Eurofine, Impt shall not be liable for loss, cost, damages or expenses incurred by the client, or any other person or company, resulting from the use of any information or interpretation given in this report, In no case shall Eurofine; Impt be liable for consequential damages including, but not limited to, lost profits, damages for refaure to meet deadines and lost production arising from this propri. This document shall not be expreduted except in full and refates only to the times tested, Utilises indicated otherwise, the tests were, the tests were similar and the times, the tests were similar and the times, the tests were similar and the times, the tests were similar and the times test.

Report Number: 488191-W



Appendix H: Understanding Your Report



UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev2

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- ♦□ the project objectives as we understood them and as described in this report;
- ♣□ the specific site mentioned in this report; and
- ❖□ the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- ♦ the report was not written for you;
- **∲** the report was not written for the site specific to your development;
- the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- ♦ the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.



SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

5. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

7. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

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Appendix Five: Local Water Management Plan

Proporodomron

Greenpatch, Dalyellup



M□□2017□





DISCLAIMER

and subject to an agreement between JDA Consultant Hydrologists ("JDA") and the
client for whom it has been prepared ("Client"), and in the control of the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and in the client for whom it has been prepared ("Client"), and it is the client for whom it has been prepared ("Client"), and it is the client for whom it has been prepared ("Client"), and it is the client for whom
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	Name	Signature	Date
Author	Alexi Rogers I/I Gregorio Serafini	DRG .	24 May 2017
Checked by:	Jim (Davies)	J. R. Doves	24 May 2017
Approved by	Jim (Davies)	A.R. Daves	24 May 2017

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EXECUTIVE SUMMARY

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TABLE 1: SUMMARY OF LOCAL WATER MANAGEMENT STRATEGY

Principle	Key LWMS Elements
Water Quantity One of the contract of the con	Modern and a series of the series of th
Water Quality III	commod and a Darid and and and and and and and and and an
Water Conservation	
Economic Viability III COIII p III COIII	
Public Health	
Protection of Property	dominional 00 raRamed moral raminada Dominional compositionada compositi
Social Values	•
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APPENDICES

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1. INTRODUCTION

Background 1.1

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1.2 **Statutory Framework**

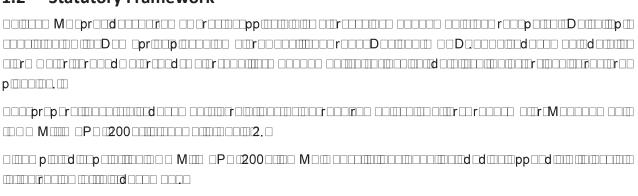


TABLE 2: INTEGRATED PLANNING AND URBAN WATER MANAGEMENT

Planning Phase	Planning Document	Urban Water Management Document and Status
		Dalla parametric configuration management only for Greenpatch
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	FUTURE PREPARATION	FUTURE PREPARATION



1.3 Key Design Principles and Objectives

1.3.1 Groundwater Management

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1.3.2 Flood Management

1.3.3 Water Quality Management

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2. OBJECTIVES AND CRITERIA

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2.1 Dalyellup Beach Estate Water Management Plan (JDA, 2010)

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2.2 National Water Quality Management Strategy

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the nation's water bodies and the need to manage them in an environmentally sustainable way. The
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2.2.1 Australian & New Zealand Guidelines for Fresh and Marine Water Quality

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2.2.2 Australian Guidelines for Urban Stormwater Management

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2.2.3 Australian Guidelines for Water Quality Monitoring and Reporting

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2.3 Stormwater Management Manual for Western Australia (DoW, 2004-2007)

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in Western Australia in 1998 to define and describe in practical terms Best Management Practices (BMP's)
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also relied only on the use of "in transit" and "end of pipe" stormwater treatment rather than adopting a
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■ Water Quantity III

• ■ Water Conservation ■

• □ Ecosystem Health Ⅲ

• □ Economic Viability □

■ Public Health ■

• □ Protection of Property □

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■ Social Values

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■ Development □

2.4 Better Urban Water Management (WAPC, 2008)

2.5 SWCC Natural Resource Management Strategy

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2.6 Local Government Guidelines for Subdivisional Development (IPWEA, 2009)

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2.7 Water Resource Considerations when Controlling Groundwater Levels in Urban Development (DoW, 2013)



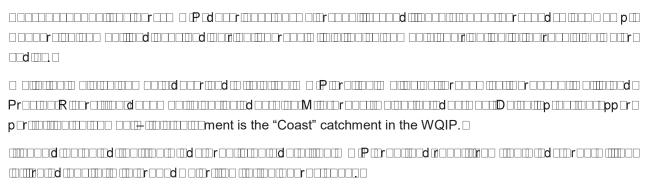
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2.8 Guidelines for Soil Filter Media in Bioretention systems; Stormwater Biofiltration Systems (FAWB, 2008 & 2009)

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2.9 Vegetation guidelines for Stormwater Biofilters in the south-west of Western Australia (Monash, 2014)

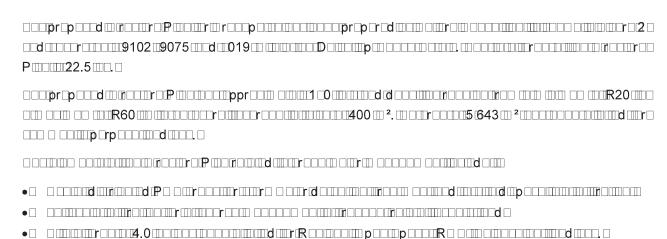
2.10 Leschenault Estuary Water Quality Improvement Plan (DoW, 2012)



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3. PROPOSED DEVELOPMENT







4. EXISTING ENVIRONMENT

4.1 Location & Land-use

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4.2 **Topography**

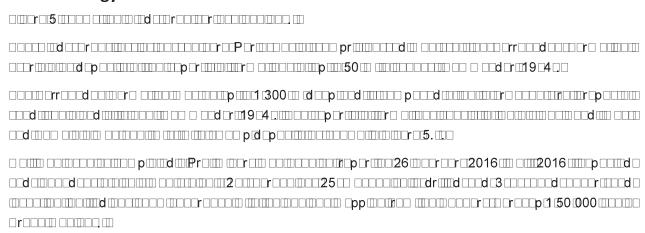
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4.3 Climate

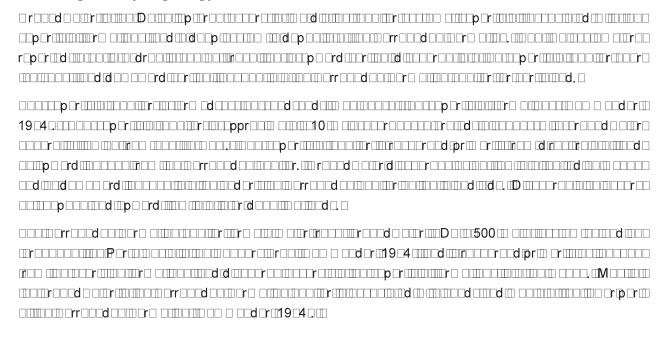
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4.4 Geology

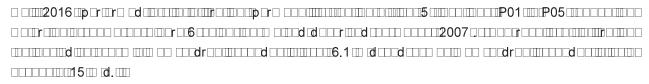


4.5 Hydrogeology

4.5.1 Regional Hydrogeology



4.5.2 Local Hydrogeology





4.6 Groundwater

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4.6.1 Assessment of Groundwater Level Data

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Figure 8 Centre Study Area

Figure 9 Northern Boundary

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Figure 10 Eastern Boundary

4.6.2 Impact of Urbanisation

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4.6.3 Groundwater Quality

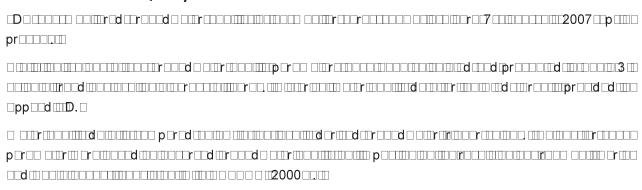


TABLE 3: GROUNDWATER QUALITY DATA SUMMARY

Parameter	Study Area Monitoring Results July 2007- April 2016							Guideline
and Unit	Mean	Median	Minimum	Maximum	90 th Percentile	10 th Percentile	No. of Samples	Value ²
рпп	7.2	7.2□	6.2□	□3□	7.6□	6.7□	94□	6.5Ⅲ.5□
	1620□	1610□	730□	3600□	2100□	1100□	200□	□1 Ⅲ00□
	1000□	995□	2□0□	1500□	1300□	700□	21 □□	□1 □300 □
	0.31 🗆	0.12□	0.02□	1.6□	0.□4□	0.04□	45□	0.55□
	0.29□	0.03□	□0.001□	1.4□	1.1□	0.01□	4□□	1.1□
	1,1□	0.57□	0.03□	7.1□	2.09□	0.2□	52□	Ш
	1.31□	0.9□	0.19□	□1□	2.24□	0.29□	57□	2.2□
	0.43□	0.6□	0.1□	0.□□	0.7□	0.1□	11□	Ш
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	0.06□	0.04□	0.01 🗆	0.3 🗆	0.14□	0.01□	5□□	0.05□
	9.35□	7.2□	0.01 🗆	69□	12.□□	0.73□	63□	0.5□
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	94.6□	97□	44□	250□	136□	4□2□	23□	Ш

Note: 1. Where parameter values are less than limit of detection, limit of detection used for calculation purposes.

^{2.} Guideline value based on local data where water quality of groundwater has been found to not impact on the receiving environment (North and South Lakes), JDA (2014).



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4.7 Acid Sulphate Soils

4.8 Surface Hydrology

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4.9 Wetlands





5. LOCAL WATER MANAGEMENT STRATEGY

5.1 **Proposed Water Management System**

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5.2 **Water Balance**

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TABLE 4: SIT	E WATER BALANCE						
Pre- Development		Use	Area (ha)	Quantity mm/yr		Total kl/yr	% (Approx)
Inputs	Rainfall		22.5	834		162,000	83
	Stormwater - External		5.04	667		33,600	17
					Input total	195,600	100
Outputs							
	Evapotranspiration	Native Vegetation	17.3	290		50,200	26
		Cleared Pasture	3.4	690		23,500	12
		WQ Treat Basin	0.5	900		4,500	2
	Superficial aquifer recharge					117,400	60
					Output total	195,600	100
					Balance	0	
Post Development		Use	Area (ha)	Quantity mm/yr		Total kl/yr	
Inputs	Rainfall		22.5	720		162,000	63
	Water supply - GW	POS				45,000	17
		Domestic	2.5	0.75		18,800	7
	Stormwater - External		5.04	667		33,600	13
					Input total	259,400	100
Outputs							
	Evapotranspiration	Residential	14.35	360		51,660	20

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Drainage

WQ Treat Basin

POS

ROS

Superficial aquifer

recharge



5.3 Water Sources & Sustainability Initiatives

Documposition within the development will be consistent with Water Corporation's "Waterwise" land

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5.3.1 Water Supply & Sewerage

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Residential Lot Water Supply

Residential Lot Sewerage Reticulation

5.3.2 Water Efficiency Measures



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The Water Corporation's Domestic Water Use Study (Loh & Coghlan, 2003) identified that through the use



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5.4 Groundwater Management

5.4.1 Design Groundwater Level

5.4.2 Separation to Groundwater

5.5 Stormwater Management

5.5.1 Stormwater Management System

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5.5.2 Catchment Details



TABLE 5: POST-DEVELOPMENT LOSS MODEL SETUP

Land-Use	Initial Loss	Proportional Loss	Continuing Loss		
	(mm)	(%)	(mm/hr)		
Residential Lots	15	-	10		
Road Reserves	1.5	20	-		
Basins	0	5	-		
Active POS	15	90	-		

5.5.3 Modelling Parameters

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5.5.4 Conceptual Stormwater System Design

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TABLE 6: POST-DEVELOPMENT LWMS CATCHMENT LAND USE BREAKDOWN

C-+-h+	Catchment Area (ha)						
Catchment ID	Infiltration Basin ID	Lots	Roads	Infiltration Basins	POS	ROS	Total
1	-	0.96	-	-	0.13	-	1.09
2	А	1.91	0.70	0.09	0.14	-	2.85
3	В	1.65	1.20	0.20	0.43	-	3.48
4	В	0.61	0.23	0.11	0.11	-	1.06
5	В	0.08	0.05	0.07	0.12	-	0.31
6	В	0.95	0.41	0.10	0.15	-	1.62
7	В	0.07	0.10	0.13	0.22	-	0.52
8	С	1.62	1.02	0.41	0.41	-	3.46
9	-	-	0.56	-	-	-	0.56
10	-	-	-	-	0.27	1.82	2.09
11	-	-	-	-	0.16	2.17	2.33
12	А	-	-	-	1.20	-	1.20
13	-	-	-	-	1.94	-	1.94
Greenpa	tch Total	7.85	4.27	1.10	5.28	3.99	22.5
ExtCatch1	В	14.35	4.45	-	-	-	18.8
ExtCatch2	В	1.89	0.59	-	-	-	2.48
External Cat	chment Total	16.24	5.04	-	-	-	21.28



TABLE 7: INFILTRATION BASIN DESIGN – MODELLING RESULTS

	Infiltration Basin ID →	А	В	С
	Contributing Catchment	2, 12	ExtCatch1, ExtCatch2, 3, 4, 5, 6 & 7	81
Basin Specifications	Base Area (m²)	240	3,200	350
	Top Area (m²)	895	6,000	4,109
Speci	Basin Invert (mAHD)	5.15	5.35	5
asin	Top Area Elevation (mAHD)	6.35	6.55	6.2
	Batter (1:x)	1:6	1:6	1:6
	DGL (mAHD)	4.65	4.85	4.5
	Critical Storm Duration (hrs)	1	1	6
	Max. Water Depth (m)	1.19	1.13	1.11
1%	Max. Water Level (mAHD)	6.34	6.48	6.11
AEP	Top Water Level Area (m²)	889	5,826	3,977
	Peak Flow Rate (m³/s)	0.81	7.5	0.271
	Fraction of Runoff Stored (%)	87	83	68
	Critical Storm Duration (hrs)	3	6	3
	Max. Water Depth (m)	0.84	0.76	0.62
20%	Max. Water Level (mAHD)	5.99	6.11	5.62
AEP	Top Water Level Area (m²)	660	4,926	688
	Peak Flow Rate (m³/s)	0.19	1.49	0.21
	Fraction of Runoff Stored (%)	78	65	52
	Critical Storm Duration (hrs)	1	24	1
63% AEP	Max. Water Depth (m)	0.14	0.23	0.25
	Max. Water Level (mAHD)	5.29	5.58	5.25
	Top Water Level Area (m²)	303	3,705	479
	Peak Flow Rate (m³/s)	0.09	0.22	0.16
	Fraction of Runoff Stored (%)	44	27	59



5.6 Water Quality Management

5.6.1 Design Approach

 $\verb| coopr | \verb| coopr | coopr | \verb| coopr | coopr | \verb| coopr | co$

5.6.2 Treatment Train

 $\verb| cocd cocp map coccorr mand (P a a a minor constant do a mand parameter a manda (P a a a minor constant do a minor parameter a manda (P a a a minor constant do a minor parameter a minor constant do minor constant do a minor constant do a minor constant do a mino$

Non-Structural Controls

STRUCTURAL CONTROLS

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- | minimum aproaded minimum and a columnia and a columnia production production and appear of a minimum and a minimum a

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5.6.3 Post-Development Nutrient Assessment

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regions have been specified to have 'Infiltration' as a second se

- Pound occupe councid accommend and an accommend pound accommend of accommend occupation and accommend occupation accommend occupation and accommend occupation accommen



6. IMPLEMENTATION

6.1 **Roles and Responsibilities**

occinid commonated fropecamination of recommon paid common paid and paradian distribution of the collection of t

TABLE 8: IMPLEMENTION RESPONSIBILITIES

	IMPLEMENTATION	RESPONSIBILITY		
LWMS Section	Action	Developer	Shire of Capel	
6.2□	Proporamental and control and proporation of the second control and	✓□		
6.3□		✓□		
6.4				
6.5□	MoomrwaProcros → PoodDoompo com	✓□		

Urban Water Management Plan

6.3 **Construction Management**

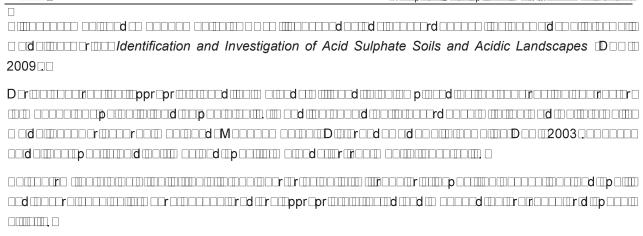
6.3.1 Dewatering

Docomación de la composição de la compos required to apply for and obtain a 5C 'Licence to Take Water' from DoW. III

6.3.2 Acid Sulphate Soils

Maca acaca with a color with a color with a color of the ppr Momo MP...





6.4 Maintenance Schedule

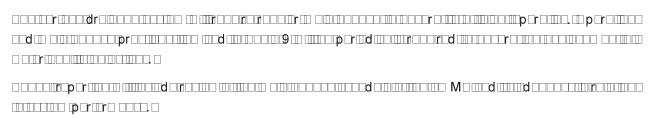


TABLE 9: MAINTENANCE SCHEDULE FOR WSUD INFRASTRUCTURE

	Maintenance Interval			
ltem	Monthly	Quarterly	Biannually	As required
Local Drainage				
Street sweeping		✓		
Education of sediment and rubbish in manholes			✓	
Education of sediment and rubbish in GPT's			✓	
Infiltration Systems and Swales				
Inspect for erosion			✓	
Mowing of grassed areas and removal of clippings.	✓			
Maintenance of vegetation. Remove dead vegetation				1
and replace where necessary.				,
Inspect for standing water 1 week after rainfall events.				✓
Remove excessive sediment build-up.				✓
Use of slow release/low P fertilisers in turf areas			✓	
Community Education Campaigns				
Leaflets Promoting Source Control Practices				✓

6.5 Monitoring Program

occu comrucipror occucionado cumo discussión accomunidad con comunidad pocumión pocumión de constante de cons
proposid do sompo com minimo mad amros. Im
Moouruou uuoperara ed upuu2 uucrapaapraamama puunauruoonuooura. a
mouranam portund occupe companionocumonocumono companior. ancopror o anamoperad accum
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6.6 Reporting & Contingency Mechanisms

6.6.1 Reporting

6.6.2 Contingency Mechanisms

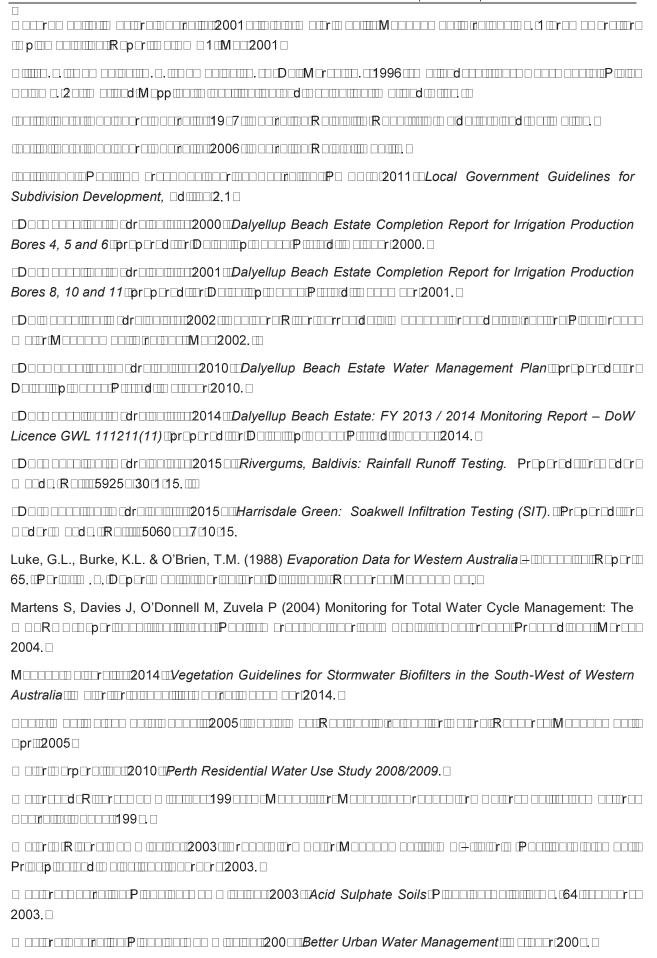
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7. REFERENCES





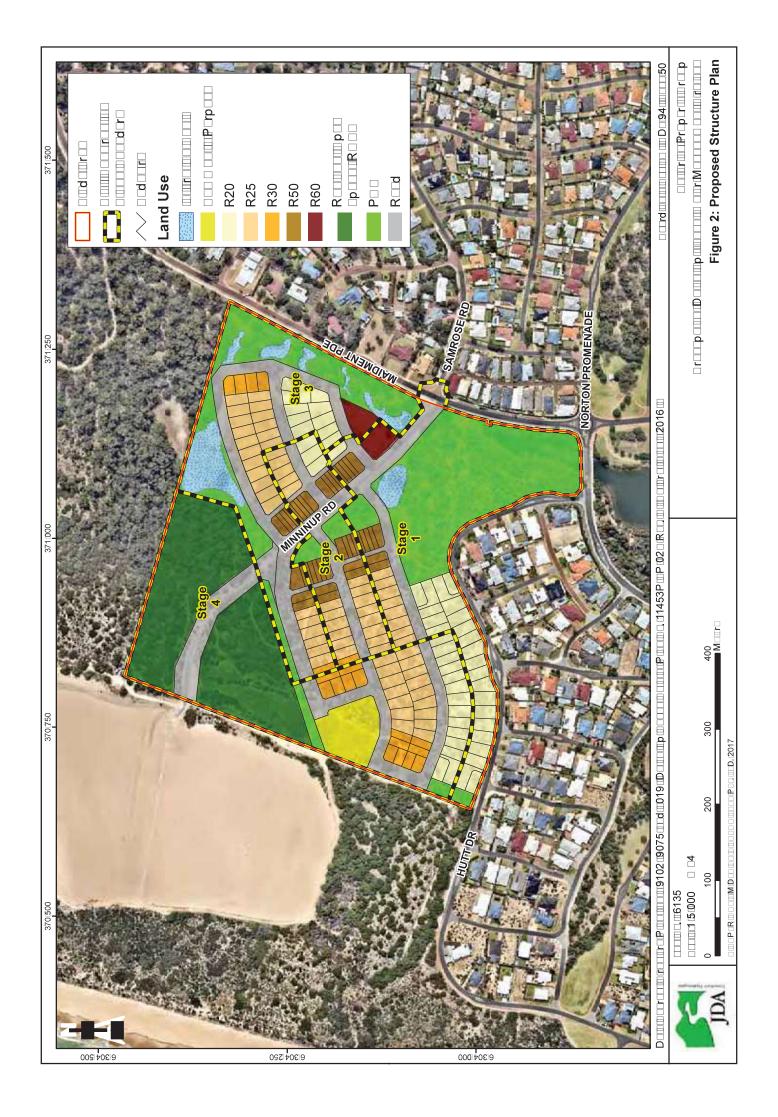


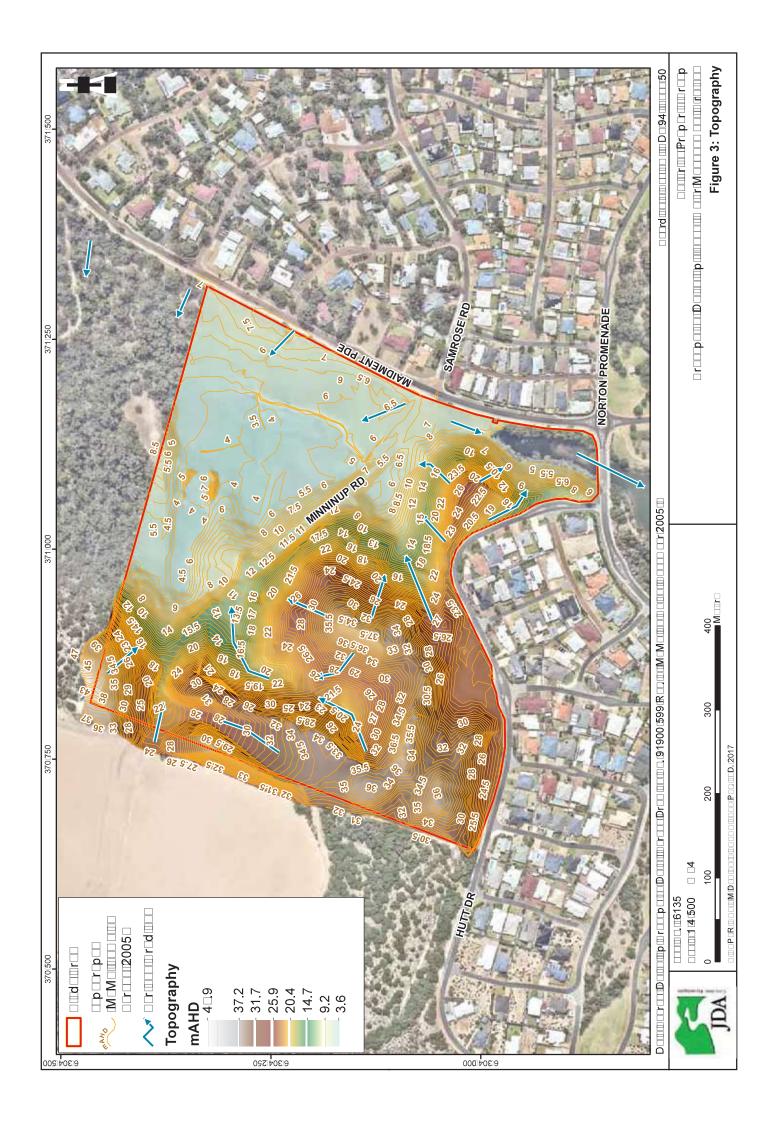


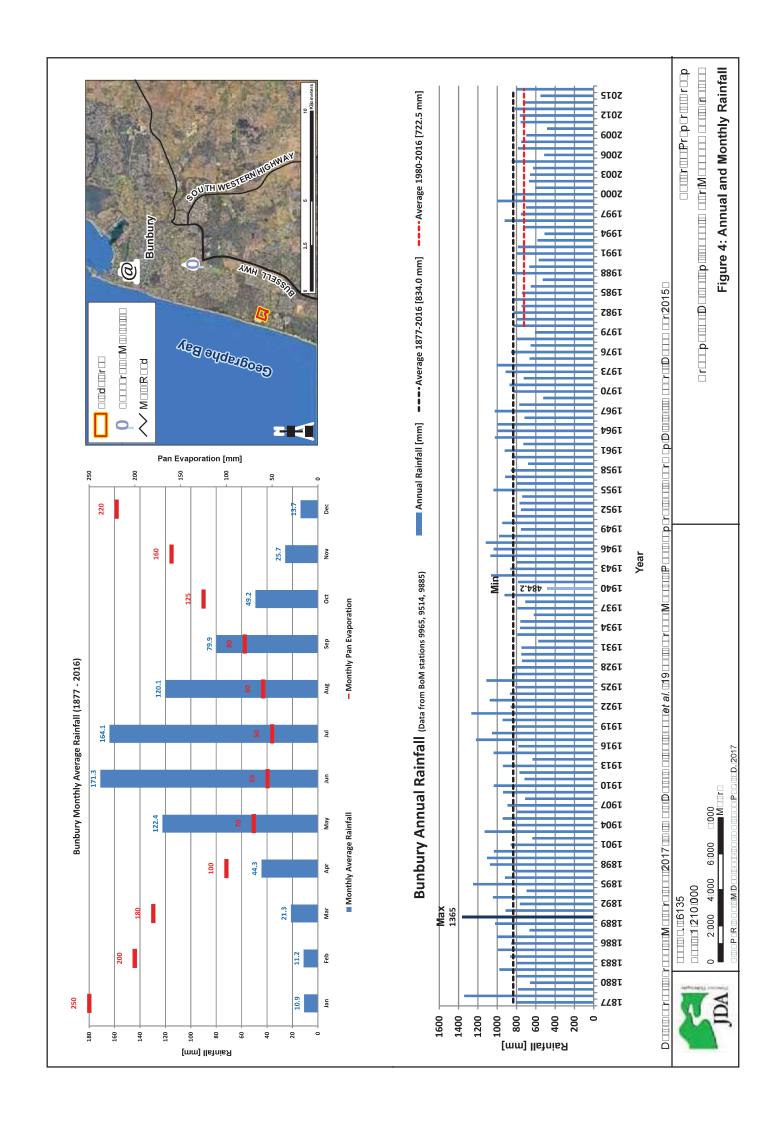
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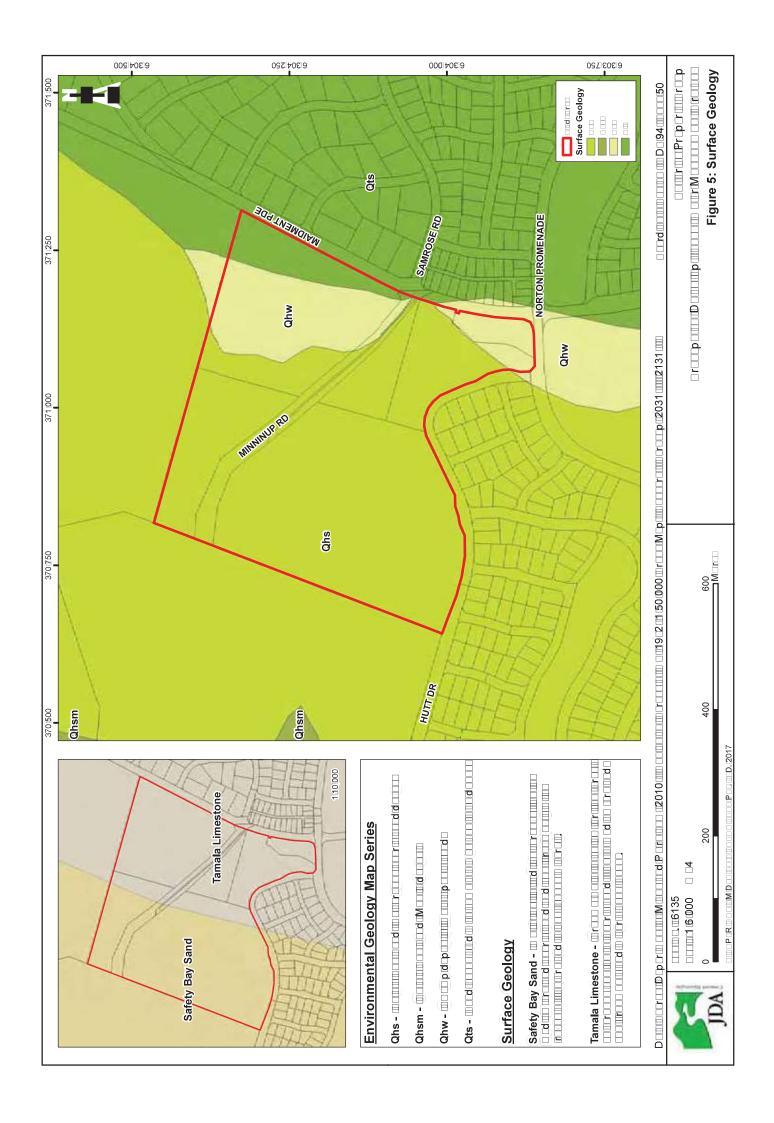
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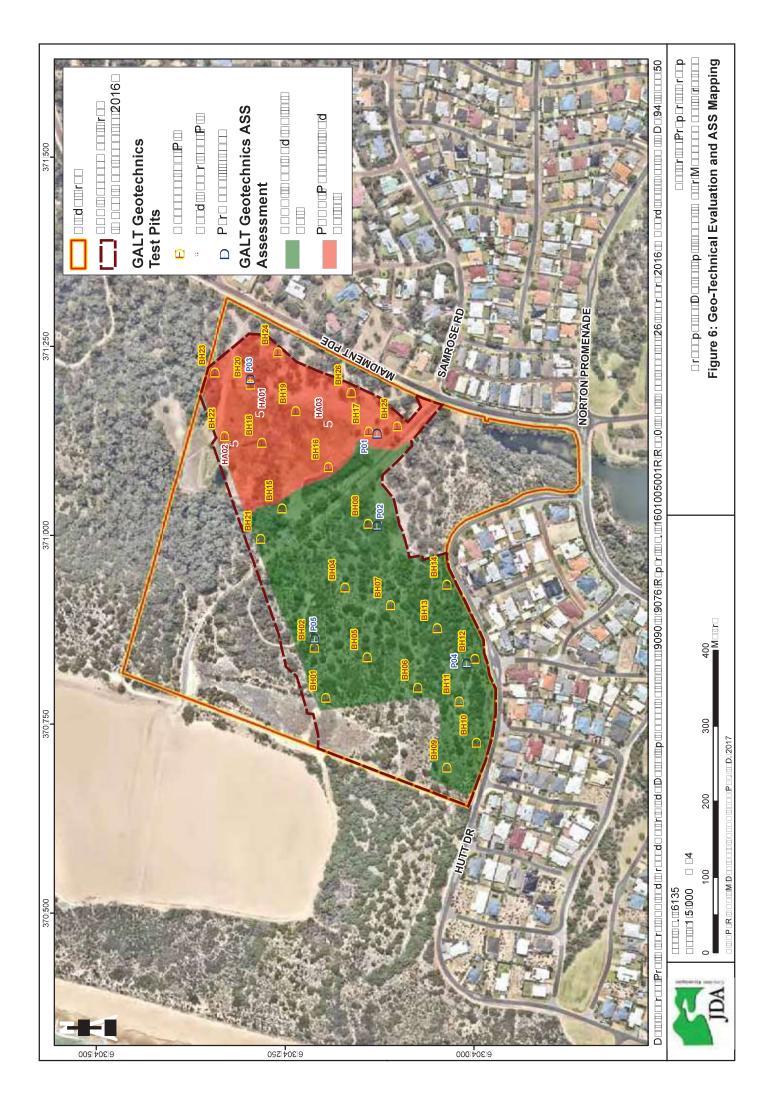


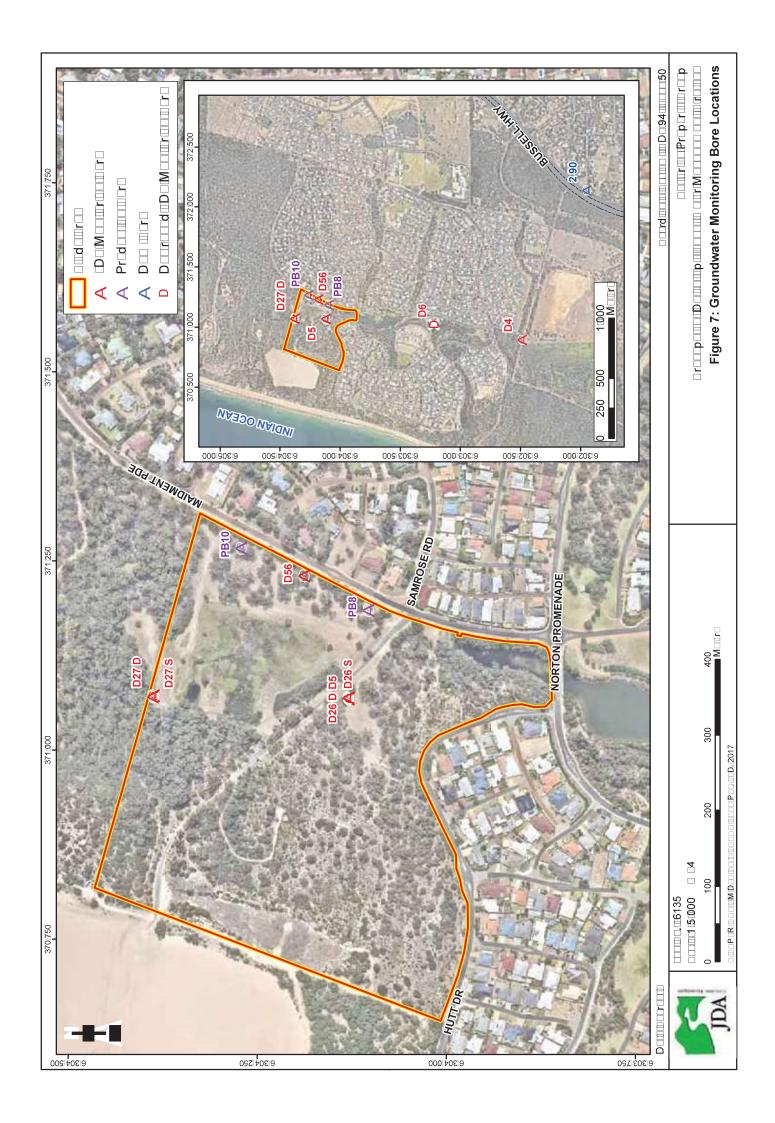


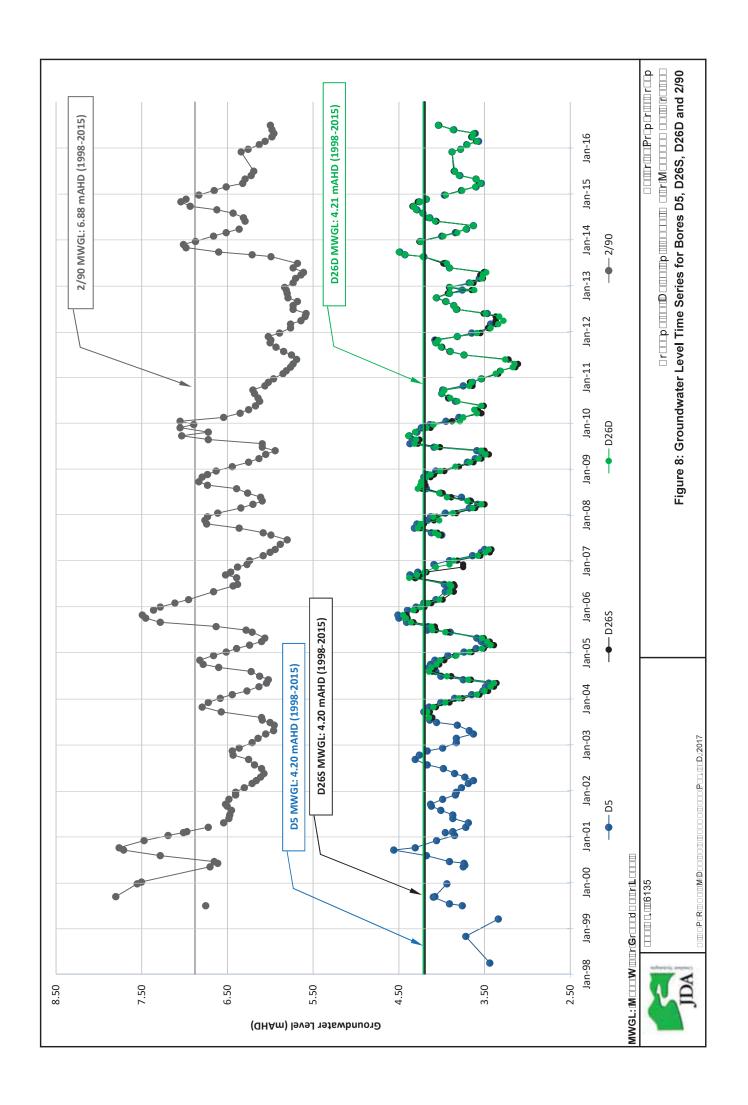


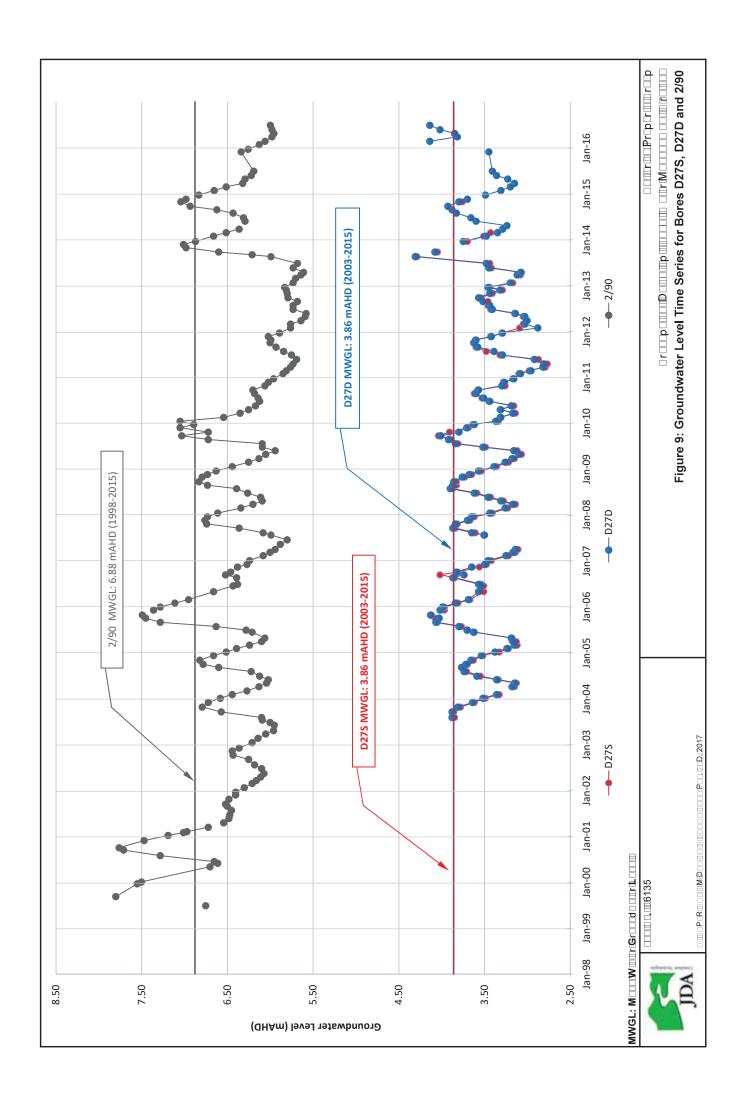


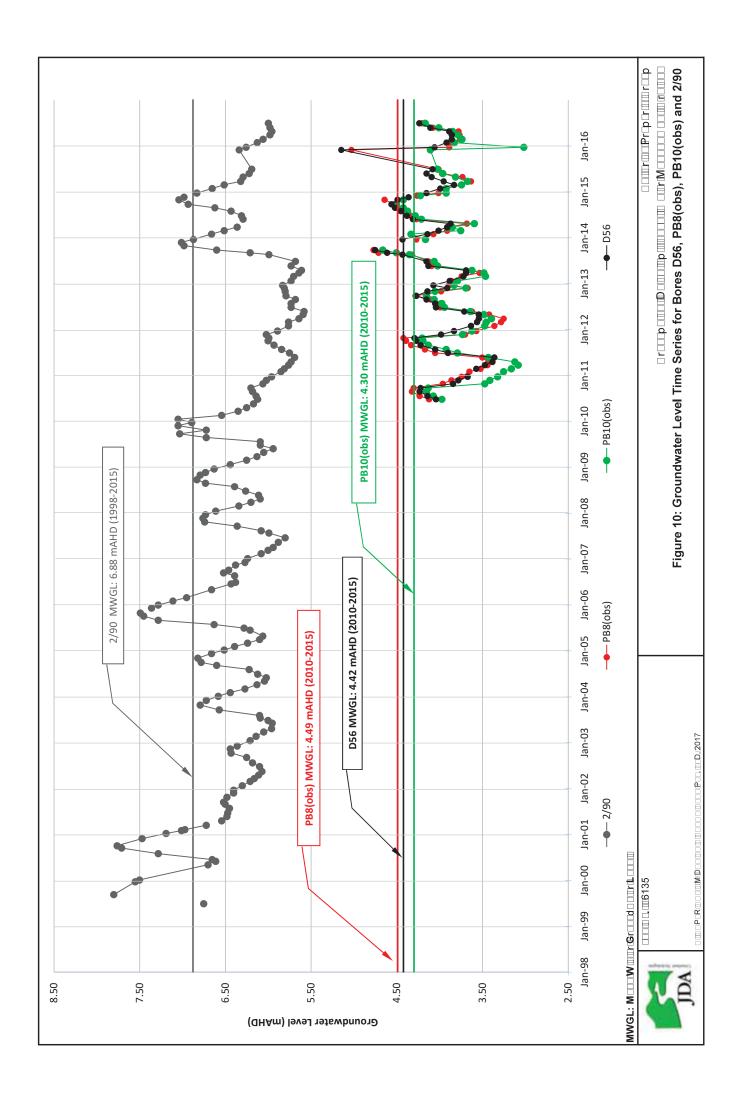


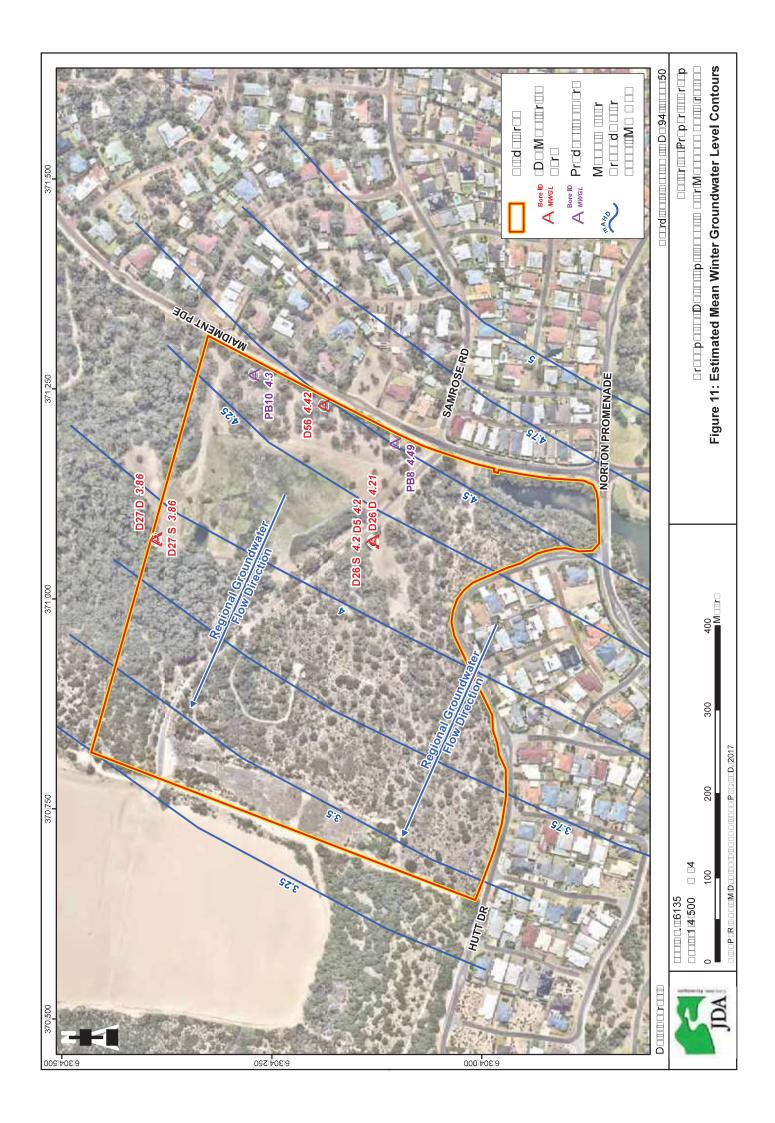


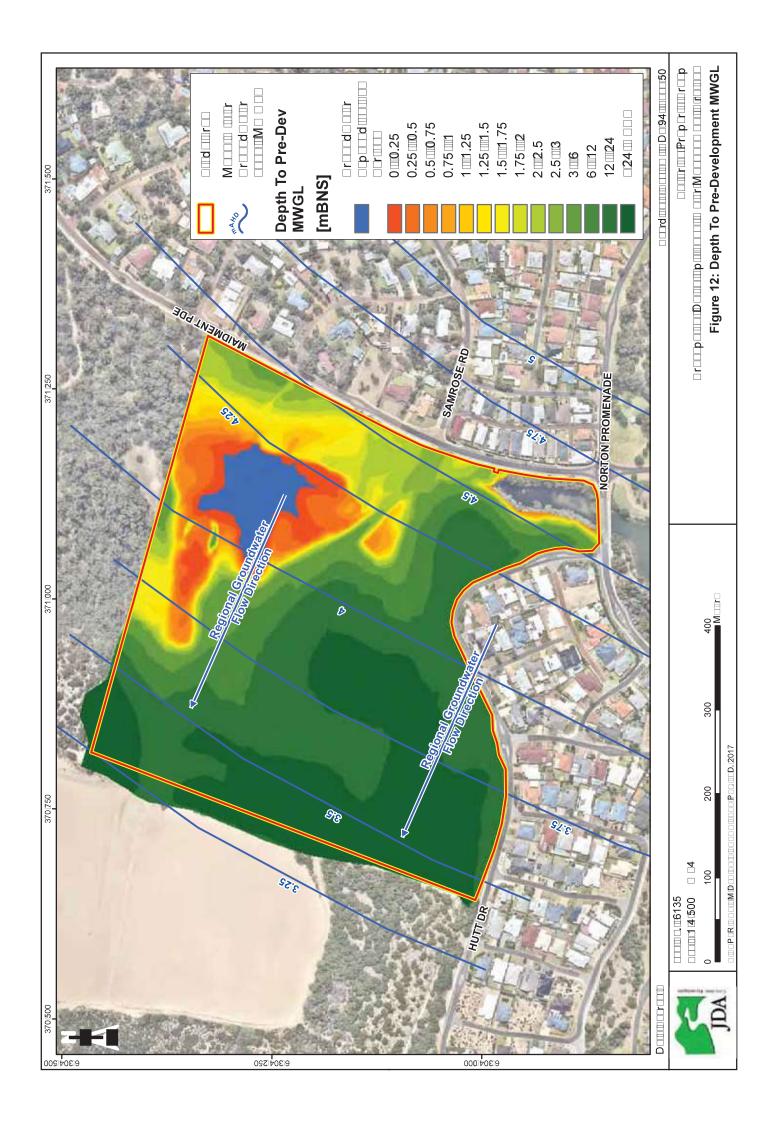


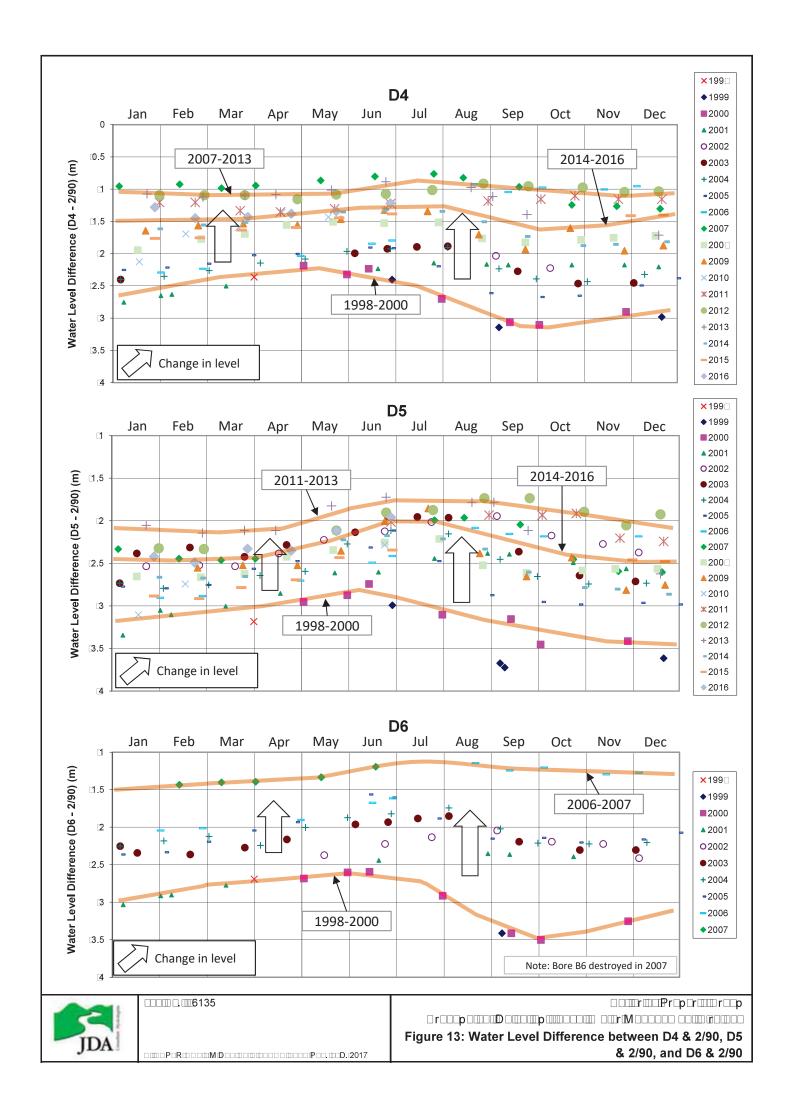


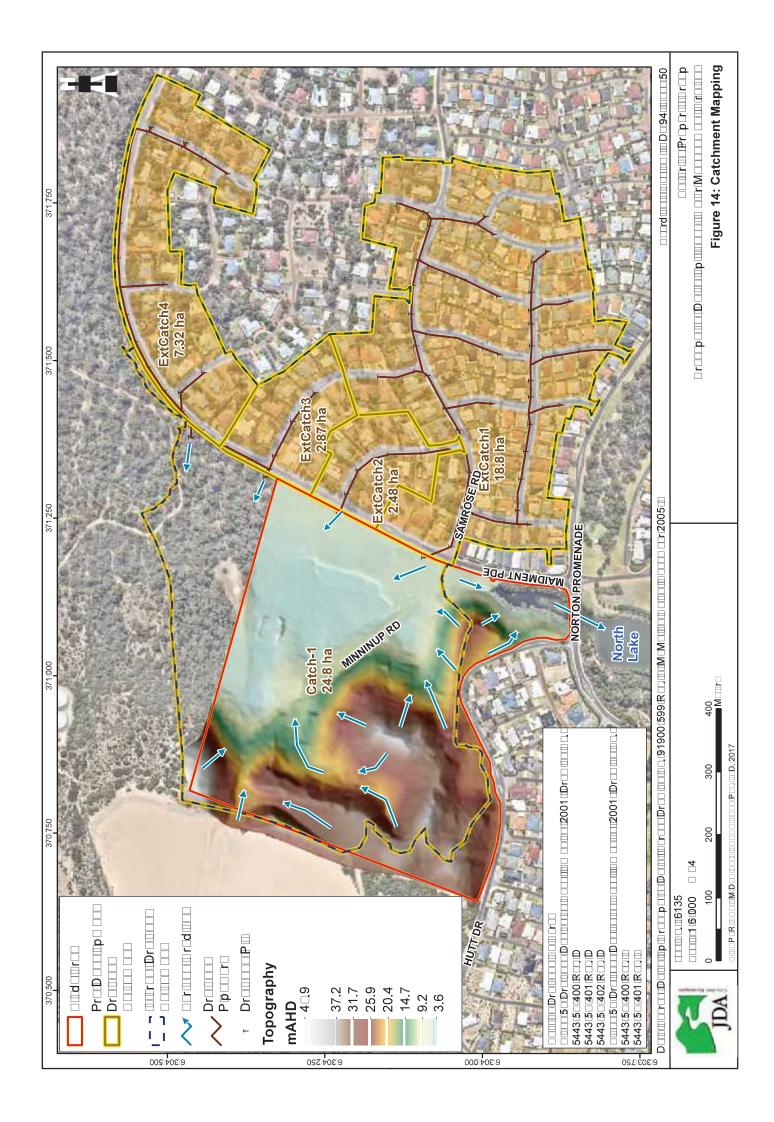


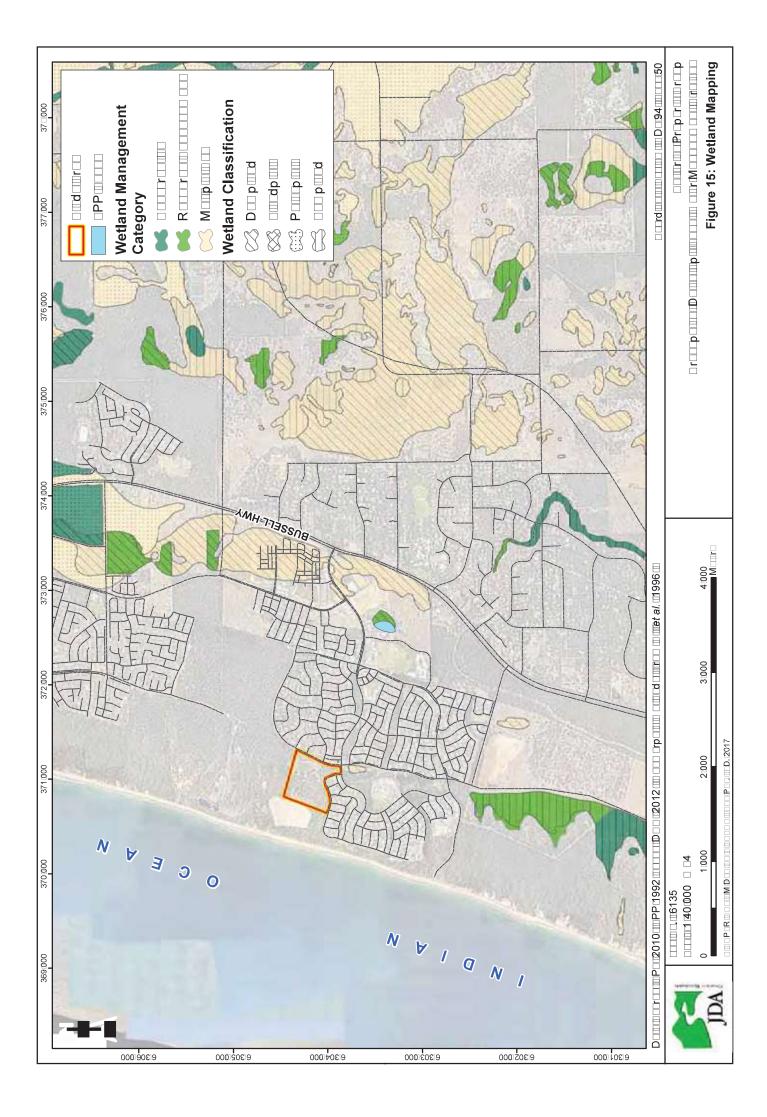




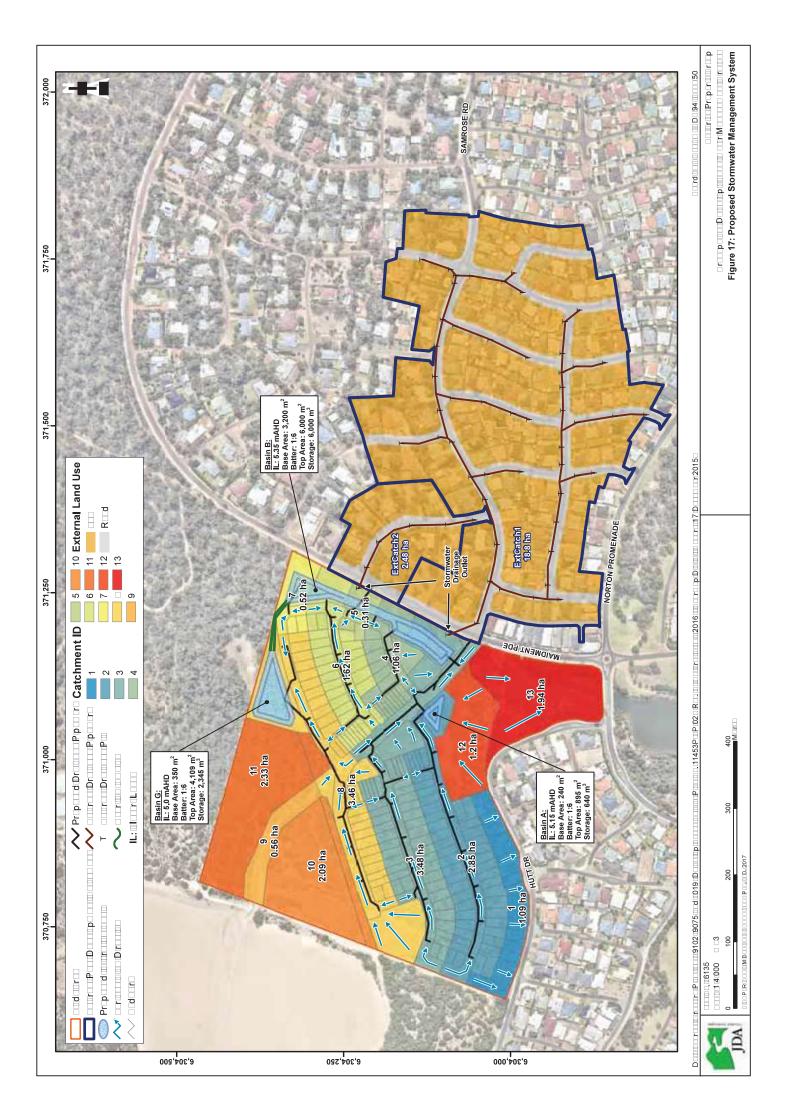


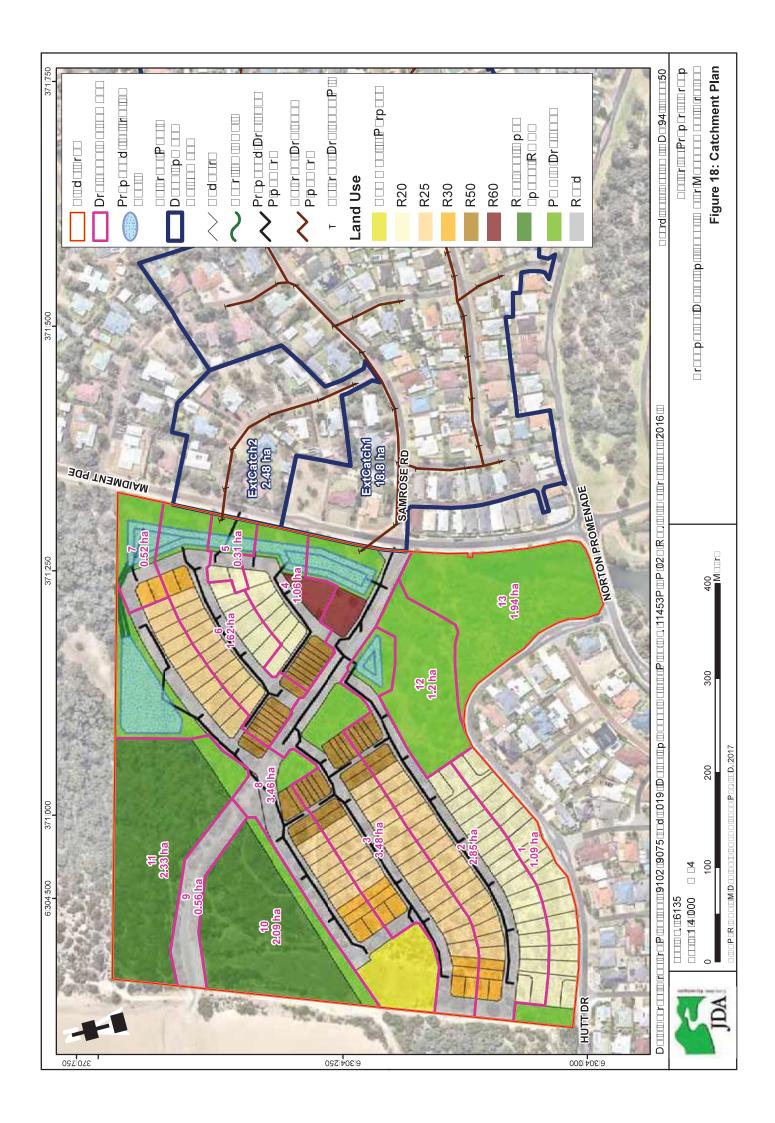




















Appendix A

Local Water Management Strategy: Checklist for Developers

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LOCAL WATER MANAGEMENT STRATEGY: CHECKLIST (WAPC, 2008)

The following checklist provides a guide to items which should be addressed by developers in the preparation of Local Water Management Strategies for assessment by the local authority when an application for a structure plan is lodged.

- 1. Tick the status column for items for which information is provided
- 2. Enter N/A in the status column if the item is not appropriate and enter the reason in the comments column
- 3. Provide brief comments on any relevant issues
- 4. Provide brief descriptions of any proposed best management practices, e.g. multi-use corridors, community based-social marketing, water re-use proposals

Applicant:	Applicant: Satterley Property Group	Date: May, 2017
Name of S	Name of Structure Plan: Greenpatch	
Contact:	Contact: Alex Rogers, JDA Consultant Hydrologists	
Address:	Address: Suite 1, 27 York St Subiaco - Perth (WA) 6008	JDA Ref.: J6135c
Telephon	Telephone: +61 (8) 6380 3431	Email: alex@jdahydro.com.au

ocal Water Management Chategy tem	Dogmirod Dolivership		Deliverable	Ī	Common
Local Water management on alegy nem	nequiled Deliverable	LWMS Reference	Comment		
Executive Summary					
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table 1: Design elements, requirements for BMPs and critical control points	Table 1, Executive Summary			
Introduction					
Total water cycle management – principles & objectives		Section 1.3			
Planning background		Section 1.2			
Previous studies		Section 2			
Proposed Development					
Structure plan, zoning and land use.	Proposed SP (Fig. 2)				
Key landscape features	Proposed POS in SP (Fig. 2)	Section 3]	
Previous land use	Existing Aerial Imagery (Fig. 1)				
Landscape - proposed POS areas, POS credits, water source, bore(s), lake details (if applicable), irrigation areas	Proposed POS in SP (Fig. 2)	Section 3			

			Deliverable	
Local water management strategy item	required Deliverable	LWMS Reference	Comment	Comment
Design Criteria				
Agreed design objectives and source of objective		Section 2		
Pre-development Environment				
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		Section 4		
Site Conditions - existing topography / contours, aerial photo underlay, major physical features	Aerial Imagery (Fig. 1) Existing Topography (Fig. 3)	Section 4.1, 4.2		
Geotechnical - topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Surface Geology (Fig. 5) Geotechnical Plan (Fig. 6) ASS Mapping (Fig. 6)	Section 4.4, 4.7, 4.8		
Environmental - areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Geomorphic Wetland Mapping (Fig. 15)	Section 4.9		
Surface Water – topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Pre-dev catchment and flow direction mapping (Fig. 14)	Section 4.8		
Groundwater – topography, pre development groundwater levels and water quality, test bore locations	Groundwater Monitoring Layout (Fig. 7), Monitoring Data (Fig. 8, 9, 10; Appendix C, D)	Section 4.6		
Water Use Sustainability Initiatives				
Water efficiency measures – private and public open spaces including method of enforcement		Section 5.3		
Water supply (fit-for-purpose strategy), agreed actions and implementation. If non-potable supply, support with water balance		Section 5.3.1		
Wastewater management		Section 5.3.1		
Stormwater Management Strategy				
Flood protection - peak flow rates, volumes and top water levels at control points,100 year flow paths and 100 year detentions storage areas	1% AEP (100yr ARI) Flood Event Plan (Fig. 19)	Section 5.5		
Manage serviceability - storage and retention required for the critical 20% AEP (5yr ARI) 5 year ARI storm events Minor roads should be passable in the 5 year ARI event	20% AEP (5yr ARI) Flood Event Plan (Fig. 20)	Section 5.5		

Moder Management Street 15 cm	Oction Double		Deliverable	
Local Water Management Strategy nem	required Deliverable	LWMS Reference	Comment	
Stormwater Management Strategy (cont)				
Protect ecology – detention areas for the 1 yr 1 hr ARI event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	63% AEP (1yr ARI) Event Plan (Fig. 21)	Section 5.5, 5.6		
Groundwater Management Strategy				
Post development groundwater levels, fill requirements (including existing and likely final surface levels), outlet controls, and subsoils areas/exclusion zones	Proposed Groundwater Management System (Fig. 16)	Section 5.4		
Actions to address acid sulfate soils or contamination	ASS Mapping (Fig. 6)	Section 4.7		
The Next Stage - Subdivision and Urban Water Management Plans	ns			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required prior to detailed design.		Section 6.2		
Monitoring				
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		Section 6.5		
Implementation				
Developer commitments		Section 6		
Roles, responsibilities, funding for implementation		Section 6.1		
Review		Section 6.6		

Western Australian Planning Commission (2008), Better Urban Water Management, Perth, WA

Appendix B

Bore Logs



LITHOLOGICAL LOG

Client: Dalyellup Beach Pty Ltd Job No: J3146 Project: Dalyellup Beach Estate Hole commenced: 5/08/2003 6304114N Bore location: 371071Ė <u>+</u> 5m Hole completed: 5/08/2003 Datum: MGA94/AHD Logged by: **Bore Name:** D26D (Deep) Total Depth: 10.0 m R.L. TOC: Natural Surface: Drill type: Air Core Hole diameter: SOIL CHARACTERISTICS 1 2 3 Slot / Depth (metres) Screen Depth ORGANIC CONTENT PARTICLE COLOUR TEXTURE MOISTURE COMMENTS SIZE Black / Grey Fine Sandy Clay Medium Moist PVC (Class 9) 0.5m ∇ Grey / Beige Clayey Sand 1.0m 1.5m Medium 2.5m Brown Low Saturated 3.0m Sand 3.5m Fine / Medium

				-	Yellow / Brown					Limestone Chips 0.25mm Diameter
			-	4.5m						
				-	Brown	Medium				
				5.0m						
					NOTES ON BO	RELOG				
				CK, WHITI						
Dark :					Grey, Blue	Tones : solid cold	our, blemish or m	ottle	ST.	ATIC WATER LEVEL
Medium					Grey, Blue					
Light:	Bro	wn, K	ed, Orange	e, Yellow,	Grey, Blue				Dai	e:
PARTI	CLE SIZ	E · Part	icles are eit	ther FINE	MEDIUM or COARSI	3				
	022 012		notes are en			-			l wi	below TOC
TEXTU	RE:	Sand,	Loamy Sa	nd, Clayey	Sand					
		Silt, L	oam, Sand	dy Loam, C	lay Loam					
		Clay,	Sandy Clay	y					Stic	kup above NS:
one.		OPPE & TOP	,	VOLUB IE	TT: 1 36 E T					
ORGA	NIC CON	IEN1:		VOLUME: SIZE:	High, Medium, Low Fine, Medium, Coa					m below
			,	SIZE:	rine, iviedium, Coa	rse			ļ	m below
MOIST	URE: So	il Moist	ure can be	either: DRY	, SLIGHTLY MOIST,	MOIST or SATU	RATED			
			ran oe		,,	01 04110				



LITHOLOGICAL LOG

Client: Dalyellup Beach Pty Ltd Job No: J3146 Project: Dalyellup Beach Estate Hole commenced: 5/08/2003 Bore location: 371071Ė 6304114N <u>+</u> 5m Hole completed: 5/08/2003 Datum: MGA94/AHD Logged by: **Bore Name:** D26D (Deep) Total Depth: 10.0 m R.L. TOC: Natural Surface: Drill type: Hole diameter: Air Core SOIL CHARACTERISTICS 1 2 3 Slot / Depth (metres) ORGANIC CONTENT Screen Depth PARTICLE COLOUR TEXTURE COMMENTS SIZE Limestone Chips 0.25mm Diameter 5.5m Brown PVC Limestone Chips 0.1mm Diameter 6.0m Coarse Sand 6.5m Limestone Chips 0.25mm Yellow Diameter 7.0m Medium Clayey Sand 7.5m Yellow / Brown Low Saturated 8.0m 8.5m Fine Clay 9.0m Brown

9.5m	
10.0m	End of Hole
NOTES ON BORELOG	
COLOURS: Solid colours are BLACK, WHITE, BEIGE	
Dark: Brown, Red, Orange, Yellow, Grey, Blue Tones: solid colour, blemish or mottle	STATIC WATER LEVEL
Medium: Brown, Red, Orange, Yellow, Grey, Blue	
Light: Brown, Red, Orange, Yellow, Grey, Blue	Date:
PARTICLE SIZE: Particles are either FINE, MEDIUM or COARSE	WL below TOC
TEXTURE: Sand, Loamy Sand, Clayey Sand	
Silt, Loam, Sandy Loam, Clay Loam Clay, Sandy Clay	Stickup above NS:
ORGANIC CONTENT: VOLUME: High, Medium, Low SIZE: Fine, Medium, Coarse	m below
MOISTURE: Soil Moisture can be either: DRY, SLIGHTLY MOIST, MOIST or SATURATED	



LITHOLOGICAL LOG

Client: Dalyellup Beach Pty Ltd Job No: J3146 Project: Dalyellup Beach Estate Hole commenced: 5/08/2003 6304394N Bore location: 371073Ė Hole completed: 5/08/2003 Datum: MGA94/AHD Logged by: 14.0 m **Bore Name:** D27D (Deep) Total Depth: R.L. TOC: Natural Surface: Drill type: Air Core Hole diameter: SOIL CHARACTERISTICS 1 2 3 Slot / Depth (metres) Screen Depth ORGANIC CONTENT PARTICLE COLOUR TEXTURE MOISTURE COMMENTS SIZE ΗА High Black Fine Loamy Sand 0.5m PVC Grey 1.0m Moist Beige 1.5m ∇ Medium Sand Low 3.0m Grey 3.5m Saturated 4.0m

4.5m	
5.0m	
NOTES ON BORELOG	
COLOURS: Solid colours are BLACK, WHITE, BEIGE	
Dark: Brown, Red, Orange, Yellow, Grey, Blue Tones: solid colour, blemish or mottle	STATIC WATER LEVEL
Medium: Brown, Red, Orange, Yellow, Grey, Blue	
Light: Brown, Red, Orange, Yellow, Grey, Blue	Date:
BARTICLE COLUMN	
PARTICLE SIZE: Particles are either FINE, MEDIUM or COARSE	WL below TOC
TEXTURE: Sand, Loamy Sand, Clayey Sand	WL below TOC
Silt, Loam, Sandy Loam, Clay Loam	
Clay, Sandy Clay	Stickup above NS:
Carly Carly	Sacrap assistantian
ORGANIC CONTENT: VOLUME: High, Medium, Low	
SIZE: Fine, Medium, Coarse	m below
MOISTURE: Soil Moisture can be either: DRY, SLIGHTLY MOIST, MOIST or SATURATED	



LITHOLOGICAL LOG

Client: Project: Dalyellup Beach Pty Ltd Dalyellup Beach Estate 371073E 6304394N J3146 5/08/2003 5/08/2003 Job No: Hole commenced: Bore location: <u>+</u> 5m Hole completed: MGA94/AHD D27D (Deep) Air Core Datum:

Bore Name:
Drill type: Logged by:

Total Depth: R.L. TOC: 14.0 m

Но	e dian	nete	er:	All Core	_			SOIL CHARA	Natural Sur	face:	
method	penetration 2	support	water	Slot / Screen Depth	Depth (metres)	COLOUR	PARTICLE SIZE	TEXTURE	ORGANIC CONTENT	MOISTURE	COMMENTS
		PVC (Class 9)			5.5m	Brown	Medium	Sand	Low	Saturated	

	NOTES ON BORELOG									
COLOURS	S: Solid colours are BLACK, WHITE, BEIGE									
Dark:	Brown, Red, Orange, Yellow, Grey, Blue Tones: solid colour, blemish or mottle									
Medium:	Brown, Red, Orange, Yellow, Grey, Blue									
Light:	Brown, Red, Orange, Yellow, Grey, Blue									
PARTICLE	E SIZE: Particles are either FINE, MEDIUM or COARSE									
TEXTURE										
	Silt, Loam, Sandy Loam, Clay Loam									
	Clay. Sandy Clay									

VOLUME: High, Medium, Low SIZE: Fine, Medium, Coarse ORGANIC CONTENT:

MOISTURE: Soil Moisture can be either: DRY, SLIGHTLY MOIST, MOIST or SATURATED

STATIC WATER LEVEL	
Date:	
WL below TOC	
Stickup above NS:	
m belo	w



LITHOLOGICAL LOG

Client: Dalyellup Beach Pty Ltd Job No: J3146 Project: Dalyellup Beach Estate Hole commenced: 5/08/2003 6304394N Bore location: 371073Ė Hole completed: 5/08/2003 MGA94/AHD D27D (Deep) Datum: Logged by: **Bore Name:** 14.0 m Total Depth: Drill type: Hole diameter: R.L. TOC: Natural Surface: SOIL CHARACTERISTICS Air Core 1 2 3 Slot / Depth (metres) Screen Depth ORGANIC CONTENT PARTICLE COLOUR TEXTURE COMMENTS SIZE 10.5m PVC 11.0m 11.5m Brown Sand Medium Saturated Low 12.5m 13.0m Clayey Sand Yellow / Brown Clay 14.0m End of Hole 14.5m

	-	
	15.0m	
	NOTES ON BORELOG	_
COLOURS: Solid colours are B		
	range, Yellow, Grey, Blue Tones: solid colour, blemish or mottle	STATIC WATER LEVEL
Medium: Brown, Red, Or	range, Yellow, Grey, Blue	
Light: Brown, Red, Or	range, Yellow, Grey, Blue	Date:
TEXTURE: Sand, Loamy	re either FINE, MEDIUM or COARSE y Sand, Clayey Sand	WL below TOC
	Sandy Loam, Clay Loam	
Clay, Sandy	Clay	Stickup above NS:
ORGANIC CONTENT:	VOLUME: High, Medium, Low	
	SIZE: Fine, Medium, Coarse	m below
MOISTURE: Soil Moisture can	be either: DRY, SLIGHTLY MOIST, MOIST or SATURATED	



JDA Consultant Hydrologists Suite 1, 27 York Street Subiaco WA 6008 Tel: 9388 2436 Fax: 9381 9279

LITHOLOGICAL LOG

Client: Satterley Propoert Pty Ltd
Project: Dalyellup Beach
Bore location:
Datum: GDA '94 MGA Zone 50
Bore Name: D5

Job No:
Hole commenced:
Hole completed:
Logged by:
Total Depth: 1.38 m

Datum: C	GDA '94 MGA Zo	ne 50	E: 371066		N: 6304132		Logged by:		1 20
Bore Nam Driller and	ne: D5 I drill type:						Total Depth: R.L. TOC:		1.38 m 5.11 mAHD
Hole diame	eter: 100 m	ım	Casing Diam:		50 mm Class	12 PVC	Natural Surface	ce:	4.65 mAHD
Depth (m) BO	ORE CONSTRUCTIO	GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	LITHOLOGIC	GRAIN SHAPE	MOISTURE	COMMENTS
0.5m			Sandy Clay	Black / Grey	Fine			Moist	
-			Clayey Sand	Grey / Beige					
1.5m	▼		Sand	Brown Yellow / Brown	Medium Fine / Medium	Moderately	Sub R	Saturated	Limestone Chips 0.25mm Diameter
5.5m									
	Gravel Sand Clayey S Sandy C		Grain Size Very Fine Fine Medium Coarse Very coarse Gravel	Sorting Poor Moderate Well Very well	Grain Shape Angular Subangular Subrounded Rounded Well rounded	Moisture Dry Moist Saturated		Date Stick Up Total Depth	m 1.38 mBTOC
	Sandy C	ıay	Gravel				I	Water Level	mBTOC
	Clay		NOTES:						,
	Coffee F								
	Bentonit	e							



JDA Consultant Hydrologists Suite 1, 27 York Street Subiaco WA 6008 Tel: 9388 2436 Fax: 9381 9279

LITHOLOGICAL LOG

Client: Satterley Propoert Pty Ltd Project: Dalyellup Beach Bore location: Datum: GDA '94 MGA Zone 50 Job No: Hole completed:

N: 6304191 Logged by: E: 371230

	me: D56	. 50	E: 3/1230		N: 6304191		Total Depth:		5.00 m
Driller and	d drill type:						R.L. TOC:		7.17 mAHD
Hole diam	neter: 100 mm	1	Casing Diam: 50 mm			ss 12 PVC Natural Surface:			6.62 mAHD
200 11111					LITHOLOG				
Depth (m)	BORE CONSTRUCTION	GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	MOISTURE	COMMENTS
0.5m			Sand	Yellow	Fine - Medium	Moderately	Sub R	Dry	
3.5m	▼							Moist	
5.0m								Saturated	
5.5m									
	Gravel Sand Clayey San	Very Fine Fine Medium	Sorting Poor Moderate Well Very well	Grain Shape Angular Subangular Subrounded Rounded Well rounded	Moisture Dry Moist Saturated		Date Stick Up Total Depth	0.55 m 5 mBTOC	
	Clay Coffee Roo		NOTES:				•	Water Level	4.6 mBTOC
	Bentonite								

Hole commenced: 13/09/01 Bore name: PB8 Client: Dalyellup Beach Estate Joint Venture Hole completed: 13/09/01 Job No: J2608 Logged by: M Yan Project: Dalyellup Beach Estate Bore location: Dalyellup Total depth.: 10.4 m Drilling company: Bunbury Drilling Company Ltd Static Water Level: 2.25 mTOC (18/09/01) Drilling method: Mud Rotary PVC STICKUP: 0.25 m Hole diameter: 250 mm Description Symbol (Lithology; colour, grain size, sortation, toundness, minor components) cvel Depth (mBNS) 0.25 m ANS stick-up Cement Grout, 0.00 - 0.70 mBNS 0.0 - 5.1 m SAND; yellow, fine to medium 250 mm hole; 10.40 m D56 5 m 150 mm PVC casing (Class 9); 0.25 m ANS - 6.9 m BNS 5.1 - 6.6 m SAND; yellow, medium to coarse 6.6 - 6.8 m LIMESTONE 6.8 - 7.4 m UMESTONE / SAND PBS Graded quartz gravel pack 7.4 - 7.7 m LIMESTONE 150 mm stainless steel, 7.7 - 8.9 m LIMESTONE / SAND 0.6 mm slot screen; 6.9m to 10.1 m BNS, 8.9 - 9.2 m LIMESTONE 9.2 - 10.2 m LIMESTONE / SAND 10 m 10.2 - 10.4 m CLAY; dark grey / green, End of hole (weathered Bunbury Basalt) Legend: 00 outside diameter ANS above natural surface BNS below batural surface 15 m

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Dalyellup Beach Estate

Figure 2: Bore PB8 Completion Diagram

Hole commenced: 19/09/01 Bore name: PB10 Client: Dalyellup Beach Estate Joint Venture Hole completed: 19/09/01 Job No: J2608 Logged by: S Wills Project: Dalyellup Beach Estate Bore location: Dalyellup Total depth.: 13.0 m Drilling company: Bunbury Drilling Company Ltd Static Water Level: 3.40 mTOC (19/09/01) Drilling method: Mud Rotary PVC STICKUP: 0.3 m Hole diameter: 250 mm Symbol Description Level (Lithology, colour, grain size, sortation, roundness, Depth (mBNS) minor components) 0.3 m ANS stick-up Cement Grout, 0.00 - 0.70 mBNS 0.0 - 3.8 m SAND; yellow 250 mm hole; 13.0 m 3.8 - 5.1 m SAND; Grey 5 m 150NB PVC casing (Class 9); 0.3 m ANS - 8.74 m BNS 5.1 - 7.5 m SAND; medium Graded quartz gravel pack PBIO 7.5 - 11.8 m LIMESTONE / SAND; creamy 10 m 150NB stainless steel, 0.6 mm slot screen; 8.74m to 12.04 m BNS, Stainless steel dome end cap 11.8 - 12.1 m SAND; medium 12.1 - 13.0 m CLAY; dark grey / green, (weathered Bunbury Basalt) End of hole outside diameter OD above natural surface ANS below batural surface BNS 15 m

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Dalyellup Beach Estate

Figure 3: Bore PB10 Completion Diagram



LITHOLOGICAL LOG

Client: Satterley Property Group
Project: Dalyellup Beach
Bore location: Adjacent to Abstraction Bore PB8
Datum: GDA '94 MGA Zone 50 E 3711
Bore Name: PB8 (obs) Job No: Hole commenced: Hole completed: Logged by: Total Depth: J4747 June 2010 June 2010 N 6304106

7.50 m

Driller an	nd drill type: Han meter: 75mm	d Auger	Casing Diam:	50mm			R.L. TOC: Natural Surfa	ce:	6.98 mAHD 6.40 mAHD
				<u> </u>	1	LITHOLOGI	CAL LOG		
Depth (m)	BORE CONSTRUCTION	GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	MOISTURE	COMMENTS
\dashv								Dry	
7									
1.0m									-
]					E: M I:				
+					Fine - Medium			Moist	
2.0m	lacksquare								
_									
7									
3.0m									
\neg			Sand	Yellow					
-			Sand	Tellow					
.]						Moderately	Sub R		
4.0m									
7									
_									
5.0m								Saturated	
7									
6.0m									
					Medium - Coarse				
-					Wedium - Coarse				
]			Limestone	Cream]				
7.0m			Limestone /	Cream	-				
			Sand						
-									
8.0m									
-									
]									
9.0m									
_									
10.0									
10.0m									
-									
11.0m									
4									
12.0m									
4	Gravel		Grain Size	Sorting	Grain Shape	Moisture	1		T
	***************************************		Very Fine	Poor	Angular	Dry		Date	
-	Sand			Moderate Well	Subangular Subrounded	Moist Saturated		Stick Up	0.58 m
\exists	Clayey Sa	nd	Coarse	Very well	Rounded	- Catarated			
4	Sandy Cla	ıv	Very coarse Gravel		Well rounded			Total Depth	8.1 mBTOC
		· J					ı	Water Level	2.75 mBTOC
\dashv	Clay		NOTES:						
	Coffee Ro	ck							
4	Bentonite								
	Belitofilte								



LITHOLOGICAL LOG

Client: Satterley Property Group
Project: Dalyellup Beach
Bore location: Adjacent to Abstraction Bore PB10
Datum: GDA '94 MGA Zone 50 E 37126
Bore Name: PB10 (obs) Job No: Hole commenced: Hole completed: Logged by: Total Depth: J4747 June 2010 June 010 N 6304274

9.00 m

Bore Na Driller a Hole dia	nd d	rill typ	e: Har	nd Auger	Casing Diam:	FOmm			Total Depth: R.L. TOC:		9.00 m 7.90 mAHD
поте ата	mete	er: /:	OTTITTI		Casing Diam:	50111111		LITHOLOGI	Natural Surfa	ice:	7.33 mAHD
Depth (m)	СО	BOF NSTRU	RE JCTION	GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	MOISTURE	COMMENTS
_											
-					-						
1.0m	1				-					Dry	
_											
_					-						
2.0m					-	Yellow					
_											
-	-				_		Fine - Medium			Moist	
3.0m											
-	-	V									
_		6 50 50 50 50 50 50 50 50 50 50 50 50 50									
4.0m	-				Sand		-				
4.0III _											
-	-				_	Grey		Moderately	Sub R		
_								ĺ ,			
5.0m	-										
_											
-	-										
6.0m											
-										Saturated	
_						Yellow					
7.0m	-										
7.om —							Medium				
-	-				_						
_							1				
8.0m	-										
_					Limestone / Sand	Cream					
-	1				-						
9.0m	1										
-	1										
_	1										
10.0m											
_											
-	1										
11.0											
11.0m	1										
_											
	1										
12.0m											
_	1		Gravel		Grain Size	Sorting	Grain Shape	<u>Moisture</u>]		
=	-		Sand		Very Fine Fine	Poor Moderate	Angular Subangular	Dry Moist		Date	
_	1		-		Medium	Well	Subrounded	Saturated		Stick Up	0.57 m
_	-		Clayey Sa	and	Coarse Very coarse	Very well	Rounded Well rounded			Total Depth	9.6 mBTOC
- - -			Sandy Cla	ay	Gravel		Well founded				
-	1		Clay		NOTES:					Water Level	3.82 mBTOC
	1		_								
-	1		Coffee Ro	ock							
	1		Bentonite								

Appendix C Groundwater Level Data

1 15/03/2001	5.40	4.70	4.11	3.72	3.99	90.9																																4.17	4.56				3.88	6.72											_
8/02/200	5.59	4.88	4.23	3.87	4.12	6.30																																4.26	4.6/				3.97	6.97											_
1/02/2001	5.63	4.93	4.25	3.96	4.13	6.32																																4.29	4.72				4.00	7.01											
8/01/2001	5.78	5.05	4.33	3.85	4.20	6.50																																4.36	4.82				4.16	7.19											
28/11/2000	90.9	5.22	4.46	4.06	4.20	6.77																																4.47	2.00				4.64	7.47											
3/10/2000	6.37	5.49	4.55	4.31	4.00	7.13																																4.58	2.88				5.14	7.76											
4/09/2000	6.54	5.66	4.54	4.56	3.71	7.12																																4.59	2.52				5.39	7.71											
/08/2000 1	6.30	5.47	4.47	4.18	4.35	69.9													1																			4.39	5.25				5.12	7.28	1										-
/06/2000 1	5.44	4.78	4.31	3.91	4.12	5.95															Ì											Ì						4.17	5.04				4.81	6.65											-
06/2000 16	5.25	4.47	4.18	3.74	3.95	5.92															ł											ł						4.16	4.50				4.69	6.61											-
05/2000 1/	5.30	4.55	4.41	3.73	3.95																																	4.20	2.01																-
5/2000 16/	5.30																																					4.17	+				4.63	6.70											
1/2000 4/0	5.84	_	_																															+				4.78	+				4.38	+											-
2/1999 5/0	:92	4.89	4.46	.94																														1				+	5.39				4.55	+											
/1999 21/1	6.35 5	4		4.08		7.25												+	+	+	+		+									+	+	+	+			4.53	+	+			5.48	+	+		+								-
999 10/09	9			4.(<u> </u>	1															1				4.5	'n	<u> </u>			5.4	7.8											_
999 8/09/1	0	1	2	0	2	7.23												<u> </u>	+	1	+		+	<u> </u>								+		+						+				1	+										_
999 7/09/1	6.4																	_	+	1	+		<u> </u>								1	+	1	+	1			+	1	<u> </u>				+	+										_
99 14/07/1	6.15	4.95																_	1	1	1		_	_								1		+	-			_		+				4	+										-
9 30/06/19	2.65	4.57	4.24	3.76	4.05																																						4.96	6.75											_
9 5/05/199																			_															1																					_
16/03/199	4.75			3.34	3.58																																																		
29/10/1998	5.55	4.30	4.34	3.72	3.93																																																		
31/03/1998	4.90	3.80	4.26	3.44	3.73																													T																					_
Water Levels (mAHD) 31/03/1998 29/10/1998 16/03/1999 5/06/1999 30/06/1999 14/07/1999 7/09/1999 10/09/1999 10/09/1999 5/01/2000 4/05/2000 16/05/2000 16/05/2000 1/06/2000 14/05/2000 3/10/2000 3/10/2000 8/01/2001 16/02/2001 16/03/2001	D2	D3	D4	DS	D7	D10	D11	D12	D13	D14	D16	D17	D18	D19	D21	D22	D24	D25	D26S	D26D	D275	0270	D28	D33	D36	D38	D42	D43	D44	D45	D46	D47	D48	DSU DE1	D52	D53	D54	2M	4M	PB13	PB14	PB15	1/90	2/90	North Lake	MB#1	MB#2	ЬПШШ	Po10	D56	P016	P017	P010	P=19	0000
<u>a</u>		7.96	7.03	5.03	6.01	12.03	7.12	8.07	8.25	7.23	6.5	9.12	8.72	7.07	6.67	6.03	5.86	6.97	5.04	5.01	6.82	0.74	40.7	7 22	7.80	9.62	10.32	5.91	7.85	7.47	8.33	8.53	9.23	9.30	TRS	TBS	TBS	24.96	II.05	TBS	TBS	TBS	14.484	14.504	5.00	8 3.1	7 83								

	5.04		3.99	4.34	5.82 5.67		6.00 5.72			3.86 3.50																													5.07 4.97	5.85				3.85	6.36 6.21	3.98									<u> </u>		_
	5.11				5.87		6.12			4.06																													5.09	+					6.44										+		
	+				7 5.94		7 6.27			1 4.28																				-	-								5.00	+		-		+	6.43	L	H								_		_
ł	+		-		5 5.67		2 6.57		6.53	1 4.64													$\frac{1}{1}$								<u> </u>								2 4.82	+	+		+	+	3 6.25									_	+		_
+	5.19		_		5.55		6.22			4.41																													4.62	+	+	1		+	6.18	L								_	+		_
10.0	4.85		3.98	4.16	5.43	4.69	5.77	6.39		3.86														-															4.54	5.67				4 43	6.10	4.08								_	4		_
t :	4.58		3.85	4.03			5.43			3.41							L													L									4.47	5.50				4.18	6.07	3.96									_		_
3.33	4.49		3.73	3.88			5.43										L													L									4.47	5.50					6.11	3.83		L									
3.04	4.56		3.63	3.76			5.52			3.31																													4.52	5.56				3.53	6.16	3.55		L									
27.5	4.67		3.69	3.85		4.44	2.60	6.22		3.44																													4.54	5.61				3.54	6.21	3.60											
5.5	4.79		3.77	4.00		4.66	5.78	6.38		3.71																													4.60	5.72				3.79	6.30	3.90											
3.97	4.99	4.09	3.83	4.21		5.02	00.9	6.61		4.06																													4.59	5.78				4.09	6.40	4.18											
3.02	4.85	4.12	3.84	4.16		4.86	5.92	92'9		4.00																													4.57	5.61				4.13	6.40	4.06											•
0.00	4.95	4.20	3.99	4.17		5.02	90.9	6.84		4.26																													4.58	5.59				4.60	6.48	4.08											
	4.98	4.24	4.13	4.21		5.16	6.20	6.91		4.51							T	T					İ							T	T								4.38	5.54				4.95	6.52	4.00									Ī		
3.00	4.99	4.23	4.12	4.18		5.21	6.19	6.95		4.58							l						t							l	T								4.42	5.53					6.50	4.04								1	†		
3.02	4.87	4.20	4.01	4.23		4.97	6.01	6.81																							l								4.34	5.41				4.93	6.45	4.13											
, t.	4.76	4.13	3.87	4.17		4.78	5.78	29.9										-					$\frac{1}{1}$																4.30	5.38				4.71	6.47	4.20								-	+		
+	4.77			4.11			5.61			3.81													$\frac{1}{1}$																4.24	+	+			+	6.48	\vdash								-	+		
+	4.57		_		5.88						L												$\frac{1}{1}$																4.15	+	+			+	6.54	\vdash								_	+		
1	7			(1)	3)										+					+			+	-		+	+			_	+	-							7	7	+	+		1		7			H			-	$\frac{1}{1}$	+	+		
20	D3	D4	D5	D7	D10	D11	D12	D13	D14	D16	D17	D18	D19	D21	D22	D24	D25	D26S	D26D	27.5U	D27D	07.0	D29	D33	980	D38	D42	D43	D44	D45	D46	D47	D48	D50	D51	D52	D53	D54	2M	4M	PB12	PB13	PB14	1/90	2/90	North Lake	Middle Lake	MB#1	MB#2	Вошш	P010	D26	P=16	P017	P010	P019	0000
7	96:	.03	5.03	5.01	12.03	7.12	8.07	3.25	7.23	6.5	9.12	3.72	.07	- 67	03	98.5	. 97	5.04	10	82	74		45.5	. 22	7 08 7	29	3.3	.91	.85	47	33	23	23	200	BS	BS	BS	TBS	24.96	.05	TBS	BS	TBS	484	14.504	00:	BS	.31	7.83								

2.2.1 2.3.6 4.3.7 4.3.9 <th< th=""></th<>
4.00 3.85 3.87 3.89 3.45 3.75 4.01 4.07 4.01 6.78 6.29 4.35 4.01 4.09 4.37 4.03 6.03 6.
4.30 4.30 4.30 4.30 4.30 4.30 4.30 4.30 4.30 4.30 4.30 4.30 4.30 4.30 6.30 <th< td=""></th<>
5.28 5.29 5.74 5.30 5.47 5.30 5.47 5.30 5.47 5.40
6.07 5.34 5.74 5.89 5.47 5.37 5.63 6.19 6.63 6.74 3.80 3.67 3.41 5.74 3.32 3.35 6.9 6.10 6.74 4.20 4.21 4.29 4.21 4.29 4.29 4.29 6.10 4.20 4.20 4.24 4.26 4.26 4.26 6.10 6.01 4.20 4.20 4.24 4.26 4.26 4.26 6.10 6.11 4.26 6.10 6.11 4.26 6.10 6.11 4.26 6.10 6.11 4.26 6.10 6.11 4.26
1.0
3.89 3.67 3.41 5.74 3.32 3.35 4.09 4.51 4.59 4.20 4.20 4.20 4.51 4.59 4.69 4.89 4.89 3.29 3.29 3.71 3.75 3.71 3.75 3.71 3.75 3.71 3.75 3.71 3.75 3.71 3.75 3.71 3.75 3.71 3.75 3.71 3.75 3.71 3.75 3.71 3.75 3.71 3.72 3.73 3.72 3.73 3.73 3.73 3.71 3.72 3.73 3.73 3.
3.89 3.67 3.41 3.32 3.35 4.09 4.51 4.50 4.20 4.20 4.20 4.20 4.20 4.20 6.10 7.00 4.20 4.20 3.46 3.39 3.36 3.66 3.89 4.11 4.08 3.91 3.76 3.89 3.43 3.39 3.69 3.41 4.15 4.15 4.15 4.15 4.06 4.26 4.26 4.26 3.39 3.69 3.74 4.15 4.11 4.15
4.20 4.20 6.0 700 4.20 6.0 6.0 6.0 4.20 6.0 6.0 6.0 3.91 3.76 3.89 3.56 3.66 3.89 4.11 4.08 3.92 3.80 3.80 3.86 3.86 3.89 4.11 4.08 3.62 3.80 3.80 3.86 3.86 3.89 4.11 4.08 3.64 3.52 3.33 3.15 3.13 3.34 3.35 3.71 3.75 3.64 3.52 3.36 3.66 3.86 3.86 3.86 3.71 3.75 3.64 3.52 3.36 3.18 3.15 3.36 3.71 3.75 5.28 5.21 5.22 5.69 5.87 5.69 5.98 6.20 6.20 5.28 5.21 5.12 5.22 5.69 5.87 5.69 5.98 6.20 6.20 6.99 5.32 5.42 6.21 4.37 4.61 4.57 6.60 6.29
420 420 610 601 420 420 426 458 466 351 376 356 336 366 389 411 408 356 380 359 350 369 364 415 412 364 359 359 369 369 344 375 364 350 350 313 339 369 341 375 364 352 358 369 369 359 374 375 364 352 356 318 315 338 369 374 375 408 487 479 481 494 514 375 528 521 572 569 598 620 622 528 553 581 572 569 598 620 622 660 678 638 644 627 613 604 602 612 650 678 638 644 627 613 6
420 420 420 450 458 466 391 376 356 386 389 411 408 396 380 359 359 359 359 412 408 386 380 359 359 366 389 411 408 386 380 359 359 369 359 371 412 386 380 389 366 389 411 408 486 380 366 389 411 408 412 486 380 366 389 374 377 377 486 380 386 389 386 389 389 386 411 408 488 381 382 481 481 481 481 481 481 481 482 482 481 482 481 482 482 482 482 482 482<
3.91 3.76 3.56 3.46 3.39 3.36 3.66 3.89 4,11 4.08 3.96 3.49 3.49 3.49 3.49 3.41 4.12 4.08 3.62 3.49 3.49 3.49 3.49 3.49 3.41 4.12 4.12 3.62 3.49 3.39 3.69 3.94 4.15 4.12 4.12 3.62 3.49 3.39 3.69 3.94 4.15 4.12 4.12 3.62 3.49 3.39 3.69 3.94 4.15 4.12 4.12 3.64 3.52 3.36 3.31 3.34 3.74 3.77 3.69 5.93 5.69 5.93 6.20 6.22 5.99 5.93 5.81 5.77 5.69 5.98 6.20 6.22 5.99 5.93 5.81 5.77 5.69 5.98 6.20 6.22 6.72 6.53 5.81 3.74 3.74 4.37 4.61 4.57 6.72 6.53 5.87 </td
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391 3.76 3.56 3.40 3.39 3.36 3.69 3.89 4.11 4.08 3.96 3.80 3.89 3.43 3.39 3.69 3.74 4.12 3.64 3.52 3.33 3.18 3.13 3.34 3.59 3.74 4.12 3.64 3.52 3.36 3.18 3.15 3.34 3.59 3.74 3.77 3.64 3.52 3.36 3.29 3.74 3.77 3.64 3.52 3.69 3.74 3.77 3.64 3.50 3.74 3.77 3.64 3.50 3.74 3.74 3.74 3.77 3.78 3.74 3.74 3.74 3.74 3.74 3.74 3.74 3.74 3.74 3.74 3.78 3.21 4.87 4.79 4.81 4.94 5.14 5.25 5.28 5.21 5.12 5.69 5.98 6.20 6.20 6.21 6.72 6.54 6.27 6.24 6.27 6.24 4.67 6.72 6.58 6.44 6.27 6.13 6.04 6.22 6.12 6.22 6.72<
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	5.85 5.92 5.12 3.43 3.43 3.43 3.43 3.43 3.43 3.43 3.4	5.[4 3.44 3.47 3.17	5.77	6.58	5.82	6.39	7.15	4	\dashv	+	\dashv	\dashv	6.53	6.21	6.02	5.99		6.25	6.21	80.9
	5.92 5.92 5.12 3.43 3.43 3.43 3.43 3.43 3.43 3.43 3.4	3.44 3.47 3.17 3.17	5.77	6.57	5.15	5.30	5.57	5.64 5	5.58 5.45	45 5.31	5.14	4.97	4.70	4.63	4.50	4.49	5.44	5.44	5.30	4.99
	5.92 5.12 3.43 3.43 3.43 3.12 3.15 3.87	3.44 3.47 3.17 3.17	5.89	6.57	6.75	68.9		1	_			6.64	6.40	6.22	60.9	90.9	6.64	6.77	6.85	6.57
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	3.39 3.43 3.12 3.15 3.87 3.59	3.44 3.47 3.13 3.17		4.10	4.26	4.33	4.72	4.78		4.47	4.29	4.09	3.85	3.55	3.59	3.62	4.45	4.30	4.20	3.89
	3.39 3.43 3.12 3.15 3.87 3.59	3.44 3.47 3.13 3.17			4.21				4.50				4.13	3.87		3.71	4.1	4.22	4.14	4.03
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	3.15	3.17	3 18	3.52	3 71	3 77	+	+	12	2 0.7	+	+	3 67	3.51	3.52	3.57	. «	207	18.5	3 56
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D36			\dagger	+	\dagger	6.73	7.14	+	7.04	6.9(6.86	99.9	6.63	6.68		0.70		79.9	
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	2.97	3.04	3.35	4.07	4.20	4.41	4.60	4.73	4.67		3.84			3.64		3.98	4 33	4.76	4.16	3.57
2/90 6.39	6.24	6.10	90'9	6.21	6.28	6,63	7.28	╀	7.49	7.36	╀	7.11	6.95	99.9	6.43	6.38	6.39	6.52	6.46	6.38
	3.64	3.0		4.40	4.58	4.68	4.94	\vdash			\vdash	4.30	3.95	4.20	4.32	4.38	4.3	5.19	5.17	4.74
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P121	\int		T	\dagger	\dagger	\dagger	+	_	<u> </u>	<u> </u>	 -	 -	 -				Ī	T	T	T

D3 D4 D5 D7 D10 D11 D12 D13 D13	4.91	4.70																				0.00
D4 D5 D7 D10 D11 D12 D13 D13		2		4.54	4.56	4.58	5.43	5.32	5.54	5.30			5.04			5.13	5.32	5.34	5.85	5.56	5.45	5.36
D5 D7 D10 D11 D12 D13	4.63	4.50	\dashv	4.34	4.36	4.34	4.57	4.60	4.74	4.84	4.84	4.77	4.67	4.57	4.51	4.54	4.61	4.74	4.88	4.97	5.01	5.01
D7 D10 D11 D12 D13	3.91	3.64		3.50			4.00	4.12	\dashv	4.29	4.17	4.13	3.96	3.68	3.58	3.67	3.77	4.01	4.18	4.21	4.22	4.21
D10 D11 D12 D13	4.69		4.33	4.27	4.33	4.45	4.95	5.22	\dashv	5.21	5.04	4.90	4.74	4.44	4.34	4.54	4.77	2.00	5.14	5.20	5.21	5.04
D11 D12 D13 D14	5.98	5.93	5.74	1	5.62	5.54	5.76	5.86	\dashv	6.79	99.9	6.53	6.38	6.15	5.99	5.91	5.86	5.98	6.31	6.84	6.79	6.64
D12 D13 D14	4.68	4.40					5.00	5.18	5.68	5.69	5.25	4.85	4.84	4.68	4.53	4.55	4.67	5.11	5.63	5.55	5.42	5.29
D13 D14	6.30	60.9	5.96	5.86			6.57	6.63	6.93	6.94	6.73	95.9	6.31	60.9	5.93	5.93	6.11	6.53	98.9	6.93	98.9	6.72
D14	6.21						6.23	6.26	-	6.26	5.97	5.87					5.77	6.16	6.58	6.53	6.41	6.40
	6.33	90.9					6.43	6.64		96.9	98.9	6.62	6.34	6.04	5.94	80.9	6.31	6.47	98.9	6.94	68.9	92.9
D16	3.42			4.37			3.67	3.85	\dashv	4.04	3.77	3.56	3.32	3.05	2.90	2.89	3.09	3.51	4.09	3.96	3.93	3.80
D17																						
D18	6.65						6.63	6.70		06.90	9.76	29.9	6.53					6.59	6.97	6.92	6.93	68.9
D19	5.41		5.00			4.87	5.58	5.68		5.84	5.63	5.51	5.34	5.11	4.97	4.93	5.12	5.48	00.9	5.87	5.76	5.68
D21			3.07				3.93	4.07		4.33	4.18	4.00	3.79	3.46	3.26	3.24	3.39	3.91	4.42	4.35	4.27	4.14
D22	3.85	3.65	3.55	3.50	3.43	3.45	3.96	4.05	5.62	5.83	4.96	4.46	4.21	3.93	3.80	3.74	3.82	4.11	4.44	4.51	4.70	4.45
D24	4.23																4.63	4.99	5.33	5.23	5.28	5.15
D25																	4.89	5.44	5.92	5.87	5.60	5.46
D26S	3.82	3.55	\vdash	3.42			4.01	4.05	\vdash	4.21	4.09	4.06	3.83	3.61	3.50	3.66	3.89	3.99	4.23	4.19	4.20	4.13
D26D	3.86	3.58	\vdash	3.45			4.04	4.08	\vdash	4.25	4.03	4.10	3.87	3.64	3.54	3.70	3.94	4.03	4.28	4.25	4.24	4.18
D27S	3.42	3.22	3.14	3.11			3.51	3.61	3.84	3.82	3.67	3.62	3.41	3.23	3.14	3.28	3.43	3.59	3.87	3.83	3.83	3.73
D27D	3.46	3.25		3.14			3.50	3.65		3.84	3.70	3.65	3.44	3.26	3.17	3.31	3.46	3.62	3.90	3.87	3.86	3.76
D28							4.04	4.04		4.80	5.74	5.19	4.34	4.01	3.84	3.76	3.89	4.43	4.89	4.86	4.75	4.63
D29		3.52	3.39	3.28	3.31	3.26			L													
D33						6.27	6.56	6.34	6.70	6.40	6.25	6.23					6.22	6.31	6.57	6:39	6.38	6.26
D36									6.43													
D38																					Dest	Dest
D42		5.80					5.95	5.92	80.9	6.16	6.15		00.9				6.01	6.01	6.38	6.27	6.40	6.30
D43																		4.89	5.03	5.15		5.24
D44																		5.05	5.22	5.37		5.49
D45																		5.00	5.26	5.31		5.33
D46																		6.42	6.58	6.73		99.9
D47																		6.48	7.15	7.25		6.90
D48																		6.43	7.61	7.41		96.9
D20																						
D51																						
D52																						
D53																						
054	1			1				+	+	1												
	5.40	5.36	+	4 99	4 87	4 92	5 11	5 23	+	5.61	5.57	5.49	5 42	5 24	5 10	5.04	5.06	5 23	5.41	5 57	5.61	7. 7.
4M	6.16	5.87	5.83	5.50	5.68	1	6.14	6.26	6.53	6.54	6.41	6.37	6.28	6.11	6.02	6.01	6.05	6.30	6.56	6.51	6.45	6.36
PB12			+					<u> </u>	\perp					l								
PB13																						
PB14																						
14.484	3.08	2.64	2.60	2.63	3.22	3.53	4.25	4.27	4.46	4.21	3.73	3.60	3.11	2.90	2.79	3.29	3.70	4.06	4.37	4.27	4.32	3.97
	6.24	80.9		5.94	5.88	5.80	5.99	80.9		6.74	9.76	6.73	6.61	6.34	6.20	60.9	6.11	97.9	6.39	6.73	6.83	6.79
	4.13	3.95		3.96	4.10	4.35	4.80	5.12		4.92	4.68	4.49	4.30	3.90	3.80	4.29	4.60	4.78	4.82	4.91	4.84	4.84
Middle Lake																						
MB#1																						
MB#2			H								H											
Вошши																						
P010																						
D56	_																					
P016																						
P017																						
P010																						
P019																						
P020		$\frac{1}{2}$	+	+	$\frac{1}{2}$	+	$\frac{1}{2}$	+	+	+	$\frac{1}{2}$	+	1	+	1	1		1		1		
P021	_																					

D3 D4 D5 D7 D10	5.26				5			1000										+	+	+	+
D4 D5 D10		5.16	5.01	4.92	4.82	4.66	4.80	2.67	6.02	5.86	5.87	5.60	5.50	5.50	5.25	5.11	5.15 5	5.12 4	4.93 5	5.27 5.31	+
D5 D7 D10	4.98	4.91	4.80	4.69	4.60	4.50	4.48	4.77	4.88	5.02	5.10	5.12	5.10	5.02	4.93	-	+	\dashv	_		6 4.90
D10	4.17	4.07		3.70	3.61	3.53	3.59	4.09	4.37	4.34	4.38	4.29	4.24	4.14	3.95	3.80	_	_		1	\dashv
D10	5.14	4.96	4.63	4.45	4.38	4.34	4.48	4.84	5.23	5.22	5.17	5.28	5.21	5.05	4.74	4.44	+	4.41 4	4.31 4	4.57 4.82	+
	6.57	6.45	6.27	60.9	5.96	5.82	5.74	5.83	60.9	6.84	7.06	7.02	6.87	6.75	9.76	+	+	+	+	+	+
D11	5.21	5.03	4.81	4.61	4.43	4.39		4.90	5.75	5.81	5.78	5.54	5.33	5.12	4.91	+	4.58 4	+	+	4.66 5.98	8 6.04
D12	6.63	6.44	6.21	6.05	5.92	5.81	5.78	6.43	98.9	7.05	7.13	86.9	6.78	6:29	6.33	+	-	+	-	6.17	
D13	98.9	6.21	5.80	2.68	2.67	5.59	2.60	6.04	6.67	6.74	8.78	6.62	6.51	6.31	6.18	\dashv	+	+	+	5.99	
D14	6.67	6.52	6.21	6.19	5.95	5.83	5.86	6.39	08.9	7.06	7.14	7.00	6.83	6.63	6.37	6.13	9 80.9	90.9	6.01 6	6.25	
D16	3.70	3.51	3.23	3.06	2.91			3.50	4.32	4.80	4.59	4.18	3.88	3.63	3.35	\dashv	+	.84	e e	12	1
D17		6.64	6.39						6.81	7.31	7.38	7.19	7.02	6.82	92.9	6.35	_				
D18	6.83	6.73	6.55					6.57	7.04	7.10	7.05	7.05	66.9	88.9	6.74	95.9	6.41 6	6:39		6:39	
D19	5.61	5.48	5.32	5.08	4.95	4.83		5.39	6.11	6.15	6.12	5.93		5.63	5.45	5.29			4.95 5	20	
D21	4.08	3.89	3.61	3.76	3.93	3.28		3.82	4.54	4.57	4.59	4.46	4.20	4.01	3.74	3.48	3.24	_	3	3.54	
D22	4.38	4.29	4.07	3.86	3.73	3.59		3.88		5.71	5.74	5.04		4.65	4.44	4.27		4.05 3	3.94 4	4.05	
D24	4.98	4.80							4.34	5.35	5.34	5.16	5.09	4.95	4.84	4.71					
D25	5.38	5.20	4.94	4.63	4.42	4.41	4.33	5.11	5.92	6.03	6.02	5.74	5.45	5.27	5.11					28	
D26S	4.09	3.97	3.80	3.63	3.54	3.45	3.50	4.02	4.28	4.26	4.39	4.31	4.13	4.10	3.88	3.75	3.54 3	3.58	3.51 3	3.82	\vdash
D26D	4.13	4.02	3.84	3.67	3.57	3.49	3.54	4.07	4.32	4.30	4.39	4.31	4.18	4.10	3.79		\vdash	H		82 3.90	0 4.00
D27S	3.65	3.54	3.36	3.22	3.15	3.07	3.12	3.49	3.81	3.89	4.04	3.91	3.69	3.64	3.34		\vdash	3.32 3			
D27D	3.68	3.57	3.39	3.26	3.18	3.10	3.16	3.52	3.84	3.92	4.01	3.80	3.71	3.62	3.37		_	_			
D28	4.59	4.43	4.18	3.92	3.83	3.64	3.61	4.02	4.90	5.06	5.01	4.86	4.66	4.52	4.31	_					
D29												l	4.92	4.54	4.25	4.05	3.86	\vdash	\vdash	40	<u> </u>
D33								6.50	6.76	6.53	6.55	6.45	6.33		6.34					6.29 6.37	_
D36																					
D38	Dest	Dest	Dest	Dest	Dest	Dest	Dest		6.80	7.27	7.32	7.16	7.01	t	l	H		H	ŀ		
D42	6.27	6.18						6.29	6.53	6.41	6.53	6.53	6.49	6.38				H			
D43	4.95	4.93	4.89	4.72	4.57	4.48	4.57	4.91	5.29	5.34	5.40	5.35	5.29	5.16	5.10	4.80	H	H	H	H	+
D44	5.43	5.33	5.19	5.02	4.90	4.79	4.78	4.97	5.31	5.52	5.68	5.58	5.56	5.42	5.35	5.25	H	5.20 5	5.16	25 5.24	\perp
D45	5.27	5.21	208	4 96	4.85	4 72	4.69	4 99	5.28	5.43	5 49	5.46	5.41	5 33	5.23	5 13	<u> </u>		+	_	╀
046	9.57	77.9	537	5,75	60.9	2 08	7 97	6 17	08.9	18.9	7.21	70.7	5 95	6.87	6.56	6.37	6 22	+	+	6.25 6.40	+
040	0.01	0.30	6.30	0.23	6.09	0.30	0.93	6.10	0.00	7.43	1 7 46	70.7	7.05	0.07	0.30	0.37	+	614	+	+	0.40
747	0.79	0.90	0.30	0.11	0.02	0.50	100	0.19	0.30	7.43	7.40	07:7	7.03	6.79	0.31	+	+	+	+	+	+
D48	p.87	6.63	6.31	6.10	5.99	5.90	2.87	01.0	65.7	7.68	/./3	7.43	7.10	6.83	6.54	6.30	6.11	6.08	6.07	6.11 6.27	b.39
D20		6.62	6.51	6.34	6.22	60.9	6.02	6.36	7.24	7.33	7.30	7.09	6.79	6.82	89.9	+	+	+	+	6.28	+
D51		1				+				+		+						+			+
D52						1				1											
D53																					
D54																+		_			
2M	5.54	5.47	5.37	5.19	5.07	4.94	4.87		5.23	5.57	5.72	5.57	5.64	5.59	5.48	5.32	5.15 5	5.03 4	4.99	4.98 5.06	+
4M	6.30	6.23	6.13	6.02	5.93	5.80	5.77	6.12	6.61	69.9	6.63	69.9	09.9	6.44	6.30	\dashv	+	\dashv	$\frac{1}{1}$	5.95 6.0	-
PB12																	\dashv	\dashv	+	+	+
PB13														4.26	4.68	4.20	4.12 4	4.14 4	4.12 4	4.30 4.21	1 4.25
PB14																+	+	+	+	+	+
				0	0	0	0	100						4.66	5.00	4.46	4.35	4.38	4.38	4.46 4.47	4.51
	3.81	4.38	2.91	2.59	2.63	2.73	3.23	3.85	3.85	4.52	4.65	4.52	3.87	3.37	3.87	+	+	+	+	+	+
14.504	6.73	6.63	6.44	6.25	6.13	6.05	5.94	60.9	60.9	6.72	7.03	6.72	7.05	68.9	7.05	\dashv	+	+	+	6.12 6.14	4 6.18
North Lake	4.72	4.48	4.00	3.92	3.92	3.83	4.19	4.63	5.03	4.87	4.88	4.91	4.81	4.52	4.08	3.81	3.70	3.95	3.85	4.22	
Middle Lake		1						-				-				-	+	+	+	$\frac{1}{1}$	+
MB#1		1	6.25	80.9	5.98	5.65	90.9	6.55	7.24	7.23	7.01	7.23	6.81	09.9	6.81	+	+	$\frac{1}{1}$	9	6.42	+
MB#2			6.32	6.13	6.05	5.70	6.05	6.51	7.18	7.26	7.05	7.26	6.87	89.9	6.87				9	\dashv	1
Ьпшшш		1			1	\dashv	7	\dashv	+	\dashv			+				+	+	4	4.12 4.23	\dashv
P010								+				+	+	+		+	-	+	3	\dashv	8 4.16
D26																			4	4.04	
P016																					
P017																					
P010			 																		
P019																					-
P=20																					
P021								\vdash	\vdash	_		F	r	l		ŀ		L	L	 -	H

D2	6.40	6.29	6.26	6.15	6.11	5.93	5.84	5.85	5.96	D.31	6.50	6.84	9.79	89.9	6.48	6.32	6.02	5.93	2.80	2.80	5.92	0.43
D3	5.23	5.18	5.14	5.04	5.10	4.86	4.76	4.73	4.96	5.52	5.57	5.62	5.63	5.59	5.36	5.26		4.93	4.80	4.95	4.88	5.36
D4	4.89	4.83	4.80	4.77	4.65	4.61	4.43	4.38	4.39	4.53	4.61	4.75	4.85	4.89	4.87	4.74	4.67	4.67	4.55	4.44	4.50	4.66
DS	3.99	3.75	3.64	3.54						3.74	3.90	4.00	4.07	4.08	3.82	3.65		3.43			3.47	3.83
D7	4.88	4.68	4.58	4.37	4.29	4.13	4.04	4.14	4.24	4.58	4.72	4.96	5.04	4.95	4.86	4.73	4.39	4.22	4.12	4.16	4.38	4.74
D10	5.94	5.90	5.86	5.77	5.71	5.64	5.59	5.57	5.61	5.71	5.71	5.86	5.94	5.97	5.94	5.85	5.74	5.70	5.63	5.61	5.57	5.71
D11	6.02	5.94	5.90	5.86	5.77	5.71	5.64	5.59	5.57	5.61												
D12																						
D13																						
D14																						
D16											1	1	+	\dashv	\dagger	1	1					
D17						_					+	1		+	\dagger						1	
D18												1				1						
D19																					1	
D21																						
D22																						
D24																						
D25																						
D26S	3.97	3.64	3.67	3.53	3.34	3.32	3.14	3.11	3.22	3.74	3.91	4.00	4.06	4.07	3.82	3.55	3.46	3.37	3.37	3.37	3.51	3.82
D26D	3.97	3.68	3.65	3.54	3.37	3.31	3.17	3.15	3.26	3.74	3.90	4.01	4.07	4.04	3.82	3.59		3.34	3.28	3.33	3.49	3.83
D27S	3.58	3.26	3.28	3.17	3.10	2.98	2.79	2.77	2.87	3.32	3.48	3.60	3.63	3.61	3.43	3.30		3.05	3.00	3.05	3.15	3.43
D27D	3.57	3.30	3.27	3.16	3.08	2.96	2.82	2.81	2:92	3.29	3.39	3.58	3.62	3.60	3.42	3.29	2.88	3.03	3.01	3.03	3.14	3.41
D28																						
D29																						
D33											6.39	6.61	6.35	6.31								
D36																						
D38																						
D42											6.16						+					
D43	5.05	4.95	4.86	4.64	4.59	4.36	4.18	4.15	4.33	4.64	4.76	5.03	5.14		5.07	4.82	4.53	4.33	4.24	4.27	4.49	4.81
D44	5.27	5.20	5.17	5.06	4.96	4.84	4.73	4.63	4.68	4.86	4.95	5.24	5.37	5.41	5.37	5.26	+	4.88	4.69	4.65	4.74	2.08
D45	5.18	5.05	5.02	4.97	4.88	4.77																
D46	6.37	6.24	6.19	6.12	6.03	5.95	5.87	5.81	5.81	00.9	6.18	6.54	92.9	6.51	6.35	6.20	5.99	5.91	5.83	5.77	5.86	6.21
D47	6.34	6.20	6.11	6.12			5.99			90.9	80.9	6.46	6.49	6.42	6.26	60.9	5.96				5.89	7.13
D48	6.32	6.18	60.9	6.03							6.05	6.40	6.44	6.39	6.25	6.07						90.9
D20																		1		1		
D51																						
D52												1			+							
D53				_							1	\dagger	+	\dagger	\dagger	$\frac{1}{1}$						
D54												0	0		0		+				0	
ZM	5.22	5.14	5.08	5.02	4.95	4.83	4./4	4.6/	4.60	4.72	4.86	5.08	5.26	5.34	5.30	5.22	5.35	4.93	5.11	5.01	5.00	5.14
200	20.00	27.0	20.0	20.0	50.0	60.0	27.0	02.5	3.05	200	2,50	2.22	2 22	25.5	2 27	0.33	+	200.0	2000	20.0	20.0	0.20
rB12 PB13	3.23	3.14 4.13	4 11	3 97	76.7	7.00	4,74	67.7	4.56	4.73	3.12	5.07	5.26	5.32	5.24	3.13	4.57	7.00	7.01	4.62	4.12	4 33
PB14	4.76	4.65	4.62	4.53	4.27	4.13	4.00	3.95	4.10	4.33	4.58	4.70	4.87	4.82	4.82	4.48	4.23	4.14	4.02	4.12	4.26	4.51
PB15	4.49	4.41	4.36	4.29					4.82	5.05	5.21	5.44	5.62	2.67	5.62			4.87		4.81	4.99	5.30
1/90	1.60	3.76	3.54	3.13	3.91	2.62	2.44	2.66	3.18	3.78	3.92	4.18	4.21	4.00	3.72	3.29	2.60	2.70	2.58	3.04	3.42	3.84
2/90	6.20	90.9	6.02	5.96	5.85	5.81	5.76	5.73	5.69	5.75	5.84	5.93	00.9	5.99	6.02	5.89		5.76	5.64	5.59	5.58	5.73
North Lake																						
Middle Lake				$\frac{1}{1}$	$\frac{1}{1}$	$\frac{1}{1}$					1	1	\dagger	1	1	$\frac{1}{1}$	+					
MB#1				_	-	+					+	+	\dagger	+	\dagger	+	+	+	+		1	
MB#2		000		-			;	ç	c i		-			-	0					- (8
Pottonia	4.30	3.96	3.86	3.74	3.65	3.52	3.44	3.43	3.50	3.80	4.17	4.33	4.39	4.42	3.70	3.57	3.36	3.28	3.25	3.42	3.62	3.99
7 10	1.1.4	01.0	3.42	0.00	3.20	3.1/	9.00	0.13	30.0	3.60	3.33	47.7	4.20	4.21	4,75	0.00	0.40	04.0	01.0	0.40	2.03	0.00
PU16	4.22	, 0.0	3.70	3.07	_	3.3/); t	0.30	3.30	0.50	50.1	5 74	4.2,	4.23	3.30	3.03	2.03	000	40.0	5.04	3.71	1
PD17							4.66	4.57	4.60	4.76	4.89	5.13	5.27		5.28	5.18	4.97			4.68	4.79	
P010															5.38	5.27	5.13			5.12	4.99	4.61
P019							5.24				5.01	5.25	5.42	5.45	5.43	5.29	5.12					
P020					_	_			_							_						
															1	+	1					

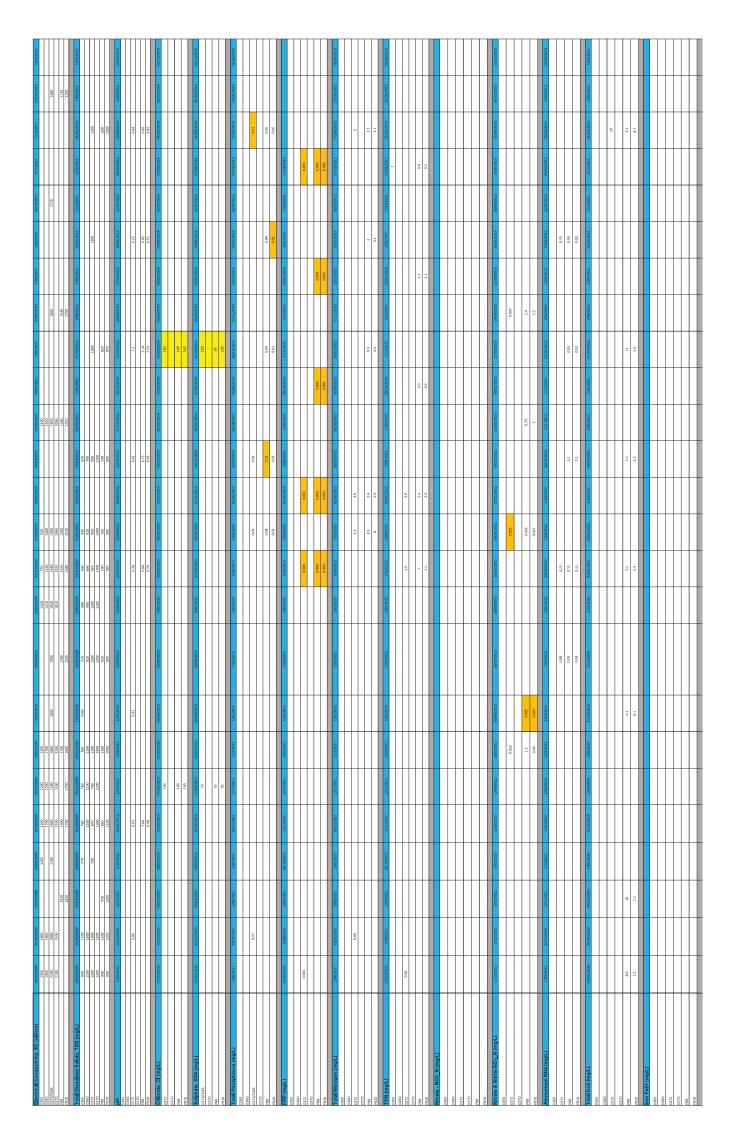
D3 D4 D5 D7 D10 D11		0.37	0.02	6.44	0.32	10.0	0 1	20.0			D./1	0.54	6.94	/.To	7.31	0.93	0.70	6.67	6.52	6.21	6.15
D4 D5 D7 D10 D11	2.28	5.37	5.68	5.30	5.23	5.63	5.28	5.12	5.20			_		L	6.17	5.83	5.64	5.51	5.32	5.21	5.14
D5 D7 D10 D11 D12	4.72	4.77	4.84	4.83	4.77	4.80	4.66	4.58	4.55	4.53	4.72	4.80	5.02	5.10	5.21			5.16	5.05	4.96	4.85
D7 D10 D11 D12	3.86	3.95	4.06	3.91	3.76	3.91	3.68	3.56	3.53	3.50	\vdash	H		H	4.49			4.25	4.00	3.84	3.71
D10 D11 D12	4.80	4.91	4.95	4.83	4.84	5.07	4.73	4.45	4.46	4.45	\vdash	┝	\vdash	┞	5.67			5.29	5.03	4.83	4.54
D11 D12	5.75	5.77	5.81	5.82	5.84	5.84	5.79	5.73	5.67	5.64					6.95			6.89	6.64	6.28	6.31
D12											H	H	<u> </u>	\vdash							
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D25									-												
D26S	3.86	3.96	4.07	3.93	3.65	3.91	3.63	3.52	3.55	3.51	3.91	3.98		4.43	4.50			4.26	3.99	3.83	3.72
D26D	3.86	3.95	4.07	3.91	3.62	3.90	3.66	3.53	3.52	3.48	H	\vdash	H	H	4.50			4.25	3.98	3.82	3.72
D2.75	3.46	3.46	3.54	3.41	3.29	3.44	3.17		3.08	3.07	3.42	+	4.29		4.05			3.70	3.51	3.43	
0220	3 44	3.52	3.57	3.44	3.32	3.46	3.20		3.12	3.08	<u> </u>	_	4.31		4.08			3.75	3.48	3.35	3.29
D28												+							2		
D29		\dagger					\dagger		$\frac{1}{1}$	+	-	+	+	<u> </u>		I			T		
222		6 30	6 20								6 37	6 22	6.45	87.7	716			6 33			
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038																					
D38	1	t	1	ı	1		Ì	1	1		+	+	1	+	100				Ì		
042			0				1	!			+	+	+	0.47	0.78			0			-
D43	4.81	4.94	5.06	4.97	4.81	4.93	4.74	4.45	4.44	4.48	5.04	5.07	5.34	+	5.63	+		5.26	4.91	4.69	4.61
D44	5.12	5.25	5.73	5.20	5.08	5.23	5.04	4.89	5.41	4.86	+	+	+	+	5.89			5.78	5.33	5.17	2.
D45											+	+		+							
D46	6.24	6.31	6.37	6.27	6.18	6.32	6.20	5.97	5.91	5.91	6.24	6.27	6.72	6.92	7.31			6.84	6.58	6.51	6.29
D47	6.04	6.24	6.28																		
D48	60.9	6.17	6.26																		
D50																					
D51																					
D52																					
D53																					
D54																					
2M	4.96	5.07	5.44	5.50	5.51	5.49	5.46	5.09	4.99	4.92	5.19	5.11	5.36		2.67			5.77	5.59	5.45	5.27
4M	6.05	6.10	6.73	6.46	6.37	6:39	6.35	6.26	00.9	5.92					6.84			6.92	6.74	98.9	6.18
PB12	3.18	3.23	3.29	3.18	3.21				2.97	2.99		_			3.80			3.66	3.45	3.27	3.10
PB13	4.44	4.51	4.61	4.54	4.47		4.31	4.18	4.52	4.36		4.56			5.13			4.89	4.64	4.49	4.37
PB14	4.61	4.68	4.77	4.68	4.52	4.54	4.44	4.20	4.30	4.24	4.50	_		_	5.33			5.08	4.74	4.55	4.48
PB15	4.67	4.85	4.91	4.87	2.64				4.45	4.32			5.29		5.53			5.18	4.75		4
1/90	3.95	4.22	4.33	3.92	3.68	3.65	3.08	2.80	2.90	3.03		3.99		4.75	4.87	4.60	3.89	3.57	3.04	2.79	2.86
2/90	5.73	5.68	5.79	5.80	5.81	5.83	5.73	5.70	5.64	5.61					09.9	86.9	7.01	6.87	99.9	6.51	6.36
North Lake																					
Middle Lake																					
MB#1																					
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Pomoo	3.99	4.10	4.28	3.98	3.67	3.89	3.86	3.74	3.53	3.62	4.09	4.13	4.32	4.71	4.77			4.27	4.07	3.91	3.87
P010000	3.98	4.07	4.16	4.06	3.70	3.84	3.80	3.47	3.49	3.63		_		_	4.67			4.17	4.34	3.76	3.86
D56	4.05	4.15	4.27	4.14	3.91	4.07	3.88	3.72	3.69	3.69	H				4.75			4.43	4.14	4.01	3.91
P=16		5.02	5.03	4.95			4.74		3.09	4.47	\vdash	5.00		_	5.58			5.16	4.87		4.54
P017	5.04	5.16	5.25	5.16			4.96			4.75	├	\vdash	H	H	5.73			5.49	5.26		5.1
P010	4.69	4.80	4.84	4.89	2.38		4.98		3.12	4.45	4.71			5.18	5.38			5.21	5.01		4.65
P019										4.59	4.88	H	5.27		5.57			5.35	5.12	5.02	4.87
P=20																					
PU21		T						\vdash	\vdash	H			-			l					

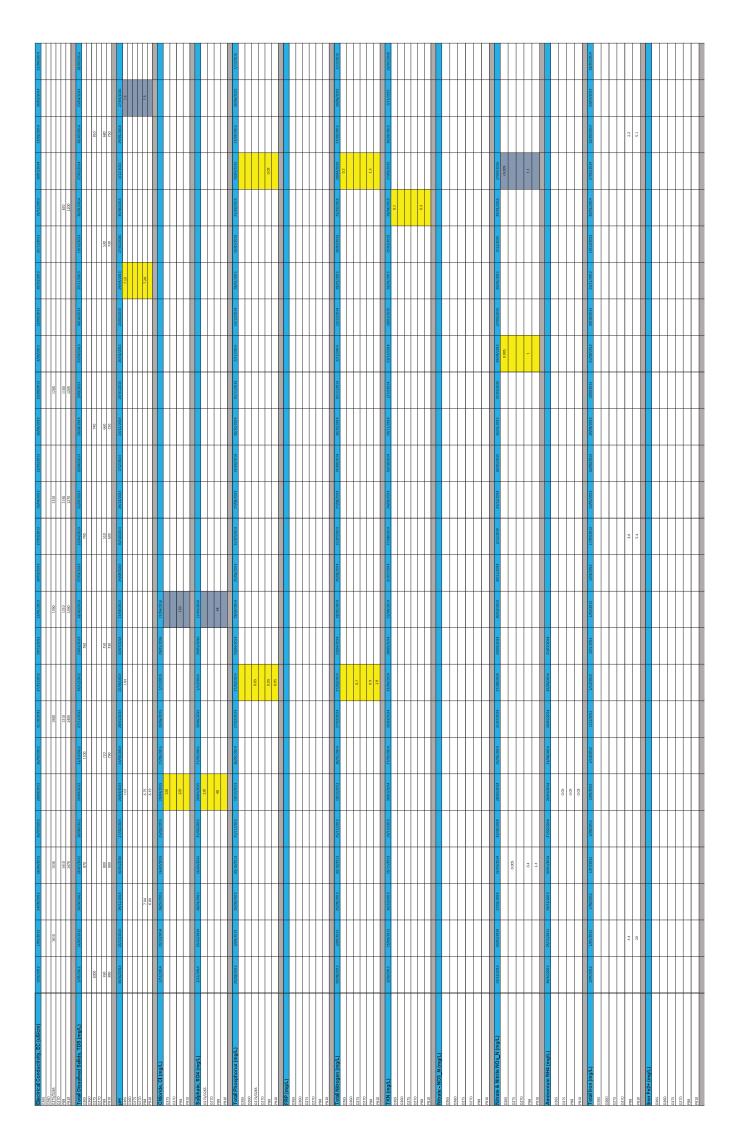
D3 D4 D5 D7 D10		5	98.9	6.97	7.01	56.9	9	99.9	_	6.37	0.15	00.0	5.95 6.14	6.35	0.47	0.30	17.9	6.10	5.98	90.9
D4 D5 D7 D10	2.06	5.83	5.75	5.76	5.83	5.81	5.57	5.47									5.19	5.19	5.07	5.27
D5 D7 D10	4.80	4.94	2.00	5.09	5.12	5.20	5.17	5.13		5.02	4.89 4	4.76 4	4.69 4.70		3 4.81		4.86	4.85	4.61	4.55
D7 D10	3.63	4.07	4.14	4.22	4.29	4.33	4.26	4.18			_						3.78	3.71	3.57	3.65
D10	4.46	4.97	5.09	5.15	5.19	5.27	5.26	5.13			4.73 4			53 4.72			4.85	4.64	4.45	4.46
	6.17	6.21	6.24	6.45	6.71	7.02	6.99	88.9									6.16	6.04	5.95	5.87
D11																				
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D26S	3.63	4.06	4.16	4.22	4.30	4.34	4.28	4.18			3.77 3		3.56 3.60				3.78	3.70	3.60	3.65
D26D	3.63	4.08	4.15	4.22	4.30	4.33	4.26	4.18		3.95	3.76 3	3.61 3	3.55 3.6	3.80	3.85	3.88	3.78	3.70	3.59	3.6
D27S							3.76													
D27D	3.24	3.60	3.66	3.83	3.88	3.93	3.80	3.70		3.49	3.31 3	3.20	3.15 3.23	3.36	3.41	3.45			4.14	3.82
D28																				
D29																				
D33		6.39	6.44	6.44	6.54	6.47	6.45							6.24	_	6.28				
D36																				
D38																				
D42																				
D43		5.11	5.21	5.29	5.39	5.39	5.31	5.06		H	\vdash	ł	H	\vdash	F	H	4.74	4.62	4.56	4.6
D44	5 01	5.40	5.37	5 59	5 66	5 70	5.48	5 43		5 19	5.21	4 86	4 86 5.05	517	5 15	5 13	4 99	4 91	477	4 80
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D47																				
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D52																				
D53																				
D54																				
2M	5.42	5.15	5.30	5.43	5.49	5.59	5.63	5.86			5.32 5	5.17 5	5.12 4.97		9 5.00	\dashv	5.29	5.16	90'9	5.22
4M	6.22	6.33	6:39	6.46	6.46	6.52	09.9	6.52		1	1		1	-	+	+	6.31	6.04	5.97	6.2
PB12	3.10	3.71	3.39	3.59	3.70	3.82	3.65		3.47	3.19	3.03	1	3.07 3.1	1	3.32	3.25	3.14	5.02	2.91	5.5
PB13	4.33	4.62	4.81	4.90		5.18	4.93		4.69	+	+	+	1	+	+	+	4.25		3.99	4.3
PB14	4.39	4.67	4.91	5.04	5.13	5.19	5.08		4.83	+	+	+	4.42 4.55	+	4.80	+	4.35	4.24	4.14	4.12
PBI3		4.92	3.06	3.24	3.30	5.37	3.20	.00	4.30	7.43	4.23	4.1/	4.04	4.74	+	4.03	4.22	C	4.TO	Ü,
06/T		3.88	4.28	4.42	4.60	4.62	4.29	3.92		+	+	+	+	+	+	+	2.95	2.11	7:27	7.07
2/ 30		0.29	16.0	0.43	0.07	0.93	7.04	0.30	+	+	+	+	+	+	+	+	07.0	0.13	0.00	2
Middle lake								+			+				_					
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B B B B B B B B B B B B B B B B B B B	3.68	4.27	4.33	4.41	4.49	4.53	4.64	<u> </u>	4.26	4.01	3.93	3.75	3.63	73 3.97	4.01	5.03	3.89	3.89	3.76	3.7
P010	3.60	4.22	4.29	4.38	4.43	4.51	4.43		4.23	-	\vdash		.68 3.82			\vdash	3.02	3.83	3.74	3.79
D56	3.87	4.31	4.38	4.45	4.52	4.56	4.49	4.36									4.06	3.92	3.86	3.8
P016		5.02	5.14	5.19	5.21	5.27	5.21		5.01		4.94					\vdash	4.72	4.49	4.43	4.4
P017		5.32	5.38	5.49	5.59	5.65	5.52		5.30					L		\vdash	4.92	4.90	4.81	4.8
P010	4.72	4.93	4.99	5.15	5.19	5.25	5.18		5.02	4.79	5.23 5	5.58 5	5.21 4.7		4.87	4.80	4.69	5.69	6.03	5.7
P=19	4.85	5.11	5.21	5.33	5.36	5.40	5.31		5.17								4.72	4.63		4.46
P□20																				
P021														L			L			

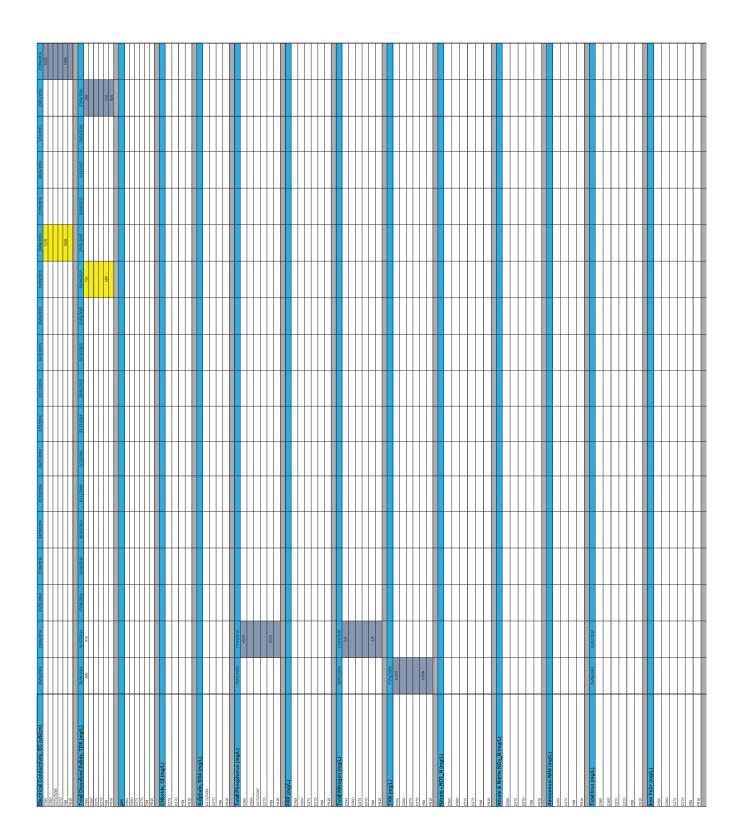
8.42 DD2 6.74 6.53 7.06 DB3 5.72 5.93 7.03 D4 4.58 4.64 6.01 D7 4.50 4.64 8.07 D10 3.61 3.86 8.07 D10 3.61 3.86 8.07 D10 3.85 4.60 4.87 8.07 D10 3.85 4.60 4.87 8.07 D10 5.85 5.83 4.02 8.07 D10 5.85 5.83 4.02 8.03 D10 5.85 4.02 7.02 8.04 D2 D10 5.85 4.02 8.05 D24 D27 3.83 4.02 8.04 D25 3.63 3.87 6.26 8.04 D24 D27 3.83 4.02 8.04 D24 D27 3.85 4.02 8.04 D24 D27 3.85 4.02					
D3 3.27 5.29 D4 4.58 4.64 D5 3.61 3.86 D11 5.85 5.83 D12 D13 4.60 4.87 D13 5.85 5.83 D14 5.85 5.83 D15 D14 7.85 D24 5.39 D25 3.62 3.87 D26 3.63 3.62 3.87 D27 3.63 3.87 D28 3.62 3.87 D28 3.63 3.87 D29 D29 D39 B38 4.02 D30 D30 B38 D42 4.95 5.06 D40 D41 4.95 5.06 D40 D42 4.95 5.06 D40 D41 A.95 5.06 D40 D42 A.78 D41 D48 D42 C.29 6.25 D53 D54 D44 4.95 5.06 D51 D51 C.29 3.11 D84 C.29 6.52 D54 A.M 6.29 6.52 D54 A.M 6.29 6.52 D54 A.M 6.29 6.50 North Lake Middle Lake Middle Lake Middle Lake Middle Lake Middle Lake Middle Lake Middle Lake Middle Lake Middle Lake D56 5.98 4.01 D56 3.89 4.11 D56 4.69 D57 A.89 4.98 D57 A.89 D57 A.8	8.25	70	6.24	6.39	4,70
D4 4.58 4.64 D5 3.61 3.86 D7 4.60 4.87 D10 5.85 5.83 D11 0.013 D13 4.64 4.87 D24 0.02 D25 0.02 D26 3.63 3.87 D275 3.63 3.87 D275 3.62 3.87 D275 3.63 3.87 D275 3.62 3.87 D275 3.63 3.87 D276 3.63 6.26 D38 0.38 D44 4.95 5.06 D44 4.95 5.06 D44 4.95 5.06 D45 0.48 D45 0.62 D52 0.62 D52 0.62 D48 0.78 D48 0.78 D48 0.78 D48 0.78 D49 0.78 D49 0.78 D50 0.79 D50 0.79 D50 0.79 D71 0.79 D72 0.79 D73 0.79 D74 0.79 D75 0.79 D75 0.79 D76 0.79 D77 0.79 D77 0.79 D78 0.79 D78 0.79 D78 0.79 D78 0.79 D79 0.7	7.96	D3	2.7/	5.59	3.66
D5 3.61 3.86 D7 4.60 4.87 D10 5.85 5.83 D11 6 4.87 D12 D12 D13 D14 D14 D16 D17 D18 D18 D24 D24 3.62 3.87 D25 3.85 4.02 D25 3.85 4.02 D27 D26 3.85 4.02 D28 3.87 D27 D26 3.63 3.87 D27 D26 3.85 4.02 D28 D44 4.95 5.06 D44 4.95 5.06 D44 4.95 5.06 D45 D45 6.23 6.26 D45 D45 6.23 6.26 D47 D45 6.23 6.26 D48 D45 6.23 6.26 D54 D45 6.23 6.26 D54 D45 6.23 6.26 D54 D45 6.23 6.26 D54 D45 6.23 6.26 D54 A78 5.23 4.97 D54 A78 5.23 4.97 D55 A78 D67 A8B A78 D67 A78 D77 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A78 D78 A	7.03	D4	4.58	4.64	4.78
D12 D13 D14 D15 D15 D17 D18 D19 D19 D19 D19 D21 D22 D26 D27 D26 D27 D28 D28 D28 D28 D28 D28 D28 D28 D28 D28	5.03	DS	3.61	3.86	4.04
D10 5.85 5.83 D11 D12 D12 D13 D14 D15 D15 D17 D18 D19 D19 D21 D22 D22 D24 D25 D26 D25 D26 D27 D27 D28 D27 D28 D29 D33 D38 D44 D43 D43 D47 D48 D48 D53 D54 D48 D54 D48 D54 D48 D54 D48 D54 D48 D54 D48 D54 D48 D54 D48 D54 D54 D48 D57 D54 D57 D57 D58 D58 D67 D78 D79 D79 D79 D79 D79 D79 D79 D79 D79 D79	70	70	7 60	187	7 03
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D11 D12 D13 D13 D14 D15 D15 D17 D18 D19 D21 D22 D24 D25 D26 D27 D27 D27 D27 D27 D27 D27 D27 D27 D27	12.03	DIO	5.85	5.83	5.91
D12 D13 D14 D16 D17 D16 D17 D17 D19 D21 D22 D22 D24 D25 D26S B26S B27S B27S B27S B27S B27S B27S B27S B27	7.12	D11			
D13 D14 D15 D16 D17 D18 D18 D19 D27 D27 D26 D26 D26 D27 D27 D27 D27 D27 D28 D27 D28 D28 D29 D47 D47 D47 D47 D48 D52 D54 D48 D54 D48 D54 D48 D54 D48 D54 D48 D54 D48 D57 D58 D68 D89 D81 D81 D81 D81 D81 D81 D81 D81 D81 D81	8.07	D12			
D14 D14 D16 D17 D18 D19 D19 D21 D24 D24 D25 D265 D265 D265 D27 D27 D28 D28 D28 D28 D28 D42 D42 D42 D42 D43 D43 D44 D43 D44 D48 D53 D64 D64 D64 D64 D64 D64 D64 D64 D64 D64	8.25	D13			
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D19 D22 D24 D25 D26 D26 D26 D26 D26 D27 D27 D28 D28 D29 D38 D42 D42 D43 D43 D42 D44 D44 D49 D43 D47 D49 D48 D51 D53 D53 D53 D53 D64 D48 D65 D64 D48 D65 D79 D79 D79 D79 D79 D79 D79 D79 D79 D79	8.72	D18			
D21 D22 D24 D25 D26 D26 D27 D27 D27 D27 D27 D27 D27 D27 D27 D27	7 0 7	D19			
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D24 D25 D26S S25 D26C S25 D26C S27 D27 D28 D23 D23 D23 D23 D33 D34 D42 D43 D42 D44 D45 D42 D44 D45 D45 D48 D53 D54 D54 D54 D54 D54 D54 D54 D54 D54 D54	6.03	D22			
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D255 D256 D275 D275 D275 D275 D275 D278 D28 D29 D29 D39 D33 D34 D44 D44 D44 D47 D47 D47 D47 D48 D52 D53 D53 D54 D47 D48 D52 D53 D54 D48 D52 D53 D54 D48 D50 D51 D52 D53 D54 D48 D50 D51 D52 D53 D54 D48 D48 D48 D48 D48 D48 D50 D51 D52 D53 D54 D48 D50 D51 D52 D53 D54 D48 D48 D48 D48 D49 D48 D50 D51 D52 D53 D54 D50 D51 D52 D53 D54 D48 D57 D48 D58 D59 D50 D51 D50 D51 D50 D51 D50 D51 D50 D51 D50 D51 D50 D51 D50 D51 D50 D51 D50 D51 D50 D51 D50 D50 D51 D50 D50 D50 D50 D50 D50 D50 D50 D50 D50	1 0	1 0			
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D27D D28 D28 D29 D29 D29 D29 D29 D38 D42 D43 D43 D44 D43 D44 D45 D44 D45 D44 D47 D48 D46 D50 D50 D50 D53 D53 D53 D54 D54 D48 D55 D53 D53 D54 D57 D57 D58 D58 D58 D59 D59 D59 D59 D59 D79 D79 D79 D79 D70 D70 D70 D70 D70 D70 D70 D70 D70 D70		3200			
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D29 D33 D36 D37 D42 D43 D42 D43 D44 4,95 5,39 D44 D45 D45 D47 D48 D51 D52 D53 D53 D54 AM C,29 C,29 C,26 D54 AM C,29 C,29 C,20 D54 AM C,29 C,29 C,20 D54 AM C,29 C,29 C,20 AM C,20 C,20 AM C,20 AM C,20	7.04	D28			
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D38 D42 D43 4,78 D44 4,95 D45 D46 C,23 C,26 D48 D48 D50 D51 D52 D53 C,29	7.80	D36			
D42 D43 D44 D44 D45 D44 D45 D47 D46 D47 D48 D46 D47 D48 D50 D51 D52 D53 D53 D54 D54 D54 D57 D57 D58 D58 D58 D58 D59 D59 D59 D59 D59 D59 D59 D79 D79 D79 D79 D70 D70 D70 D70 D70 D70 D70 D70 D70 D70	0 62	D38			
D42 D43 D44 D43 D47 D44 D45 D45 D45 D46 D47 D48 D50 D51 D52 D53 D54 ZM D53 D54 ZM AM 6.29 C.29 3.11 PB13 PB14 A.32 PB15 PB15 PB15 PB15 S29 3.11 PB17 AMB#1 A32 S4.01 D56 S.98 A.11 PB17 AMB#1 A38 A.01 D56 S.98 A.11 PB17 A48 A.89 A.11 PB17 A48 A.89 A.11 PB17 A48 A.89 A.11 PB17 A48 A.89 A.11 PB17 A 489 A.18 PD18 D56 A.99 A.11 PB17 A 489 A.18 PD19 D56 A.90 A.90 A.90 A.90 B-70 A.90 A.90 A.90 A.90 B-70 A.90 A.90 A.90 A.90 B-70 B-70 B-70 B-70 B-70 B-70 B-70 B-7	3.02	222			
D43 4.78 5.06 D44 4.95 5.06 D45 6.23 6.26 D48 6.23 6.26 D47 D48 D51 D52 D53 D53 D54 AM 6.29 6.52 AM 6.29 6.52 PB13 6.29 7.99 3.11 PB14 4.32 4.51 PB15 4.82 5.08 North Lake Middle Lake Middle Lake Middle Lake Middle Lake Middle Lake Middle Lake Middle Lake Middle Lake PD101111 3.85 4.01 D56 PD10111 3.85 4.01 D56 PD10 4.69 PD10 4.69 PD10 4.69	10.32	D42			
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D45 D46 D46 D47 D48 D48 D48 D48 D50 D51 D52 D53 D54 S497 S49 S497 S491 S497 S491 S492 S451 S491 S492 S498 S401 S494 S496 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S496 S498 S401 S498 S401 S498 S401 S498 S401 S498 S401 S498 S401 S498 S401 S401 S401 S401 S401 S401 S401 S401	7 25	777	7 05	202	5 22
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D47 D48 D48 D50 D51 D52 D53 D53 D54 2M 5.23 4.97 AM 6.29 6.52 AM 6.29 6.52 AM 6.29 6.52 AM 7.90 7.99 7.99 7.99 7.90 7.99 7.90	8.33	D46	6.23	6.26	6.52
D48 D50 D51 D52 D53 D53 D53 D54 D554 D554 C2M S.23 C4.97 AM 6.29 6.52 PB12 PB13 PB14 A.32 A.51 PB15 PB15 A.82 S.08 A.11 PB15 A.82 S.08 A.12 PB16 A.82 S.96 S.96 S.96 S.96 S.96 S.96 S.96 S.96	8.53	D47			
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D53 D54 D55 D54 D54 D55 D75 D75 D75 D75 D75 D75 D75 D75 D75	TRS	N52			
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AM	24.96	NC MC	5.23	4.97	5.39
PB12 2.99 3.11 PB13 2.99 3.11 PB14 4.32 4.51 PB15 4.82 5.08 1/90 3.25 3.60 2/90 5.96 5.98 North Lake Niddle Lake Middle Lake NB#1 MB#2 3.78 4.08 PUTITION 3.85 4.01 D56 3.89 4.11 D56 3.89 4.14 PUTI 4.89 4.98 PUTI 4.45 4.56 PUTI 4.45 PUTI 4.60 4.60 PUTI 4.		1417	21.0		0 0
PB12 2.99 3.11 PB13 4.32 PB14 4.32 4.51 PB15 4.82 5.08 1/90 3.25 3.60 2/90 5.96 5.98 North Lake Middle Lake Middle Lake Night 2 PUTUTE 3.78 4.08 PUTUTE 3.89 4.01 PUT 4.89 4.98 PUT 4.89 4.56 PUT 4.89 4.56 PUTU 4.45 4.56	11.05	4M	6.29	6.52	6.27
PB13 4.32 4.51 PB14 4.32 4.51 PB15 4.82 5.08 1/90 3.25 3.60 2/90 5.96 5.98 North Lake Middle Lake MB#1 MB#2 PUITTIL 3.78 4.08 PUITTIL 3.85 4.01 D56 3.89 4.11 D66 3.89 4.14 PUT 4.89 4.98 PUT 4.45 PUT 4.50	TBS	PB12	2.99	3.11	3.22
PB15 PB16 PB17 PB17 PB17 PB17 PB18 A82 5.08 1/90 3.25 3.60 2/90 S.96 S.96 S.98 North Lake Middle Lake Middle Lake NB#1 NB#2 PDITITIN 3.78 PDITITIN D56 3.89 4.01 PD 66 3.89 4.11 PD 7 PD 7 PD 7 PD 7 PD 7 PD 7 PD 7 PD 7	TDC	1111			00 5
PB14	183	PBI3			4.89
1/90 3.25 5.08 1/90 3.25 3.60 2/90 5.96 5.98 North Lake Middle Lake Middle Lake MB#2 4.08 POTITION 3.78 4.08 POTITION 3.85 4.01 D56 3.89 4.14 PUT 4.89 4.98 PUT 4.45 4.56 PUT 4.50 4.60 PUT 4.50 4.69 PUT 4.60 4.60 PUT 4.60 4.69 PUT 4.60 4.60 PUT 4.60 4	TBS	PB14	4.32	4.51	4.67
1/90 3.25 3.60 2/90 5.96 5.98 North Lake	TRS	PR15	4.82	5.08	5 30
179U 3.25 3.50 2/90 5.96 5.98 North Lake	4 4 40 4	007.5			
North Lake North Lake North Lake Middle Lake North Lake No	14.484	1/30	3.25	3.00	3.94
North Lake North Lake North Lake NM#1 NM#1 NM#2 A.08 A.01 D.56 3.89 4.11 D.56 3.89 4.11 D.16 A.54 A.74 D.17 A.89 A.98 D.17 A.89 A.56 D.17 A.60 A.60 A.60 A.60 D.70 D.70 A.60 A.60 A.60 D.70 D.70 A.60 A.60 A.60 D.70 D.7	14.504	2/90	5.96	5.98	00.9
Middle Lake MB#1 MB#2 PUTITION BY 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2 00	North Take			
MODIE LAKE MB#1 MB#2 PDITTUTE PDITTUTE D56 3.89 4.11 PDITT PDITT 4.69 4.64 4.65 PDITT 4.89	0010	2007 10 10 10 10 10 10 10 10 10 10 10 10 10			
MBH1 MBH2 PUILLINI D56 3.78 4.08 PTIOTITIE 3.85 4.01 PTIO PTIO PTIO 4.89 4.74 4.89 PTIO PTIO 4.89 4.56 PTIO 103	IVIIddie Lake				
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3.78 4.08 3.85 4.01 3.89 4.11 4.64 4.74 4.89 4.98 4.45 4.56 4.60 4.69	7.83	MB#2			
D56 3.85 4.01 P16 4.64 4.74 P17 4.89 4.98 P11 4.45 4.56 P11 4.45 4.56 P11 4.60 4.69		Ьпшш	3.78	4.08	4.21
Port 4.69 4.69 4.69 4.69		4 111	2 0 5	100	717
3.89 4.11 4.64 4.74 4.89 4.98 4.45 4.56 4.60 4.69		111	0.00	1.0	4.17
4.64 4.74 4.89 4.98 4.45 4.56 4.60 4.69		D56	3.89	4.11	4.24
4.89 4.98 4.45 4.56 4.60 4.69		P=16	4.64	4.74	4.99
4.60 4.69		2007	00 1	00 1	17
4.45 4.56		/101	60.4	4.30	3.12
4.60 4.69		PUI	4.45	4.56	4.70
		P019	4.60	4.69	4.92
1		DCDG			
07.1					
200					

Appendix D Groundwater Quality Monitoring Data

1800 2000 2000 1300 1200	8004/2009 820 1100 1300 1300 1300 830 790	1/08/2011		31/10/2012		31/10/2012			1/05/2011				1)05/3011			1)05/2011				1/06/2011							26/10/2011				1/08/2011			23/10/2009			10				
1700 1500 2000	03/200 810 1100 1200 1300 730	6.97	7.05	29/2012		09/2012			04/2011	900	50'0	000	15/2011			04/2011		1.7	116	15/2011							19/2011			H	1102/20	6970		6007/60			5.3		$\frac{ }{ }$	$\frac{1}{1}$	
1900 2100 1900 1700	38	6/2011 27/6		18/2012 26/0		8/2012 26/			102/10	0.13			N/2011 1/0			102/10		1.6		M/2011 1/0	1.7	358					8/2011 1/0				7/22 1102/9		H	37/2009 24/8			69		+		_
2100 2 2400 2 2 2400 1 1 1	960 23/0 960 3 1300 3 1400 2 1500 1 1000 1	1/0		17/2012 28/0		2802			0/2010	80'0			3/2011 19/0			0/102/0		113		19/01	1.6						1/2011 1/02	2.005			0/1 1/02/5			6/2009 23/0			55		+	$\frac{1}{1}$	
1800	830 830 1200 1200 1100 1	04/2011 24/t	7.6	06/2012 26/0		06/2012 26/0			07/2010 26/1	0.12			1/02/2011			07/2010 26/1		2		31/2	13						36/2011 27/0		+		04/2011 1/0	1.6	0.28	05/2009 25/0			13			$\frac{1}{1}$	
1800 1700 2100	730 730 1200 1100 1300	/02/2011 15)		230	160	150	26	88 88	/04/2010 22/	0.03	0.21	0.16	/01/2011 1/	0.02		/04/2010 22/		13	1.3	/07/2010 26,	2						705/2011			H	(01/2011 19)	0.59	H	/03/2009 28,			9.5		H	$\frac{1}{1}$	_
1800 1400 2200	730 730 1100 880 1300	8,1	8.1	1/04/2012 1		004/2012			20.02/2017	0.04			31/02/2010	0.005		X 0102/2010		111		0/04/2010 22	1.3	1.3					9/04/2011 1	0.009	1.1	0.89	6/10/2010 31	0.82	H	3/01/2009 26	ct.		8.2		H	$\frac{1}{1}$	_
1900 1300 2100	800 800 1200 850 1400	3,710/2010 3	7.6	1/03/2012		1/03/2012			23/10/2009 1	0.01			13/10/2009	0.005		33/10/2009		1.4		17/02/2010 2	111						31/01/2011 1	0.04			22/07/2010 2	9670		20/11/2008 2	777				H	$\frac{1}{1}$	_
1700 1200 2000	780 780 1100 770 1300	8.3		1/02/2012		1/02/2012			24/09/2009	0.15			24/09/2009	0000		24/09/2009		1.3		23/10/2009	1.3						26/10/2010	9000			20/04/2010	0.87	0.092	6/11/2008					H	H	_
1900 1200 2100 1500 2000	9007/2008 990 1200 800 1400 960 1300	20/04/2010	7	1/01/2012		1/01/2012			26/08/2009	0.01			26/08/2009	0.005		26/08/2009		1.3		24/09/2009	1.2						22/07/2010	900'0	+		17/02/2010	0.86		27/08/2008	70%						_
2000 1700 2200 1800 2100	25/06/2008 890 1300 1100 1400 1400	7,02/2010		1/12/2011		1/12/2011			23/07/2009		0.07	50'0	23/07/2009		70'0	23/07/2009			0.9	26/08/2009	0.63						20/04/2010	0.033	0.045	0.51	23/10/2009	0.61		30/07/2008			9 9 9				
1700 1300 1400 1000	23/05/2008 780 11100 830 910 650 710	19/01/2010 7.35 7.2 7.45	7.45	1/11/2011		1/11/2011			25/06/2009		0.38	1000	25/05/2009		0.005	25/06/2009			0.46	23/07/2009		0.88					17/02/2010	800			24/09/2009	0.41		25/05/2008	77 88	7.3	9.1		Ħ	Ħ	_
3900 3600 1800 2000	23/04/2008 820 1200 1200 1100 1200 1300	25/10/2009 7.5 7.15 8.2	111	26/10/2011		26/10/2011			28/05/2009		0.36	0,01	28/05/2009		0.005	28/05/2009			0.44	25/06/2009		0.66	8			001	0.0	0.047		I	26/08/2009	0.21		23/05/2008		- 1 - 1	9.2		Ħ		
1900 1900 2200 1600 1800	27/03/2008 940 1200 1200 1400 1000 1200	24/09/2009 7.05 6.9 7.25	6.75	1/09/2011		1102/60/1			30/04/2009		0.07	10'0	30/04/2009		0.005	30/04/2009			0.34	28/05/2009		0.64	28/05/2009			001	24/09/2009	0.031			23/07/2009	31.0	0.32	23/04/2008			7.3		Ħ		
1900 1900 2200 1700 1900	27/02/208 900 1200 1200 1400 1400 1100	26/08/2009 7.3 7.5		1/08/2011		1/08/2011			26/03/2009		0.15	1000	26/03/2009		0000	26/03/2009			0.33	30/04/2009		0.31	30/04/2009			10 00	26/08/2009	80'0			25/05/2009	600	0.12	27/03/2008			1000				
1900 1700 2300 1600 2000	17/01/2008 1000 1200 1100 1500 1500 1300	23/07/2009	6.36	240		22/02/2011	120		23/02/2009				23/02/2009			23/02/2009	0.35			26/03/2009		0.31	26/03/2009			<0.1	23/07/2009		0.017	0000	28/05/2009	010	0.15	27/02/2008			0.07		Ħ		
1900 1600 2200	20/12/2007 730 1200 1100 1400	7,15		1/06/2011		1/06/2011			23/01/2009		0.03	10'0	23/01/2009		0.005	23/01/2009			0.42	23/02/2009			23/02/2009	40.1	0.2		25/06/2009		0.005	0.0006	30/04/2009	800	650'0	17/01/2008							
1800 1500 2200 1600 2200	22/11/2007 700 1200 990 1400 1400 1400	27/08/2008		1/05/2011		1/02/2011			20/11/2008				20/11/2008			20/11/2008	0.19			23/01/2009		0.38	23/01/2009			0.2	28/05/2009		9000	900'0	26/03/2009	610	0.072	20/12/2007							
1900 1300 2300 1400 2300	~	NI III	7.55	19/04/2011 240	190	19/04/2011	120	49	6/11/2008				6/11/2008			6/11/2008				20/11/2008			20/11/2008	40.1			30/04/2009		0.032	0.15	23/02/2009			22/11/2007	18 18	1.7	8 8	23/02/2009	4000		
2100 2100 2300 2300	20/09/2007 800 1200 550 1400 650 1500		7.45	20/04/2010	280	20/04/2010	76	140	27/08/2008				27/08/2008			27/08/2008	0.23			6/11/2008			6/11/2008				26/03/2009		0.017	0.15	23/01/2009	010	0,11	24/10/2007				23/01/2009			
1900 1700 1300	15/	24	7.15	23/02/2009	440	23/02/2009	90 00		25/05/2008		7000	000	25/05/2008		0000	25/06/2008			0.25	27/08/2008			27/08/2008	9			23/02/2009	\$1000	0.1		6/11/2008			20/09/2007			6.9	20/11/2008			
1800 2000 1500 1600	27/07/2007 30 1200 1100 1300 1900		7.25	25/06/2008	290	25/06/2008		59	22/11/2007	90'0	0.14	0.03	0.005	0.003	0.005	22/11/2007	0.35	1.4	0.35	22/11/2007	0.18	0.38	22/11/2007	0.7	8.0	10 0	25/06/2008		0.1	0.1	25/06/2008		0.11	27/07/2007			10.0	25/06/2008	0.01	0.01	0.01
	olved Solids, TDS (mg/L)								JL)																		I (mg/L)														







No. of Samples	No. of Samples 218	No. of Samples	No. of Samples	No. of Samples	No. of Samples	No. of Samples	No. of Samples	No. of Samples	No. of Samples	No. of Samples	No. of Samples 45	No. of Samples	No. of Samples
10th Percentile 1100	10th Percentile 700	10th Percentile 6.7	10th Percentile 124			10th Percentile 0.005	10th Percentile 0.29	10th Percentile 0.20	10th Percentile 0.10	10th Percentile 0.01	10th Percentile 0.04	10th Percentile 0.73	10th Percentile 0.01
90th Percentile 2100	90th Percentile 1300	90th Percentile 7.5	90th Percentile 322	90th Percentile 136.0	90th Percentile 0.14	90th Percentile 0.005	90th Percentile 2.24	90th Percentile 2.09	90th Percentile 0.70	90th Percentile 1.10	90th Percentile 0.84	90th Percentile 12.80	90th Percentile
Max 3600	Max 1500	Max 8.3	Max 440	Маж 250.0	xeM 0.38	Max 0.070	Max 8.10	7.10	Max 0.80	Max 1.40	Max 1.60	Max 69.00	Max 0.01
Min 730	Min 280	Min 6.2	Min 120	Min 44.0	Min 0.01	Min 0.005	Min 0.19	Min 0.03	Min 0.10	Min 0.00	Min 0.02	Min 0.01	Min 0.01
Median 1610	Median 995	Median 7.2	Median 180	Median 97.0	Median 0.04	Median 0.005	Median 0,90	Median 0.57	Median 0.60	Median 0.03	Median 0.12	Median 7.20	Median 0.01
Mean 1620	Mean 1000	Mean 7.2	Mean 210	Mean 94.6	Mean 0.06	Mean 0.008	Mean 1.31	Mean 1.10	Mean 0.43	Mean 0.29	Mean 0.31	Mean 9.35	Mean 0.01
All Bores →	All Bores ↓	All Bores ↓	All Bores →	All Bores →	All Bores 👃	All Bores →	All Bores ↓	All Bores 4	All Bores 4	All Bores ↓	All Bores →	All Bores 🕹	All Bores 🕹
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le 10th Percentil 1100 11480 1200 1900 1200	10th Percentil 626 626 626 601 764 7100 590 590 740	10th Percentil 7.1 7.0 6.7 6.5 6.5	le 10th Percentil 162 440 120 140	10th Percentil 89 90 97 97	10th	10th Percentil 0.0	a		10th	le 10th Percentil 0.0 0.0 0.0 0.1 0.0 0.0 0.0	le 10th Percentil 0.2 0.3 0.3 0.1	9	10th Percentil 0.01
90th Percenti 1500 1500 2000 2300 1700 1700 2310	90th Percenti 987 1200 1300 1400 1100 1350	90th Percenti 7.6 7.4 8.0 8.0 7.4 7.4 7.6	90th Percenti 336 440 283 230	90th Percenti 132 90 63 195	90th Percent 0.1 0.0 0.1 0.1 0.1 0.1 0.1	90th Percentil 0.0 0.0 0.0 0.0 0.0 0.0 0.0	90th Percent 0.4 0.3 2.0 0.5 0.5 2.2 2.3	90th Percentil 1.0 0.2 0.2 1.9 0.4 1.9	90th Percentile 0.7 0.6 0.6 0.6 0.7 0.7 0.7 0.7	90th Percent 0.0 0.0 0.1 1.1 1.1	90th Percenti 0.2 0.9 0.9 0.3	90th Percent 3 3 17 17 10 12 12 12 12 15 15	90th Parcentil 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.0
Max 1800 2100 2170 2170 3600 1900 2300	Max 1200 1300 1400 1500 1500 1500	7.6 7.6 8.3 7.6 7.6 8.1 7.6	Max 350 440 290 280	Max 160 90 90 65 65	Max 0.1 0.0 0.2 0.1 0.1 0.4	Max 0.0 0.0 0.0 0.0 0.0 0.0 0.1	Max 0.4 0.3 3.5 0.5 8.1 8.0	Max 2.0 0.2 3.9 0.4 7.0 7.1	Max 0.7 0.6 0.8 0.8 0.5 0.5 0.0 0.7	Max 0.0 0.1 0.1 1.4 1.4	Max 0.2 1.6 0.4 0.3	Max 4 4 4 18 10 10 10 12 69 69 57	Max 0.01 0.01 0.01 0.01 0.01 0.01
Min 730 3400 860 8400 820 820 820 130000 130000 130000						Min Min 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.		n Min 0.0 0.2 0.2 0.6 0.6 0.0		0.005 0.005 0.005 0.000 0.000			Min 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.0
Median 1200 1200 1700 1700 1340 1600	Media	Mediar 7.3 7.3 7.2 7.2 7.2 7.1 7.1 7.1 7.1 7.1 6.9	Media 235 240 440 150	Media 105 90 90 51 100	Median 0.0 0.0 0.0 0.0 0.1 0.1 0.1	Media 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Media 0.2 0.3 0.3 1.4 0.5 0.5 0.5	Median 0.2 0.2 1.3 1.3 0.4 0.5	Media 0.7 0.5 0.5 0.5 0.5 0.1 0.1	Media 0.0 0.0 0.0 0.1 0.1 0.1 0.1	Media 0.2 0.8 0.8 0.1	Mediar 14 14 8 8 8 8 7 7 7 7 7	Media 001 001 001 001 001 001 001
Mean 1218 1778 1618 2133 2133 1372	Mean 788 788 716 116 1029 1307 845 845 1001	7.2 7.2 7.3 7.3 7.2 7.2 7.2 7.2 7.2 7.2 7.2 7.2 7.2 7.2	Mean 234 440 180 178	Mean 109 90 90 54 131	Mean 0.0 0.0 0.1 0.1 0.1 0.1 0.1	0.0 0.0 0.0 0.0 0.0 0.0	Mean 0.3 0.3 1.5 0.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1	0.5 0.2 0.2 1.5 0.4 1.1 1.1	Mean 0.7 0.5 0.6 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	0.0 0.0 0.0 0.1 0.1	Mean 0.2 0.7 0.7 0.1 0.1	Mean 2 2 14 8 8 10 10 10 10 10 9	Mean 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.0
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Electrical Cond D265 D265 D260 D275/D265 D270 P88 P810	Total Dissolved D265 D260 D275/D265 D270 P88 P810	D265 D265 D275 D275 P88 P810	Chloride, CI (m D275 D27D P88 P810	Sulphate, SO4 D275/D265 D27D P88 P810	Total Phospho 026S 026D 0275/026S 0270 P88	FRP (mg/L) 0265 0265 0275 0270 P88	Total Nitrogen. 0265 0265 0275 0275 P88	TKN (mg/L) D26S D26C D27S D27D P88 P810	Nitrate - NO3 p 0265 0275 0275 PB8	Nitrate & Nitrite 12265 12275 12270 1988 19810	Ammonium NH D265 D275 P88 P810	Total Iron (mg/ 0265 0260 0275 0270 P88 P810	Iron Fe2+ (mg/) 0265 0265 0275 0270 P88 P810

Appendix E

Groundwater Licence 157168(3)





looking after all our water needs

Your ref: B Tilley Our ref: RF7101 Enquiries: 9726 4111



Alex Rogers JDA Consultant Hydrologists PO Box 117 SUBIACO WA 6008

Dear Alex

Re: Issue of a Licence to Take Water – GWL111211(11)
Property: Dalyellup Estate

Please find enclosed your *Licence to Take Water*, issued under section 5C of the *Rights in Water and Irrigation Act 1914*. This licence entitles you to take water, subject to certain terms, conditions or restrictions. It does not absolve the licensee from responsibility for compliance with the requirements of all Commonwealth and State legislation.

It is important that you read the conditions of your licence carefully. If you do not understand your licence, please contact the Department as soon as possible, as there are penalties for failing to comply with all of your licence conditions. Under Section 26GG(2) of the *Rights in Water and Irrigation Act 1914*, you have a right to apply to the State Administrative Tribunal to request a written statement of reasons for the period for which the licence is granted or for a review of any term, condition or restriction included in the licence. You have 28 days from the date you received this letter to request that the decision be reviewed

For further information please contact the State Administrative Tribunal:

State Administrative Tribunal 12 St Georges Terrace PERTH WA 6000

GPO Box U1991 PERTH WA 6845

Telephone: (08) 9219 3111 Toll-free: 1300 306 017 Facsimile: (08) 9325 5099 www.sat.justice.wa.gov.au If you wish to continue taking water after this *Licence to Take Water* expires, it is your responsibility to apply to the Department of Water for its renewal. If this licence expires and you have not applied to renew it, then the taking of water must cease, or you will be in breach of *the Rights in Water and Irrigation Act 1914*. It is suggested that an application for renewal be made at least one month in advance of the *Licence to Take Water* expiry date.

Should legal access to the land cease, for example you decide to sell your property, before the Licence to Take Water expiry date, you are required to inform the Department using Form 6 - Notice that Licence Holder is not or may not be Eligible to Hold a Licence and return the enclosed licence within 30 days. Failure to comply is a breach of the *Rights in Water and Irrigation Act 1914.*

You may apply to amend or transfer the *Licence to Take Water* at any time. The Department may also amend, suspend or cancel this licence in certain circumstances. For further information, please refer to the Frequently Asked Questions (FAQ's) on the Departments website; http://www.water.wa.gov.au/

Please note that the Department maintains a 'Water Register' containing information on Western Australia's water availability and licensing details. An extract of this licence has been placed on the register and can be viewed online at; http://www.water.wa.gov.au/ags/WaterRegister/.

If you have any queries relating to the above matter, please contact Officer Ben Tilley on 9726 4129.

Yours faithfully

Mick Owens

Program Manager - Licensing

M

Department of Water

South West Regional Office - Bunbury

6 March 2013

Page 1 of 2 Instrument No. GWL111211(11)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Dalyellup Beach Pty Ltd		
Description of Water Resource	Bunbury Perth - Superficial Swan	Annual Water Entitlement	311000 kL
Location of Water Source	Lot 9076 On Plan 55511 - Volu Lot 9533 On Plan 69839 - Volu Lot 9532 On Plan 69839 - Volu Lot 8002 On Plan 69839 - Volu Lot 8012 On Plan 69839 - Volu	me/Folio LR3138/950 - Lot 1184 F me/Folio 2696/377 - Lot 9076 Da me/Folio 2773/192 - Lot 9533 Da me/Folio 2773/191 - Lot 9532 Da me/Folio Lr3160/975 - Lot 8002 M me/Folio Lr3160/976 - Lot 8012 In intersection of Norton Prom & Da	lyellup lyellup lyellup Aaidment Pde Dalyellup Dalyellup
Authorised Activities	Taking of water for	Location of Activity	
	Irrigation of up to 44.3 ha of public open space	Lot 1184 on Plan 29066 - Volu Lot 1184 Hutt Dr Dalyellup	me/Folio LR3138/950 -
		Lot 9076 On Plan 55511 - Volu Lot 9076 Dalyellup	ıme/Folio 2696/377 -
		Lot 9533 On Plan 69839 - Volu Lot 9533 Dalyellup	ıme/Folio 2773/192 -
		Lot 9532 On Plan 69839 - Volu Lot 9532 Dalyellup	me/Folio 2773/191 -
		Lot 8002 On Plan 69839 - Volu Lot 8002 Maidment Pde Dalyel	
		Lot 8012 On Plan 69839 - Volu Lot 8012 Dalyellup	nme/Folio Lr3160/976 -
		Road Reserve - Round-about or Prom & Dalyellup Bvd	n intersection of Norton
Duration of Licence	From 25 February 2013 to 19 F	abruary 2023	

This Licence is subject to the following terms, conditions and restrictions:

- 1 The annual water year for water taken under this licence is defined as July 1 to June 30 next.
- 2 The licensee is to comply with the 'Groundwater Monitoring Program for GWL111211(11)' and any amendments made by or with the approval of the Department.
- 3 The licensee shall not use water for sprinkler irrigation of lawns and gardens between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.

Page 2 of 2 Instrument No. GWL111211(11)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

- 4 Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.
- 5 The licensee must install a cumulative water meter of a type approved under the Rights in Water and Irrigation (Approved Meters) Order 2009 to each water draw point under this licence.
- 6 The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" before any water is taken under this licence.
- 7 The licensee must take and record the reading from each meter required under this licence at the beginning and another at the end of the water year defined on this licence.
- 8 In addition to taking and recording the reading(s) at the beginning and the end of the water year, the licensee must, as close as practicable to the end of each month (other than the month in which the water year ends), take and record the reading from each meter required under this licence.
- 9 The licensee must submit to the Department of Water the recorded meter readings and the volume of water taken within the water year by July 31 each year.

End of terms, conditions and restrictions

Groundwater Monitoring Program for GWL111211 (11)

Licensee(s):

Dalyellup Beach Pty Ltd

Location of Water Source:

Well ID	Lot Number
PB8	Lot 9076
PB10	Lot 9076
PB12	Lot 1184
PB13	Lot 9533
PB14	Lot 9533
PB15	Lot 9532
PB16	Lot 8002
PB17	Lot 8012
PB18	Lot 8012
PB19	Lot 8012
North Lake	Lot 8002 on Plan 69839
Middle Lake	Lot 8012 on Plan 69839
Round-about Lake	Road Reserve - Round-about on Norton Prom & Dalyellup Bvd

The location of production wells is shown on the attached plan.

Groundwater Monitoring Commitments

1) The licensee shall have a water sample from each of the nominated sampling points listed below submitted to a laboratory for analysis quarterly according to the following schedule:

Sept or Oct	Dec or Jan	March or April	June or July
pH EC* @ 25°C TDS (mg/l)	pH EC @ 25°C TDS (mg/l)	pH Electrical Conductivity @ 25 °C Salinity (mg/l TDS) Total Nitrogen (TN mg/L) Nitrite/Nitrate as N (NOx as N mg/L) Total Phosphorus (TP mg/L) Sulphate (SO ₄ mg/L) Chloride (Cl mg/L)	TDS (mg/l)

Nominated Sampling Points

Well ID	Lot Number
D4	Lot 1 on Diagram 91461
D10	Road Reserve - corner of Harewoods Rd & Sherwood Drv
D27s	Lot 9076 on Plan 55511
PB8	Lot 9076 on Plan 55511
PB10	Lot 9076 on Plan 55511
PB12	Lot 1184 on Plan 29066
PB13	Lot 9533 on Plan 96839
PB14	Lot 9533 on Plan 96839
PB15	Lot 9532 on Plan 69839
PB16	Lot 8002 on Plan 69839
PB17	Lot 8012 on Plan 69839
PB18	Lot 8012 on Plan 69839
PB19	Lot 8012 on Plan 69839

The location of production wells is shown on the attached plan.

2) The licensee shall measure and record the groundwater levels monthly from each of the nominated sampling points listed below:

Well ID	Lot Number
D4	Lot 1 on Diagram 91461
D10	Road Reserve - corner of Harewoods Rd & Sherwood Dry
D27s	Lot 9076 on Plan 55511
PB8	Lot 9076 on Plan 55511
PB10	Lot 9076 on Plan 55511
PB12	Lot 1184 on Plan 29066
PB13	Lot 9533 on Plan 96839
PB14	Lot 9533 on Plan 96839
PB15	Lot 9532 on Plan 69839
PB16	Lot 8002 on Plan 69839
PB17	Lot 8012 on Plan 69839
PB18	Lot 8012 on Plan 69839
PB19	Lot 8012 on Plan 69839
2M	Lot 403 on Plan 24498
4M	Lot 6078 on Plan 23885

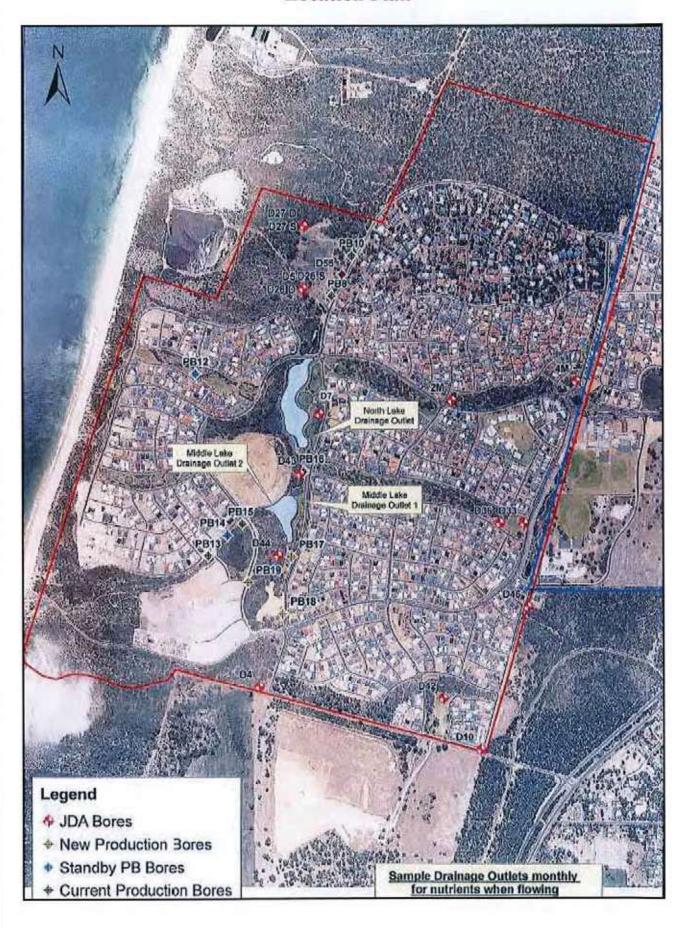
- 3) All methods and equipment used in water quality sampling should be undertaken in accordance with the Australian Standard AS/NZS 5667 (1998) and wherever possible, a NATA registered laboratory should undertake the analyses, using NATA accredited analysis methods.
- 4) The method (eg EC correction factor; gravimetric) used for the determination of TDS must be specified
- 5) The Department of Water, at its discretion, may direct changes to be made to the monitoring program at any time.
- 6) If water levels in the bore D4 drop to below 3.6m AHD abstraction from the southernmost bores will be reduced to prevent further decline.

- 7) The licensee is to provide a concise annual report prepared by a qualified professional covering data recorded during the reporting year 1 July to 30 June next, and is to include:
 - i) Tabulated monthly production data for each production bore over the reporting year
 - ii) Histograms of historical monthly and annual production data
 - iii) Tabulated water level data in metres below groundwater level (m bgl) and meters ADH (m AHD) for the reporting period
 - iv) Hydrographs of historical water level data
 - v) Tabulated geochemical data for the reporting period
 - vi) Graphs of historical geochemical data

The report is to be forwarded to the Department of Water, PO Box 261 Bunbury WA 6231, by 31 August each year.

End of monitoring and reporting commitments.

Location Plan







Your ref: GWL111211 Our ref: Rf7101 Enquiries: Henry Sieradzki

JDA Consultant Hydrologists PO Box 117 SUBIACO WA 6008

Attention:

Alex Rogers - Senior Engineering Hydrologist

Dear Alex

Re: Amendment of Groundwater Monitoring Program Property: Dalyellup Beach Pty Ltd

Please find enclosed the following:

 The amended Groundwater Monitoring Program for the groundwater licence associated with the Dalyellup Beach Estate.

The amendments have been made following recent email correspondence with you and the department. The changes include;

- Substitution of monitoring bore D27S with D26S due to vandalism;
- Removal of bore PB12 as this has never been equipped; and
- Removal of bore PB14 as this has never been equipped.

Please take time to read this document as it contains important information about your rights and responsibilities.

If you have any queries about this or any other water licensing matter please contact the Bunbury office on telephone (08) 9726 4111.

Yours sincerely

Henry Sieradzki

Senior Natural Resource Management Officer

South West Region

23 January 2014

Groundwater Monitoring Program for GW111211(11)

Licensee(s):

Dalyellup Beach Pty Ltd

Water Meters and Locations

Metering Locations:

Well ID	Lot Number
PB8	Lot 9076 on Plan 55511
PB10	Lot 9076 on Plan 55511
PB13	Lot 9533 on Plan 69839
PB15	Lot 9532 on Plan 69839
PB16	Lot 8002 on Plan 69839
PB17	Lot 8012 on Plan 69839
PB18	Lot 8012 on Plan 69839
PB19	Lot 8012 on Plan 69839
North Lake	Lot 8002 on Plan 69839
Middle Lake	Lot 8012 on Plan 69839
Roundabout Lake	Road Res - Roundabout on Norton Prom & Dalyellup Blvd

(The location of production wells is shown on the attached plan.)

Groundwater Monitoring:

 The licensee shall have a water sample from each of the nominated sampling points listed below submitted to a laboratory for analysis quarterly according to the following schedule:

pH 25C EC @ 25C mg/l) TDS (mg/l) Nitrogen (TN)
/Nitrate as N (NOx as N) Phosphorus (TP)
al l pha ori

2) The licensee shall measure and record the groundwater levels monthly from each of the nominated sampling points listed below;

File No: RF7101 - Groundwater Monitoring Program,

Version 23/1/2014

Nominated Sampling Points:

Well ID	Lot Number
D4	Lot 1 on Diagram 91461
D10	Road Reserve - Corner of Harewoods Rd & Sherwood Drive
D26S	Lot 9076 on Plan 55511
PB8	Lot 9076 on Plan 55511
PB10	Lot 9076 on Plan 55511
PB15	Lot 9532 on Plan 69839
PB16	Lot 8002 on Plan 69839
PB17	Lot 8012 on Plan 69839
2M	Lot 403 on Plan 24498
4M	Lot 6078 on Plan 23885

(The locations of nominated sampling points are shown on the attached plan)

- 3) All methods and equipment used in water quality sampling should be undertaken in accordance with the Australian Standard AS/NZS 5667 (1998) and wherever possible, a NATA registered laboratory should undertake the analyses, using NATA accredited analysis methods.
- 4) The method (e.g. EC correction factor) used for the determination of TDS must be specified.
- The Department of Water, at its discretion, may direct changes to be made to the monitoring program at any time.
- 6) If water levels in the bore D4 drop to below 3.6mAHD abstraction from the southernmost bores will be reduced to prevent further decline.
- 7) The licensee is to provide a concise annual report prepared by a qualified professional covering data recorded during the reporting year from 1 July to 30 June next and is to include:
 - tabulated monthly production data for each production bore over the reporting year;
 - histograms of historical monthly and annual production data;
 - tabulated water level data in metres below ground level (m bgl) and metres AHD (m AHD) for the reporting period;
 - hydrographs of historical water level data;
 - Tabulated geochemical data for the reporting year; and
 - · Graphs of historical geochemical data.

The report is to be forwarded to the Department of Water, PO Box 261 Bunbury 6231 by 31 August each year.

End of monitoring and reporting requirements.

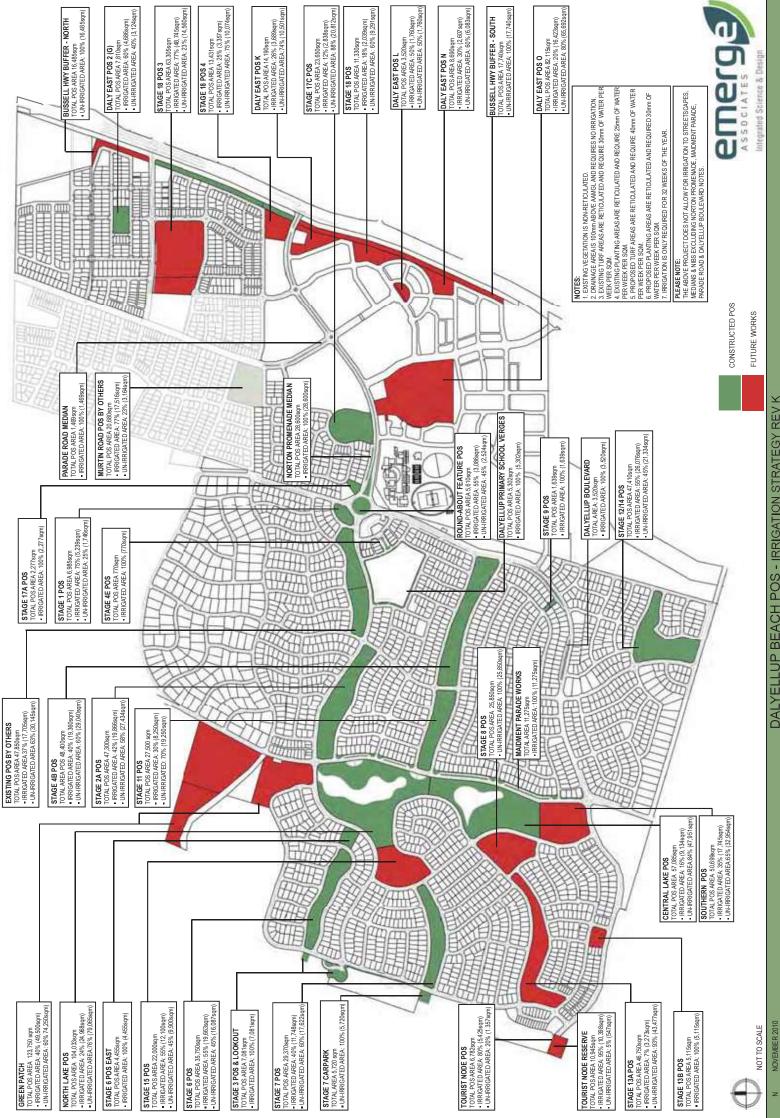
Page 2 of 3

LOCATION PLAN



Appendix F

ILWMS (Emerge, 2010) POS Irrigation Strategy



Project: DALYELLUP BEACH ESTATE Irrigation area estimates

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		4.050	405	4,455	В	100	4,455	2,878	В
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Dalyellup East									
(PC CIII) 30C (MINIMULTICE)	CONTINUENCIA DE CONTINUENCIA D	12/200	1/220	13,420	В	□09	8,052	5,202	В
00000170 400 Wru600 (pund		2:070	207	2,277	В	100	2,277	1,471	В
00000370	000 acamaca comodago arasa pacama	21/500	2.150	23,650	8	120	2,838	1,833	В
0000010P002000	mrad Scriptions	7100	710	7,810	В	□09	4,686	3,027	В
(120 mrm120 dronocous pmm)	0.00.00 (P.00.000)	10/300	1030	11,330	В	B	2,039	1,317	В
0000010P003 230 (droppou770 mro		57/550	5755	63,305	В	77	48,745	31,489	В
750 cdronnord 1350 cdronnord 1350 cd	3000 SC Wrat 00 pacae	12/210	1221	13,431	В	25□	3,358	2,169	В
IPDDIII 65D INFOIDUZODI	650 Idromocom200 Impage (parametra) accompand	12:900	11290	14,190	В	_92	3,689	2,383	В
(Poom 200 mrm300 panamasso maaram		3/200	320	3,520	В	200	1,760	1,137	В
(POOLM) 230 MODIMONICOOM	230	12,600	1/260	13,860	В	35	4,851	3,134	В
PDD	67 dromoni20 mrun 0 paromons moranima	7.900	790	8,690	В	30	2,607	1,684	В
Poom common dance		741650	7.465	82,115	В	20□	16,423	10,609	В
POOF 230 MINIMOTOCOM	$230\ mnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn$	27 000	2/700	29,700		35	10,395	6,715	В
MovemRandiPas dramos	comin parametral o mocranomenta	2016:0	2.06	22,748	В	77	17,516	11,315	В
	0	164.5	0	16,485	B	0	0	0	В
	q	17/740	0	17,740	8	00	0	0	В
Streetscapes			-						
		26:000	2:600	28,600	B	100	28,600	18,476	В
Dominip monarrd 1000 pmmm		3/200	320	3,520	B	100	3,520	2,274	В
nodo		10/250	1025	11,275	B	100		7,284	В
		4020	42	5,302	В	100	5,302	3,425	В
Pordore common		11335	134	1,469	В	100	1,469	949	В
					ľ		- 1		
Order Charles Company (1975)	260 mmage management mage mras o Orano and and and a	941575	9.45	104,033	В	24	24,968	16,129	В
260 100 100 100 100	10011101111111112 Car 11101114 11111111 5 16 111011113 5 1110111111	5195	51190	57,085	В	16	9,134	5,900	В
	(600	46:090	41609	50,699	В	35	17,745	11,463	В
DONOR DO	25 pm-mm	2000	210	5,610	В	25	3,086	1,993	В
OUTITATION 1000 INTERNATIONAL		5/200	520	5,720	В	0	0	0	В
	monrenzoe mrande paemenze monrenza	43.500	41350	47,850	B	30	14,355	9,273	В
Total	Total 1,060/154	1.060.642	106:064	1,166,706	sdm		458,644 sqm	296,284	귛

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tem	LANDSCAPE ZONE	Feature Items / Notes	Pos	10%	Tota	On it	Unit % of	Est	Chit	Est	d C
			ot	verge	POS		irrig	irrig		water	
			area	area	area			area		nse	
	AREAS TO BE WATERED BY LAKE 1 - NORTHERN LAKE	E 1 - NORTHERN LAKE									
	FOODO	25c miniminiminiming 0c mirms5c pallinin	6:350	635	6,985	В	75	5,239	В	3,384	В
	02000	500 00000000000000000000000000000000000	43:000	41300	47,300		42	19,866		12,833	В
	000031600000000	1000	6.437	644	7,081	В	100	7,081	В	4,574	В
		60° minimum (minimum) (minimum)	44 000	4400	48,400	В	40	19,360	В	12,507	В
		1000 10	2007	20	770		100	770	В	497	В
		450 @000@0000000000000000000000000000000	321500	31250	35,750	В	25	19,663	В	12,702	В
		75c mrm25c pucum	4:050	405	4,455	В	100	4,455	В	2,878	В
	ZDIIIO	400 mrm800 mrnr0mrnmdpmnm	26/700	2:670	29,370		40	11,748	В	7,589	В
			25:000	21500	27,500	Ш	30	8,250	H	5,330	В
			5/200	520	5,720	В	0	0	В	0	В
		630	43.500	4:350	47,850	В	37	17,705	В	11,437	В
		260 mmm360 mmmmmmm240 mrm6 Dromonmm monitoring	941575	9.45	104,033	В	24	24,968	В	16,129	В
	Domomphonocorrection	1000 III1	4 120	402	5,302		100	5,302	88	3,425	В
	Total		336 132	33.6.13	3701515	sdm		144 405	sdm	93/2/16	귛

KIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII		23.EOU	21350	25.850	E	0	-	E	-	E
		000	000	000,04	1	9	0		,	1
		1480	8	600,1		100	600'1		8CO'I	1
	450 III.IIII.III.II.II.II.II.II.II.II.II.II	43 100	4310	47,410	В	92	26,076		16,845	В
0000130	930 @00@00000000000000000000000000000000	42.500	4/250	46,750	В	7.0	3,273	8	2,114	В
0000030	500 mrm300 pmcmc	4.650	465	5,115	В	100	5,115	В	3,304	В
	450 mmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	20:000	2:000	22,000	В	25	12,100	B	7,817	В
		9:950	966	10,945		□96	10,398		6,717	В
	300 mrm100 dromocousoo paromon100 mooreamon100	6165	617	6,782	В	000	5,425	8	3,505	В
		112/500	111250	123,750	В	40	49,500	В	31,977	В
Dominipality	1000	3/200	320	3,520	В	100	3,520	B	2,274	В
Madanara	1000 (\$00000)	10/250	1.025	11,275	В	100	11,275	В	7,284	В
	260 mm1630 mm1mm1mm1mm1m2 dr mm1m140 mm1m1.50 pm1mm1m3.50 mm1mm0m	51 195	51190	57,085	В	16	9,134	В	5,900	В
OCCURROR D	(600 monimonicon mras paramete promisso monimonica)	46:090	41609	50,699	В	35	17,745	Ш	11,463	В
Total		3751290	371529	412m9	sdm		155/19	mbs	100125	귛
AREAS TO BE WATERED BY LAK	AREAS TO BE WATERED BY LAKE 3 - ROUND-ABOUT FEATURE LAKE									
00000070	400 mrm800 pmcm	2:070	207	2,277	В	100	2,277	8	1,471	В
00000070		211500	20150	23,650	В	12	2,838	H	1,833	В
	400 dronnon450 mrm 50 pmomo	7/100	710	7,810	В	□09	4,686	В	3,027	В
0000000000	120 Wrws2 dramocos pwcmo	10:300	1030	11,330	В	100	2,039	В	1,317	В
Росш	300 manimananananana400 mrm/0 dramanan200 penama	12:200	11220	13,420	В	□09	8,052	В	5,202	В
OUTCOM OUR DO U.S	230 IdrammonT70 IIIro	57.1550	5755	63,305	B	77	48,745	В	31,489	В
00000000000	750 dromoon/50 aram/oo pacaa	12/210	1221	13,431	В	25	3,358	В	2,169	В
Poom	650 dramoroz00 arago paramos amoronamad	12:900	1290	14,190	В	28□	3,689	Н	2,383	В
Воош	200 mrm300 pmrmmr500 mrmmmmd	3/200	320	3,520	В	200	1,760	В	1,137	В
PootM	230 manuarano arabatan dramanizo aram 50 paro antido manada	12.600	1/260	13,860	В	35	4,851	В	3,134	В
Poom	670 dromongo mrano pacamas mooreamas	7.900	790	8,690	В	30	2,607	В	1,684	В
Poom		74/650	7.465	82,115	В	20	16,423	8	10,609	В
Poor	230 താന്വതാനാനാനായാവായ രൂഗതാനായാ തഴുക്കുള്ള ക്രാവത്തായുള്ള വാധത്തായുള്ള വ	27:000	2/700	29,700	В	35	10,395	В	6,715	В
Mortingendipo	690 Wrw120 droppoomo pacamow10 moorpamoma	20.6.0	2.06	22,748	В	77	17,516	В	11,315	В
	1000 INDEPENDENT	164.5	0	16,485	B		0	В	0	В
	1000 (11) [11] [11]	17/740	0	17,740	В	0	0	В	0	В
PorodoliR codiModilico	1000 (\$\text{\$\}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}	1335	134	1,469	В	100	1,469	В	949	В
O Drama@Pron coods	250 WrM750 (pmcm)	26.000	2/600	28,600	В	100	28,600	8	18,476	В
RODOMOCOMICONINGPOO	45p mm30p mrm25p pmpmp	5100	510	5,610	В	55	3,086	В	1,993	В
Total		34□520	311430	3791950	sqm		162:390	mbs	104!904	귛
T-free		010000	100001	4 1400 1700						

AREAS TO BE WATERED BY L	AREAS TO BE WATERED BY LAKE 3 - ROUND-ABOUT FEATURE LAKE									1
00000370	40° mrm80° p.mcmc	2:070	207	2,277	В	100	2,277	8	1,471	Н
00000070	Occident and the control of the cont	211500	2:150	23,650	В	12□	2,838	8	1,833	Н
000001000002000	400 dr.m.n.n.1450 mr.m.150 pm.n.m.	7000	710	7,810		□09	4,686	8	3,027	Н
000000000000	120 Wrws2 dramocous pwomo	10(300	1030	11,330	В	10	2,039	8	1,317	Н
Pool	300 million in committed on million 10 milli	12/200	1220	13,420	B	09	8,052	8	5,202	Н
00000000000000000000000000000000000000	230 Idr IIII 1 III	57.550	5755	63,305	В	□22	48,745	8	31,489	Н
000000000000	750 drowcood 50 arano pacae	12/210	1221	13,431	В	25□	3,358	8	2,169	Н
Poom	650 Idramon 1200 mr 1160 p month 1190 month 1111	12:900	11290	14,190	B	26	3,689	B	2,383	Н
Ь	200 mrm30 pmmm50 mmmma	3/200	320	3,520	В	20□	1,760	Н	1,137	Н
PootM	230 monmoon common drancom drango mranso pacamonso monromada	12/600	11260	13,860	В	35	4,851	8	3,134	Н
Poom		7.900	790	8,690	В	30□	2,607	8	1,684	Н
Ь	coe memerenedado enrado paremo	74.650	7.465	82,115	В	20□	16,423		10,609	Н
Poor	230 mmmmmmmmmm drammmm20 mrmf50 pmcmm400 mcmcmmmdpmcmm	27:000	2/700	29,700	В	35	10,395	8	6,715	Н
Morting	690 mrm120 dromocomo panamon10 moornamon	2016.0	2.06	22,748	В	77	17,516	8	11,315	Н
	1000 (11000:000)	164.5	0	16,485	В	00	J	0	٥	0
	1000 mmmmmm	17/7/40	0	17,740	В	□0)	0	0	0
PorodofReedtModes	1000 [pm:m:	11335	134	1,469	В	100	1,469	8	949	Н
	250 III III 50 (\$000)	26:000	2/600	28,600	В	100	28,600	8	18,476	Н
RODD	450 mm300 mrm25 pmm	5000	510	5,610	В	25□	3,086	8	1,993	Н
Total		34□520	31430	3791950	sqm		162/390	sqm	1041904	귛
										Ц
Total		1.060.642		106/064 1/166/706	Sam		461 004	a com	291744	<u> </u>

	Iotal		1 000 042	100,004	0070001	Sdin		401334	SdIII	73 44	Y.	_
L	AREAS TO BE WATERED BY IRON	BRIDGE HOLDINGS										_
	Poom	120 @00000000000000000000000000000000000	10700	1070	20,570	В	75	15,428	8	996'6	В	
	Poom	120 @0@@0@0000@0@0@0@0@0@0@0@0@0@0@0@0@0@	23/350	2.335	25,685	В	75	19,264	В	12,444	В	
	Poot	1000 @DOMESTIC WITH BELLEVIEW WITH B	49/700	4.970	54,670	B	0	0	B	0	В	
	Poom	750 dromoni200 mru50 pmm	21450	2045	23,595	В	25□	5,899	В	3,811	В	
	Poom	100 dromoon850 mrm250 pmomo	10/600	1.060	11,660	В	□06	10,494	В	6,779	В	
	Total		123⊞00	1213110	1361110	sam		51004	sam	33.000	귚	

Appendix G

JDA (2015a, b) Infiltration Testing Reports

Rivergums, Baldivis: Rainfall Runoff Testing

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DISCLAIMER

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Checked by	John Barnett	Volyen Barried.	30 January 2015
Approved by	Jim Davies	(P. Danes	30 January 2015

J5925b 30 January, 2015



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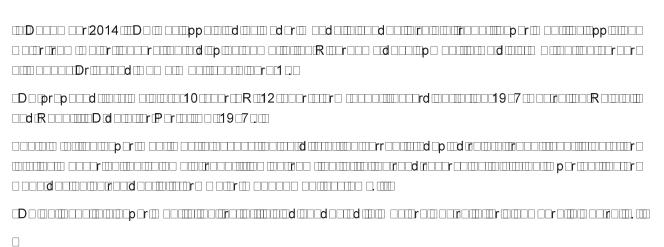
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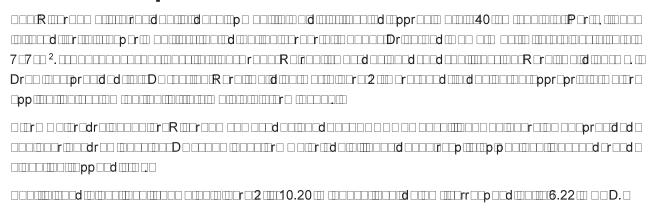
1. INTRODUCTION





2. BACKGROUND

2.1 Lot Description



2.2 Climate

TABLE 1: 1987 PERTH IFD AVERAGE RAINFALL INTENSITY (mm/hr)

Duration			Pe	rth 1987 IF	-D		
		A	verage Rai	nfall Inten	sity (mm/h	r)	
	1 Yr	2 Yr	5 Yr	10 Yr	20 Yr	50 Yr	100 Yr
5 [M	5□.9□	77.9□	102.0□	120□	145.0□	1 □1.0 □	212.0□
10 M □□□	43.9□	57.7□	75.0□	□7.4□	105.0□	130.0□	152.0□
30 IM	24.3□	31.6□	39.9□	45.7□	53. □□	65.7□	75.6□
1 ⊞r□	15.9□	20.5□	25.6□	29.0□	34.0□	41.1□	47.0□
2□r□□	10.2□	13.1□	16.1□	1□2□	21.1 🗆	25.4□	2□9□
3∭r□□	7. □2 □	10.0□	12.3□	13. □□	16.0□	19.1□	21.7□
6∭r⊡	4.97□	6.35□	7.72□	□62□	10.0 🗆	11.□□	13.4□
12∭r∐	3.17□	4.05□	4.91□	5.47	6.31□	7.5□	8.47
24⊞r□	2.02□	2.59□	3.16□	3.54□	4.09	4. 🗆 🗆	5.53□
4 🗆 🗆 r 🗆	1.26□	1.62□	2.0□	2.27□	2.64□	3.1□□	3.63□
72∭r□	0.93□	1.20□	1.49□	1.70□	1.99□	2.4□	2.75□

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□ 30 □ 10 17 □ 2015 □



TABLE 2: 1987 PERTH IFD RAINFALL (mm)

			Pe	erth 1987 IF	D		
Duration			R	ainfall (mn	1)		
	1 Yr	2 Yr	5 Yr	10 Yr	20 Yr	50 Yr	100 Yr
5 I M	4. □□	6.4□	□4□	9.9□	12.0□	15.0□	17.6□
10 M	7.3□	9.6□	12.5□	14.6□	17.5□	21.7□	25.4□
30 M	12.1 🗆	15. □□	19.9□	22. □□	26.9□	32. □□	37.□□
1r□	15.9□	20.5□	25.6□	29.0□	34.0□	41.1□	47.0□
2□r□□	20.4□	26.2□	32.2□	36.4 □	42.2□	50. □□	57.□□
3∭r⊡	23.4□	30.0□	36.9□	41.4□	4□0□	57.3□	65.1□
6∭rШ	29. □□	3□1□	46.3□	51.7□	60.0□	70. □□	□0.4□
12∭r□□	3□0□	4□6□	5□9□	65.6	75.2□	90.0□	101.6
24∭r∐	4□.5□	62.2□	75. □□	□4.9□	9□1□	117.1	132.7□
4□□□r□□	60.5□	77.7□	96.0□	10□9□	126.7□	152.6□	174.2□
72∭r□□	67.0□	□6.4□	107.3□	122.4□	143.3□	172. □□	19□0□

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 $= 0.010 \, \text{more} \, \text{Resonant moscopers} \, \text{and more} \, \text{defection} \, \text{def$

2.3 Hydrogeology

 $\verb| consideration | consider$

 $= \operatorname{our} = \operatorname{out}



3. EXPERIMENTAL DESIGN

3.1 Lot Description

3.2 Rainfall Temporal Patterns

| Column | production | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror | mirror

3.3 Applied Water Volume

12r.10r....R......r...65.6

7 7 1 2 2 1 0.0656 1 1 5 1.7 1 3

 $\verb| compound | \verb| compound | compound$

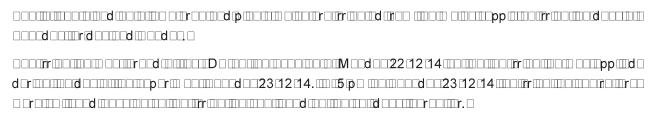
3.4 Water Application Method

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3.5 Monitoring Bores

3.6 Lot Irrigation



3.7 Lot Runoff on to Roads





4. MONITORING DATA

4.1 Flow Rate

aa ad 5 1000 mm aaramaaram aramaaaad aaramaaaparm aaam
• □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □
• c cool our unocuran prouncium un union o curanno communad (proceerouscool o
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TABLE 3: WATER TANKER METER READINGS

Time (Hrs)	(LPM)	Total (L)
□ 730□	350□	0 🗆
7เ35□	240□	1400□
740	240□	2090□
7.50□	250□	4930□
7.55□	250□	6590□
	240□	□100□
□05□	430□	□600□
□10□	400□	11300□
□15□	400□	13790□
□25□	400□	16550□
□30□	400□	19000□
□31□	240□	19150□
□37□	250□	20600□
□45□	240□	22700□
□53□	240□	24500□
9100	240□	25□00□
9₫5□	240□	29500□
9₫6□	150□	29700□
9เ30□	136□	31700□

Time (Hrs)	(LPM)	Total (L)
10.000	133□	36000□
10.004□	133□	36400□
10105	105□	36470□
101200	100□	3□700□
10⊡53□	100□	41200□
11 🗓 00 🗆	100□	41 □00 □
11 02 🗆	60□	42000□
11 🛮 12 🗆	5□□	42700□
11 🖪 0 🗆	60□	43700□
12100	60□	45406□
12⊈5□	60□	4□060□
13 100 🗆	59□	4923□□
13[30]	60□	50960□
14100	59□	52700□
1430	5□□	54340□
15100	57□	5573□□
15เ30□	57□	5577□□
16100	56□	59215□
16106	200□	60134□

4.2 Groundwater Levels

[5925□] 30□□□□□□2015□ 7□



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TABLE 4: RECORDED GROUNDWATER LEVELS 23/12/14

Time		Groundw	ater Level	s (mAHD)	
(Hrs)	B1	B2	B3	B4	B5
7เ30□	4.43□	4.40□	4.41□	4.41□	4.43□
□125□	4.63□	4.47□	4.41	4.41□	4.74□
□40□	4.70□	4.50□	4.42□	4.41	4.7□□
□4□□	4.73□	4.51□	4.42	4.42□	4. □0 □
9.005□	4.77□	4.54□	4.45□	4.43□	4. □3 □
91 🗆	4.□0□	4.56□	4.47□	4.47□	4. □4 □
9เ36□	4.□2□	4.5□□	4.4 🗆	4.51□	4. □3 □
9.55□	4.□3□	4.59□	4.49□	4.54□	4. □4 □
1030	4.□4□	4.61□	4.52□	4.5□□	4. □4 □
11.000	4.□3□	4.62□	4.53□	4.59□	4. □3 □
11เ35□	4.□2□	4.62□	4.54□	4.60□	4. □1 □
12.000	4.□0□	4.62□	4.55□	4.60□	4.79□
12⊈5□	4.7□□	4.61□	4.56□	4.61□	4.79□
13.000□	4.7□□	4.61□	4.56□	4.61□	4.7□□
13 🖸 🗆	4.77□	4.62□	4.56□	4.61	4.7□□
14.000	4.77□	4.62□	4.5□□	4.63□	4.7□□
14 ⅓0 □	4.77□	4.62□	4.59□	4.63□	4.7□□
15100	4.76□	4.61□	4.59□	4.63□	4.77□
15⅓0□	4.76□	4.61□	4.59□	4.63□	4.7□□
16.000□		4.61□	4.59□	4.63□	4.7□□
16 :3 3□		4.61□			
16⊈2□					
16.53□				4.62	
16.55□					4.7□
17.000					

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4.3 Catch Cups

TABLE 5: CATCH CUP DATA (mm)

		Time/(mm)		
Cup#	7:30 to 8:20 am	8:20 to 8:45 am	8:45 to 9:15 am	TOTAL
1□	11□	7□	11□	29□
2□		10□	11□	29□
3□	16□	15□	15□	46□
4□	16□	15□	16□	47□
5□	16□	16□	16□	4□□
6□	16□	16□	16□	4□□
7□	12□	15□	15□	42□
	16□	16□	16□	4 □□
9□	16□	16□	16□	4□□
10□	15□	14□	15□	44□
11□	16□	16□	16□	4□□
12□	15□	15□	9□	39□
13□	15□	15□	11□	41□
14□	14□	13□	9□	36□
15□	16□	16□	16□	4□□
16□	17□	16□	16□	49□
17□		13□	16□	29□
1 🗆		16□	16□	32□
19□		16□	16□	32□
Average	14.7□	14.5□	14.3□	41.2□

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4.4 Flow from Lot to Roads

□ 30 □ □ □ □ □ 2015 □ 9 □



5. INTERPRETATION OF RESULTS

5.1 Water Balance

5.2 Specific Yield Calculation

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5.3 Runoff Coefficients

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5.4 Effectiveness of Soakwells



6. **CONCLUSIONS**

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7. REFERENCES

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Figures

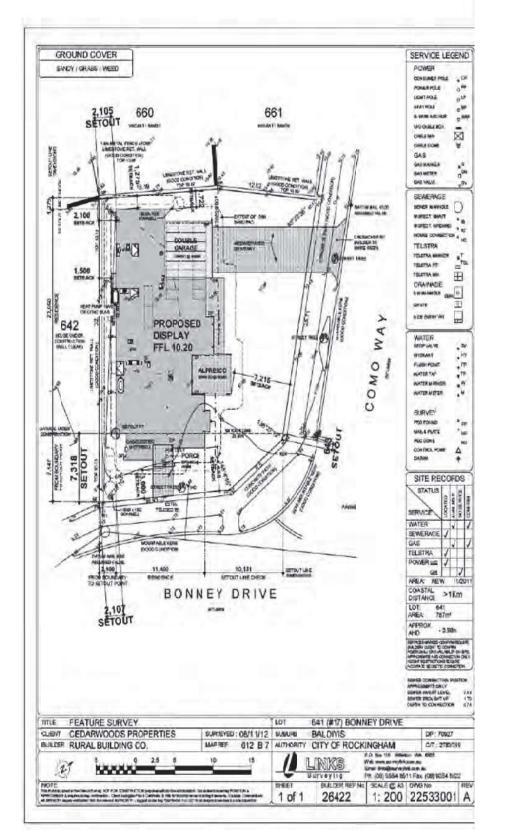




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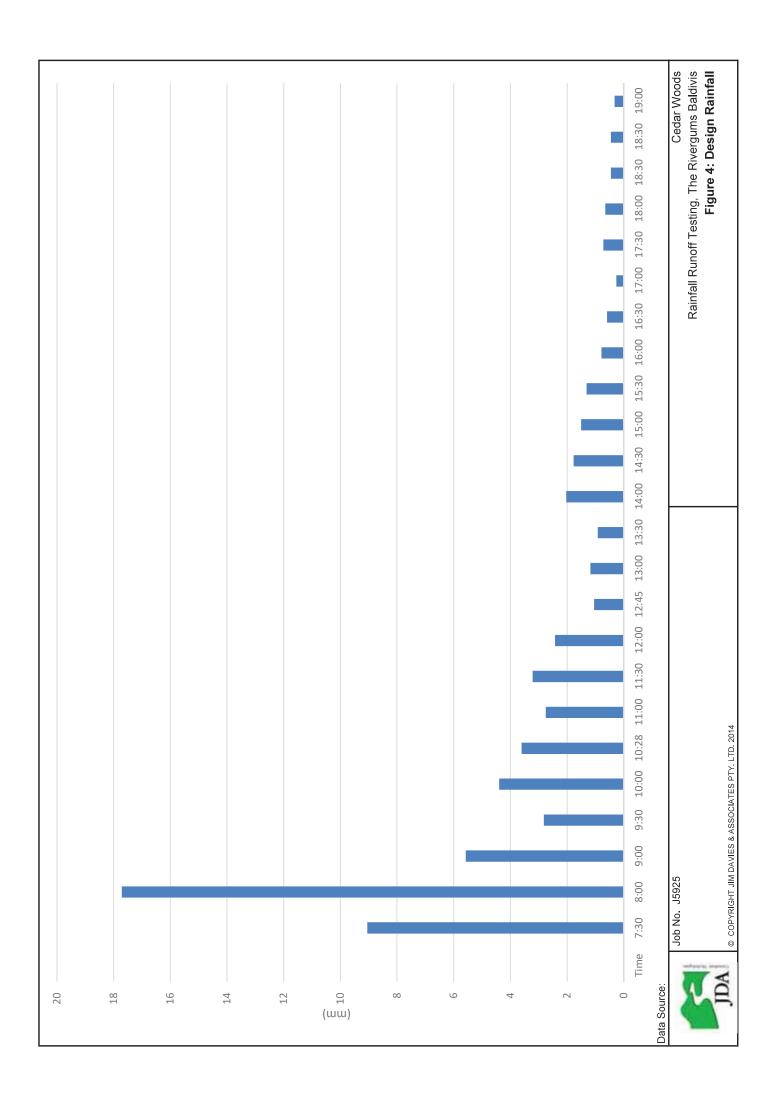
Figure 1: Study Area



Job No. J5925





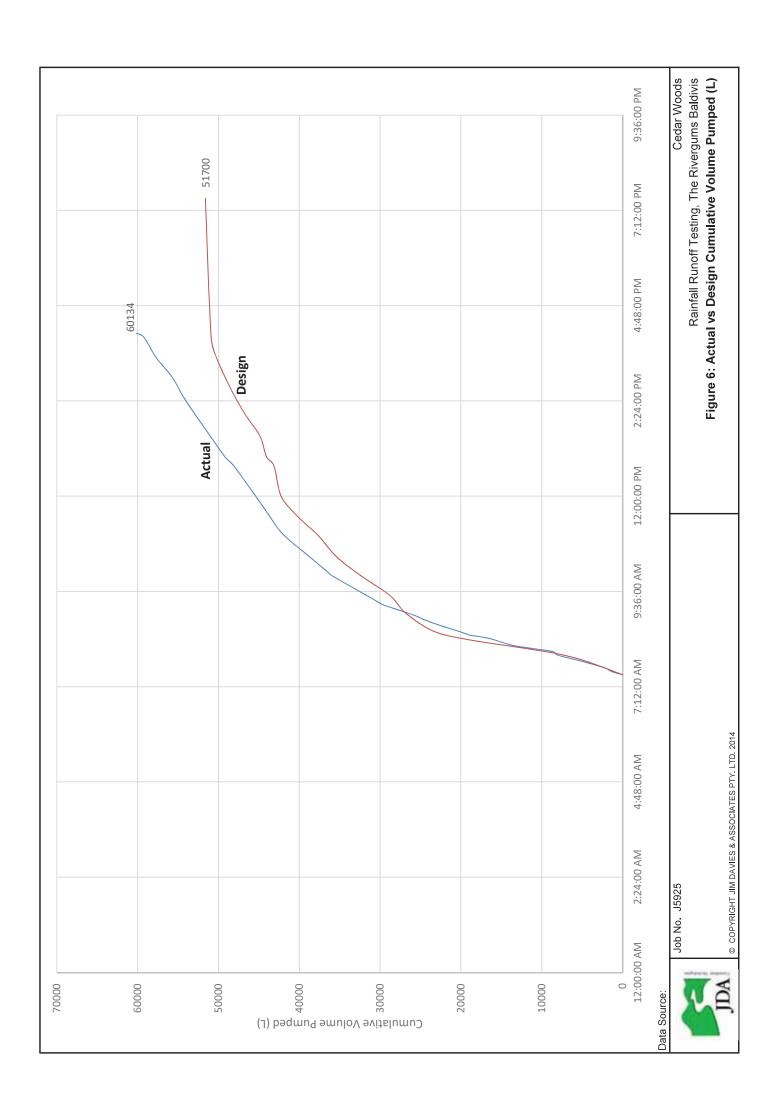


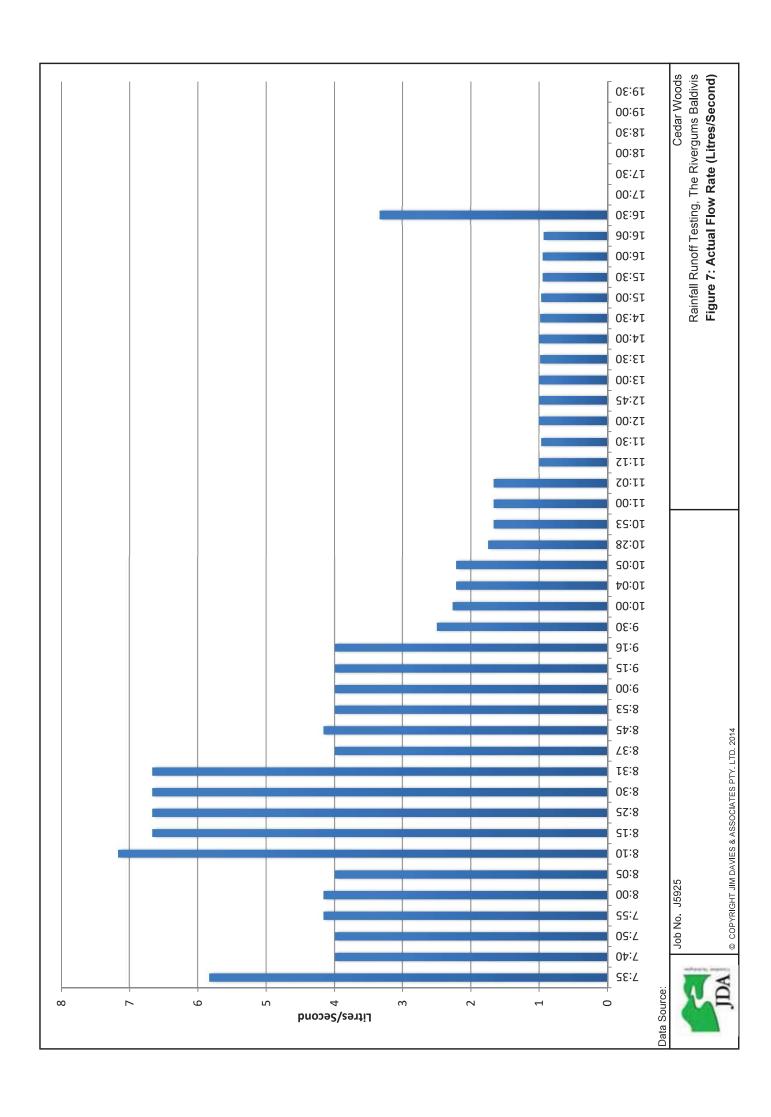
Summary lable	12 hr 1(0 yr ARI Stc	12 hr 10 yr ARI Storm over 787 m $^{\Lambda}$ 2	m^2							
Time Step Time	% e	% ⊠	depth (mm)	L/30 mins	r/s	Roof (L)	Roof	Balance	Balance	Each	Each Downpipe
	+						(r/s)	(-)	(r/s)	Downpipe (L)	(r/s)
1 0.5h	13.8 ر	13.8	9.1	7125	4.0	3206	1.8	3919	2.2	267	0.15
2 1h	27.0	40.8	17.7	13939	7.7	6273	3.5	7667	4.3	523	0.29
3 1.5h	8.5	49.3	5.6	4388	2.4	1975	1.1	2414	1.3	165	0.09
4 2h	4.3	53.6	2.8	2220	1.2	666	9.0	1221	0.7	83	0.05
5 2.5h	6.7 ر	60.3	4.4	3459	1.9	1557	6.0	1902	1.1	130	20.0
9 3h	5.5	65.8	3.6	2839	1.6	1278	0.7	1562	6.0	106	90'0
7 3.5h	4.2	70.0	2.8	2168	1.2	926	0.5	1193	0.7	81	0.05
8 4h	4.9	74.9	3.2	2530	1.4	1138	9.0	1391	0.8	95	0.05
9 4.5h	3.7	78.6	2.4	1910	1.1	098	0.5	1051	9.0	72	0.04
10 5h	1.6	80.2	1.0	826	0.5	372	0.2	454	0.3	31	0.02
11 5.5h	1.8 م	82.0	1.2	676	0.5	418	0.2	511	0.3	35	0.02
12 6h	1.4	83.4	6.0	723	0.4	325	0.2	398	0.2	27	0.02
13 6.5h	3.1	86.5	2.0	1600	6.0	720	0.4	880	0.5	09	0.03
14 7h	2.7	89.2	1.8	1394	0.8	627	0.3	767	0.4	52	0.03
15 7.5h	2.3	91.5	1.5	1187	0.7	534	0.3	653	0.4	45	0.02
16 8h	2.0	93.5	1.3	1033	0.6	465	0.3	568	0.3	39	0.02
17 8.5h	1.2	94.7	0.8	620	0.3	279	0.2	341	0.2	23	0.01
18 9h	0.9	92.6	9.0	465	0.3	209	0.1	256	0.1	17	0.01
19 9.5h	0.4	0.96	0.3	207	0.1	93	0.1	114	0.1	8	00:0
20 10h	1.1	97.1	0.7	268	0.3	256	0.1	312	0.2	21	0.01
21 10.5h	h 1.0	98.1	0.7	516	0.3	232	0.1	284	0.2	19	0.01
22 11h	0.7	98.8	0.5	361	0.2	163	0.1	199	0.1	14	0.01
23 11.5h	h 0.7	99.5	0.5	361	0.2	163	0.1	199	0.1	14	0.01
24 12h	0.5	100.0	0.3	258	0.1	116	0.1	142	0.1	10	0.01
Average	ge		2.7	2151	1.2	896	0.5	1183	0.7	81	0.04
Total	100		9:29	51627		23232	12.9	28395	15.8	1936	1.08
12 hr :	12 hr 10yr storm	ı = 65.6 mm		Roof Area =	= 350 m^2	350 m^2 (45% of lot)	ot)		12 Downpipes	pipes	
787m,	787m^2 * 0.0656 m =	$5 m = 51.7 m^{4}$	n^3	Balance Area = $437 \text{ m}^{4}2 (55\% \text{ of lot})$	ea = 437 n	n^2 (55% ₁	of lot)				

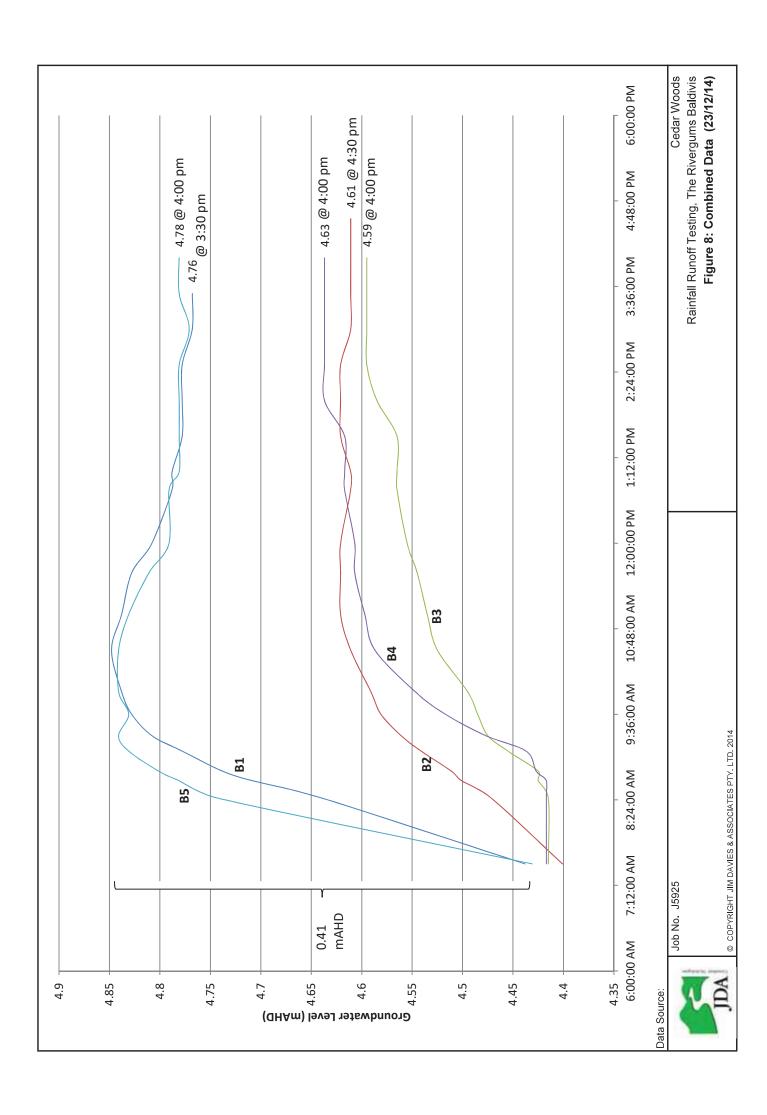
Data Source:

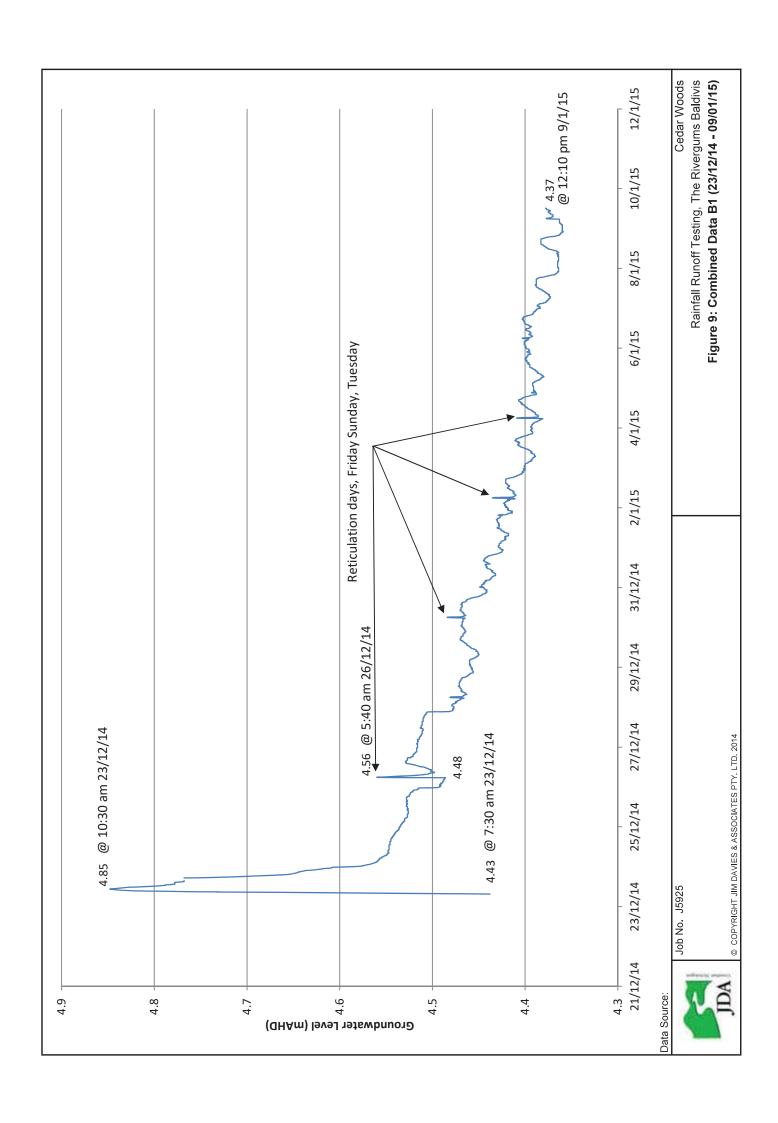
Job No. J5925

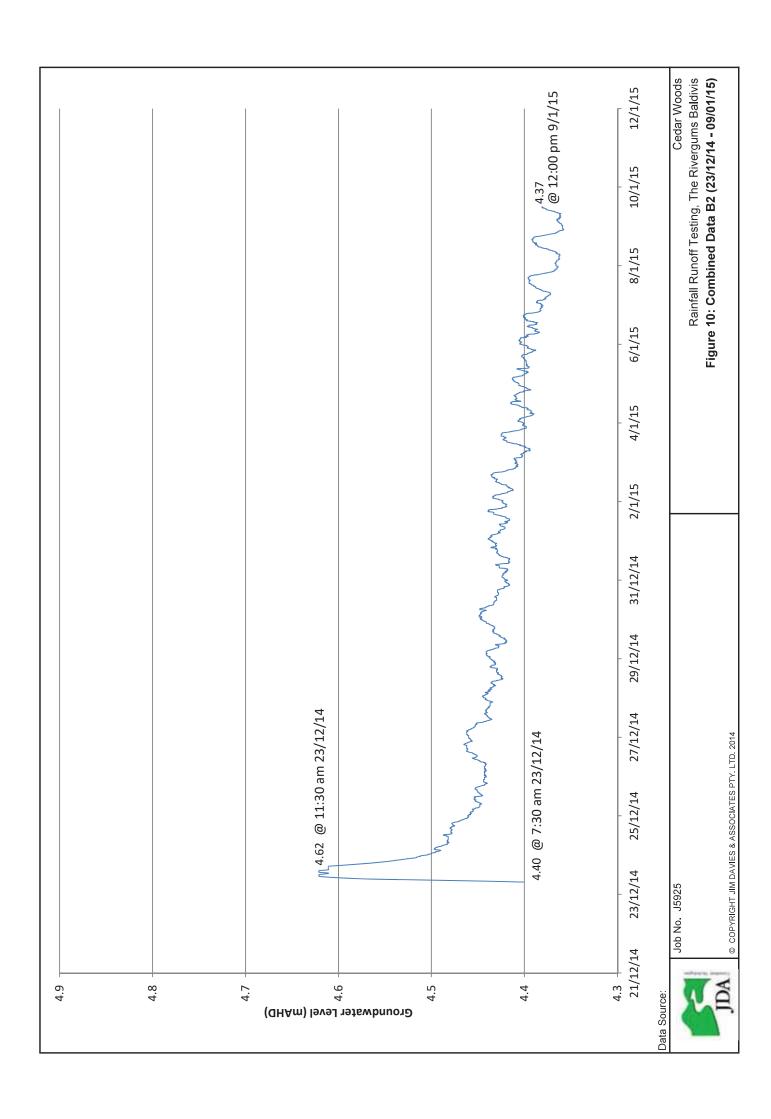
Cedar Woods
Rainfall Runoff Testing, The Rivergums Baldivis
Figure 5: Summary Table

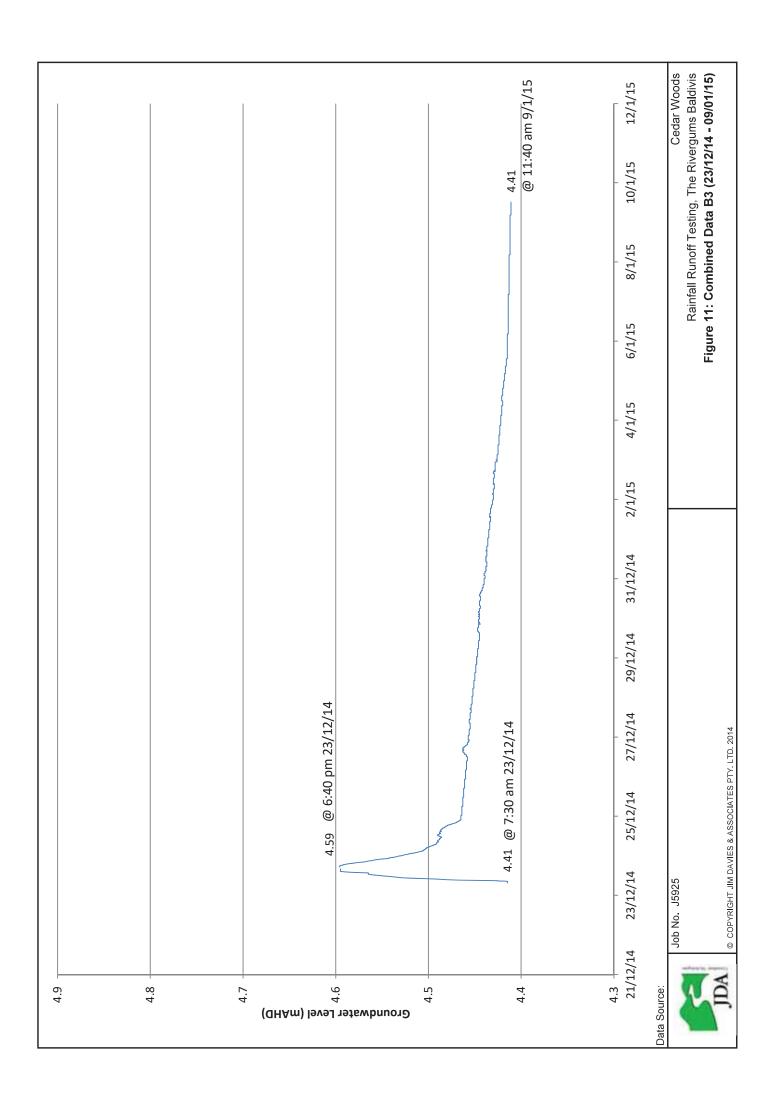


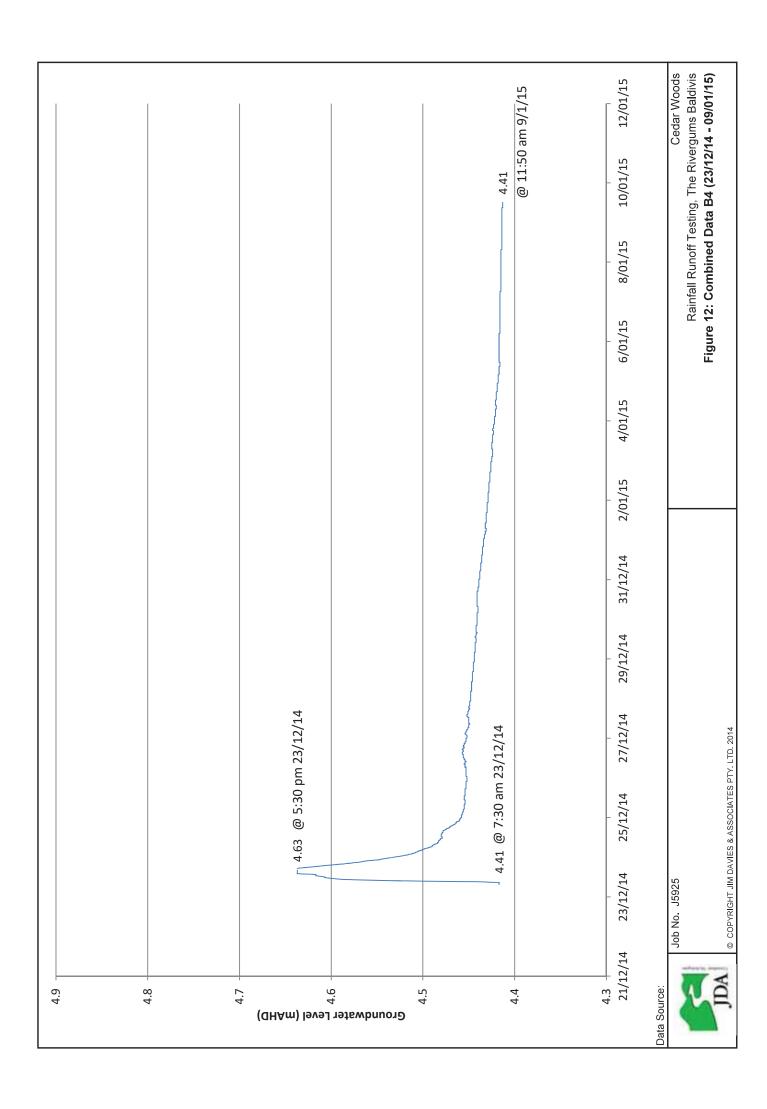


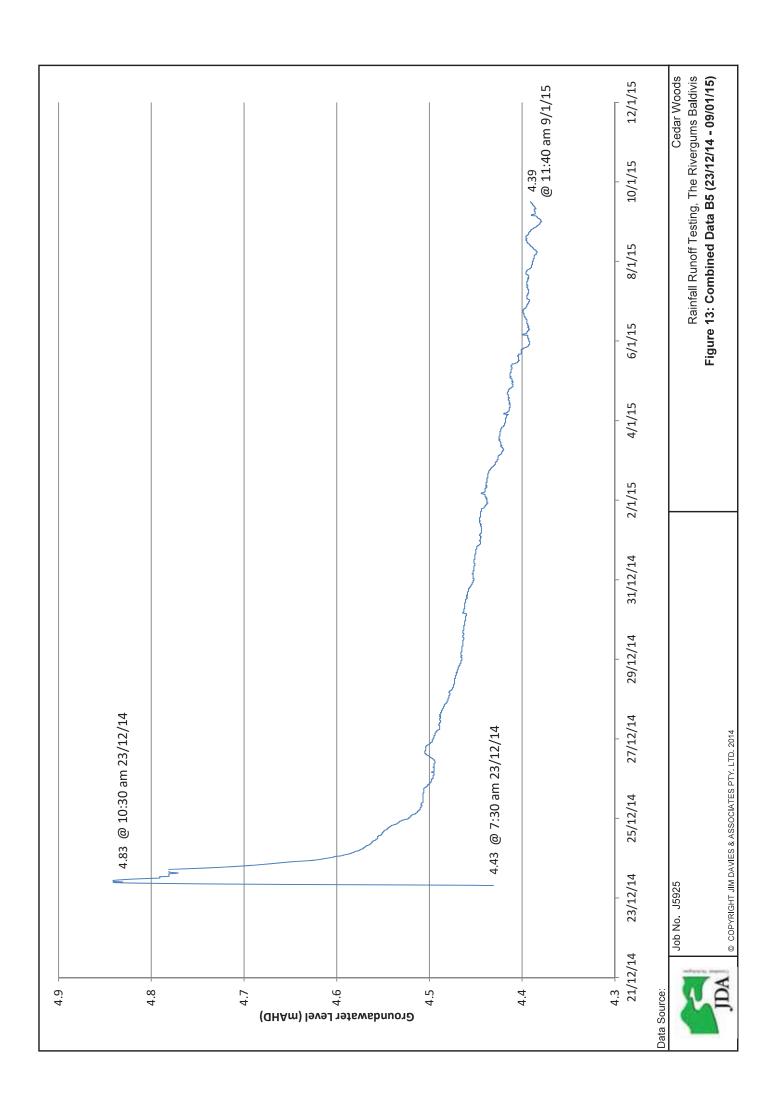


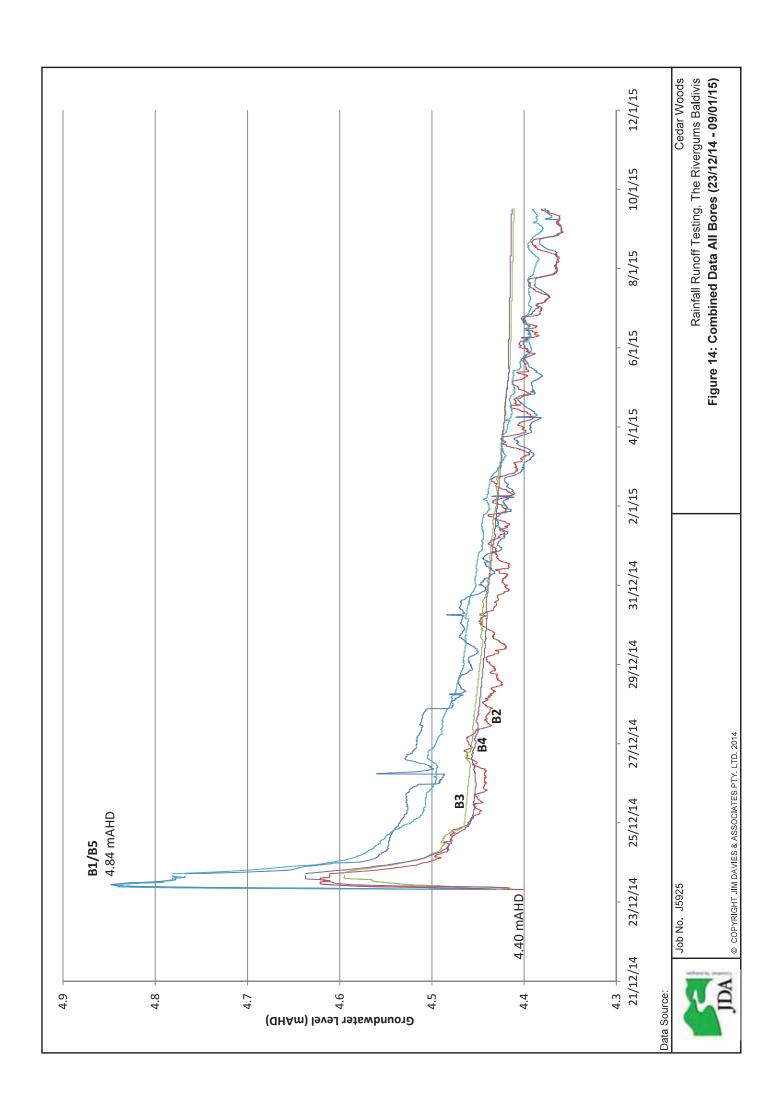
















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Figure 16: Groundwater Levels (10:30am 25/12/14)

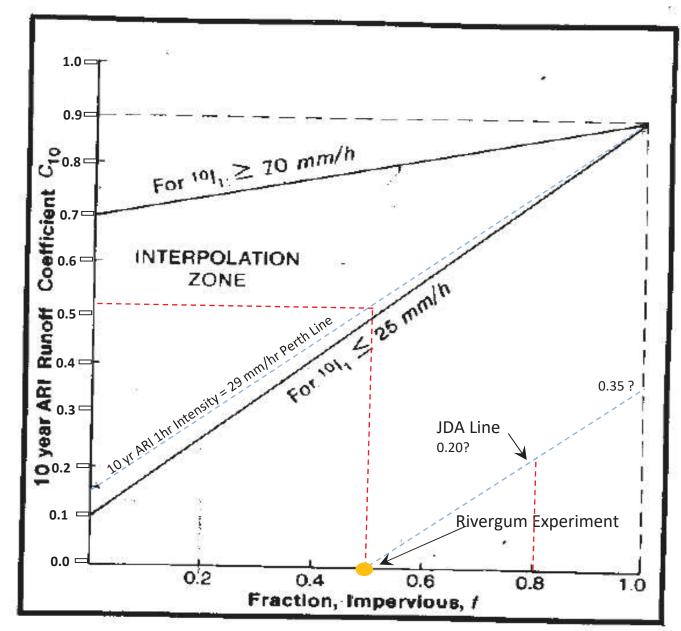


Figure 14.13 - Runoff Coefficients

Data Source: Australian Rainfall & Runoff



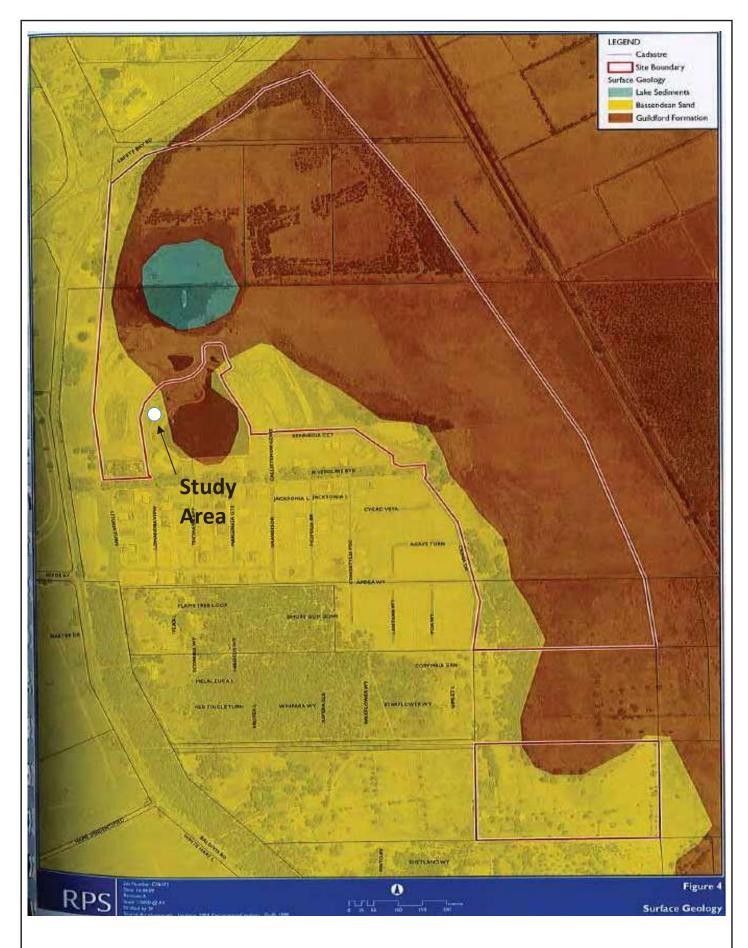
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Cedar Woods Rainfall Runoff Testing, The Rivergums Baldivis

Figure 17: Runoff Coefficients

APPENDIX A

RPS Figures

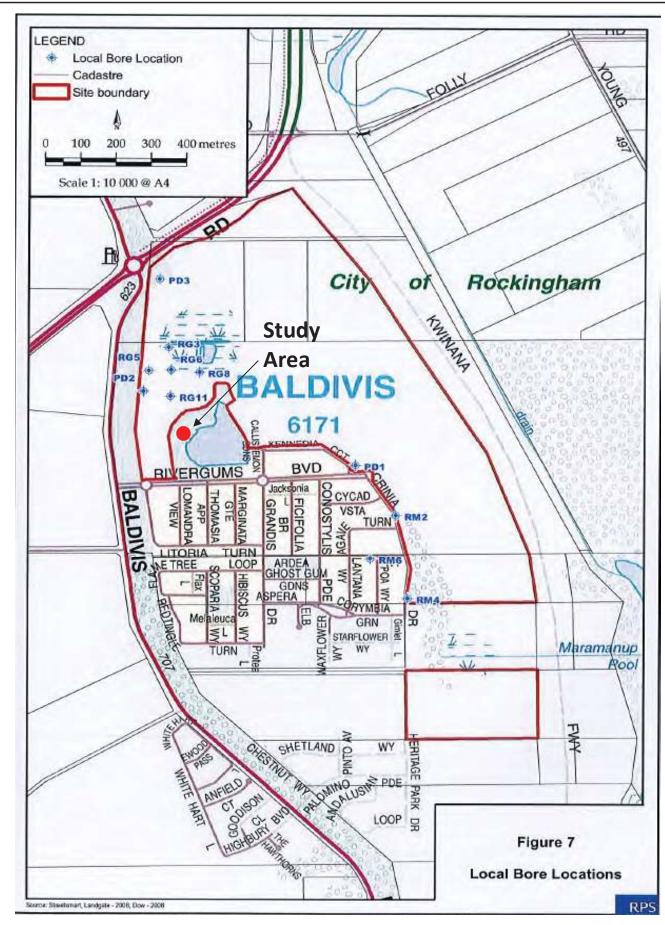


Data Source: RPS The Rivergums Baldivis - Post-urban Water Prediction Modelling (PUWPM)



Job No. J5925

Cedar Woods Rainfall Runoff Testing, the Rivergums Baldivis Figure 1A: Surface Geology, The Rivergums Baldivis



Data Source: RPS The Rivergums Baldivis - Post-urban Water Prediction Modelling (PUWPM)

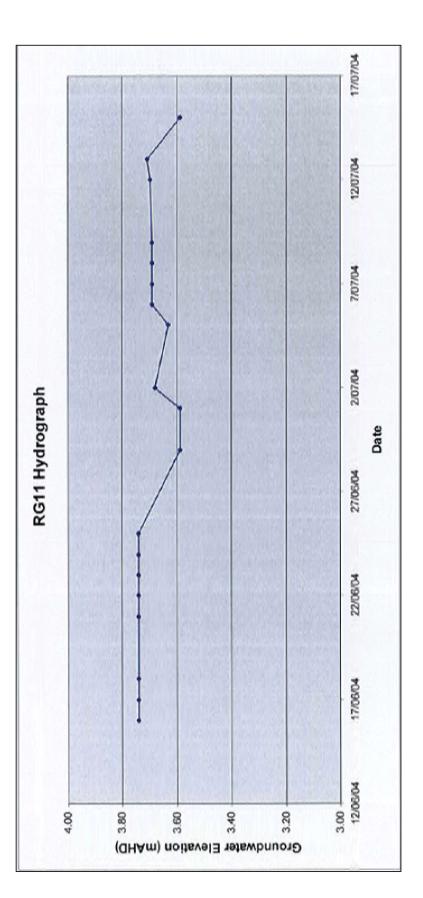


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Rainfall Runoff Testing, the Rivergums Baldivis

Cedar Woods

Figure 2A: Surface Geology, The Rivergums Baldivis

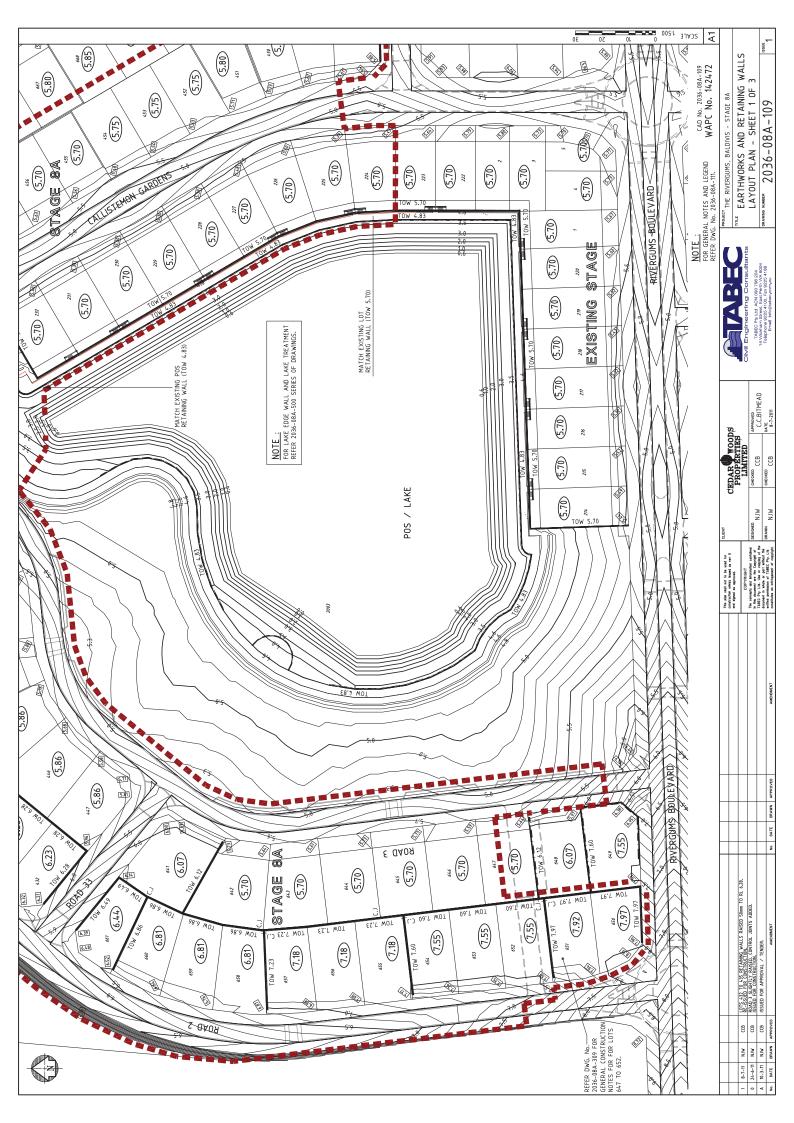


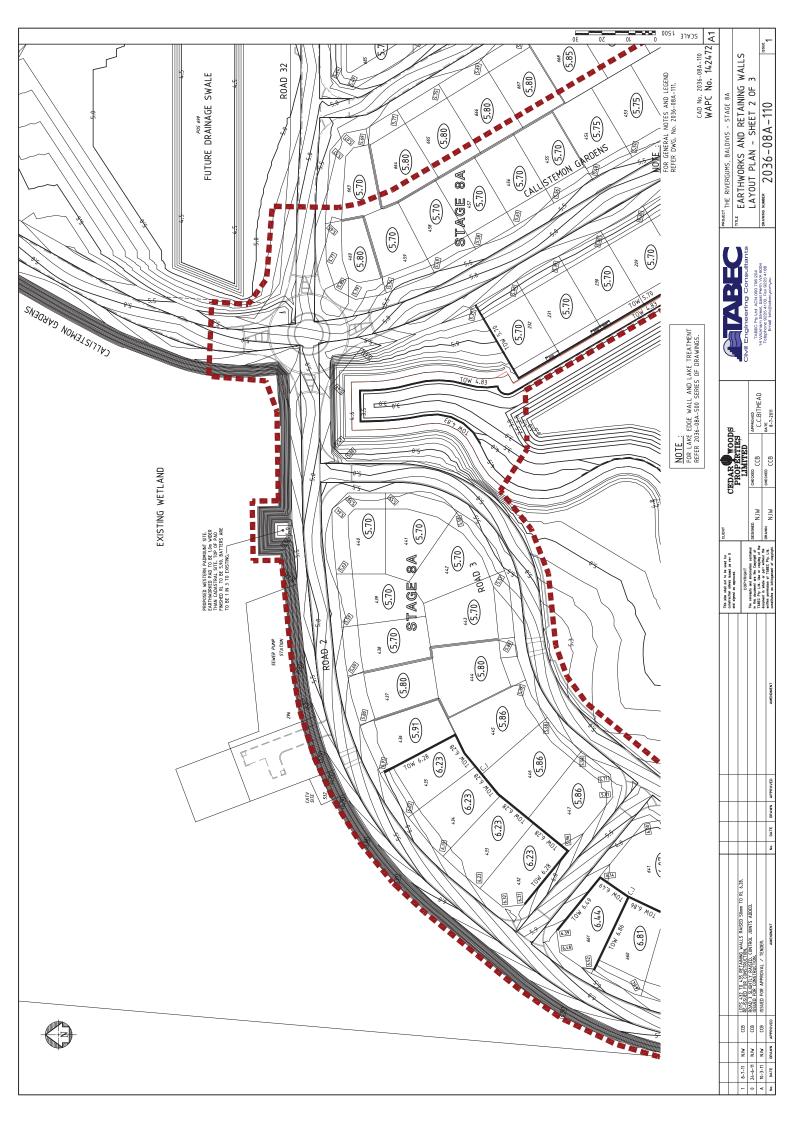
Cedar Woods
Rainfall Runoff Testing, the Rivergums Baldivis
Figure 3A: RPS RG11

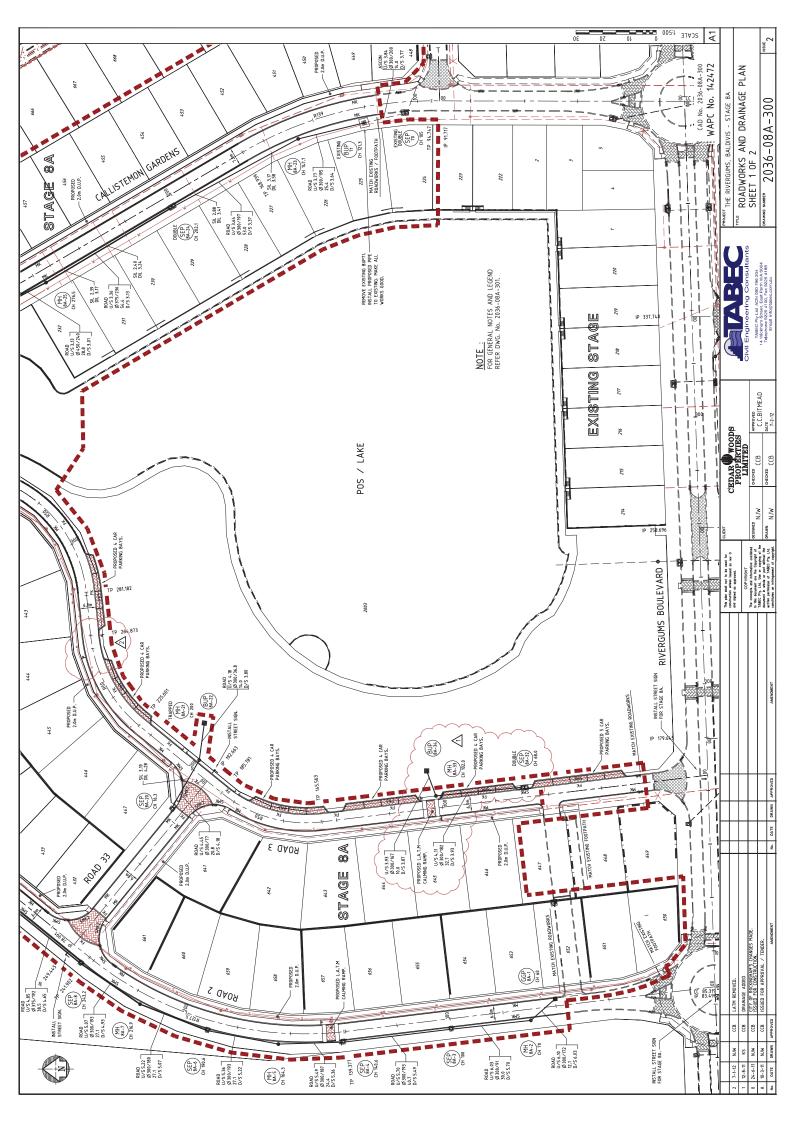


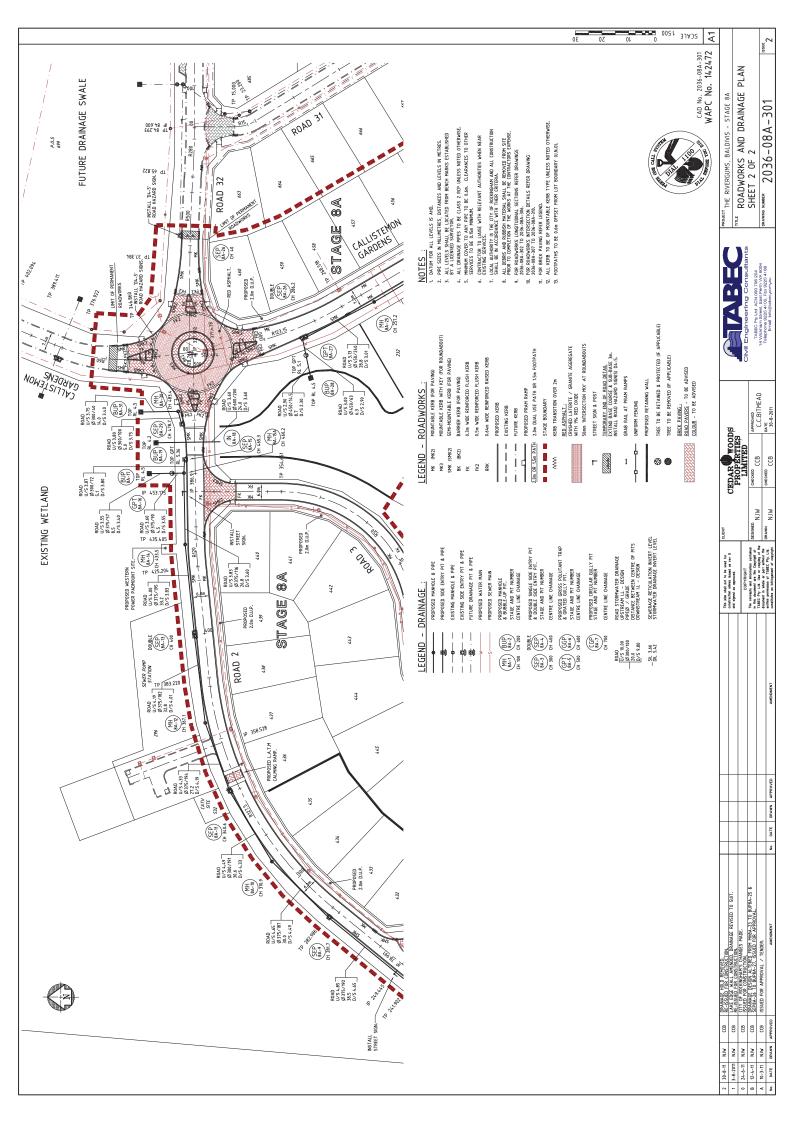
APPENDIX B

TABEC Drawings









APPENDIX C

How Much Runoff? Coefficients for Urban Land Use in South West WA and A Comparison Between Rational Method and Volumetric Runoff Coefficients. Poster Paper by Jim Davies IPWEA WA State Conference 2012

How Much Runoff? Coefficients for Urban land Use in South West WA and a comparison between Rational Method and volumetric runoff coefficients

im Davies (PhD, FIEAust, Member IPWEA, SIA WA Member)

JDA Consultant Hydrologists



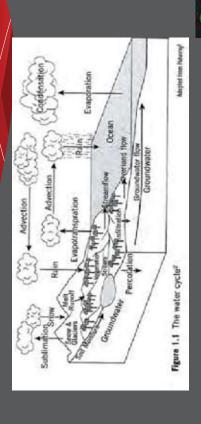
When is Runoff Generated?

* When rainfall rate exceeds soil infiltration rate, (called infiltration excess runoff).

OR

 * When rainfall lands on saturated surface (called saturation excess runoff).



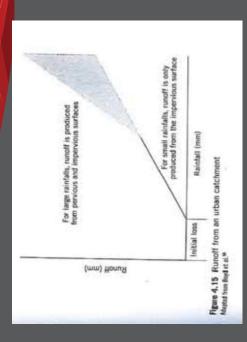


Runoff Coefficient Definition

- Runoff coefficient is a term used widely in Hydrology and has different meanings in different contexts. It is a ratio and therefore dimensionless.
- * The fraction of rainfall which results in surface runoff:
- * can be for an individual storm or for longer eg a year.
 - * More precisely called the volumetric runoff coefficient.
- In the Rational Method, the ratio of rainfall intensity to peak runoff per unit area.



Reproduced from Ladson 2008





Runoff Coefficient Definition

- Runoff coefficient is a term used widely in Hydrology and has different meanings in different contexts. It is a ratio and therefore dimensionless.
- The fraction of rainfall which results in surface runoff:
- * can be for an individual storm or for longer eg a year.
- More precisely called the volumetric runoff coefficient.
- In the Rational Method, the ratio of rainfall intensity to peak runoff per unit area.



R produced in a model 200

atchment	Location	Area (hn)	Initial loss (mm)	4
Aaroubra	Sydney	57.3	0	0.157
trathfald	Sydney	234	0	0.289
amison Park	Sydnay	22.1	0	0.207
Ishers Ghost	Sydney	226	D	0.252
iralang	Carsberra	76	3.26	0.349
ong Gully	Canberra	490	0	0.059
Мамероп	Canberra	445	0	0.208
Surtin	Canbarra	2690	0	0.174
Anna Street	Melbourne	70	0	0.306

Rational Method

* Peak flow estimate:

Q = F.C.I.A.

Where $Q = peak flow (m^3/s)$

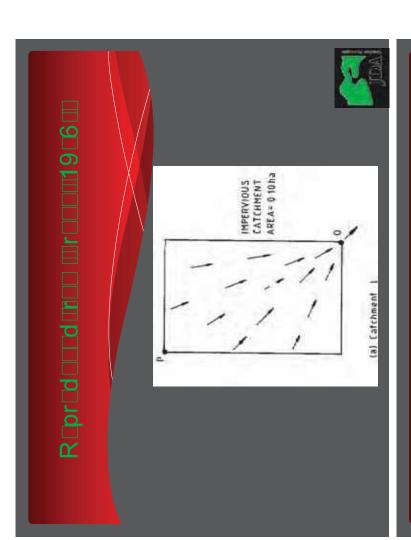
F = conversion factor = 0.00278

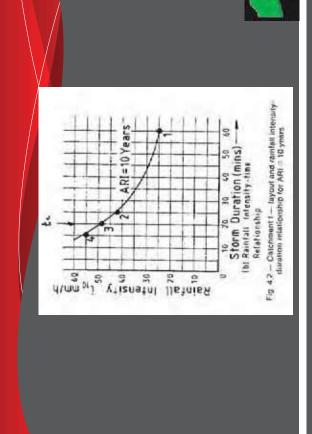
C = Rational Method runoff coefficient I = average rainfall intensity over time of

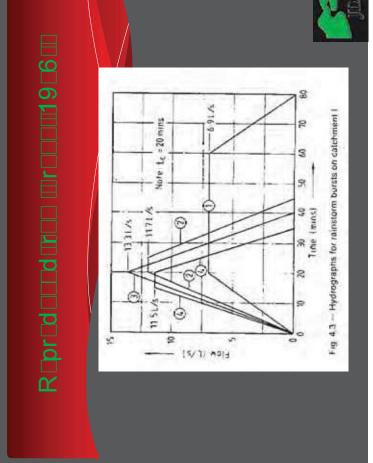
concentration (mm/hr)

A = catchment area (ha)











= average rainfall intensity over time of

concentration (mm/hr)

A = catchment area (ha)

C = Rational Method runoff coefficient

F = conversion factor = 0.00278

Where Q = peak flow (m^3/s)

Peak flow estimate:

Q = F.C.I.A.

Rational Method

AR&R (EA, 2000)

Section 1.16

Section 14.5.5 Rational Method runoff coefficient

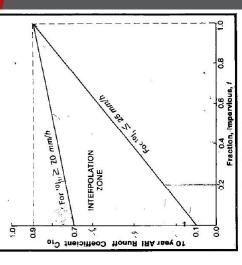
AR&R (EA, 2000)

Section 5.3.2 R

• Recommend of the mention



Reproduced from AR&R

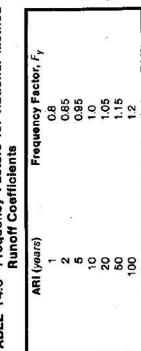


 Prrmd^0] with Prrm^0 .

Figure 14.13 - Runoff Coefficients

Reproduced from AR&R

TABLE 14.6 - Frequency Factors for Rational Method Runoff Coefficients Frequency Factor, Fy ARI (years)





α cample: Fully Impervious Catchment $C_{R} = 1.0$

Q, flow (m³/s) વિ_p



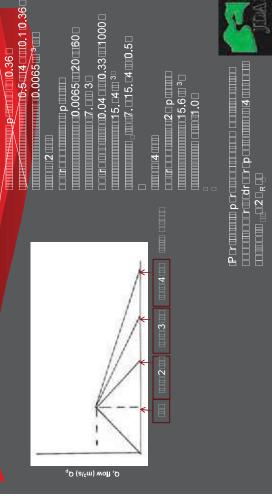
To Match Peak Flows

			\
Rational Method Runoff	lov	Volumetric Runoff Coefficient C _v	ent C,
Coefficient C,	tb = 2tc	Tb = 3tc	Tb = 4tc
0.10	0.10	0.15	0.20
0.25	0.25	0.38	0.50
0.50	0.50	0.75	1.00
0.75	0.75	N/A	N/A
1.0	1.0	N/A	N/A

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- minima R. R. R. L. P. M. L. D. M. D. D. D. C. R. R. L. D. D. C. L. D. L. D. C. L. D. L. D. C. L. D. C. L. D. L. D. C. L. D. L. D. L. D. L.



Example: Partially Impervious Catchment C_R = 0.



Conclusions

- IPWEA Subdivision Guidelines silent on runoff coefficient values.
- Ladson (2008) shows E. States fraction impervious up to 0.4.
- AR&R recommends Figure 14.13 for Rational Method runoff coefficient.
- * AR&R Figure 14.13 indicates for f = 0.4, approx Rational Method $C_R = 0.5$ (10yr).
- Need for more consistency in SW WA on values of runoff coefficients.
- * To match flood peaks C_v volumetric runoff coefficient must be greater than C_R (Rational Method runoff coefficient). For example if used C_R = 0.5, need to use C_v say 1.0 to match flood peaks.
- Need for better understanding of different definitions of Rational Method runoff coefficient C_R compared with volumetric runoff coefficient C_R.









Harrisdale Green: Soakwell Infiltration Testing (SIT)





DISCLAIMER

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QUALITY ASSURANCE

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	Name	Signature	Date
Author	Darcy Bott		
Checked by	Jim Davies		
Approved by	Jim Davies		



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1. INTRODUCTION

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TABLE 1: SOAKWELL & BORE SURVEY

Bore	Top of Casing (mAHD)	SWL (15/9/2015)	SWL (29/9/2015)	SWL (12/10/2015)
HGJDA113s	26.43	25.15	25.05	24.94
HGJDA114s	26.39	25.14	25.04	24.93
HGJDA115s	26.32	25.06	24.96	24.86
HGJDA116s	26.45	25.11	25.01	24.90
HGJDA117s	26.40	25.16	25.04	24.93
HGJDA118s	26.36	25.18	25.06	24.95
HGJDA119s	26.38	25.17	25.05	24.94
HGJDA120s	26.30	25.14	25.020	24.920
HGJDA121s	26.35	25.13	25.03	24.90
HGJDA121d	26.50		22.43	22.23

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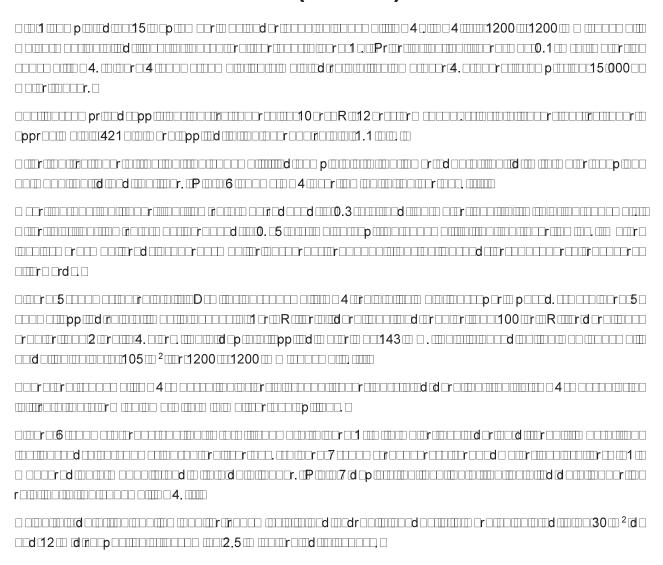


TABLE 2: SOAKWELL SUMMARY

ES.	Soakwell	Size (mm	Capacity (m³)	Plan Area	Base Open	Side Area (m²)	Side Slot Size (mm x	Side Slot	Side Slot Number	Total Side	Side Open	Total Open	Side Plus
		x mm)		(IIII)	Area (m²)		шш	Area (m²)		Area (m²)	(%)	Area (m²)	area (m²)
		1200 	1.35□	1.13	0.031	4.52□	4545	0.0065	1	0.12	2.63	0.15	2.66
2		1500 — 1500	2.65□	1.76	0.125□	7.06□	45 11145	0.0065	24□	0.16	3.20□	0.2	7 □
3		1200 	1.35	1.13	□0	4.52□	4545	□90000	1	0.12	2.07	0.125	5.66



2. SIT 1: SOAKWELL 4 (15/9/15)

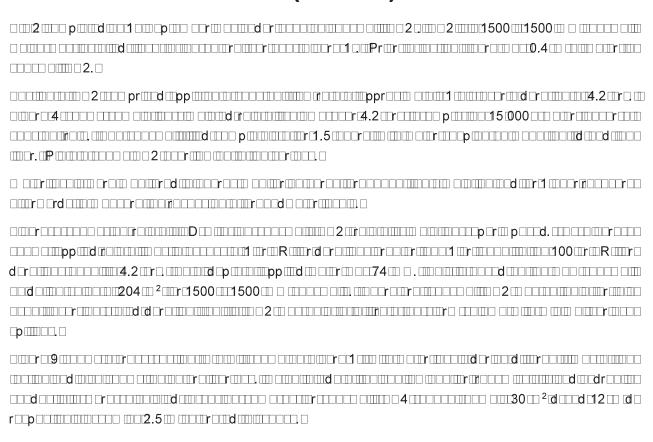


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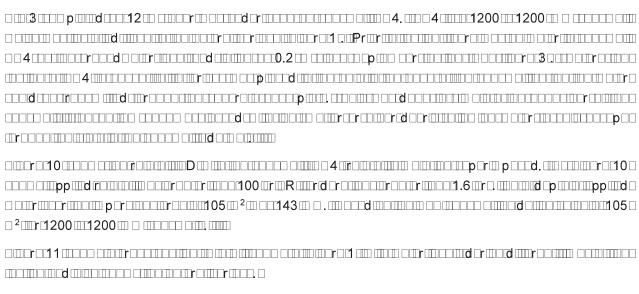
3. SIT 2: SOAKWELL 2 (18/9/15)



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4. SIT 3: SOAKWELL 4 (12/10/15)



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5. SUMMARY

TABLE 3: SOAKWELL INFILTRATION TESTING (SIT) RESULTS SUMMARY

soakwell	Soakwell size (mm x mm)	Date	Applied Water (L)	Applied Time (hrs)	Average Infiltration Rate (m³/hr)	Average Infiltration Rate (m³/d)	Initial Loss (mm)	Lot area (m²)	Continuing Loss (mm/hr) ¹	Notes
SO4	1200 x 1200	15/9/15	15000	4.20	3.6	86	13	105	34	No blockage
SO2	1500 x 1500	18/9/15	15000	4.80	3.1	86	13	204	17.5	No blockage
SO4	1200 x 1200	12/10/15	15000	4.25	3.6	86	13	105	34	Base blocked

000||3|||000 ||100|||113||00 ||100||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1200 ||1 $= 0.02 \pm 0.00$ $= - \cos \theta + \sin \theta +$



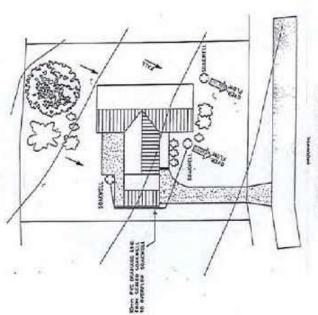
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FIGURES



CITY OF ARMADALE

MINIMUM REQUIREMENTS FOR INTERCONNECTING SOAKWILLS



INDICAL LOT ARRANGEMENT

 Soulouis for stat where the teret table 25mm in form than 3 min 30 per when pictude in accordance with the Realth Department's "marked for determining the observation or separation of the spiral or statistically at soil.
 This system is not statistically the cloy soils.
 All conducting to the installed and making any from footings and 2m from boundary. 3108

SUPPLYSION CONDITIONS GIRT

L'Pranide a "es-combincted" diagram, ance complake

2. Spokerell applient size to be based on a abilious 300m? rented near

A Location to by in terming saviety of black or building covelage

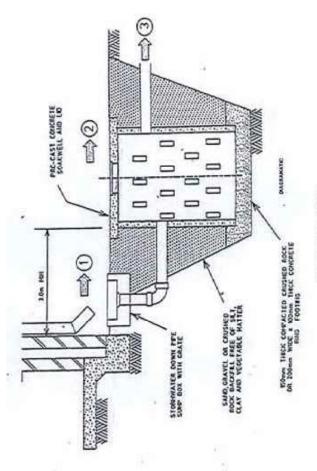
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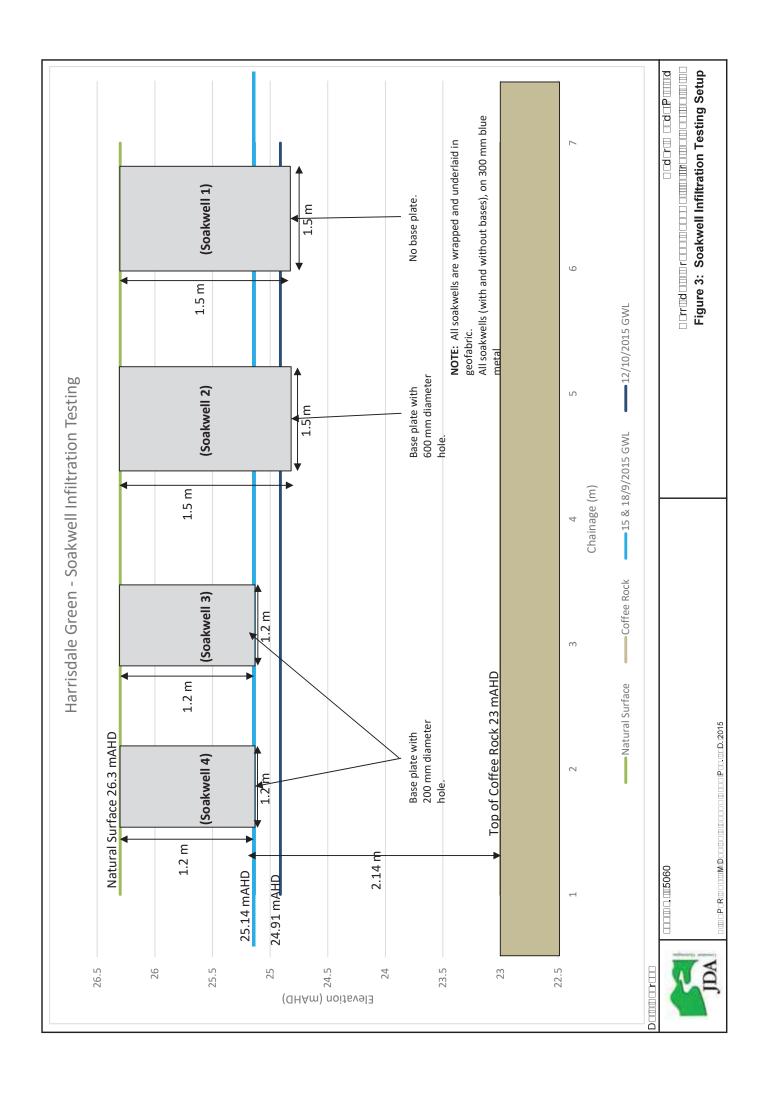


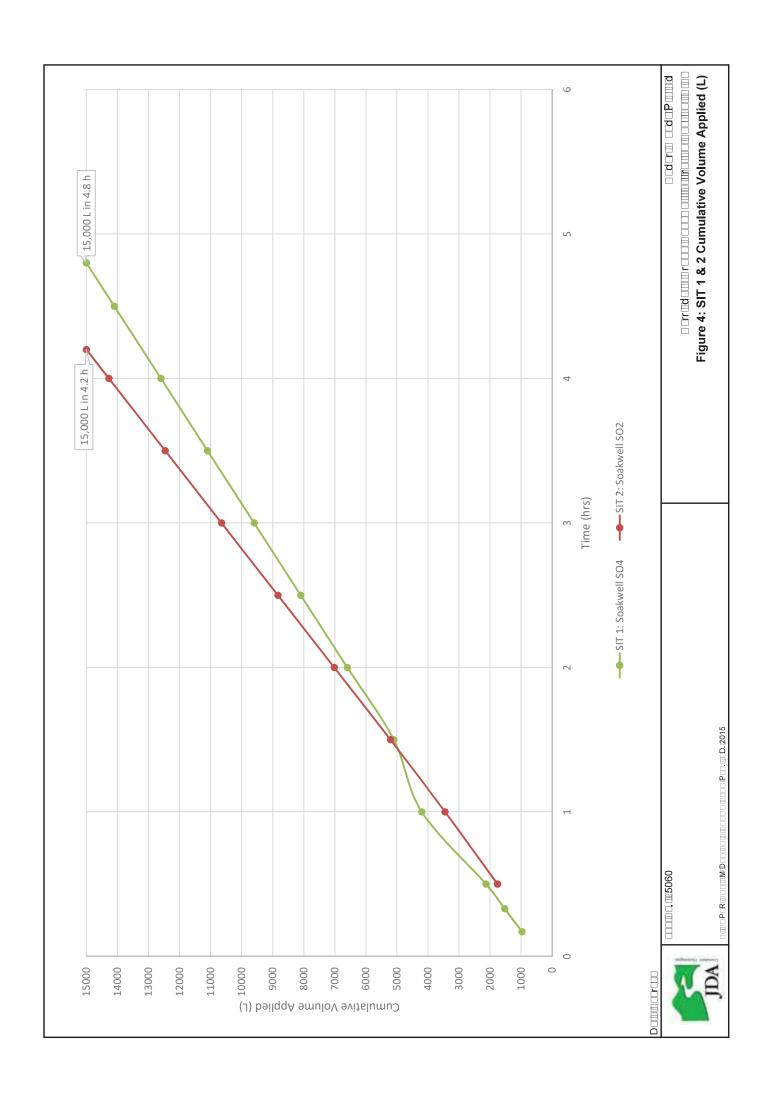
SOAKWELL SIZES

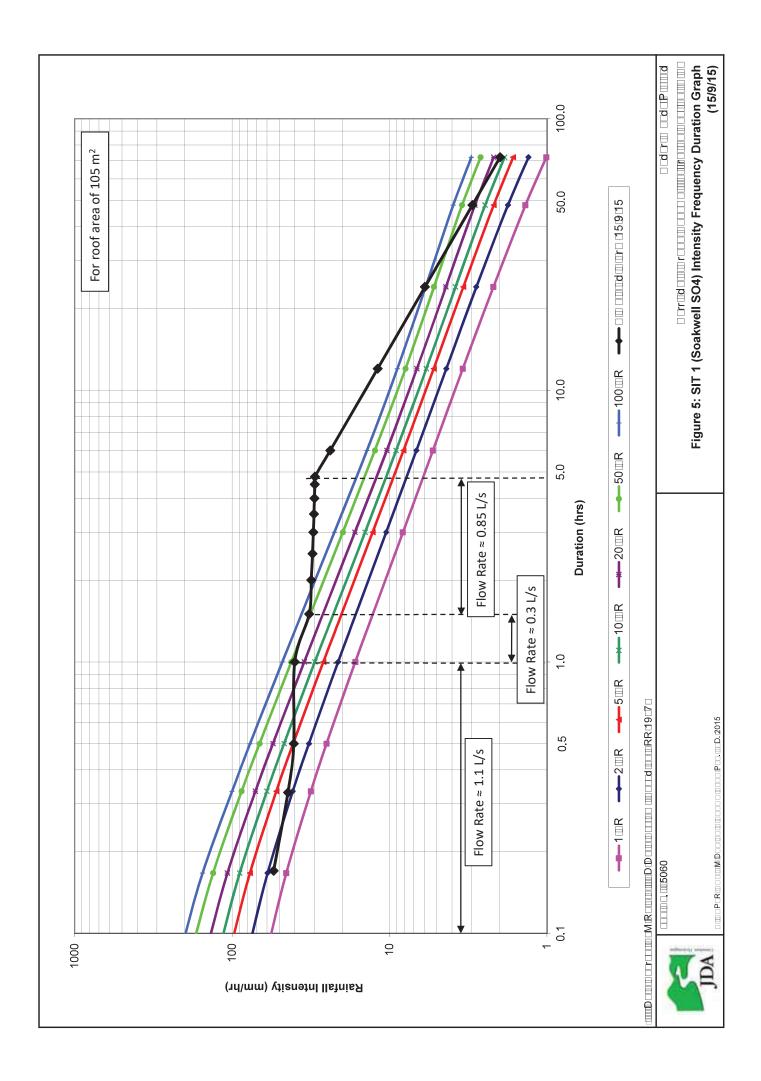
Saakwells shall have a total capacity at least equal to 130 litror per 13 square meters of root or paved area from which stormwater is discharged.

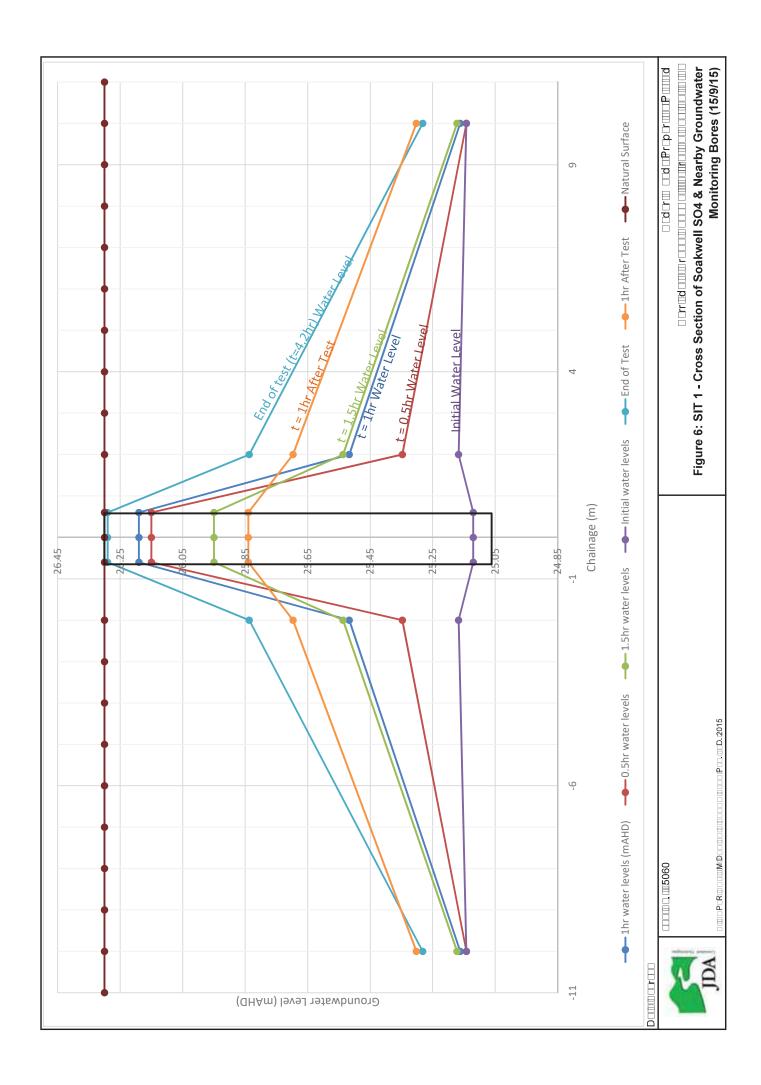
SGAKWELL SIZE (nm) BIAM x HETGHT	ACCOMMODATED (m2)
900×600	75
900×500	57
900×1200	52
1200×660	05
1200×1200	100
1200×1500	130
1500×600	60
1500×1200	091
4500×1500	200
1800×600	110
1500×900	170

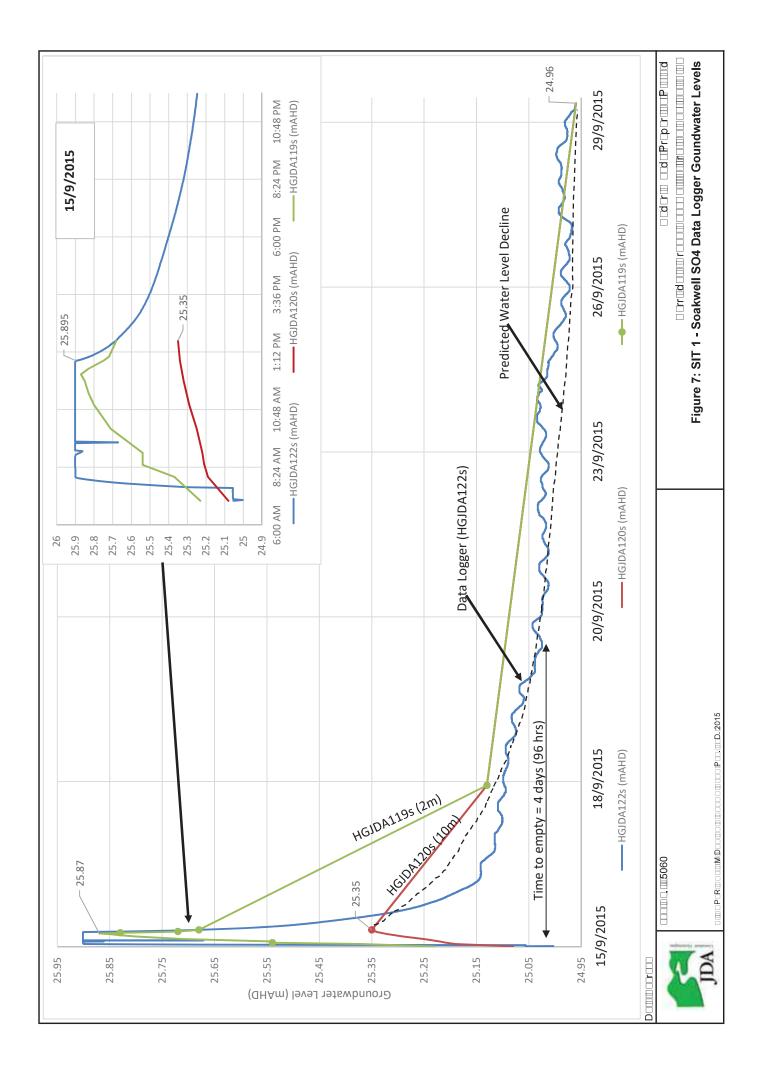
Figure 2: City of Armadale Soakwell Standards

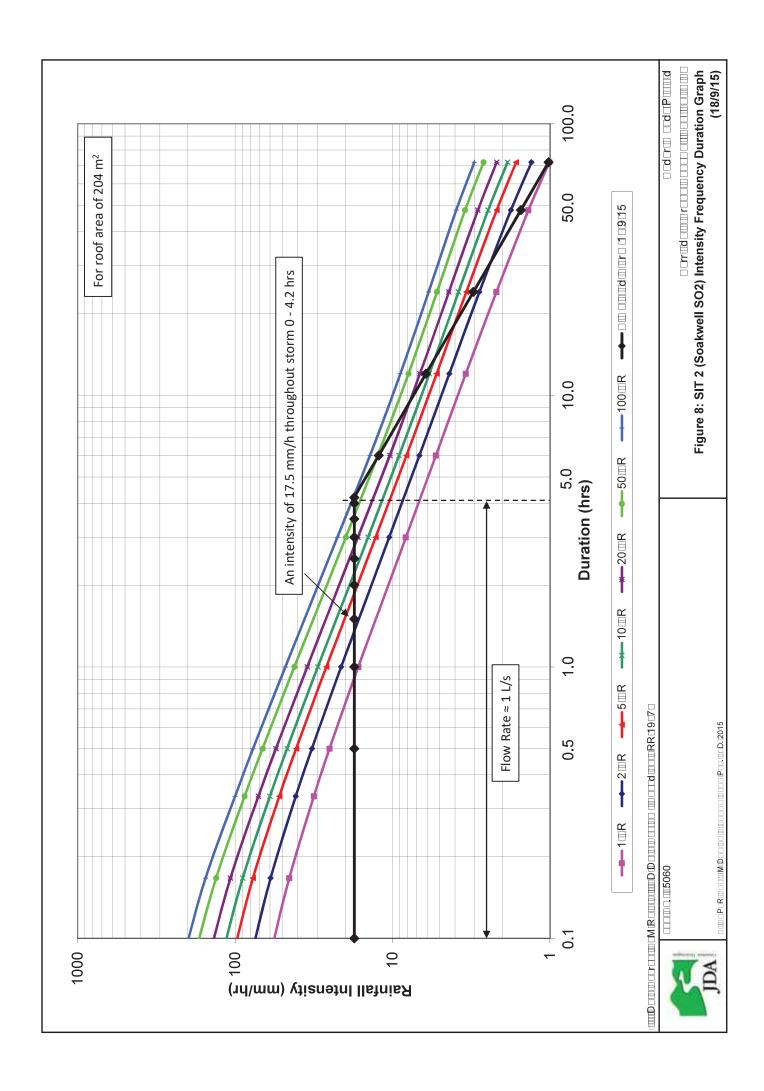


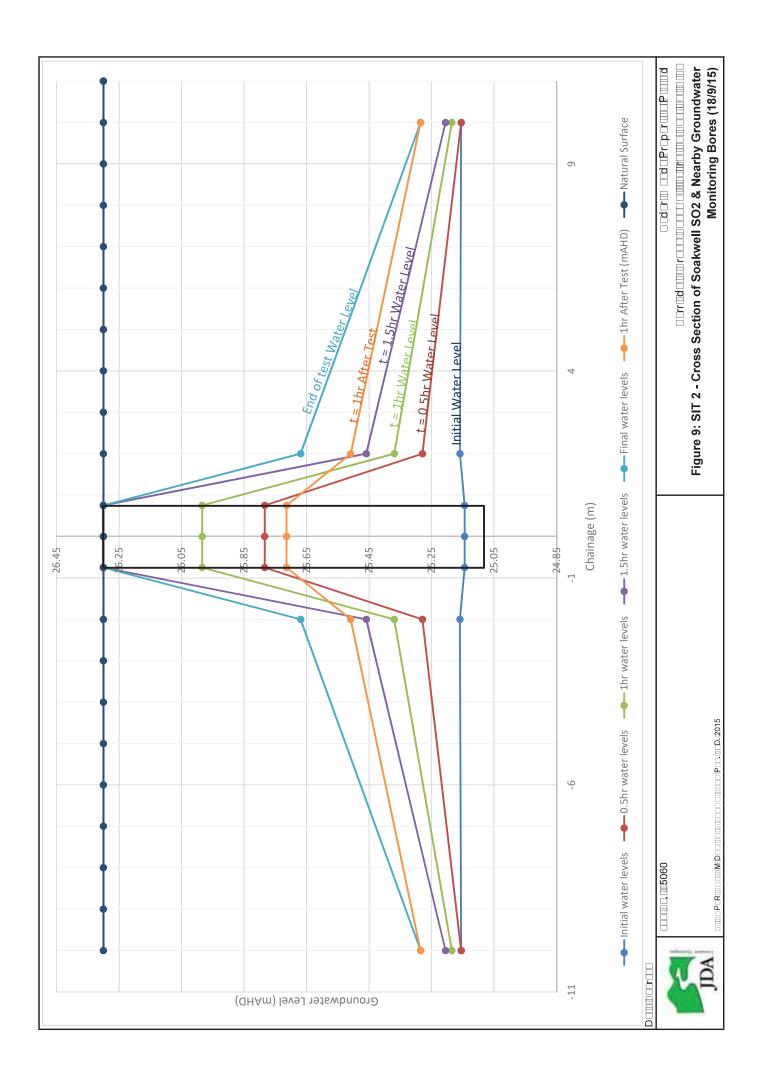


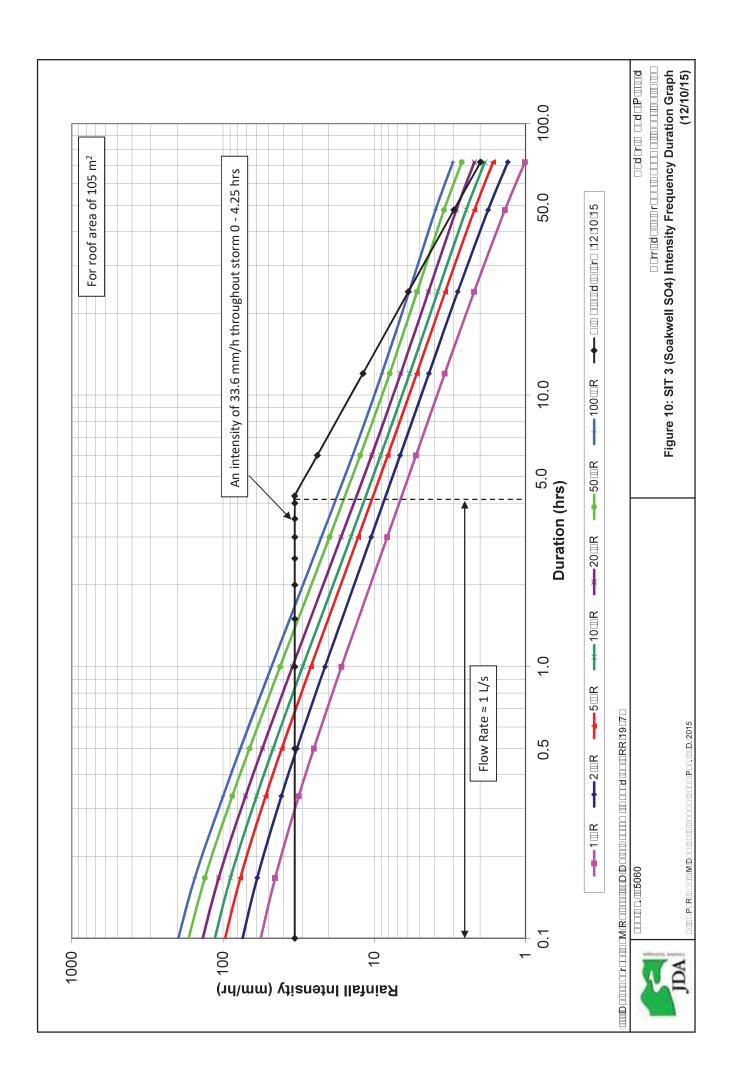


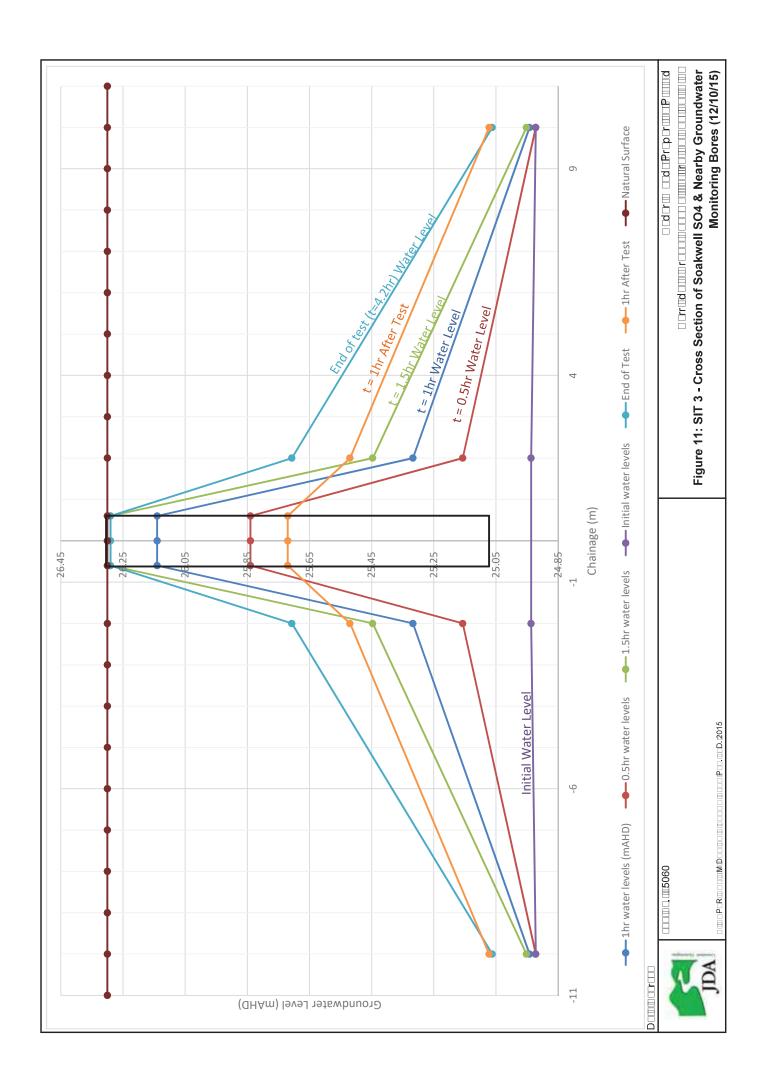












PLATES





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Plate 1: Soakwell SO2 Installation (4/9/2015)





o cd crm ocd dPrcp crwdP wwd

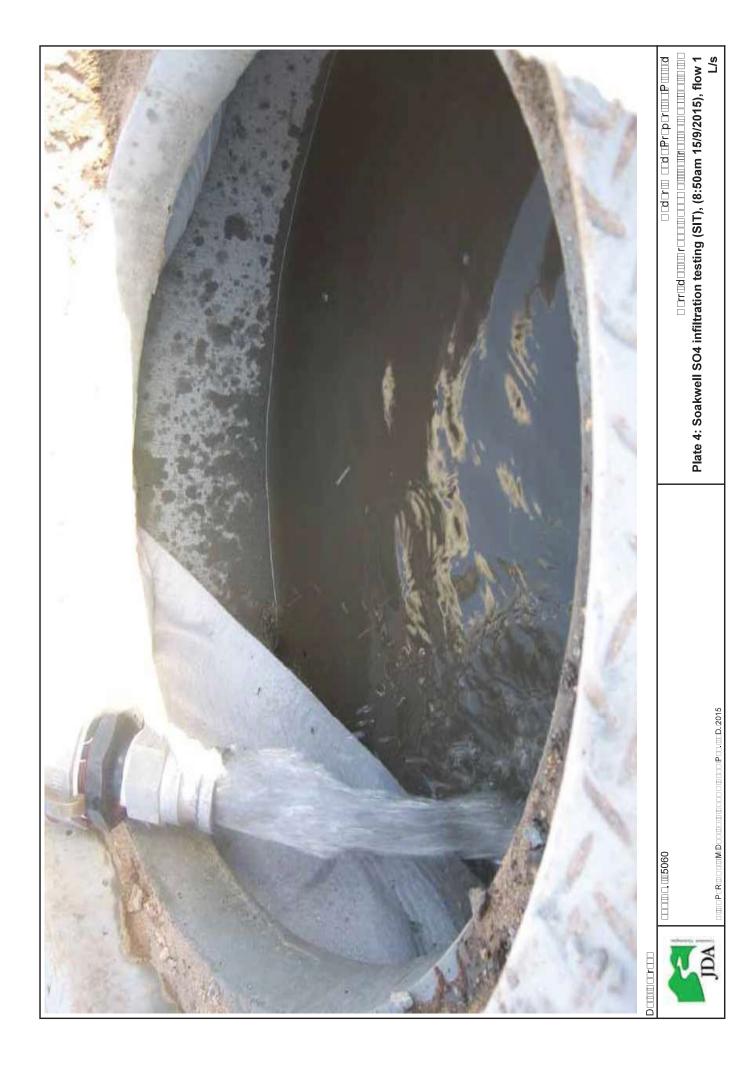
Plate 2: Soakwell SO4 Geofabric Liner, with monitor bore HGJDA124s (4/9/2015)





o cd crm ocd dPrcp crwdP wwd

Plate 3: Soakwell SO2 Backfilling. With monitoring bore HGJDA125s (4/9/2015)



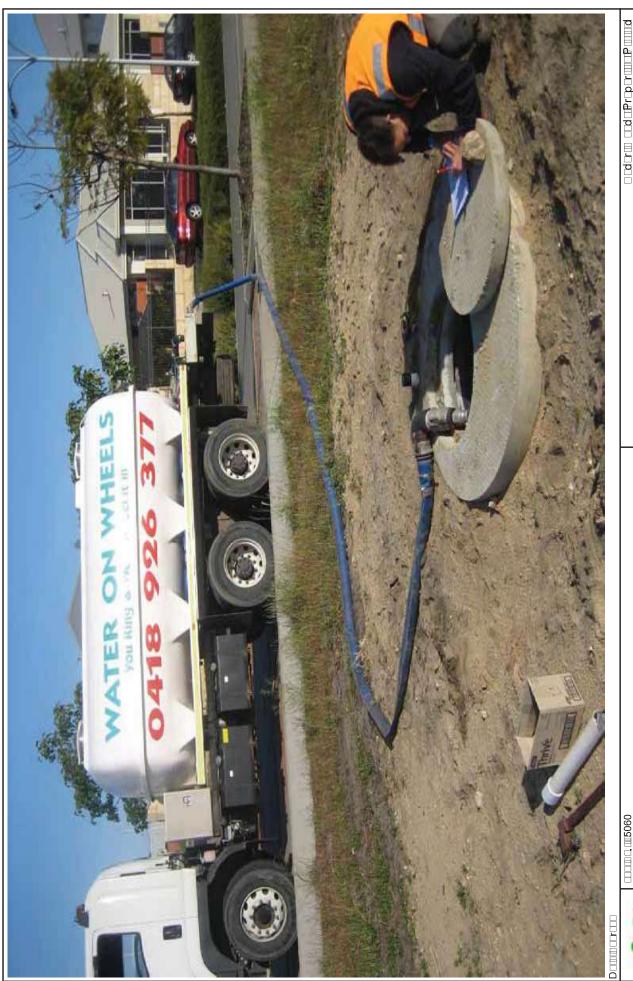


Plate 5: SO4 soakwell infiltration testing (SIT), (15/9/2015), 15000L water tanker

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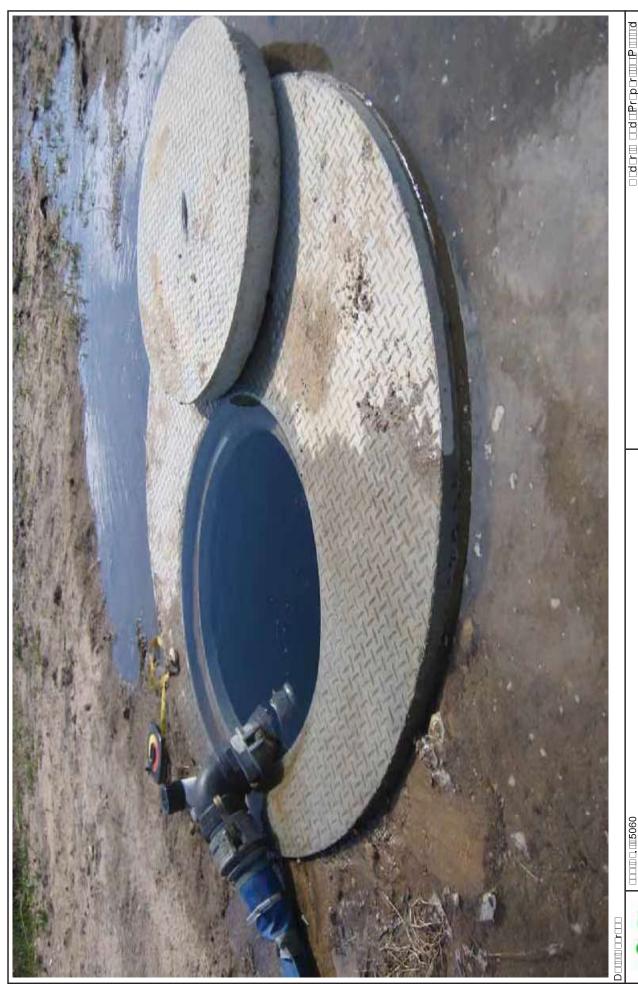


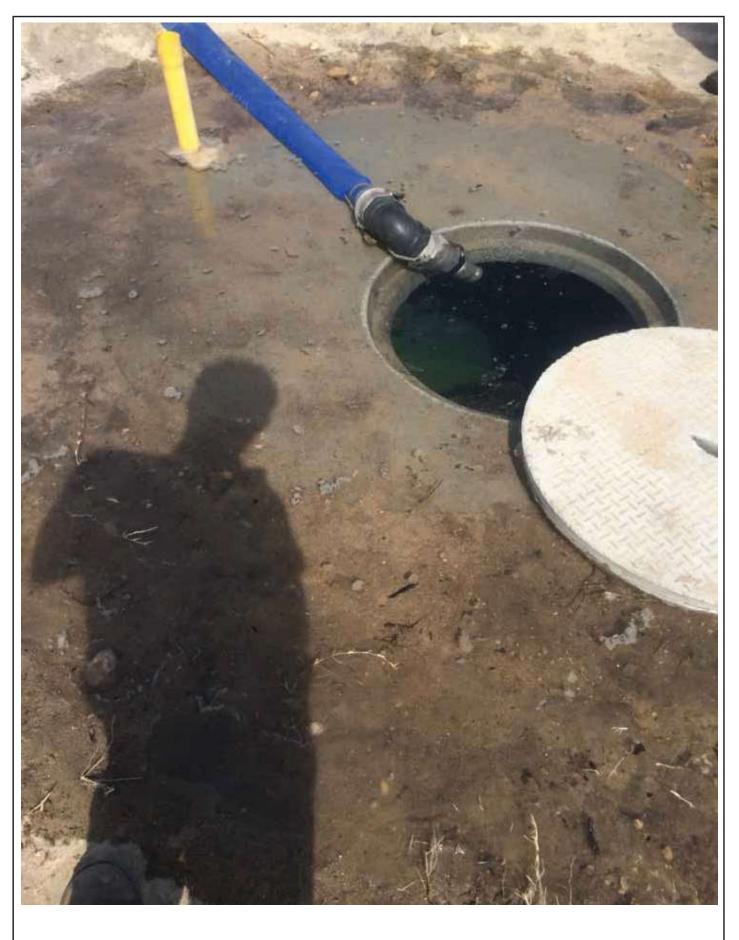
Plate 6: SO4 Soakwell infiltration testing (SIT) overflowing to surface (15/9/2015)



Plate 7: Water Level Data Logger HGJDA122s (15/9/2015)



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Plate 8: Soakwell SO2 soakwell infiltration testing (SIT) overflowing to surface (18/9/2015)

LOSSES AT CATCHMENT SCALE

The processes that contribute to rainfall loss may be well defined at a point; the difficulty occurs in trying to estimate a representative value of loss over an entire catchment. Spatial variability in topography, catchment characteristics (such as vegetation and soils) and rainfall makes it difficult to link the loss to catchment characteristics.

To overcome this, simplified lumped conceptual loss models are used. They combine the different loss processes and treat them in a simplified fashion.

Rainfall Loss Continuing Loss
Rainfall Volume

Figure 2: Initial loss - continuing loss model

The most commonly-used model in Australia is the *initial loss* – continuing loss model (Figure 2).

The initial loss occurs in the beginning of the storm, prior to the commencement of surface runoff. The continuing loss is the average rate of loss throughout the remainder of the storm.

This model is consistent with the concept of runoff being produced by infiltration excess,

i.e. runoff occurs when the rainfall intensity exceeds the infiltration

capacity of the soil.

In recent years a second runoff-generating mechanism, saturated overland flow, has been identified. This assumes that runoff is generated from the saturated portions of the catchment; this area increases with the duration

Initial Loss

Proportional Loss

Reamflow

Adrograph

Hydrograph

Time

Figure 3: Initial loss - proportional loss model

flow concept is consistent with the *initial* loss – proportional loss model (Figure 3). The initial loss is as defined above. The proportional loss is a (constant) fraction of the rainfall after surface runoff has commenced, and can be

The saturated overland

regarded as 100 percent

runoff from the saturated portion of the catchment, and zero runoff from the remainder. For simplicity, the proportional loss coefficient for a storm is usually taken as a constant.

Both the initial loss – continuing loss and the initial loss – proportional loss models were investigated. Only the initial loss – continuing loss model work is presented here since the initial loss – proportional loss model was found to be inferior in estimating the correct design flows.

Applying a point infiltration equation

A pilot study was undertaken on nine catchments to see if the application of a 'theoretically correct' loss model based upon a point infiltration equation (Green-Ampt) provided superior results to the simplified models at the catchment scale. Although the Green-Ampt equation was able to be successfully applied to each catchment, the results were not on average superior to those produced using the simplified loss models. Hence, this approach was not pursued further.

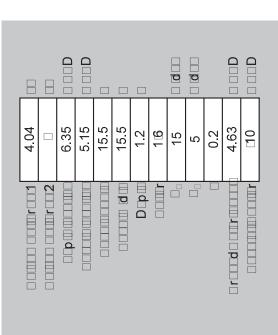
and severity of the storm.



Appendix H MODRET Infiltration Modelling

MODRET - Summary Results

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D = 2016

d□□□	240.0	462.0	0.957	0'56				
	0.0	173.0	474.0	640.0				
	5.15	5.65	6.15	6.35				

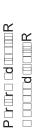
Critical Design Event

		\square_{ϵ}	593	731	09	971	1052	12□1	1512	1334		
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			H	6.34	6.26	6.13	96'5	5.9	5.49	5.15		
		3	242	345	440	641	653	711	1009	902		
10 r R		□ 3 □										
	В											
		$\square^3\square$	191	273	483	562	549	700	5 2	_27		
5⊞r⊞R□		$\square^3\square$	169	232	376	364	260	243	19	3		
	В		5.64	5.75	66"5	2.97	5.79	5.77	69.5	5.16		
		$\square \square_3 \square$	5	112	177	229	307	396	494	25□		
1 III r		$\square^3\square$	4	49	26	0	4	0	0	0		
	Ь		5.29	5.29	5.23	5.15	5.16	5.15	5.15	5.15		
			0.5□r	1 <u></u>	3□r	6□r	12□r	24□r	4	72□r	J□96	120 lr

MODRET - Summary Results

6135

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		0	6□4	1456	2319	3276	432□	0009		
5		5.35	5.55	5.75	5.95	6.15	6.35	6.55		

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Critical Design Event

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	В		6.41	6.48	6.45	6.43	6.32	6.31	6.29	6.05		
		$ \square ^3 \square$	209□	3021	3671	5444	5319	6620	7904	6752		
10≡r⊞R□		\square_{8} \square										
	В											
		$\square_{\epsilon}\square$	1622	2335	41	4748	43□0	25 🗆 7	664□	6192		
5⊞r⊞R□		$\square^3\square$	1253	175	3010	3066	2129	2452	2341	1553		
	Ь		5.7	5. 2	60.9	6.11	5.91	2.9□	55	5.77		
		\square_{ϵ}	650	26	1365	1769	2306	2981	3739	4169		
1⊞r⊞R□		$\square^3\square$	316	403	520	643	6_5	798	753	699		
	В		5.44		5.50		5.55		5.57	5.55		
			0.5□r	1	3_r	6 -	12□r	24□r	4	72□r	96□r	120□r

MODRET - Summary Results

6135

D = 17 = 2016



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5.70	477.0	0'9288
6.20	2345.0	4109.0

Q

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□ d □ 0

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	100yr ARI Volumes [m³]	olumes [m³]
	To Ba	To Basin C
		Basin B
_ 0.5□r	722	430
		105□
3□.	1094	1434
. 19	12□1	1660
12□r	1479	1270
24□r	1015	13.5
4	2174	952
72□r	2136	0

Critical Design Event

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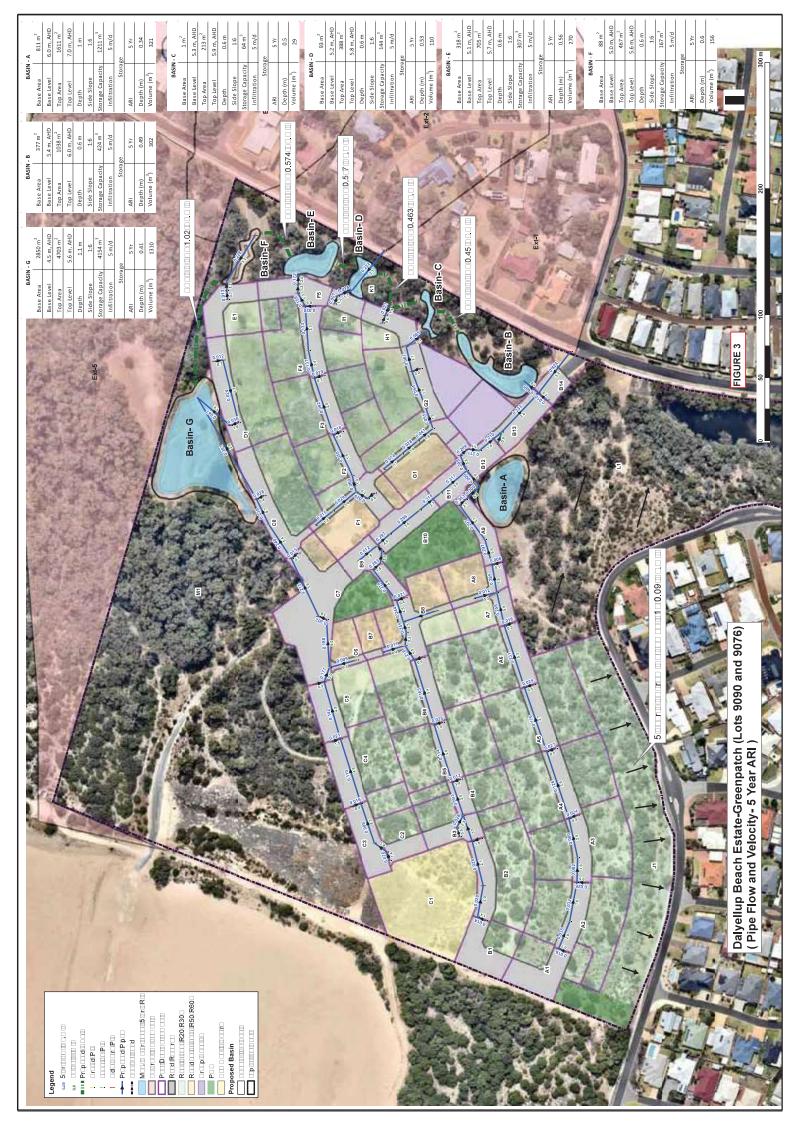
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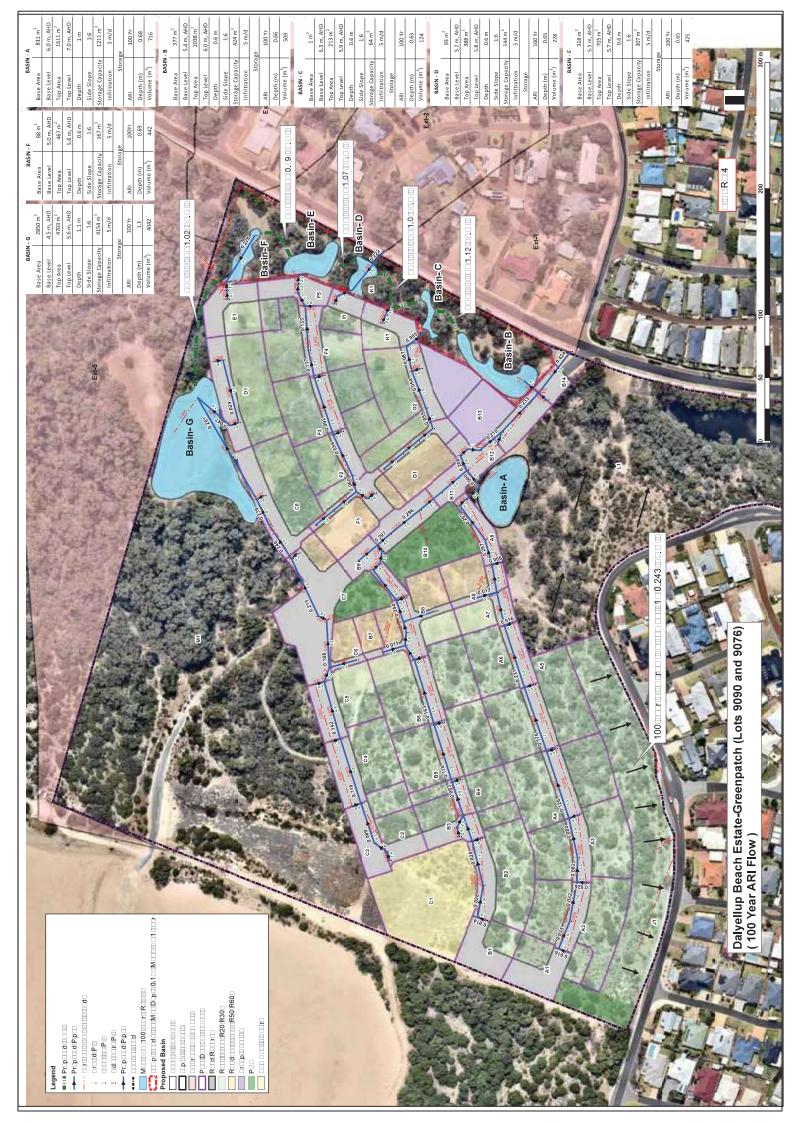
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		1 ⊞r⊞R□			5 			10R			100 Tr R	
	В			D			D			D		
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0.5□r	5.21	102	146	5.47	223	2□5			344	5.01		
1 🗆 r	5.25	118	199	5.55	273	3□6			467	9	159□	1939
3□r	5.24	115	300	5.62	328	633			619	6.1	1971	2527
6□r	5.13	09	37	5.49	233	_22			□53	6.11	2009	2941
12□r	5.16	7	502	5.45	212	67			954	5.92	1299	2749
24□r	5.01	2	647	5.2	133	1057			1202	2.	1150	3200
4□□ r	2	0	10	5	0	1295			1470	2.7	477	3126
72□r	2	0	902	5	0	1336			1457	5	0	2136
96□r												
120□r												

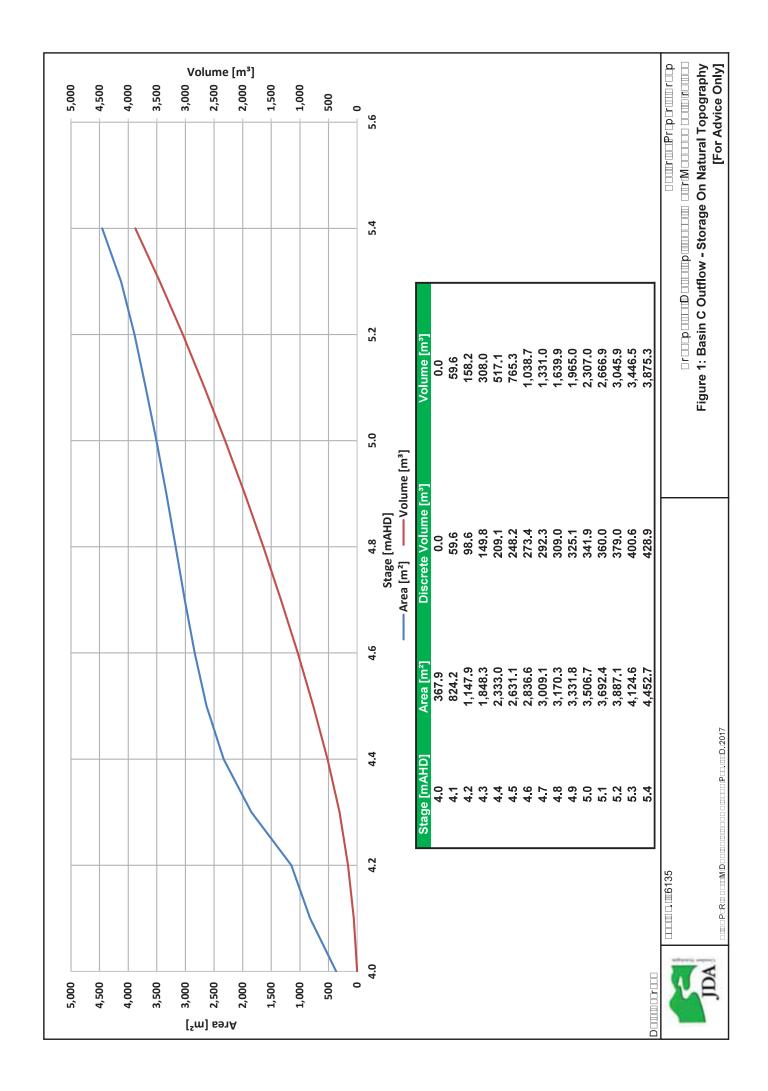
Appendix I

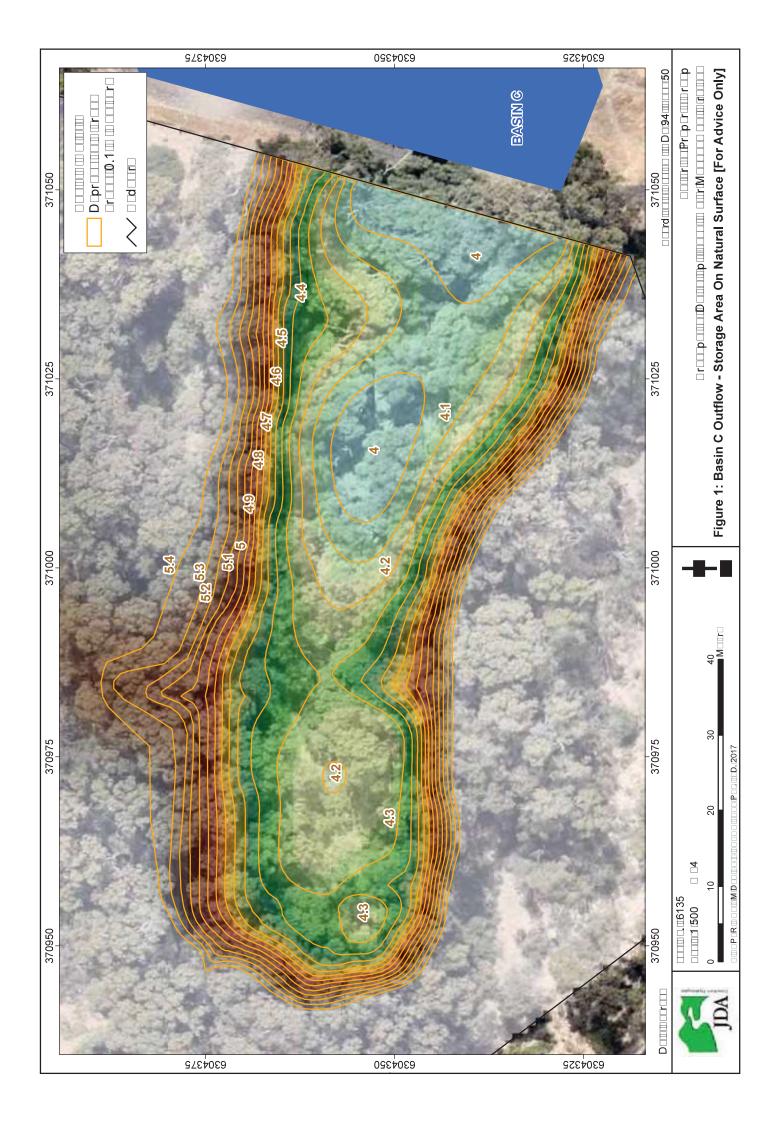
Calibre Detailed Catchment Stormwater Modelling

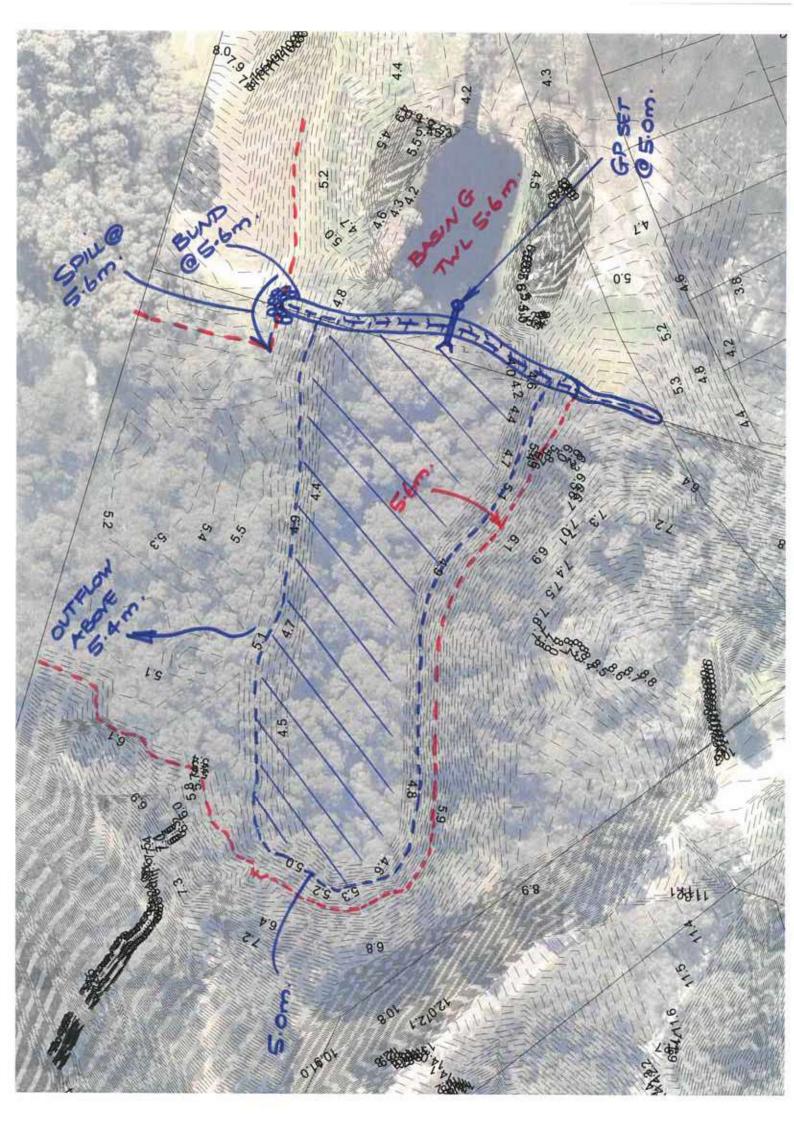




Appendix J ROS Storage Calculations







Appendix K UNDO Modelling Results





Project:

J6135a Dalyellup Greenpatch LWMS

- Pre-Dev

Date:

8/08/2016

Version:

Version 1.1.0.16209

			Inpu	ıt load	Total area	Total percent (%)
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)		49
Residential	76	16.30	1609.30	430.36	21.45	49
Industrial, commercial & schools	0	0.00	0.00	0.00	Nitrogen input (kg/ha/yr)	Phosphorus input (kg/ha/yr)
Rural living	0	0.00	0.00	0.00		
Public open space	0	0.00	0.00	0.00	83.94	21.36
Road reserve	24	5.15	79.29	24.71	μ	
					Nitrogen export (kg/ha/yr)	Phosphorus (kg/ha/yr)
					7.92	0.14

			Inpu	ıt load		
Size	Percent	Area	Nitrogen	Phosphorus	Terrano and the	il - see
(m²)	(%)	(ha)	(kg)	(kg)	Total area	Total percent (%
<400	0	0.00	0.00	0.00	16.303672	76
400-500 m ²	0	0.00	0.00	0.00		
501-600 m ²	100	16.30	1609.30	430.36	Nitrogen input (kg)	Phosphorus input (kg)
601-730 m ²	0	0.00	0.00	0.00		
>730 m²	0	0.00	0.00	0.00	1609.30	430.36
lultiple dwellings	0	0.00	0.00	0.00		

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Road reserve

Landuse	Percent	Area		
	(%)	(ha)	Total area	Total percent (%
Roads	80	4.12		
Road reserve - impervious	0	0.00	5.148528	24
Road reserve - native garden	0	0.00	Nitrogen input	Phosphorus input
Road reserve - non-native garden	20	1.03	(kg)	(kg)
Road reserve - turf	0	0.00	79.29	79.29
Road reserve - not fertilised	0	0.00		

Soil and drainage information

Type of drainage	Infiltration	Does it contain imported fill? No	
Soil type	Spearwood Dune	Does subregion contain onsite sewage diposal system?	No
Depth to groundwater (m)	10		
Groundwater slope (%)	0.25		
Soil PRI	11.0		

Note: Please attach the results of soil tests to this report when submitting.

			Inpu	ıt load	Total area	Total percent (%)
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)	AND SECTION AND ADDRESS OF THE PARTY OF THE	
Residential	0	0.00	0.00	0.00	22,33	51
Industrial, commercial & schools	0	0.00	0.00	0.00	Nitrogen input	Phosphorus input
Rural living	0	0.00	0.00	0.00		
Public open space	95	21.21	84.85	0.00	9.45	0.16
Road reserve	5	1.12	9.38	0.30	Nitrogen export	Phosphorus
					0.81	0.00

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Public Open Space (POS)

Landuse	Percent	Area		
	(%)	(ha)		
Native gardens	0	0.00	Tables and T	Telegraphy to a server and a server a server and a server and a server and a server and a server and a server and a server and a server and a server and a server and a server and a server and a server and a server and a server
Non-native gardens	0	0.00	Total area	Total percent (%
Not fertilised	0	0.00	21,21	95
Nature	100	21.21		
Sport	Ö	0.00	Nitrogen input	Phosphorus input
Recreation	0	0.00	(kg)	(kg)
Golf course	0	0.00	84.85	0.00
Bowling green	0	0.00		
Impervious	0	0.00		
Water body	0	0.00		

Road reserve

Landuse	Percent	Area		
1 1 1 1 1 1	(%)	(ha)	Total area	Total percent (%)
Roads	70	0.78	V-SUMMAN AND AND AND AND AND AND AND AND AND A	
Road reserve - impervious	0	0.00	1.11639	5
Road reserve - native garden	30	0,33	Nitrogen input	Phosphorus input
Road reserve - non-native garden	0	0.00	(kg)	(kg)
Road reserve - turf	0	0.00	9.38	9.38
Road reserve - not fertilised	0	0.00		

Soil and drainage information

Type of drainage	Infiltration	Does it contain imported fill? No	
Soil type	Quindalup Dune	Does subregion contain onsite sewage diposal system?	No
Depth to groundwater (m)	5		
Groundwater slope (%)	0.25		
Soil PRI	12.2		

Note: Please attach the results of soil tests to this report when submitting.

Page 4 of 4

Summary: No	itrient stripping	devices				
Treatment	Name	Size (m²)	Treated area	Treating	N removed (kg/ha/yr)	P removed (kg/ha/yr)
Load remove	d				0.14	0.00
Net export					NaN	NaN

Summary: Nutrient load exports					
Region	Area (ha)	P export (kg/ha/yr)	N export (kg/ha/yr)		
Subregion 5	21.45	0.14	7.92		
Greenpatch	22.33	0.00	0.81		

AD (kg/ha/yr)	LOAD REMOVED	(kg/ha/yr)	NET LOAD EXPO	ORT (kg/ha/yr)
PHOSPHORUS	NITROGEN	PHOSPHORUS	NITROGEN	PHOSPHORUS
0.07	0.14	0.00	NaN	NaN
	PHOSPHORUS	PHOSPHORUS NITROGEN	PHOSPHORUS NITROGEN PHOSPHORUS	PHOSPHORUS NITROGEN PHOSPHORUS NITROGEN







Project:

J6135a Dalyellup Greenpatch LWMS

- Post-Dev

Date:

8/08/2016

Version:

Version 1.1.0.16209

			Inpu	ıt load	Total area	Total percent (%)
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)		
Residential	0	0.00	0.00	0.00	2.63	6
Industrial, commercial & schools	0	0.00	0.00	0.00	Nitrogen input (kg/ha/yr)	Phosphorus input (kg/ha/yr)
Rural living	0	0.00	0.00	0.00		
Public open space	100	2.63	34.67	1.05	18.43	0.55
Road reserve	0	0.00	0.00	0.00		
					Nitrogen export (kg/ha/yr)	Phosphorus (kg/ha/yr)
					1.85	0.02

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Public Open Space (POS)

Landuse	Percent	Area		
	(%)	(ha)		
Native gardens	0	0.00	Englander II	
Non-native gardens	0	0.00	Total area	Total percent (%)
Not fertilised	80	2.10	2.63	100
Nature	0	0.00		
Sport	0	0.00	Nitrogen input	Phosphorus input
Recreation	20	0.53	(kg)	(kg)
Golf course	0	0.00	34.67	1.05
Bowling green	0	0.00		
Impervious	0	0,00		
Water body	0	0,00		

Soil and drainage information

Type of drainage	Infiltration	Does it contain imported fill? No	
Soil type	Spearwood Dune	Does subregion contain onsite sewage diposal system?	No
Depth to groundwater (m)	1		
Groundwater slope (%)	0.25		
Soil PRI	11.0		

Note: Please attach the results of soil tests to this report when submitting.

	Total area	Total percent (%)				
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)		
Residential	45	1.97	96.06	25.24	4,38	10
Industrial, commercial & schools	12	0.53	13.87	3.36	Nitrogen input (kg/ha/yr)	Phosphorus input (kg/ha/yr)
Rural living	0	0.00	0.00	0.00		
Public open space	14	0.61	43.82	7.97	44.82	9.89
Road reserve	29	1.27	19.55	6.09		
					Nitrogen export (kg/ha/yr)	Phosphorus (kg/ha/yr)
					4.23	0.07

			Inpu	it load		
Size	Percent	Area	Nitrogen	Phosphorus	HANDOW II	Daniel was not
(m²)	(%)	(ha)	(kg)	(kg)	Total area	Total percent (%
<400	40	0.79	18.51	5,42	1.9701	45
400-500 m ²	60	1.18	77.55	19.81	1,5701	
501-600 m ²	Ö	0.00	0,00	0.00	Nitrogen input (kg)	Phosphorus input (kg)
601-730 m ²	0	0.00	0.00	0.00		
>730 m²	0	0.00	0.00	0.00	96.06	25.24
Aultiple dwellings	0	0.00	0.00	0.00		

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Commercial, Industry and Schools

Landuse	Percent	Area	Total area	Total percent (%)
	(%)	(ha)	Total area	Total percent (78)
Light industrial	0	0.00	0.53	12
Heavy industrial	0	0.00		
Commercial / Offices	0	0.00	Nitrogen input (kg)	Phosphorus input (kg)
Schools	0	0.00		
Public buildings	100	0.53	13.87	3.36

Public Open Space (POS)

Landuse	Percent	Area		
	(%)	(ha)		
Native gardens	0	0.00	Employee 1	La company and
Non-native gardens	50	0.31	Total area	Total percent (%)
Not fertilised	0	0.00	0.61	14
Nature	0	0.00		
Sport	0	0.00	Nitrogen input	Phosphorus input
Recreation	50	0.31	(kg)	(kg)
Golf course	0	0.00	43.82	7.97
Bowling green	0	0.00		
Impervious	0	0.00		
Water body	0	0.00		

Road reserve

Landuse	Percent	Area		
	(%)	(ha)	Total area	Total percent (%)
Roads	80	1.02	1000	
Road reserve - impervious	0	0.00	1,26962	.29
Road reserve - native garden	0	0.00	Nitrogen input	Phosphorus input
Road reserve - non-native garden	20	0.25	(kg)	(kg)
Road reserve - turf	0	0.00	19.55	19.55
Road reserve - not fertilised	0	0.00		

Soil and drainage information

Type of drainage
Infiltration
Does it contain imported fill? No

Soil type
Quindalup Dune
Does subregion contain onsite sewage diposal system? No

Depth to groundwater (m) 25

Groundwater slope (%) 0.25

Soil PRI 12.2

Note: Please attach the results of soil tests to this report when submitting.

			Input load		Total area	Total percent (%)
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)		
Residential	47	1.85	111.36	28.66	3.94	9
Industrial, commercial & schools	0	0.00	0.00	0.00	Nitrogen input (kg/ha/yr)	Phosphorus input (kg/ha/yr)
Rural living	0	0.00	0.00	0.00		
Public open space	30	1.18	84.52	15.37	58.48	12.43
Road reserve	23	0.91	13.96	4.35		
					Nitrogen export (kg/ha/yr)	Phosphorus (kg/ha/yr)
					5,55	0.08

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Residential

			Inpu			
Size	Percent	Area	Nitrogen	Phosphorus	Proximal 1	Torrest Lancas and A
(m²)	(%)	(ha)	(kg)	(kg)	Total area	Total percent (%)
<400	13	0.24	5.66	1.66	1.851894	47
400-500 m ²	87	1,61	105.70	27,00	1,031031	
501-600 m ²	0	0.00	0.00	0.00	Nitrogen input (kg)	Phosphorus input (kg)
601-730 m ²	0	0.00	0.00	0.00		
>730 m²	0	0.00	0.00	0.00	111.36	28.66
Multiple dwellings	o	0.00	0.00	0.00		

Public Open Space (POS)

Landuse	Percent	Area		
	(%)	(ha)		
Native gardens	0	0.00	V-22-11	1
Non-native gardens	50	0.59	Total area	Total percent (%
Not fertilised	0	0.00	1.18	30
Nature	0	0.00	17.58	
Sport	0	0.00	Nitrogen input	Phosphorus input
Recreation	50	0.59	(kg)	(kg)
Golf course	0	0.00	84.52	15.37
Bowling green	0	0.00		
Impervious	0	0.00		
Water body	0	0.00		
			-	

Road reserve

Landuse	Percent	Area		
	(%)	(ha)	Total area	Total percent (%
Roads	80	0.72		
Road reserve - impervious	0	0.00	0.906246	23
Road reserve - native garden	0	0.00	Nitrogen input	Phosphorus input
Road reserve - non-native garden	20	0.18	(kg)	(kg)
Road reserve - turf	0	0.00	13.96	13.96
Road reserve - not fertilised	0	0.00		

Soil and drainage information

Type of drainage	Infiltration	Does it contain imported fill? No	
Soil type	Quindalup Dune	Does subregion contain onsite sewage diposal system?	No
Depth to groundwater (m)	25		
Groundwater slope (%)	0.25		
Soil PRI	12.2		

			Inpu	ıt load	Total area	Total percent (%)
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)		
Residential	64	2.52	146.68	37.48	3.94	.9
Industrial, commercial & schools	0	0.00	0.00	0.00	Nitrogen input (kg/ha/yr)	Phosphorus input (kg/ha/yr)
Rural living	0	0.00	0.00	0.00		
Public open space	0	0.00	0.00	0.00	48.00	11.39
Road reserve	36	1.42	21.84	6.81	Alfanon and an annual and	Di-
					Nitrogen export (kg/ha/yr)	Phosphorus (kg/ha/yr)
					4.77	0.08

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Residential

			Inpu	rt load		
Size	Percent	Area	Nitrogen	Phosphorus	Branner van 1	
(m²)	(%)	(ha)	(kg)	(kg)	Total area	Total percent (%)
<400	21	0.53	12.44	3.64	2.521728	64
400-500 m ²	63	1.59	104.23	26.63	2.321720	
501-600 m ²	0	0.00	0.00	0.00	Nitrogen input (kg)	Phosphorus input (kg)
601-730 m ²	0	0.00	0.00	0.00		
>730 m²	16	0.40	30.01	7.21	146.68	37.48
Aultiple dwellings	0	0.00	0.00	0.00		

Road reserve

Landuse	Percent	Area		
	(%)	(ha)	Total area	Total percent (%)
Roads	80	1.13		
Road reserve - impervious	0	0.00	1.418472	36
Road reserve - native garden	0	0.00	Nitrogen input	Phosphorus input
Road reserve - non-native garden	20	0.28	(kg)	(kg)
Road reserve - turf	0	0.00	21.84	21.84
Road reserve - not fertilised	0	0.00		

Soil and drainage information

Type of drainage

Infiltration Does it contain imported fill? No Soil type Spearwood Dune Does subregion contain onsite sewage diposal system?

Depth to groundwater (m) 5.5

Groundwater slope (%) 0.25

Soil PRI 11.0

			Inpu	ıt load	Total area	Total percent (%)
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)		
Residential	76	16.30	1609.30	430.36	21,45	49
Industrial, commercial & schools	0	0.00	0.00	0.00	Nitrogen input (kg/ha/yr)	Phosphorus input (kg/ha/yr)
Rural living	0	0.00	0.00	0.00		
Public open space	0	0.00	0.00	0.00	83.94	21.36
Road reserve	24	5.15	79.29	24.71		
					Nitrogen export (kg/ha/yr)	Phosphorus (kg/ha/yr)
					7.92	0.14

			Inpu	rt load		
Size	Percent	Area	Nitrogen	Phosphorus	Terrore Til	The American
(m²)	(%)	(ha)	(kg)	(kg)	Total area	Total percent (%
<400	0	0.00	0.00	0.00	16.303672	76
400-500 m ²	0	0.00	0.00	0.00	201303072	
501-600 m²	100	16.30	1609.30	430.36	Nitrogen input (kg)	Phosphorus inpu (kg)
601-730 m ²	0	0.00	0.00	0.00		
>730 m²	0	0.00	0.00	0.00	1609.30	430.36
Aultiple dwellings	0	0.00	0.00	0.00		H=

Road reserve

Landuse	Percent	Area		
	(%)	(ha)	Total area	Total percent (%
Roads	80	4.12		
Road reserve - impervious	0	0.00	5.148528	24
Road reserve - native garden	0	0.00	Nitrogen input	Phosphorus input
Road reserve - non-native garden	20	1.03	(kg)	(kg)
Road reserve - turf	0	0.00	79.29	79.29
Road reserve - not fertilised	0	0.00		

Soil and drainage information

Type of drainage	Infiltration	Does it contain imported fill? No	
Soil type	Spearwood Dune	Does subregion contain onsite sewage diposal system?	No
Depth to groundwater (m)	10		
Groundwater slope (%)	0.25		
Soil PRI	11.0		

			Inpu	ıt load	Total area	Total percent (%)
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)		
Residential	88	1.16	75.83	19.37	1,31	3
Industrial, commercial & schools	0	0.00	0.00	0.00	Nitrogen input (kg/ha/yr)	Phosphorus input (kg/ha/yr)
Rural living	0	0.00	0.00	0.00		
Public open space	12	0.16	6.38	1.89	67.82	16.34
Road reserve	0	0.00	0.00	0.00	Nitrogen export (kg/ha/yr)	Phosphorus (kg/ha/yr)
					6.70	0.11

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Residential

			Inpu	rt load		
Size	Percent	Area	Nitrogen	Phosphorus	Programme of	E
(m²)	(%)	(ha)	(kg)	(kg)	Total area	Total percent (%)
<400	0	0.00	0.00	0.00	1.155792	88
400-500 m ²	100	1.16	75.83	19.37	1.133792	
501-600 m ²	0	0.00	0.00	0.00	Nitrogen input (kg)	Phosphorus input (kg)
601-730 m ²	0	0.00	0.00	0.00		
>730 m²	0	0.00	0.00	0.00	75.83	19.37
Iultiple dwellings	0	0.00	0.00	0.00		

Public Open Space (POS)

Landuse	Percent	Area		
	(%)	(ha)		
Native gardens	0	0.00	V-192-11	2.00
Non-native gardens	50	0.08	Total area	Total percent (%
Not fertilised	0	0.00	0.16	12
Nature	50	0.08		
Sport	0	0.00	Nitrogen input	Phosphorus input
Recreation	0	0.00	(kg)	(kg)
Golf course	0	0.00	6.38	1,89
Bowling green	0	0.00		
Impervious	0	0.00		
Water body	0	0.00		

Soil and drainage information

Type of drainage Infiltration Does it contain imported fill? No

Soil type Quindalup Dune Does subregion contain onsite sewage diposal system? No

Depth to groundwater (m) 20

Groundwater slope (%) 0.25

Soil PRI 12.2

		Input load				Total percent (%
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)	Total area	
Residential	0	0.00	0.00	0.00	4.82	11
Industrial, commercial & schools	0	0.00	0.00	0.00	Nitrogen input (kg/ha/yr)	Phosphorus input (kg/ha/yr)
Rural living	0	0.00	0.00	0.00		
Public open space	86	4.14	16.57	0.00	9.45	0.18
Road reserve	14	0.67	3.78	0.12		
					Nitrogen export (kg/ha/yr)	Phosphorus (kg/ha/yr)
					0.89	0.00

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Public Open Space (POS)

Landuse	Percent	Area		
	(%)	(ha)		
Native gardens	0	0.00	Laborator I	Land townson
Non-native gardens	0	0.00	Total area	Total percent (%
Not fertilised	0	0.00	4.14	86
Nature	100	4.14		227
Sport	Ö	0.00	Nitrogen input	Phosphorus input
tecreation	0	0.00	(kg)	(kg)
Golf course	0	0.00	16.57	0.00
Bowling green	0	0.00		
mpervious	0	0.00		
Water body	0	0.00		

Road reserve

Landuse	Percent	Area		
	(%)	(ha)	Total area	Total percent (%)
Roads	80	0.54	-20-00	
Road reserve - impervious	0	0.00	0.674212	14
Road reserve - native garden	20	0.13	Nitrogen input	Phosphorus input
Road reserve - non-native garden	0.	0.00	(kg)	(kg)
Road reserve - turf	0	0.00	3.78	3.78
Road reserve - not fertilised	0	0.00		

Soil and drainage information

Type of drainage	Infiltration	Does it contain imported fill? No	
Soil type	Quindalup Dune	Does subregion contain onsite sewage diposal system?	No
Depth to groundwater (m)	10		
Groundwater slope (%)	0.25		
Soil PRI	12.2		

			Inpu	ıt load	Total area	Total percent (%)
Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)	459.50	
Residential	0	0.00	0.00	0.00	1,31	3
Industrial, commercial & schools	0	0.00	0.00	0.00	Nitrogen input (kg/ha/yr)	Phosphorus input (kg/ha/yr)
Rural living	0	0.00	0.00	0.00		
Public open space	100	1.31	5.25	0.00	9.23	0.15
Road reserve	0	0.00	0.00	0.00	No accompany many	- Charles because
					Nitrogen export (kg/ha/yr)	Phosphorus (kg/ha/yr)
					0.94	0.00

Landuse	Percent	Area		
	(%)	(ha)		
Native gardens	0	0.00	Lamana II	Leaven and
Non-native gardens	0	0.00	Total area	Total percent (%)
Not fertilised	0	0.00	1.31	100
Nature	100	1.31		
Sport	0	0.00	Nitrogen input	Phosphorus input
Recreation	0	0.00	(kg)	(kg)
Golf course	0	0.00	5.25	0.00
Bowling green	0	0.00		
Impervious	0	0.00		
Water body	0	0.00		

Soil and drainage information

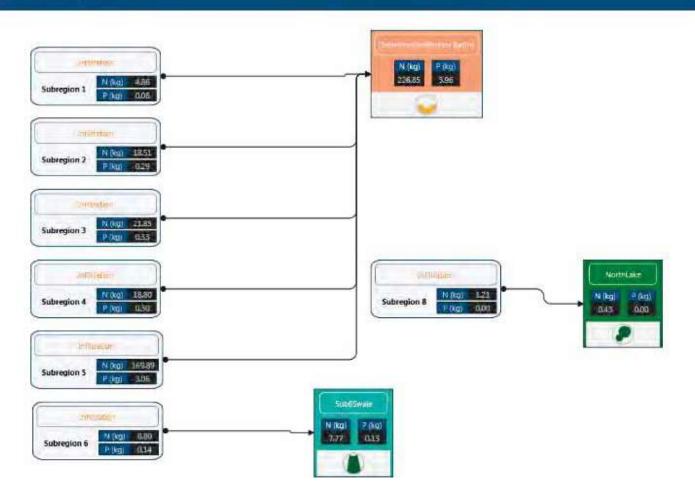
Type of drainage	Infiltration	Does it contain imported fill? No	
Soil type	Spearwood Dune	Does subregion contain onsite sewage diposal system?	No
Depth to groundwater (m)	3		
Groundwater slope (%)	0.25		
Soil PRI	11.0		

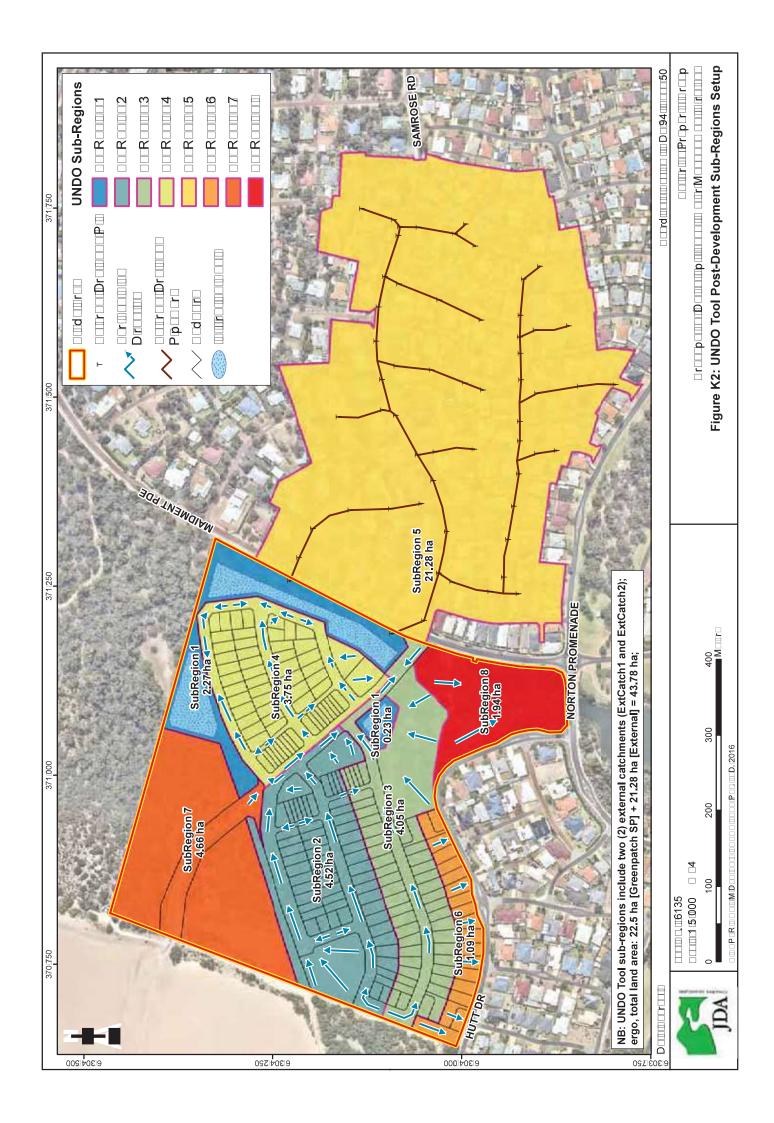
Treatment	Name	Size	Treated area	Treating	N removed	P removed
		(m²)	(ha)		(kg/ha/yr)	(kg/ha/yr)
Detention / infiltration basin	Detention/ Infiltration Basins	9100.00	36.34	Sandy soils – Runoff only (infiltration on lots)	0.73	0.01
Swale	Sub6Swale	1000.00	1,31	Sandy soils – Runoff only (infiltration on lots)	0.79	0,01
Constructed wetland	NorthLake	3200.00	1.31	Sandy soils – runoff, subsoils and groundwater	0.60	0.00
Load removed					0.20	0.00
Net export					5.47	0.09

Summary: Nutrient load exports					
Region	Area	P export	N export		
	(ha)	(kg/ha/yr)	(kg/ha/yr)		
Subregion 1	2.63	0,02	1.85		
Subregion 2	4.38	0.07	4.23		
Subregion 3	3.94	0.08	5.55		
Subregion 4	3.94	0.08	4.77		
Subregion 5	21.45	0.14	7.92		
Subregion 6	1.31	0.11	6.70		
Subregion 7	4.82	0.00	0.89		
Subregion 8	1.31	0.00	0.94		

RE-TREATMENT L	.OAD (kg/ha/yr)	LOAD REMOVE	D (kg/ha/yr)	NET LOAD EXPO	ORT (kg/ha/yr)
NITROGEN	PHOSPHORUS	NITROGEN	PHOSPHORUS	NITROGEN	PHOSPHORUS
5.67	0.10	0.20	0.00	5.47	0.09

Treatment diagram









Appendix Six: Bushfire Management Plan



NOTE: The following are addended BPP L3 Review 7 June 2017 JBS&G advice 26 August 2022

Dalyellup - Greenpatch Bushfire Management Plan

Prepared by Calibre Consulting for Satterley Property Group

March 2016 Version A

Job No. 15001P

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Disclaimer

The measures contained in this report do not guarantee that a building will not be damaged in a bush fire. The ultimate level of protection will be dependent upon the design and construction of the dwelling and the level of fire preparedness under taken by the landowner. The severity of a bush fire will depend upon the vegetation fuel loadings; the prevailing weather conditions and the implementation of appropriate fire management measures.

DOCUMENT CONTROL

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1 INTRODUCTION

This bushfire management plan is prepared for the Greenpatch locality which forms part of the Dalyellup Beach Estate. The subject land has an area of 22 hectares and is located in the north western corner of the Estate. It is situated 8kms south of Bunbury CBD and 18kms north of the Capel Townsite as shown in Figure 1.

This report has been prepared to demonstrate that appropriate regard has been given to Planning for Bush Fire Protection (2010) in the design and development of the proposed subdivision. The aim of this Report is to reduce the threat to the residents and visitors in the proposed development in the event of a fire within or adjacent to the site.

It defines the responsibilities of relevant stakeholders and the measures required to manage the potential likelihood of fires starting on the proposed lots or the adjoining land. The assets which are highlighted for protection from bush fires are:

- Any future dwellings within the development; and
- The existing development surrounding the site including existing dwellings and bushland reserves.

The first priority for the protection of these assets is the protection of people (1).



Figure 1 Location Plan

¹ State Emergency Management Committee (2014) State Emergency Management Policy 2.9 page 2.



2 EXISTING CONDITIONS

2.1 LAND USE

The subject land is vacant and is comprised of three allotments as documented in Table 1 and Figure 2.

It is bisected by Minninup Road which provides access to the adjoining Millennium Inorganic Chemicals facility. The land to the south has been developed for residential purposes as part of the Dalyellup Beach Estate. The land to the east has a mixture of standard and larger residential lots. The land to the north is Regional Open Space which also contains the Water Corporation Bunbury Waste Water Treatment Plant.

Access to the site is from Maidment Parade and Norton Promenade. Hutt Drive extends along the southern boundary of the site.

The existing conditions are shown in Figure 3 and the site photographs are contained in Appendix 1.

Table 1 Lot Details

Lot	Plan	Area (ha)
8019	55511	0.5298
9076	55511	9.7226
9105	404839	12.0347
Total		22.2871

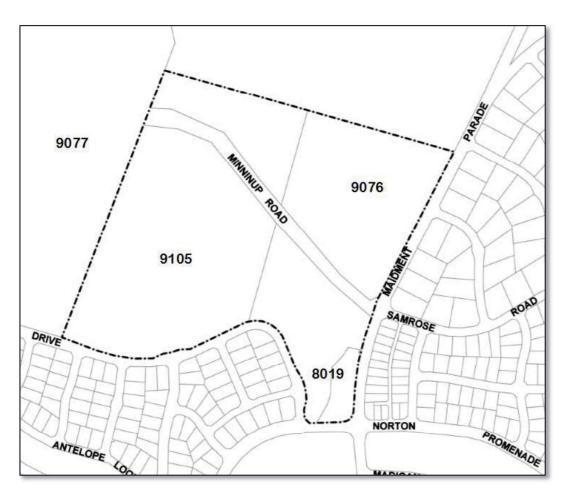


Figure 2 Cadastral Plan



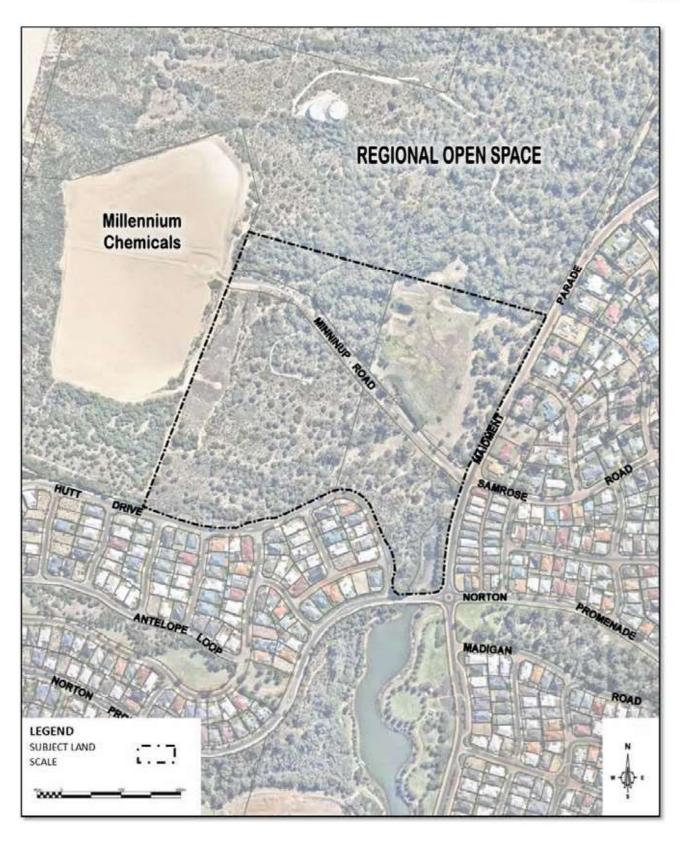


Figure 3 Existing Conditions



2.2 TOPOGRAPHY

The site has undulating topography as shown in Figure 3. The eastern and north eastern portions are relatively flat. On the southern side of Minninup Road the land rises steeply to a ridgeline with an elevation of 40m AHD. There is a then a valley with several ridges of a similar height on the western boundary.

The gradients vary across the site with some sections having slopes of more than 20 percent.

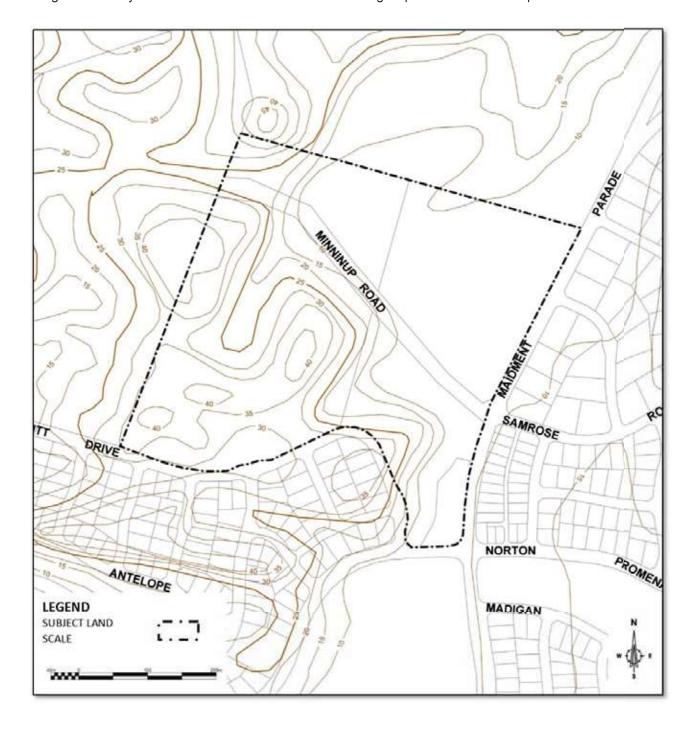


Figure 4 Topography



2.3 CLIMATE

The Dalyellup locality has a Mediterranean climate, which is characterised by hot dry summers and mild wet winters. There is an annual average rainfall of 870 mm in the locality (2) and an average temperature of 16.2 C. Temperatures can reach over 40 C in summer and fall to zero degrees in winter. There is an average of 50 days per year where the temperature exceeds thirty degrees.

During summer winds tend to be from the east and south easterly in the mornings and the west in the afternoons. Wind speeds are typically from 10 to 30 kph in the mornings and as high as 40 to 50 kph in the afternoon.

2.4 VEGETATION

A spring flora and vegetation assessment of the proposal area was undertaken by ATA Environmental in 2005. A total of 10 vegetation associations were mapped during the survey; the vegetation of the proposal area largely comprises *Agonis flexuosa* (Peppermint) and *Eucalyptus gomphocephala* (Tuart) woodland, with areas of degraded shrubland, grassland, sedgeland and cleared areas.

An additional flora and vegetation survey was undertaken by Ekologica in June 2012 to confirm the flora and vegetation identified within the proposal area during the initial survey in 2005. This was referenced in the referral of the project to the Department of Environmental Regulation in 2014 (3).

The vegetation unites are shown in Figure 5 and described as follows:

1 AflexDdJfAp: Shrubland dominated by Diplolaena dampieri and Jacksonia furcellata and

Acanthocarpus preissii with scattered Agonis flexuosa

2 AflexLgJp: Low Open Woodland of Agonis flexuosa over an Open Sedgeland dominated by

Lepidosperma gladiatum and Juncus pauciflorus

3 AlAc: Shrubland of Anthroceris littoriea and Acacia cochlearis

4 EgAflexDd: Open Woodland of Agonis flexuosa and Eucalyptus gomphocephala over a Shrubland

dominated by Diplolaena dampieri

5 EgAflexLg, Open Woodland of Eucalyptus gomphocephala and Agonis flexuosa over a Herbland

dominated by Lepidosperma gladiatum

6 Afat: Grassland dominated by *Avena fatua

7 AflexBa: Open Woodland of Agonis flexuosa and Banksia attenuata

8 MrMp: Low Open Forest of Melaleuca rhaphiophylla and Melaleuca preissiana over open water

9 ToCd: Sedgeland dominated by *Typha orientalis and *Cynodon dactylon

10 Cleared

The above vegetation classifications are an ecological classification system which considers the structural form of the vegetation (layer of dominant trees). However a specific type of vegetation may be classified as a different type of vegetation due to its fire behaviour characteristics.

² Bureau of Meteorology – Bunbury Weather Station site No 009965

³ Strategen (2014) DER referral letter



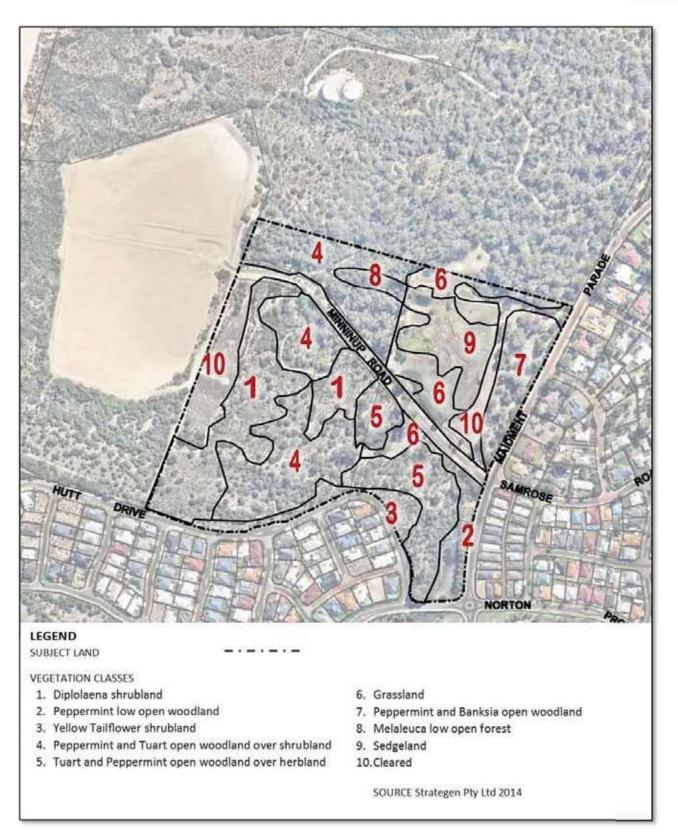


Figure 5 Vegetation



3 DEVELOPMENT FRAMEWORK

3.1 BUSHFIRE PRONE LAND

The State Bushfire Prone Maps were released on the 7th December and come into effect as from the 8th April 2016. As shown in Figure 6 all of the subject land is shown as being bushfire prone.

Bushfire prone areas are comprised of (4):

- Bushfire prone vegetation; and
- A 100m wide bushfire prone buffer.

Bushfire prone vegetation includes:

- 1. All parcels of the above vegetation that are greater than 1 hectare in size shall be identified as Bushfire prone vegetation.
- 2. Single areas of the above vegetation that are between 0.25 and 1 hectare in area and are within 100 metres of other parcels of vegetation in the identified communities greater than 1 hectare in size

The designation of bushfire prone areas triggers:

- The application of Australian Standard AS3959 Construction of Buildings in Bushfire Prone Areas under the Building Code of Australia (from the 8th April 2016);
- The provisions of the Planning and Development (Local Planning Schemes) Amendment Regulations 2015 (from the 8th April 2016); and
- The application of SPP3.7 Planning in Bushfire Prone Areas (from the 7th December 2015).



Figure 6 State Bushfire Prone Map

⁴ DFES (2014) Bushfire-Prone Area Mapping Standard Western Australia pages 2 and 7.



3.2 SPP 3.7 PLANNING IN BUSHFIRE PRONE AREAS

State Planning Policy 3.7 Planning in Bushfire Prone Areas was gazetted on the 7th December 2015. The policy provides the foundation for land use planning to address bushfire risk management in Western Australia. It contains objectives and policy measures, as well as reference to the bushfire protection criteria contained in the Guidelines.

The objectives of the policy are to:

- 1. Avoid any increase in the threat of bushfire to people, property and infrastructure. The preservation of life and the management of bushfire impact are paramount.
- 2. Reduce vulnerability to bushfire through the identification and consideration of bushfire risks in decision-making at all stages of the planning and development process.
- 3. Ensure that higher order strategic planning documents, strategic planning proposals, subdivision and development applications take into account bushfire protection requirements and include specified bushfire protection measures.
- 4. Achieve an appropriate balance between bushfire risk management measures and, biodiversity conservation values, environmental protection and biodiversity management and landscape amenity, with consideration of the potential impacts of climate change.

Clause 6.2 states that planning proposals, subdivision and development applications relating to land that has or will have a Bushfire Hazard Level (BHL) above low and/or where a Bushfire Attack Level (BAL) rating above BAL-LOW apply, is to comply with the policy measures. Where development will have, on completion, a moderate BHL and/or where BAL-12.5 to BAL-29 applies, it may be considered for approval where it can be undertaken in accordance with policy measures 6.3, 6.4 or 6.5.

Clause 6.3 applies to scheme amendments and structure plans. In summary the measures include:

- A Bushfire Hazard Level assessment determining the applicable hazard level(s) across the subject land:
- A Bushfire Attack Level (BAL) Contour Map to determine the indicative acceptable BAL ratings across the subject land;
- The identification of any bushfire hazard issues arising from the relevant assessment; and
- Evidence that the proposal will comply with the Bushfire Protection Criteria.

This information can be provided in the form of a Bushfire Management Plan.

3.3 BUSHFIRE PROTECTION CRITERIA

The Bushfire Protection Criteria are contained in Appendix 4 of the Guidelines for Planning in Bushfire Prone Areas (2015).

The criteria contain a set of performance criteria and acceptable solutions that new subdivision and developments are required to meet in bush fire prone areas. The main elements relate to:

- 1.0 Location:- hazard level rating.
- 2.0 Siting of development:- asset protection zone; hazard separation zones; and AS3959 construction standards
- 3.0 Vehicular access:- two access routes; public road design; cul-de-sacs; battle axes; private driveways; emergency access ways; fire access routes; gates; firebreaks and signs.
- 4.0 Water supply:- reticulated areas; non reticulated areas; and dams.



3.4 LPS AMENDMENT REGULATIONS 205

The Planning and Development (Local Planning Schemes) Amendment Regulations 2015 will commence operations from the 8th April 2016. The key feature is that the Regulations require a BAL assessment for any "development" in a bushfire prone area. Development is defined as meaning the construction or use, or construction and use, of any habitable building or specified building.

Where the development site as BAL 40 or BAL Flame Zone rating then a planning application will be required. The development site means that part of the land on which the building will be located. The planning application is in addition to any other provision or requirement in the Planning Scheme.

These provisions does not apply to the renovation, alteration, extension, improvement or repair of a building.

3.5 AUSTRALIAN STANDARD AS3959 (2009)

AS3959 Construction of Building in Bush Fire Prone Areas (5) provides measures for improving the ability of buildings to withstand burning debris, radiant heat and flame contact during a bush fire. The lower the separation distance from bushfire prone vegetation, the higher the standard of construction is required for buildings. The construction requirements relate to:-

- Subfloor Supports;
- Floor;
- External Walls;
- External Elements and Doors
- Roofs:
- Verandas, Decks, Steps; and
- Water and gas pipes.

The Standard contains six Bushfire Attack Levels (BAL) categories as follows:

- BAL Low The risk is considered to be very low and does not warrant any specific construction requirements.
- BAL 12.5 The risk is considered to be low but there is still a risk of ember attack.
- BAL 19 The risk is considered to be moderate. There is risk of ember attack and burning debris by wind borne embers and a likelihood of exposure to radiant heat.
- BAL 29 The risk is considered to be high. There is an increased risk of ember attack and burning debris by wind borne embers and a likelihood of exposure to an increased level of radiant heat.
- BAL 40 The risk is considered to be very high.
- BAL FZ The risk is considered to be extreme.

It is emphasised that the application the Standard's construction measures is not a complete response to bush fire safety. The Standard recognises this and it states (page 7) that:

"Improving the design and construction of buildings to minimize damage from the effects of bushfire is but one of several measures available to property owners and occupiers to address damage during bushfire. Property owners should be aware that this Standard is part of a process that aims to lessen the risk of damage to buildings occurring in the event of the onslaught of bushfire. Other measures of mitigating damage from bushfire fall within the areas of planning, subdivision, siting, landscaping and maintenance."

3.6 BUSH FIRE ORDER

⁵ Standards Australia (2009) AS 3959 – Construction of Buildings in Bush Fire Prone Areas. Sydney. Standards Australia International Ltd.



The principal method for implementing fire measures on developed land is through Council's annual Bush Fire Order, which requires the occupiers of all land to undertake fire prevention work as set out in the notice.

The Order states that for any urban land that where the area of land is 2,024m² or less then:

 All inflammable material is to be removed from the whole of the land except living trees, shrubs or plants.

Where the area of land exceeds 2,024m² then:

- A 3 metre wide firebreak is required inside and along all external boundaries of the land.
- All remaining grass inside the firebreaks to be slashed to a maximum height of 100mm. If it is impracticable to slash the grass it must be burnt or sprayed with a suitable herbicide to comply with requirements of this notice so as to prevent regrowth during the summer months.
- On the vertical plane on the side of the firebreak all trees are to be pruned to a minimum height of 5
 metres
- A 20 metre wide low fuel zone is required around all buildings on the land.

All fire prevention work must be carried out by 30th November and kept maintained throughout the summer months until the end of the Restricted Burning Period on 26th April.

4 PROPOSED DEVELOPMENT (ASSETS)

The proposed concept for the development of the site is shown in Figure 7.

The proposed development will include:

- 173 residential lots with sizes ranging between 180 and 614 square metres in size;
- 1 group house site of 2,500 sqm;
- A community purpose site of 0.5643 ha;
- 5 areas of POS with a total area of 5.8941ha; and
- A balance lot of 2.42 ha.

The balance lots and selected POS areas will be revegetated with a dedicated bushfire buffer between the revegetation and developed lots. The subdivided land will be subject to bulk earth working.



Lots 9102, 9075 and 8019, Dalyellup Beach Estate BAL SETBACKS PLAN

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5 THE BUSH FIRE ISSUE

5.1 BUSHFIRE HISTORY

The annual fire season in the South West Land Division extends from approximately mid-October to mid-May. This is the normal period where weather conditions are conducive to the ignition and spread of bushfires.

The restricted and prohibited burning periods enforced by Council extends for six months from October to April and the length of this period is normal for the region. The fire risk increases once vegetation has cured which is generally later in the season.

5.2 BUSH FIRE HAZARD

The bush fire hazard primarily relates to the vegetation on the site, the type and extent (area) of vegetation and its characteristics.

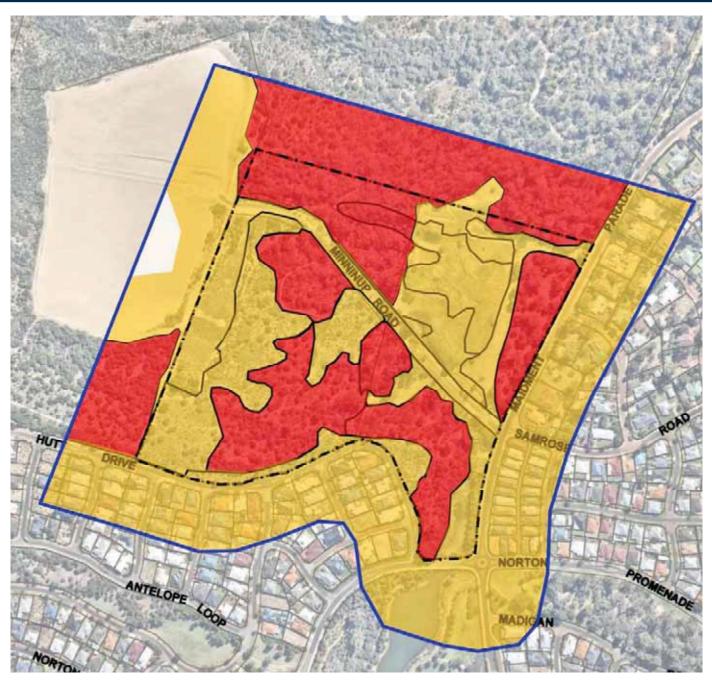
Appendix 1 of the Planning for Bushfire Protection Guidelines (2010) provides the methodology for determining the bush fire hazard. This classifies vegetation based on tree height and the percentage of canopy cover. There are 28 vegetation types which are classified into the following seven groups:

- A Forest;
- B Woodland;
- C Shrubland;
- D Scrub;
- E Mallee/Mulga;
- F Rainforest; and
- G Grassland.

The characteristics of the different hazard categories (6) are shown in Table 2. It is noted that the categories such as "suburban areas with some tree cover" do not match the vegetation classifications in AS3959 and hence are not applicable for any Bushfire Attack Level (BAL) assessment.

Figure 8 shows the bushfire hazard rating for the subject land in its current (undeveloped) condition and based upon the above classifications: These ratings will alter significantly once the land is developed.

⁶ WAPC (2014) Draft Planning for Bushfire Risk Management Guidelines Appendix 2



LEGEND

SUBJECT LAND

EXTREME HAZARD

MODERATE HAZARD (See Note 2)

LOW HAZARD

SCALE

NOTES

- 1 The hazard mapping has been prepared in accordance with the methodology contained in Appendix 2 of the Guidelines for Planning in Bushfire Prone Areas (2015).
- 2 The Guidelines designates that land with a "low" hazard rating which is located within 100m of land with an "extreme" or "moderate" hazard rating shall also be classified as having a "moderate" hazard rating so as to reflect the increased level of risk.

Date of Inspection 27/08/2015





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Plan No: 15001P



Table 2 Hazard Categories

Category	Characteristics
Low Hazard	 Areas devoid of standing native vegetation (less than 0.25ha cumulative area) Areas which, due to climatic or vegetation (eg. rainforest) conditions, do not experience bushfires Inner urban or suburban areas with maintained gardens and very limited native standing vegetation (less than 0.25 ha cumulative area)
	 Low threat vegetation, including grassland managed in a minimal fuel condition (i.e. to a nominal height of 100mm), maintained lawns, vineyard and orchards; and Pasture or cropping areas with very limited standing vegetation that is shrubland, woodland or forest with an effective up slope, on flat land or an effective down slope of less than 10 degrees, for a distance greater than 100 metres.
Moderate Hazard	 Areas containing pasture or cropping with an effective down slope* in excess of 10 degrees for a distance greater than 100 metres; Unmanaged grasslands; Open woodlands; Open shrublands; Low shrubs on areas with an effective up slope, on flat land or an effective down slope of less than 10 degrees, for a distance greater than 100 metres or flat land; Suburban areas with some tree cover; and Forest and woodlands with a permanent grass understorey or at most, a scrub understory structure consisting of multiple areas of <0.25ha and not within 20 metres of each other or single areas of <1ha and not within 100 metres of other scrub areas.
Extreme Hazard	 Forests with a scrub understorey which is multi-tiered; Woodlands with a scrub understorey which is multi-tiered; Tall shrubs; and Any area of vegetation not otherwise categorised as low or moderate.

5.3 BUSHFIRE RISK

The "risk" posed by a bush fire is a function of the "likelihood" and "consequences."

The likelihood is classified as; almost certain; likely; possible; unlikely; or rare. The likelihood of a bush fire occurring is determined by a number of factors including:-

- a) Frequency of Fire Season i.e. annual;
- b) Length of Annual Fire Season i.e. how many months;
- c) Slope Steepness the steeper the slope the greater the fire hazard;
- d) Vegetation Type forest or pasture;
- e) Vegetation Annual Driest State if reaching 100% cured;
- f) Fire History how often do fires occur;
- g) Development Density;



- h) External access; and
- i) Effectiveness of Fire Fighting Service the more effective the fire service is the lower the risk.

The likelihood of a bushfire occurring increases when there is a high chance of ignition due to the amount of fuel, the extent of vegetation curing (drying out) the temperature; relative humidity and wind speed. This is referred to as the "fire danger index" which represents the difficulty of controlling a bushfire.

The consequence arising from a bush fire might be insignificant, minor, moderate, major, or catastrophic. The priority for the formulation of fire mitigations measures are:

- The protection of life is the most important consideration. This not only includes any residents on the property but also fire fighters;
- The protection of property and in particular any dwellings; and
- The protection of the environment.

5.4 BUSHFIRE THREAT

The threat from a bushfire is the product of the hazard and risk. There are three identified bushfire threats which could impact upon the development of the subject land. These are:-

- 1. Fire originating from external sources including the surrounding farming properties, or State Forest;
- 2. Fire originating from within the property which could be from a variety of sources; and
- 3. Structural fires (dwellings and buildings).

A bushfire can have a number of ignition sources which can originate from either natural or human causes such as:

- Lighting strikes;
- Unattended camp fires;
- Discarded match or cigarette;
- Dry grass in contact with vehicle exhausts;
- Sparks from grinders, slashing or other mechanical operations;
- Backyard rubbish burning;
- Hazard reduction burns;
- Powerlines sparking in strong winds or falling;
- Pole top fires; or
- Deliberate arson.

The subject land is located in a bushfire prone area. The proposed development will retain portions of the existing remnant vegetation within the site. The surrounding land also contains significant areas of remnant vegetation. To manage this threat at an acceptable level it will require specific measures to be implemented and maintained.



6 FIRE MITIGATION MEASURES

In formulating the proposed mitigation strategy regard has been given to the objectives, general principles, guidance statements and performance criteria contained in the Planning for Bush Fire Protection Guidelines. The mandatory requirements are referred to as "acceptable solutions" and these are designated below in brackets after each heading.

The fire management recommendations for the subject land and are shown on Figure 9 and discussed further in the following sections.

6.1 BUSHFIRE PROTECTION CRITERIA

6.1.1 Element 1 Location

A1.1 Development Location

This provision stipulates that the development is to be located so that it does not require the use of BAL-40 or BAL-FZ construction standards. The use of the AS3959 construction standards is required when the proposed dwelling will be located less than 100m distance from any hazard vegetation.

The BAL Contour Plan for the proposed lots is shown in Figure 10.

The actual BAL ratings for each lot is documented in Table 3. The separation distance between the lot and the classified vegetation has been measured from the nearest part of the lot to the classified vegetation. The BAL classification may change when measured to the proposed dwelling depending upon the actual setbacks within the lots.

Hence while the nearest points of the Lot 145 has a BAL-40 rating it is noted that this is to the corner truncations and a BAL-29 rating will be achieved 1.2m within the lot.

The BAL ratings may also be modified by undertaking a Method 2 (detailed method) classification under Australian Standard AS 3959-2009.

Recommendations

- 1. That a maximum BAL 29 rating be applied to any dwelling.
- 2. In order to achieve a BAL-29 rating any dwelling Lot 145 shall be setback a minimum distance of 1.2m from the front boundary. The setback may be varied where shown in the BAL compliance certificate for the completed development, or individual BAL assessment.
- 3. That the vegetation within the BAL setback is to be maintained as low threat vegetation/low fuel zone as defined in Clause 2.2.3.2 of AS3959.

FIGURE 9 FIRE MITIGATION MEASURES



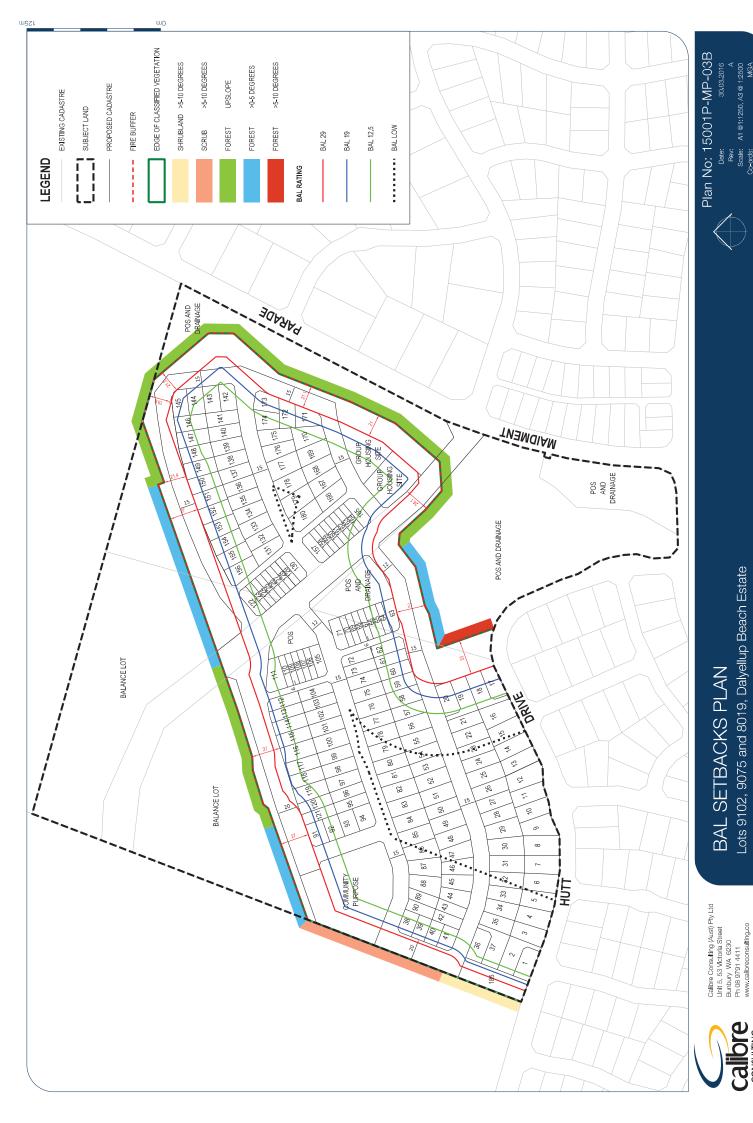




Table 3 BAL Setbacks

Lot No	Separation Distance from lot to vegetation	Slope Degrees	Vegetation Classification	BAL Rating
	distance has been measure cation may change when m setk		osed dwelling depending	
1	20m	9	Shrubland	19
2	20m	9	Shrubland	19
3	54m	9	Shrubland	12.5
4	69m	9	Shrubland	12.5
5	86m	9	Shrubland	12.5
6	>100	N/A	N/A	Low
7	>100	N/A	N/A	Low
8	>100	N/A	N/A	Low
9	>100	N/A	N/A	Low
10	>100	N/A	N/A	Low
11	>100	N/A	N/A	Low
12	>100	N/A	N/A	Low
13	>100	N/A	N/A	Low
14	>100	N/A	N/A	Low
15	85m	7	Forest	12.5
16	66m	7	Forest	12.5
17	33m	7	Forest	29
18	33m	7	Forest	29
19	33m	7	Forest	29
20	33m	7	Forest	29
21	65m	7	Forest	12.5
22	80m	7	Forest	12.5
23	94m	7	Forest	12.5
24	>100	N/A	N/A	Low
25	>100	N/A	N/A	Low
26	>100	N/A	N/A	Low
27	>100	N/A	N/A	Low
28	>100	N/A	N/A	Low
29	>100	N/A	N/A	Low
30	>100	N/A	N/A	Low
31	>100	N/A	N/A	Low
32	93m	9	Shrubland	12.5
33	80m	9	Shrubland	12.5
34	68m	9	Shrubland	12.5
35	54m	9	Shrubland	12.5
36	20m	9	Shrubland	19
37	20m	9	Shrubland	19
38	20m	9	Scrub	29
39	20m	9	Scrub	29



Lot No	Separation Distance from lot to vegetation	Slope Degrees	Vegetation Classification	BAL Rating
40	20m	9	Scrub	29
41	20m	9	Scrub	29
42	43m	9	Scrub	12.5
43	52m	9	Scrub	12.5
44	61m	9	Scrub	12.5
45	72m	9	Scrub	12.5
46	83m	9	Scrub	12.5
47	95m	9	Scrub	12.5
48	>100	N/A	N/A	Low
49	>100	N/A	N/A	Low
50	>100	N/A	N/A	Low
51	>100	N/A	N/A	Low
52	>100	N/A	N/A	Low
53	>100	N/A	N/A	Low
54	85m	7	Forest	12.5
55	74m	7	Forest	12.5
56	60m	7	Forest	19
57	50m	7	Forest	19
58	27m	7	Forest	29
59	33m	7	Forest	29
60	27m	3	Forest	29
61	28m	3	Forest	29
62	29m	3	Forest	29
63	27m	3	Forest	29
64	38m	7	Forest	29
65	43m	7	Forest	29
66	50m	7	Forest	19
67	55m	7	Forest	19
68	62m	7	Forest	12.5
69	68m	7	Forest	12.5
70	73m	7	Forest	12.5
71	80m	7	Forest	12.5
72	60m	7	Forest	19
73	60m	7	Forest	19
74	60m	7	Forest	19
75	60m	7	Forest	19
76	65m	7	Forest	12.5
77	71m	7	Forest	12.5
78	79m	7	Forest	12.5
79	88m	7	Forest	12.5
80	>100	N/A	N/A	Low
81	>100	N/A	N/A	Low
82	>100	N/A	N/A	Low
83	>100	N/A	N/A	Low



Lot No	Separation Distance from lot to vegetation	Slope Degrees	Vegetation Classification	BAL Rating
84	>100	N/A	N/A	Low
85	93m	9	Scrub	12.5
86	85m	9	Scrub	12.5
87	73m	9	Scrub	12.5
88	60m	9	Scrub	12.5
89	52m	9	Scrub	12.5
90	40m	9	Scrub	12.5
91	27m	4	Forest	29
92	43m	4	Forest	19
93	58m	4	Forest	12.5
94	73m	4	Forest	12.5
95	60m	Upslope	Forest	12.5
96	60m	Upslope	Forest	12.5
97	60m	Upslope	Forest	12.5
98	60m	Upslope	Forest	12.5
99	60m	Upslope	Forest	12.5
100	60m	Upslope	Forest	12.5
101	60m	Upslope	Forest	12.5
102	60m	Upslope	Forest	12.5
103	60m	Upslope	Forest	12.5
104	60m	Upslope	Forest	12.5
105	80m	Upslope	Forest	12.5
106	74m	Upslope	Forest	12.5
107	67m	Upslope	Forest	12.5
108	63m	Upslope	Forest	12.5
109	56m	Upslope	Forest	12.5
110	50m	Upslope	Forest	12.5
111	31m	Upslope	Forest	19
112	27m	Upslope	Forest	29
113	27m	Upslope	Forest	29
114	27m	Upslope	Forest	29
115	27m	Upslope	Forest	29
116	27m	Upslope	Forest	29
117	31m	Upslope	Forest	19
118	31m	Upslope	Forest	19
119	27m	Upslope	Forest	29
120	27m	Upslope	Forest	29
121	27m	4	Forest	29
122	37m	5	Forest	19
123	45m	5	Forest	19
124	51m	5	Forest	12.5
125	56m	5	Forest	12.5
126	61m	5	Forest	12.5
127	66m	5	Forest	12.5



Lot No	Separation Distance from lot to vegetation	Slope Degrees	Vegetation Classification	BAL Rating
128	71m	5	Forest	12.5
129	79m	5	Forest	12.5
130	85m	5	Forest	12.5
131	60m	5	Forest	12.5
132	58m	5	Forest	12.5
133	56m	5	Forest	12.5
134	56m	5	Forest	12.5
135	56m	5	Forest	12.5
136	56m	5	Forest	12.5
137	56m	5	Forest	12.5
138	52m	Upslope	Forest	12.5
139	52m	Upslope	Forest	12.5
140	54m	Upslope	Forest	12.5
141	54m	Upslope	Forest	12.5
142	36m	Upslope	Forest	19
143	33m	Upslope	Forest	19
144	27m	Upslope	Forest	29
145	19.8m	Upslope	Forest	40
	A BAL 29 rating applie	es with a 1.2m setba	ck within Lot 145.	
146	28m	Upslope	Forest	29
147	24m	Upslope	Forest	29
148	23m	Upslope	Forest	29
149	22m	Upslope	Forest	29
150	27m	4	Forest	29
151	27m	4	Forest	29
152	27m	4	Forest	29
153	27m	4	Forest	29
154	29m	4	Forest	29
155	30m	4	Forest	29
156	32m	4	Forest	29
157	67m	3	Forest	12.5
158	60m	3	Forest	12.5
159	56m	3	Forest	12.5
160	51m	3	Forest	12.5
161	49m	3	Forest	19
162	41m	Upslope	Forest	19
163	38m	Upslope	Forest	19
164	33m	Upslope	Forest	19
165	29m	Upslope	Forest	29
Group House	21m	Upslope	Forest	29
166	66m	Upslope	Forest	12.5
167	60m	Upslope	Forest	12.5
168	52m	Upslope	Forest	12.5
169	39m	Upslope	Forest	19



Lot No	Separation Distance from lot to vegetation	Slope Degrees	Vegetation Classification	BAL Rating
170	30m	Upslope	Forest	29
171	21m	Upslope	Forest	29
172	21m	Upslope	Forest	29
173	21m	Upslope	Forest	29
174	33m	Upslope	Forest	19
175	43m	Upslope	Forest	12.5
176	53m	Upslope	Forest	12.5
177	60m	Upslope	Forest	12.5
178	74m	Upslope	Forest	12.5
179	87m	Upslope	Forest	12.5
180	75m	Upslope	Forest	12.5

6.1.2 Siting and Design of Development

A2.1 Asset Protection Zone (APZ)

An asset protection zone is simply a "low fuel zone" located around a building. The requirements for the asset protection zone are as follows:

- a) Width: 20 metres measured from any external wall of the building or building envelope. Where the slope increases above 10 degrees, the APZ should be increased to ensure the potential radiant heat impact of a fire does not exceed 29kW/m². Where a full 20 metre APZ is not possible, the APZ should be sufficient enough to ensure the potential radiant heat impact of a fire does not exceed 29kW/m²:
- b) Location: within the boundaries of the lot on which the building is situated;
- c) Fine Fuel load: reduced to and maintained at two tonnes per hectare;
- d) Trees (crowns) are a minimum distance of ten metres apart. A small group of trees within close proximity to one another may be treated as one crown provided the combined crowns do not exceed the area of a large or mature crown size for that species;
- e) No tall shrubs or trees located within two metres of a building;
- f) No tree crowns overhang the building;
- g) Fences within the APZ are constructed using non-combustible materials (e.g. iron, brick, limestone, metal post and wire); and
- h) Sheds within the APZ should not contain flammable materials.

Due to the design of the subdivision the simplest means of achieving the asset protection zone is to locate this around the boundary of the residential properties in the POS areas. This is incorporated in the "bushfire buffer" as shown in Figure 9.

A2.2 Hazard Separation Zone (HSZ)

The most efficient and cost effective fire management measure is to provide a large open space around the buildings. This is designed to separate the buildings from the wooded areas with a high bushfire hazard rating. A hazard separation zone provides a "defendable space" which slows down a fire as it moves towards the development and allows for active firefighting.

The greater the separation distance the lower the hazard rating for the asset; and conversely, the closer to the vegetation, the higher the hazard rating for the dwelling.

Acceptable Solution A2.2 requires:



- An 80m hazard separation zone from the outside of the APZ i.e. a total distance of 100m;
- Generally located within the subject land; and
- Shall be maintained as a low fuel zone.

The HSZ may be reduced where the construction of the dwelling meets the appropriate BAL rating for that site provided that it does not exceed BAL - 29.

Recommendations

4. That each dwelling on land with a Bushfire Attack Level of BAL-12.5 or greater is to provide a 20m wide asset protection zone. These can overlap common lot boundaries.

6.1.3 Element 3 Vehicular Access

A3.1 Two Access Routes

The principal access to the site is from Maidment Avenue. In order to provide multiple access routes two emergency access ways will be provided as documented in A3.6 below.

A3.2 Public Roads

The proposed subdivision will be 6m wide and designed in accordance with the standards specified in the Local Government Subdivisional Guidelines (7) which meet required specification for bushfire access.

A3.3 Cul – de-sacs

There are no cul-de-sacs in the development.

A3.4 Battle-Axes

There are no battle axe legs in the development.

A3.5 Private Driveways Longer than 50 metres

There are no driveways greater than 50m in length.

A3.6 Emergency Access Ways

Two emergency access ways will provided from the subdivision as shown in Figure 9 and these will connect:

- To Maidment Avenue near the northern boundary of the subject land; and
- To Hutt Drive on the western boundary of the subject land.

These will be constructed:

- To have a minimum trafficable surface of 6 metres comprising of a 4m formed surface with 1m shoulders:
- To have a horizontal clearance to vegetation of 6 metres;
- To have a vertical clearance: 4.5 metres; and
- With access gates with a minimum width of 3.6m at each end of the emergency access way with sign posting indicating that the access way is for emergency purposes only.

The emergency access way on the western boundary is shown in Figure 8 as being on Lot 185. While this is shown on the draft structure plan as being POS it is necessary to ensure that public access in an emergency is always available.

A3.7 Fire Service Access Routes

⁷ Institute of Public Works Engineering Australia WA Division Inc. (2009) Local Government Subdivisional Guidelines Perth



This is not applicable to the development.

A3.8 Firebreak Width

All lots more than 0.5 hectares in size are required to have a 3m boundary firebreak. This will only apply to the revegetated areas of Regional Open Space as shown in Figure 9.

Recommendations

- 5. That the subdivision roads be designed in accordance with Institute of Public Works Engineering Australia WA Division Inc. (2009) Local Government Subdivisional Guidelines.
- 6. That emergency access ways be provided linking to Maidment Parade and Hutt Drive as shown. These shall have gates provided at each end way having a minimum width of 3.6m and shall be sign posted as "Emergency Access Only".
- 7. The emergency access ways shall be provided on public land.

6.1.4 Element 4 Water

A4.1 Water– Reticulated Areas

The subdivision, development or land use is provided with a reticulated water supply in accordance with the specifications of the relevant water supply authority and Department of Fire and Emergency Services.

A4.2; A4.3 Water- Non Reticulated Areas

This is not applicable to the development.

Recommendations

- 8. That fire hydrants are to be provided in accordance with the Water Corporation's Water Reticulation Standard No 63.
- 9. A plan demonstrating the location and capacity of fire the fire hydrants shall be submitted to the Shire of Capel and DFES

6.2 STAGING

The proposed subdivision plan does not make any provision for the staging of the development. In the event that the subdivision is staged then it is necessary to ensure that appropriate interim measures are provided. These may include:

- Interim access or emergency access ways;
- Creation of additional low fuel zones to ensure that the BAL ratings shown in Figure 9 can be applied; or
- The provision of boundary firebreaks especially on any balance lot.

Recommendations

10. In the event of any staging of the proposed subdivision a statement of the proposed interim fire management measures and plan are to be submitted and approved by DFES as an adjunct to Figure 9.



6.3 PURCHASER ADVICE

All prospective purchasers must be made aware of the fire management issues, measures and responsibilities associated with the subdivision.

This can be a notification shall be placed upon the Certificate of Title of all lots pursuant to Section 70A of the Transfer of Land Act advising landowners of this Fire Management Plan and BAL requirements.

Recommendations

- 11. A notification shall be placed upon the Certificate of Title of all lots pursuant to Section 70A of the Transfer of Land Act advising landowners of this Bushfire Management Plan.
- 12. That prospective purchasers be provided with a copy or summary of this Bushfire Management Plan.

6.4 IMPLEMENTATION

The management of the risk posed by bushfires is a shared responsibility between landowners, government and industry. While state and local government undertakes bushfire prevention measures (e.g. planned burning), land use planning and emergency response (fire suppression); land owners in bushfire prone areas must take the necessary steps to prepare their property. These responsibilities are summarised in Table 2 (over the page).

Recommendations

- 13. In the event that the subdivision is not completed with five years this Bushfire Management Plan shall be reviewed and updated as required.
- 14. Unless individual BAL assessments are undertaken, then a compliance certificate/report for the BAL Contour Map shall be issued before any building permits are issued for any individual lots.



Table 4 Implementation

Rec No	RESPONSIBILITIES	wно	WHEN
1. 🗆		Rodom	
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3. 🗆			
4. 🗆		Roodoo	
5. 🗆			
6. 🗆	ocomo crocomonom comopred ed manenMade calPeredec oed manDrinomanos a mocomonimonaproad ed manenda o crocom ano a mid mai3.6e med mocimopoand mo mo crocom accam anom		
7.□	ocene crocomunicam acumo imperaded imperamed. a		
	occurcumdrocumromoproaded unacerdocum unucum curc orperouncum cur Rouncum unaderd una63. un o	Dompero	
9. 🗆	opmodo ocromomomod mpominamaninamadrom commune mid mimomorom cpomid Doco c	Docomporo	
10.	munomonumonumomorpoed mod munomumo onum mopropaed murm mom access and accrowed publicamumo ence mid med mpproed malbass. a	Dompera	
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12. 🗆		Dompero	
13. 🗆	mannanananananad mininanana pinid an mannanaranana a acamaiM acaoon acaiP mannamarana ad mad mpd aud mannananad. a	Dompro	
14. 🗆	o omernidad como omerened craccomonació parene eramonació perantamento em como Mepacemento da como e condació en como da como en como	R d	



7 CONCLUSION

The subject land is located within a bush fire prone area where fires occur on a regular basis. These fires can pose a risk to life and property.

The proposed subdivision will provide for additional areas of revegetation extending from the adjoining Regional Open Space to the north. To manage this threat at an acceptable level it will require specific measures to be implemented and maintained within the subject land.

The purpose of this Bushfire Management Plan is to minimise the impact of a bush fire to people residing in the proposed development. It demonstrates that the proposed development complies with the criteria within State Planning Policy 3.7 and the Guidelines for Planning in Bushfire Prone Areas.

The factors affecting the survivability of a dwelling include (8):

- Terrain (slope);
- Vegetation overall fuel load;
- Weather (temperature, relative humidity, wind speed);
- Distance of building from unmanaged vegetation;
- Individual elements surrounding the building that are either a shield or an additional fuel source;
- Proximity to surrounding infrastructure;
- Building design and maintenance;
- Human behaviour probability to be present and capacity to fight the fire;
- Access to the building and how that influences human behaviour;
- Water supply for active and/or passive defence; and
- Power supply.

These factors have been considered in the design of the development and the fire management measures in this report.

The management of the risk posed by bushfires is a shared responsibility between landowners, government and industry. While state and local government undertakes bushfire prevention measures (e.g. planned burning), land use planning and emergency response (fire suppression); land owners in bushfire prone areas must take the necessary steps to prepare their property. These responsibilities are summarised in Table 4.

The recommendations in this report should not be construed to assure total bush fire protection and do not guarantee that a building will not be damaged in a bush fire. The severity of a bush fire will depend upon the vegetation fuel loadings; the prevailing weather conditions and the implementation of appropriate fire management measures. These measures are required to be established by the 30th November and kept maintained throughout the summer months until the end of the Restricted Burning Period on 26th April.

Dalyellup Greenpatch BMP

⁸ Leonard J (2009) Report to the 2009 Victorian Bushfires Royal Commission Building Performance in Bushfires CSIRO page 22.



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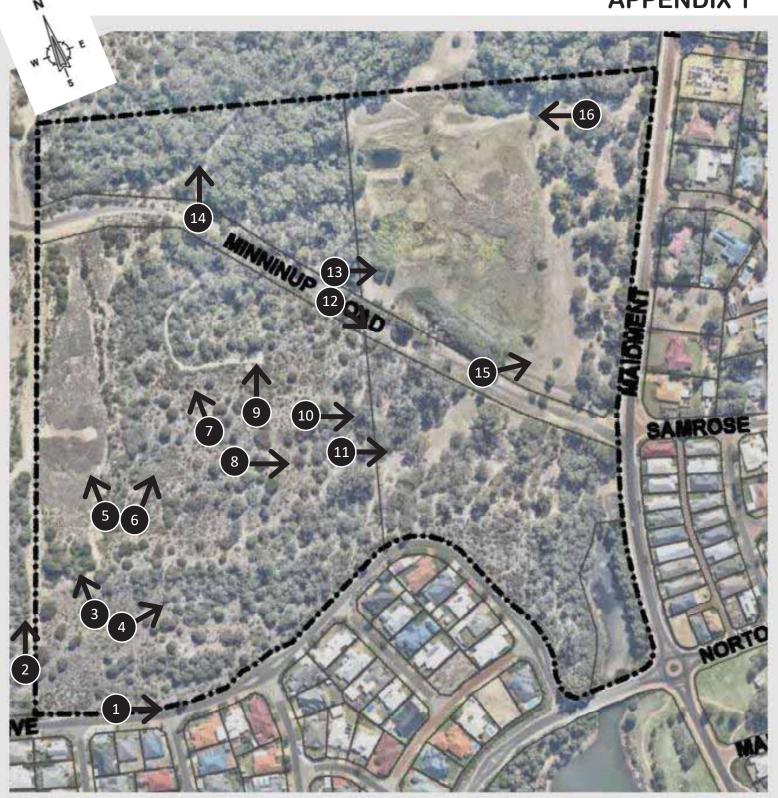
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Appendix 1 Site Photographs



SITE PHOTOGRAPHS LOCATION PLAN



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 7



Photo 8



Photo 9



Photo 10



Photo 11



Photo 12



Photo 13



Photo 14



Photo 15



Photo 16

Greenpatch Dalyellup

Bushfire Protection Criteria (2015)

Compliance checklist for performance criteria and acceptable solutions

A1.1 Development location Does the proposal comply with the performance criteria by applying acceptable solution A1.1? Yes	Element 1: Location	
Element 2: Siting and Design of Development A2.1 Asset Protection Zone Does the proposal comply with the performance criteria by applying acceptable solution A2.1? Yes	· · · · · · · · · · · · · · · · · · ·	
Element 2: Siting and Design of Development A2.1 Asset Protection Zone Does the proposal comply with the performance criteria by applying acceptable solution A2.1? Yes	Does the proposal comply with the p	performance criteria by applying acceptable solution A1.1?
A2.1 Asset Protection Zone Does the proposal comply with the performance criteria by applying acceptable solution A2.1? Yes No N/A A2.2 Hazard Separation Zone Does the proposal comply with the performance criteria by applying acceptable solution A2.2? Yes No N/A Element 3: Vehicular Access A3.1 Two access routes Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes No N/A A3.2 Public road Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes No N/A A3.3 Cul-de-sacs Does the proposal comply with the performance criteria by applying acceptable solution A3.3? Yes No N/A A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Yes ✓ No	N/A
No N/A A3.2 Public road Does the proposal comply with the performance criteria by applying acceptable solution A2.2? Yes ✓ No N/A A2.2 Hazard Separation Zone Does the proposal comply with the performance criteria by applying acceptable solution A2.2? Yes ✓ No N/A Element 3: Vehicular Access A3.1 Two access routes Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes ✓ No N/A A3.2 Public road Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes ✓ No N/A A3.3 Cul-de-sacs Does the proposal comply with the performance criteria by applying acceptable solution A3.3? Yes No N/A ✓ A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A ✓ A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Element 2: Siting and Design	of Development
A2.2 Hazard Separation Zone Does the proposal comply with the performance criteria by applying acceptable solution A2.2? Yes No N/A Element 3: Vehicular Access A3.1 Two access routes Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes No N/A A3.2 Public road Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes No N/A A3.3 Cul-de-sacs Does the proposal comply with the performance criteria by applying acceptable solution A3.3? Yes No N/A A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?		erformance criteria by applying acceptable solution A2.1?
Poes the proposal comply with the performance criteria by applying acceptable solution A2.2? Yes	Yes ✓ No	N/A
Flement 3: Vehicular Access A3.1 Two access routes Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes		
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Yes	Element 3: Vehicular Access	
A3.2 Public road Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes	A3.1 Two access routes	
A3.2 Public road Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes No N/A A3.3 Cul-de-sacs Does the proposal comply with the performance criteria by applying acceptable solution A3.3? Yes No N/A A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Does the proposal comply with the p	erformance criteria by applying acceptable solution A3.2?
Does the proposal comply with the performance criteria by applying acceptable solution A3.2? Yes No N/A A3.3 Cul-de-sacs Does the proposal comply with the performance criteria by applying acceptable solution A3.3? Yes No N/A A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Yes ✓ No	N/A
A3.3 Cul-de-sacs Does the proposal comply with the performance criteria by applying acceptable solution A3.3? Yes No N/A ✓ A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A ✓ A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?		
A3.3 Cul-de-sacs Does the proposal comply with the performance criteria by applying acceptable solution A3.3? Yes No N/A A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Does the proposal comply with the p	erformance criteria by applying acceptable solution A3.2?
Yes No N/A ✓ A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A ✓ N/A ✓ N/A ✓ A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Yes ✓ No	N/A
Yes No N/A ✓ A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A ✓ A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?		
A3.4 Battle axe Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Does the proposal comply with the p	
Does the proposal comply with the performance criteria by applying acceptable solution A3.4? Yes No N/A ✓ A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Yes No	N/A ✓
Yes No N/A ✓ A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	·	
A3.5 Private driveways longer than 50m Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Does the proposal comply with the p	
Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Yes No	N/A ✓
Yes No N/A ✓	Yes No	N/A ✓
A3.6 Emergency access ways		
Does the proposal comply with the performance criteria by applying acceptable solution A2.6?		
Yes ✓ No N/A N/A	Yes V No	N/A
A3.7 Fire service access routes Does the proposal comply with the performance criteria by applying acceptable solution A3.7?		performance criteria by applying acceptable solution A3.7?
		N/A ✓

Greenpatch Dalyellup

Bushfire Protection Criteria (2015)

Compliance checklist for performance criteria and acceptable solutions

Element 4: Water	
A4.1 Reticulated areas Does the proposal comp Yes	ly with the performance criteria by applying acceptable solution A4.1? No N/A
A4.2 Non-reticulated are	
Yes Yes	No N/A V
•	in non-reticulated areas (1 additional lot) ly with the performance criteria by applying acceptable solution A4.3? No N/A N/A
Applicant's Declara	tion
I declare that the info	rmation provided is true and correct to the best of my knowledge.
Full name:	Geoffrey Lush
Applicant signature:	beoffrey hund. 24 March 2016



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NOTE: Addendum to Calibre BMP March 2016 Version A

BPAD Level 3 Document Review

Dalyellup – Greenpatch Bushfire Management Plan and DFES Submissions

Project Number: 170327

Report Date: 7 June 2017



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Summary

It is my opinion that the proposed development can meet the relevant acceptable solutions for Elements 1, 2 and 3 of the Bushfire Protection Criteria.

The supporting Bushfire Management Plan would need to be amended with my recommendation to provide additional information demonstrating that there are valid reasons why the second access route can only be provided as an emergency access way.

It is my opinion that there is no substantiating reason for the decision maker to not support the proposed structure plan by invoking the precautionary principle of SPP 3.7 Policy Measure 6.11 given that:

- Compliance with the Bushfire Protection Criteria can be achieved;
- The required information has been presented in the subject BMP; and
- There is no increase in the threat of bushfire to people, property and infrastructure by the proposed development but rather a decrease in the threat to existing dwellings and their occupants adjacent to the proposed development and a lower threat to future buildings and their occupants compared to the existing dwellings.



1 Reviewer Details / Document Control

Reviewer	Bushfire Planning and Design (BPAD) Acc	creditation	Signature
Mike Scott	Level 3 Bushfire Planning and Design Practitioner	27795	Whenly
	BPP Group Pty Ltd t/a Bushfire Prone Planning ACN: 39 166 551 784		

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Review Version	Submitted to	Submitted Date
v1.0	Satterley (Mitchell Dodson)	7-Jun-17
	Amendment Record	Submitted Date
-		



2 Reviewed Document/s Details

Reviewed Documents Details		
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Produced By:	Calibre Consulting (Aust) Pty Ltd Unit 5 53 Victoria Street Bunbury WA 6231	
Prepared For:	Satterley	
Document Purpose:	To accompany the Greenpatch structure plan submission	
Subject Site Location	Lots 9105, 9076 & 8019 Maidment Parade, Dalyellup	
Local Government:	Shire of Capel	
	Document 2	
Title:	SCHEDULE OF SUBMISSIONS GOVERNMENT AGENCIES GREENPATCH STRUCTURE PLAN – LOTS 9105, 9076 & 8019 MAIDMENT PARADE, DALYELLUP	
Version:	-	
Notes:	The relevant content for reviewing is Section 10 containing the DFES comments.	



3 Review Commissioning and Scope

Bushfire Prone Planning (BPP Group Pty Ltd) has been commissioned by the Satterley Property Group to review the subject documents and produce a report based on the defined scope of the review.

The subject BMP was submitted to the relevant decision makers as supporting documentation for the proposed development – the Greenpatch Structure Plan. With due process, the decision makers have sought the comments and recommendations of relevant government agencies including DFES.

The resulting DFES advice regarding the BMP gave the following recommendation for the proposal:

"Fundamentally the proposed structure plan does not comply with the intent, objectives and policy measures of SPP 3.7. The intensification of development at this location would result in an increase in the threat of bushfire and is subsequently not supported."

Scope of the Review

- 1. Familiarisation with the subject BMP.
- 2. Address the DFES comments stated at item 10 of the document:

SCHEDULE OF SUBMISSIONS GOVERNMENT AGENCIES
GREENPATCH STRUCTURE PLAN – LOTS 9105, 9076 & 8019 MAIDMENT PARADE, DALYELLUP

- 3. Provide an expert opinion on the stated comments; and
- 4. Provide advice on how the proposed structure plan might better meet the requirements of the state bushfire provisions (as established in State Planning Policy 3.7 Planning in Bushfire Prone Areas and associated legislation and guidelines) if it is considered possible or necessary.



4 Addressing DFES Comments – Meeting SPP 3.7 Policy Objectives and Measures

Department of Fire and Emergency Services – Comments re SPP 3.7

1. Policy Objective

i Policy Objective 5.1 of SPP3.7 applies and states:

"Avoid any increase in the threat of bushfire to people, property and infrastructure. The preservation of life and the management of bushfire impact are paramount."

2. Policy Measure

i. Policy Measure 6.11 of SPP 3.7 applies to the proposal and states:

"The presumption against approving further strategic planning proposals, subdivision and development applications or intensification of land uses, where there is a lack of certainty that the potential for significant adverse impacts can be adequately reduced or managed in the opinion of the decision maker."

DFES Comments:

In line with the intent of SPP 3.7 and the above policy objective/measure, DFES do not support the proposed structure plan as an extreme bushfire hazard exists, which cannot be reduced by a BMP because of the extent of vegetation bordering the subject site as well as the lack of two publicly available access routes, making the location unsuitable for intensification.

Mike Scott (Bushfire Prone Planning) - Statement of key elements that will direct my opinion

With Respect to SPP 3.7 Policy Objective 5.1

1. The legitimacy of primarily assessing a development proposal against the Policy Objectives:

The following is quoted from State Planning Policy 3.7 (SPP 3.7):

"This policy contains objectives and policy measures, as well as reference to the bushfire protection criteria contained in the Guidelines. The objectives outline the <u>general aims</u> on which the policy measures and bushfire protection criteria are based...while the policy measures <u>apply as relevant</u> to the type of proposal and stage of the development process" (emphasis is mine).

The key point is that the policy objectives are just setting the framework. From this framework (general aims) the actual requirements for assessing development proposals is derived and is set out by the legislated bushfire provisions, policy measures and with the detail provided in the Guidelines — in particular, the bushfire protection criteria.

A Bushfire Management Plan (BMP) produced to support a development proposal must assess compliance with the detailed requirements (such as those contained in the Guidelines / Bushfire Protection Criteria), to a level corresponding to the planning stage.



It follows from this that a decision maker (WAPC / local government and their advisors) would also be required to follow the same process in their appraisal of the BMP - that is, consider the detail. If the BMP indicates that compliance with the requirements set out in the Guidelines is or can be achieved, then by default the Policy objectives will have been met.

It is not possible to determine compliance with a Policy objective without addressing the specific detailed requirements that have been developed, by the planning authority, from the Policy objective.

2. Does the subject structure plan avoid any increase in the bushfire threat?

Figure 1: BAL Contour Map Pre-Development illustrates the potential bushfire impact on the existing development that is presented by the existing vegetation.

Figure 2: BAL Contour Map Post-Development illustrates the potential bushfire impact on the existing development that is presented by the proposed remaining vegetation after the development is completed.

Pre-Development

The existing vegetation on the proposed development site presents the potential for a landscape scale bushfire event impacting upon existing residential development. This can occur from a northerly around to a westerly direction and will impact upon dwellings that have not been constructed to a standard that corresponds to the potential bushfire impact.

The pre-development potential bushfire impact can be represented as the Bushfire Attack Levels to which the adjoining dwellings can be exposed and is presented as a BAL Contour Map (Figure 1).

Along Maidment Parade, there are seventeen existing dwellings adjacent to the proposed development of which fourteen are currently exposed to BAL-29 with three exposed to BAL-19.

Along Hutt Drive there are sixteen existing dwellings adjacent to the proposed development of which six are rated BAL-FZ, one BAL-29, two BAL-19 and seven BAL-12.5.

The following table summarises the bushfire threat, on the basis of their indicative BAL's, to which the existing thirty-six dwellings are currently exposed.

BAL-Rating	BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5	BAL-Low
No. Dwellings	6		15	5	7	
Percentage	18%		46%	15%	21%	

Post-Development

After the proposed development has been completed, including the planned revegetation, most existing vegetation will have been removed to accommodate dwelling construction or will be managed to a low threat state as part of each dwelling's APZ.



There will be two significant areas of vegetation that remain as public open space/drainage. These areas are isolated by development (roads and lots for construction. As a result, these areas will not support landscape scale fire and a bushfire event within them would be contained and provide increased options for controlling a bushfire. The bushfire threat is lowered.

The vegetation area that will form the public open space/drainage alongside the eastern boundary of the proposed development will result in a much-reduced fire run for an east- west direction fire, resulting in a lower bushfire threat compared to prior to development. A fire with a longer run can still eventuate in a north-south direction but the threat to neighbouring dwellings will be from a flanking fire rather than a head fire i.e. a lower threat.

The post-development potential bushfire impact can be represented as the Bushfire Attack Levels to which the adjoining dwellings can be exposed and is presented as a BAL Contour Map (Figure 2).

Note that the potential bushfire impact (represented as Bushfire Attack Levels) for public open space/drainage alongside the eastern boundary of the proposed development, has been assessed using AS3959-2009 Method 2. The reduced fire run and BAL calculations are included in Appendix 1.

Of the seventeen existing dwellings along Maidment Parade adjacent to the proposed development, twelve will be exposed to BAL-29 with five exposed to BAL-12.5.

Of the sixteen existing dwellings along Hutt Drive adjacent to the proposed development, six will remain exposed to BAL-FZ, one to BAL-29, one to BAL-19, four to BAL-12.5. and four to BAL-Low.

The following table summarises the bushfire threat, on the basis of their indicative BAL's, to which the existing thirty-six dwellings would be exposed post development.

BAL-Rating	BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5	BAL-Low
No. Dwellings	6		13	1	9	4
Percentage	18%		40%	3%	27%	12%

Post development 13 existing dwellings will be exposed to BAL-12.5 or less, compared to 7 currently – an increase of 86%. Dwellings exposed to BAL-19 or greater will decrease from 26 to 20, a reduction of 23%.

This represents a significant lowering of bushfire threat to existing dwellings after the implementation of the proposed development.

Additionally, future dwellings that are constructed on the proposed lots, will be better equipped to withstand a bushfire event from the existing vegetation surrounding the development. This will be achieved due to the use of the required separation distances from areas of classified vegetation to limit the potential bushfire impact to \leq BAL-29 and the requirement to construct the dwellings to the standard corresponding to their determined BAL rating.



With Respect to SPP 3.7 Policy Measure 6.11

The DFES comment regarding Policy Measure 6.11 of SPP 3.7 applying to the proposal, quotes the wording from the definition of the 'Precautionary Principle' taken from Appendix 1 of the Guidelines rather than the actual policy measure. The content of Policy Measure 6.11 stated in SPP 3.7 is:

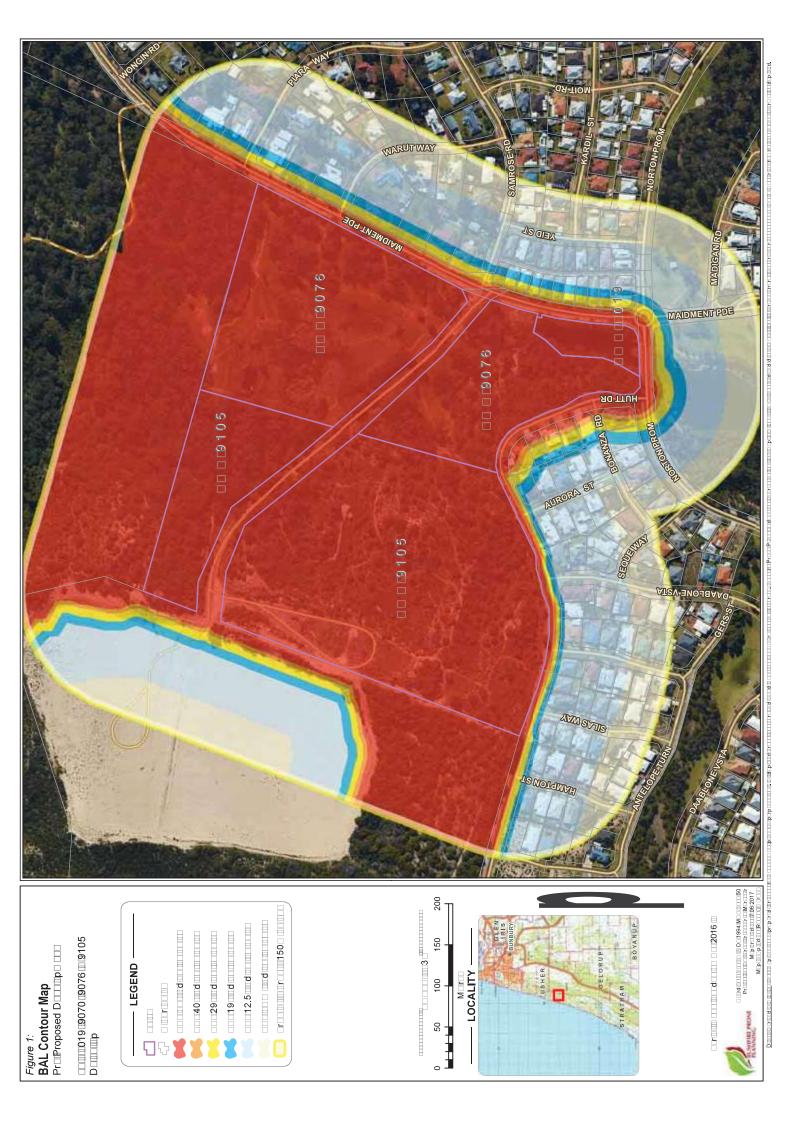
"Where a landowner/proponent has not satisfactorily demonstrated that the relevant policy measures have been addressed, responsible decision makers should apply the precautionary principle to all strategic planning proposals, subdivision and development applications in designated bushfire prone areas. For example, if a landowner/proponent cannot satisfy the performance principles of the relevant policy measures through either the application of the acceptable solutions outlined in the Guidelines, or through the alternative solutions endorsed by the WAPC and State authority/relevant authority responsible for emergency services, the application may not be approved."

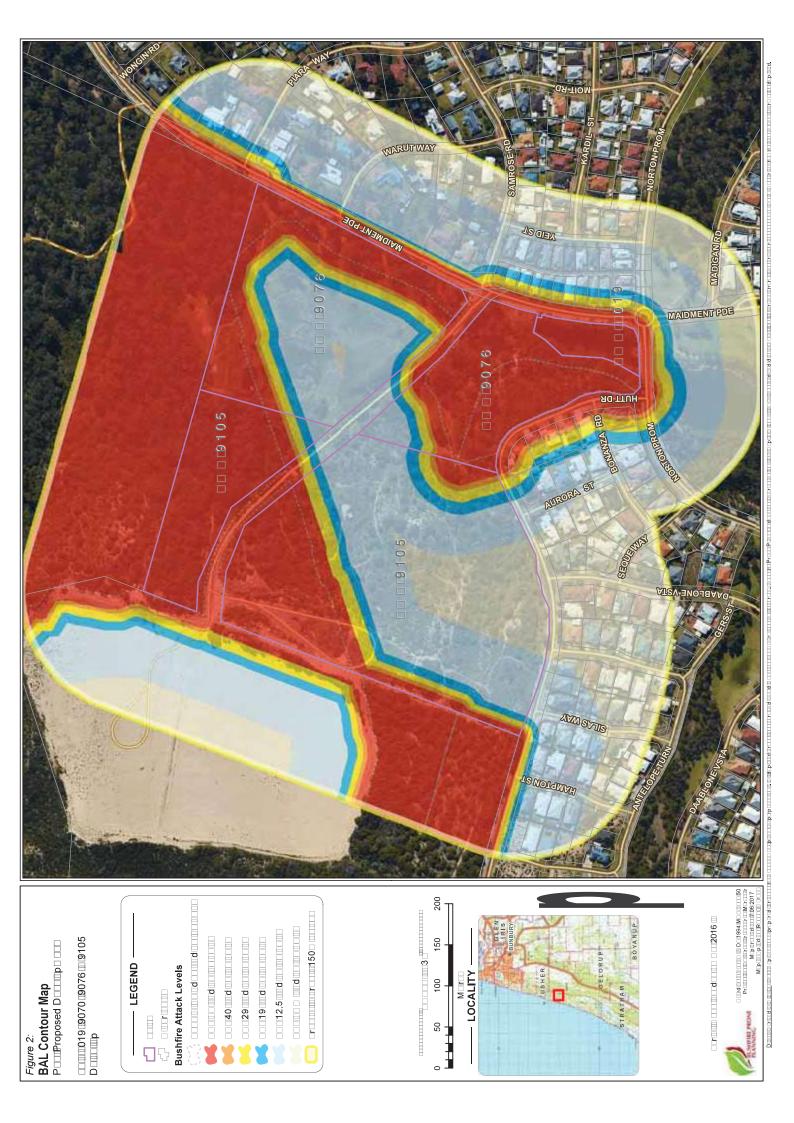
For the subject structure plan, the relevant SPP 3.7 policy measure to be considered in this discussion is Policy Measure 6.3 – 'Information to accompany strategic planning proposals'. The requirements of this policy measure are that a Bushfire Management Plan is to accompany the proposed structure plan and is to contain:

- A BAL contour map (given the lot locations are known);
- The identification of any bushfire hazard issues; and
- Clear demonstration that compliance with the bushfire protection criteria in the Guidelines can be achieved in subsequent planning stages.

If the requirements are met the policy measure can be considered satisfactorily addressed with the proposed structure plan consequently meeting bushfire planning requirements. This is supported by the statement from Section 4.5.1 of the Guidelines:

"Acceptable solutions contained within this document are intended to provide a straightforward pathway to assessment and approval. Compliance with the acceptable solutions contained within this document automatically achieves the intent of the relevant bushfire element".







Mike Scott (Bushfire Prone Planning) – Addressing DFES Comments re SPP 3.7

The necessary assessment of a proposed development's compliance with clearly defined specific requirements cannot be made by making generalised statements against broadly defined framework statements. Rather, an assessment against the more detailed Guidelines is what will determine if the proposal meets the objectives of the Policy by providing targeted substance to the assessment.

If the proposal can comply with the Guidelines and the bushfire protection criteria, then the objectives of the Policy are met automatically or vice versa. The position of compliance or not with a Policy, cannot be arrived at from the other direction i.e. by broad statements against generalised policy requirements.

As much as a proponent must provide detailed and substantiated assessment for consideration, any judgement assessment should need to be equally detailed and address specifics rather than generalisations – otherwise the entire risk assessment process has no real credibility.

There is seemingly a lack of understanding from DFES regarding how the bushfire provisions and associated Policy and Guidelines have determined that bushfire risk can be mitigated – even an extreme hazard level. Particularly with respect to how the different components work together and are supported by relevant research.

The specified requirements while imperfect and always subject to improvement, are nonetheless documented and provide quantitative measures upon which planning and assessment decisions can be made. This is a better approach than relying on subjective opinion alone. It is the approach proponents are required to use and the same method should be utilised by decision makers in assessing compliance.

Development approval decisions should not be based solely on the existence or not of a bushfire risk - extreme or otherwise. For a given location the assessed offsite risk is going to exist and will remain. The decision should be based on the proposal's ability to employ all the approved risk mitigation measures - (that have been developed for WA, by the relevant decision makers and their advisors, to provide possible solutions to achieve SPP 3.7 Policy objectives and measures) - to the standard and extent required onsite with appropriate consideration of the offsite risk. For further discussion on this aspect refer to my comments under the Bushfire Protection Criteria Element 1 – Location.



Mike Scott (Bushfire Prone Planning) – Opinion Statements

It is my opinion with respect to Policy Objective 5.1 that:

- 1. The threat of bushfire to people, property and infrastructure within the existing residential area will be reduced after the proposed development is completed;
- 2. The threat of bushfire to people, property and infrastructure within the proposed development will be less than what the existing development is currently exposed to due to the implementation of the required bushfire mitigation measures;
- 3. The bushfire threat to people, property and infrastructure will not be increased by the proposed development. Therefore, SPP 3.7 Policy Objective 5.1 has been met

It is my opinion with respect to Policy Measure 6.11 that:

- 1. SPP 3.7 Policy Measure 6.3 has been satisfactorily addressed. Figure 10 of the subject BMP provides the BAL contour plan. As discussed in addressing the DFES comments regarding the Bushfire Protection Criteria, the relevant acceptable solutions for each element have, in my opinion, been met (with further recommendations provided for Element 3); therefore
- 2. There is no substantiating reason to invoke the precautionary principle of SPP 3.7 Policy Measure 6.11 because compliance with the bushfire protection criteria in the Guidelines can potentially be achieved and be further developed at subsequent planning stages. That is, the bushfire risk can potentially be managed using the mitigation measures that have been put in place by the state bushfire provisions, Policy and Guidelines.



5 Addressing DFES Comments - Compliance with the Bushfire Protection Criteria

Department of Fire and Emergency Services - Comment re Element 1 (Location)

"The proposal does not meet Element 1 - Location: the proposed structure plan is in a location where an extreme bushfire hazard exists that cannot be adequately reduced. The proposed BAL construction standard focuses on asset protection and this should not be incorrectly equated with a lower risk to people and the subject site."

Mike Scott (Bushfire Prone Planning) - Statement of key elements that will direct my opinion

Bushfire hazard levels are defined (Guidelines for Planning in Bushfire Prone Areas WAPC 2017 v1.1) and are determined for areas of bushfire prone vegetation. The hazard levels broadly quantify (extreme, moderate, low) the potential bushfire threat they represent to life and property that might be positioned near or within that vegetation.

It is obvious, but important to appreciate, that this hazard level will always remain unchanged if the vegetation is not removed or modified (and maintained in the lower threat state in perpetuity). The implications are that all cases of development on land supporting bushfire prone vegetation will most likely, on completion, continue to be surrounded by the bushfire prone vegetation for which the bushfire hazard level most likely (and practically) will not be changed by the development.

The only way to avoid this is to make sure that any future development only takes place on land devoid of vegetation or only supporting low height and/or low density and generally sparse vegetation (i.e. presenting a low to moderate Bushfire Hazard Level). This would present significant limitations to development in many populated areas.

Therefore, when considering a development proposal's ability to comply with Element 1 (Location) of the BPC, the purpose of assessing the bushfire hazard levels needs to be understood. The purpose exists at two different planning levels:

- 1. If a choice of sites is available for the development and they present different Bushfire Hazard Levels, then to meet the intent of the element, the site of least possible bushfire risk should be selected. This is appropriate at higher levels of strategic planning; or
- 2. If there are no alternative sites then consideration of the Bushfire Hazard Levels must be based on the pre-development bushfire risk compared to the post development risk with the understanding that the Bushfire Hazard Level of vegetation external to the subject site will most likely not change (as discussed) and that it is the bushfire threat level <u>onsite</u> that is to be assessed in determining compliance with the element. This is appropriate at lower levels of strategic planning.



The Guidelines for Planning in Bushfire Prone Areas (WAPC 2017 v1.1) state that achieving the intent of Element 1 can be met where:

"The strategic planning proposal, subdivision and development application is located in an area where the bushfire hazard assessment is, or will on completion be moderate or low, or a BAL-29 or below, and the risk can be managed."

Two points of clarification are required to be able to consider this statement:

- 1. What is the appropriate form of bushfire risk assessment to be considered at different planning stages? The Guidelines state that where lot layout is not known the appropriate assessment is to determine the Bushfire Hazard Levels. If the lot layout is known, the determination of BAL ratings provides a more accurate and site-specific result.
- 2. How is the requirement that the "risk can be managed" to be assessed? The management requirements that need to be met for obtaining planning approval with respect to the bushfire provisions, are established by the bushfire planning legislation, SPP 3.7 and the associated Guidelines. Specifically, these are set out as the Bushfire Protection Criteria and in summary are:
 - Sufficient separation from bushfire prone vegetation such that buildings will not be exposed to radiant heat flux levels above those represented by the BAL-29 rating;
 - That the design and construction of vehicular access/egress to/from the development is safe and available at all times, including during a bushfire event; and
 - That adequate firefighting water supplies are available.

Expanding on point No. 2, these criteria set out what is acceptable with respect to the location, design and construction of the actual infrastructure associated with a development – <u>not the construction of future buildings</u>. The Guidelines then provide 'deemed to satisfy' acceptable solutions which if met will achieve the intent of the element and therefore meet the requirements for planning approval for that element of the criteria.

Given the DFES comment on the use of BAL construction standards I also need to clarify where the use of increased construction standards (AS 3959-2009) - corresponding to determined BAL ratings (and applicable to certain building classes as per the Building Code of Australia) — fits in to the planning approval process.

Where acceptable solutions are being applied to achieve the intent of a Bushfire Protection Criteria element, any assessment of the application of building standards is not relevant. The application of a building standard is a component of the building approval process, not planning approval.

However, applying bushfire construction standards to specific classes of buildings is an additional means of mitigating bushfire risk for those buildings and their occupants. These construction standards



are based on research, and set out in AS 3959-2009 (to which the Building Code of Australia, as applicable to WA, refers). The standard states:

"This Standard is primarily concerned with improving the ability of buildings in designated bushfireprone areas to better withstand attack from bushfire thus giving a measure of protection to the building occupants (until the fire front passes) as well as to the building itself."

As such the application of construction standards can be appropriate to consider when alternative solutions are required to be developed to achieve the intent of the Bushfire Protection Criteria.

Mike Scott (Bushfire Prone Planning) – Addressing DFES Comment re Element 1 (Location)

- The proposed development is an extension of an existing residential subdivision. There is only a single option for location of the development being considered. Therefore, it is the bushfire risk that will remain onsite after the completion of the development that is to be considered. The external risk cannot be changed.
- The lot layout is known for the proposed development. The relevant bushfire risk assessment is the BAL ratings to which any proposed lot will be exposed.
- The subject BMP has indicated that the required vegetation separation distances can be achieved by lot and road design and incorporating onsite vegetation management where required such that no lot will be subject to a BAL rating greater than BAL-29. This includes the proposed plan for the POS including any revegetation.
- Future construction standards and their implications do not need to be considered with respect to determining planning compliance.

It is my opinion that the proposed development meets acceptable solution A1.1 – Development Location and therefore complies with Element 1 – Location.



Department of Fire and Emergency Services - Comment re Element 2 (Siting and Design)

The proposal does not meet Element 2 - Siting and Design: there is inadequate physical separation between the extreme bushfire hazard to minimise the level of bushfire impact because of the extent of vegetation bordering the subject site.

Mike Scott (Bushfire Prone Planning) - Statement of key elements that will direct my opinion

The Guidelines for Planning in Bushfire Prone Areas (WAPC 2017 v1.1) state that achieving the intent of Element 2 – Siting and Design, can be met where:

Every habitable building and every proposed lot can achieve an Asset Protection Zone (APZ) that meets the established requirements for:

- width (to ensure the potential radiant heat impact does not exceed that 29kW/m² (a BAL-29 rating);
- location (both within and outside the lot as allowed); and
- will be managed in accordance with the requirements of 'Standards for Asset Protection Zones'.

Mike Scott (Bushfire Prone Planning) – Addressing DFES Comment re Element 2 (Siting and Design)

- The subject BMP has indicated that no lot will be subject to a BAL rating greater than BAL-29 where it is adjacent to the identified bushfire prone vegetation including the POS. Therefore, the required APZ width has been met in this direction within the lot.
- Where a lot is alongside another lot it would be reasonable to expect, given the proposed lot sizes that the required size APZ (for planning approval purposes) would be achieved either within the lot or across lots as being an area managed to a low bushfire threat state once the development is completed.
- The physical separation distances to separate the proposed lots from the offsite vegetation that have been incorporated into the subdivision design are indicated in Figure 9 of the subject BMP. These result in the potential radiant heat impact at the lot boundary does not exceeding 29kW/m². Given that a building will be setback from this boundary (to varying extents) the potential heat impact on the building will be lower still.
- The required physical separation from the offsite vegetation (which retains its extreme bushfire hazard level rating), to satisfy planning requirements, will be able to be achieved by the installation of an APZ of the required dimensions that will ensure the potential radiant heat impact on a future building does not exceed 29kW/m².



It is my opinion that the proposed development in its completed state, once the onsite vegetation is removed and/or modified to the extent indicated in the BMP, will be able to meet acceptable solution A2.1 - Asset Protection Zone and therefore complies with Element 2 - Siting and Design of Development.

Department of Fire and Emergency Services - Comment re Element 3 (Vehicular Access)

The proposal does not meet Element 3 - Vehicular Access: it is essential that residents, as well as emergency services, have safe access and egress from the subdivision plan area as well as to individual lot(s)/development. The reliance on an EAW to achieve two access routes is not acceptable.

Mike Scott (Bushfire Prone Planning) - Statement of key elements that will direct my opinion

The Guidelines for Planning in Bushfire Prone Areas (WAPC 2017 v1.1) state that the intent of Element 3 – Vehicular Access is:

- "To ensure that the vehicular access serving a subdivision/development is available and safe during a bushfire event;" and
- "That the intent may be achieved where the internal layout, design and construction of public and private vehicular access and egress in the subdivision /development allow emergency and other vehicles to move through it easily and safely at all times."

The Guidelines provide acceptable solutions (A3.1 to A3.8) that if complied with, would enable a proposal to receive planning approval. Of these acceptable solutions 'A3.1- Two Access Routes' is the primary solution directed at internal access layout and design. The remainder are directed at the construction specifications for the various vehicular access/egress components (e.g. roads, cul-de-sacs, private driveways, access ways etc).

The acceptable solution A3.1 is:

"Two different vehicular access routes are provided, both of which connect to the public road network, provide safe access and egress to two different destinations and are available to all residents/the public at all times and under all weather conditions" – (which would include a bushfire event).

In summary, the requirements are:

- 1. Two different access routes;
- 2. Each route to provide access and egress from and to, different destinations; and
- 3. Together the routes must be able to provide for safe travel.



Access Routes

The Guidelines indicate that installing public roads is the preferred option to ensure that two different vehicular access routes are provided. However, in certain circumstances the second route can be provided by an Emergency Access Way (EAW). The Guidelines 'A3.6 – Emergency access way state':

"An access way that does not provide through access to a public road is to be avoided in bushfire prone areas. Where no alternative exists (this will need to be demonstrated by the proponent), an EAW is to be provided as an alternative link to a public road during emergencies."

Further explanation is provided at 'E3.6 - Emergency access way':

"An EAW is not a preferred option however may be used to link up roads to allow alternative access and egress during emergencies where traffic flow designs do not allow for two-way access."

The key point is that the provision of an EAW as the second access route can meet the acceptable solution for Element 3 if there are no alternatives and the case demonstrating why there are no alternatives is presented.

Safe Travel

The Guidelines provide no further guidance given as to what constitutes 'safe access/egress'. Bushfire Prone Planning take the position that this is determined by conducting a risk assessment of the route and considering all factors that can impact upon personal safety and their relative importance to the specific situation. The outcome is a considered opinion based on experience and any available research.

Key to the assessment is the appreciation that any bushfire prone vegetation alongside an access route potentially presents a significant hazard. The hazards include reduced vision (smoke), obstacles (trees alongside the road or fallen over the road) and radiant heat.

As a result, a baseline position is that an access/egress route that requires travelling more than 200m through bushfire prone vegetation - that would be assessed as representing an extreme or moderate Bushfire Hazard Level - should be considered a potentially unsafe route. In such a situation, an alternative route must be available that is unlikely to be simultaneously affected by fire.

The final important aspect to be considered when developing and accessing vehicular access/egress design is that you are not going to, practically, be able to account for absolutely every possible bushfire event or at least a mature stage of that event. There will potentially be a time when the access routes that are considered appropriate and safe for most possibilities might be compromised.

Typically, this would occur when the decision to leave the threatened site has been left too late. However, this is also the situation in which the bushfire measures that the bushfire provisions have required to be put into place, come into play. Specifically, these are the implementation and



maintenance of the required Asset Protection Zone for every building and the construction of habitable buildings to the standard required that corresponds to the potential bushfire impact that has been determined for that building at that site. In such a situation protection of life is provided by the viable option of sheltering in place.

Mike Scott (Bushfire Prone Planning) – Addressing DFES Comment re Element 3 (Vehicular Access)

- The structure plan for the proposed development shows that one access route will be provided by a public road linking with the existing public road system and the requirement for the second access route will be met by the provision of two EAW's.
- Each of these access routes will have bushfire prone vegetation adjoining the route. However, the distance to travel through the vegetated area on each route will be approximately 60m significantly less than the 200m that designates an unsafe route.
- The EAW's are able to be constructed to meet the design parameters as per the Guidelines.
- The subject BMP has not presented a case demonstrating why the preferred option of using a public road as the second access route has not been employed.

It is my opinion that the proposed development will meet the acceptable solutions A3.2-3.8 that are relevant, including A3.1- Two Access Routes, and therefore complies with Element 3 – Vehicular Access, provided it can be demonstrated that there are valid reasons why the second access route can only be provided as an EAW.

Recommendation: The case for adoption of an EAW as the second access route, rather than a public road, needs to be made in the Bushfire Management Plan.

My discussions with the Shire of Capel they have resulted in the Shire making the following statement regarding the provision of road access onto Hutt Drive:

"Based on Shire Officer advice, this has not been supported due to increased traffic volume on a section of Hutt Drive that has a steep gradient and increased intersection demand at Norton Promenade"

If any further information such as specific analysis of traffic modelling for the area was to be developed, this would also need to be included.

Additionally, I would recommend removing the EAW onto Maidment Parade. Leaving this in place would direct residents into a higher risk vegetation area and it is not necessary. This route would however be a useful additional access for fire services. I suggest it is constructed to serve as a cycle way that would also be accessible by a light tanker appliance.



Appendix 1 – AS3959-2009 Method 2 Data and Calculation Output

Determination of Flame Width by Reducing Fire Run:

Short Fire Run Head Fire Width Calculation

Imputs				Outputs		
Fire Run Meters	FDI	Surface Fuel Load	slope	Total Fire length	Head Fire Width	
30	80	25	0	31.00	10.98	
				#DIV/01	MOIV/0!	
				#DIV/0!	#DIV/01	
				#DIV/0!	MDIV/0!	
				#DIV/01	MDIV/01	

Equation derived from:

Alexander, M. E. (1985, April). Estimating the length-to-breadth ratio of elliptical forest fire patterns. In Proc. 8th Conf. Fire and Forest Meteorology (pp. 287-804).

NOTE: Draft Only - to be used for A-Forest, 8-Woodland and D-Scrub Vegetation Classifications and only for fire runs up to 100m (max)

Disclaimer: DFES will accept the use of the outputs from this draft calculator but reserve the right to withdraw its use at any time.

Determination of Separation Distances for Subject Vegetation Area:



Calculated June \mathbb{F}_{ϵ} 2017, 5:02 pm (MDc v.4.7)

Greenpatch Dalyellup - Forest Vegetation Alongside Maidment Road

	Minin	ium Distance Calculator - AS3959-2	009 (Method 2)
Inputs			Outputs
Fire Danger Index	80	Rate of spread	2.4 km/h
Vegetation classification	Forest	Flame length	19.8 m
Surface fuel load	25 t/ha	Flame angle	29 *, 33 *, 39 *, 44 *, 47 * & 64 *
Overall fuel load	35 t/ha	Elevation of receiver	4.79 m, 5.39 m, 6.23 m, 6.87 m, 7.24 m & 8.89 m
Vegetation height	n/a	Fire intensity	43,400 kW/m
Effective slope	0 =	Transmissivity	0.884, 0.875, 0.862, 0.849, 0.841 5 0.788
Site slope	0 *	Viewfactor	0.5909, 0.4302, 0.2875, 0.1929, 0.1557 & 0.0415
Flame width	10,98 m	Plinimum distance to < 40 kW/m²	13.4 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	15.3 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	10 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	21.2 m
		Minimum distance to < 10 kW/m²	23.2 m
		Minimum distance to < 2.5 kW/m ³	42,1 m

Rate of Spread - Moerther, 1973 & Noble et al., 1980

Flame length - NSW Hural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flams angle - Douglas & Tan, 7005

Raidant heat flux - Drysdale, 1999, Sullivan et al., 2983, Douglas & Tan, 2005

NOTE: Addendum to Calibre BMP March 2016 Version A



JBS&G63493-147238 63493 L01 Greenpatch Structure Plan bushfire advice (Rev A)

26 August 2022

Alex Maguire
Satterley Property Group
Via email: alexm@satterley.com.au

Bushfire advice: Greenpatch Structure Plan, Dalyellup

Dear Alex,

The Greenpatch Structure Plan is being progressed to decision by Western Australian Planning Commission (WAPC). Two versions of the Structure Plan have been considered by relevant agencies. Following lodgement of Version 2 with WAPC, Satterley Property Group (the applicant) submitted a Supplementary Report for consideration, which addressed the submissions lodged and the decision of Shire of Capel (the Shire) not to support the Structure Plan. The Supplementary Report also included a modified plan in support, namely Version 3 of the Structure Plan, which remains the version Satterley is seeking WAPC to consider (see Attachment A).

The Greenpatch Structure Plan site comprises Lots 9109, 9076 and 8019 (fronting Maidment Parade and Hutt Drive), Dalyellup in the Shire of Capel and is entirely situated within a designated bushfire prone area (see Plate 1).

At a meeting with relevant WAPC officers on 21 July 2022, bushfire management was raised as a key matter of discussion, particularly with regards to the following:

- 1. General design compliance of the Structure Plan with the latest requirements under the updated Version 1.4 of *Guidelines for Planning in Bushfire Prone Areas* (the Guidelines).
- 2. Establishment of Asset Protection Zones (APZs) throughout areas of Public Open Space (POS) and the required ongoing maintenance of these areas by the Shire.

This letter has been prepared to address the abovementioned queries and facilitate ongoing consideration of the Greenpatch Structure Plan.









Plate 1: Greenpatch site location and designated bushfire prone status

General design compliance of the Greenpatch Structure Plan

Strategen-JBS&G has reviewed Version 3 of the Greenpatch Structure Plan (see Attachment A) against updated requirements of Version 1.4 of the Guidelines. The evolution from Version 1 through to Version 3 of the Structure Plan has seen a gradual improvement in bushfire compliant design, such that Version 3 will meet all relevant compliance requirements of the Guidelines, as summarised below:

1. <u>Element 1 Location</u> will be met through delivering BAL-29 or lower for all future areas of habitable development. This will primarily be achieved through provision of a comprehensive perimeter road network and the various APZs within the approved EPBC clearing footprint, which will buffer the BAL-40/FZ impacts from adjacent areas of retained vegetation. Whilst the proposed Community lot in the west may require a small setback along its western boundary to avoid habitable development in areas of BAL-40/FZ, this is manageable within the context of the size of the proposed lot and likely design elements that will be factored in at a subdivision and/or DA planning stage. A BAL contour map prepared at the subdivision stage will set the necessary APZ/setback controls and adequately demonstrate these outcomes.

- 2. <u>Element 2 Siting and Design of Development</u> will be met through provision of compliant forms of low threat separation (i.e. perimeter roads and APZs) to ensure all future areas of habitable development achieve an acceptable rating of BAL-29 or lower. As previously stated, a BAL contour map prepared at the subdivision stage will set the necessary APZ/setback controls and adequately demonstrate these outcomes. .
- 3. <u>Element 3 Vehicular Access</u> will be met through the following:
 - a. provision of compliant internal public roads
 - b. provision of through access connections with Maidment Parade in the east and Hutt Drive in the southwest, which will provide at least two different access routes in two different directions to at least two different suitable destinations
 - c. avoidance of any permanent no-through roads (i.e. all proposed roads will be through roads)
 - d. provision of a comprehensive perimeter road network in areas where proposed habitable development directly abuts external areas of classified vegetation
 - e. provision of a compliant Fire Service Access Route; and whilst this is not a formal compliance requirement, it is expected to bolster the overall bushfire management outcome.
- 4. <u>Element 4 Water</u> will be met through connection with the existing reticulated water supply and provision of a compliant network of street hydrants.

Establishment of APZs throughout POS

Ideally, the intention is for any APZs mapped as occurring within POS (as per Attachment A) to be established in accordance with Schedule 1 APZ Standards of the Guidelines. This will require the Shire to maintain the APZs to the relevant standards following transfer of land.

Should the Shire refuse this commitment, an alternative option will need to be sought that does not involve any ongoing vegetation maintenance requirement. One option may include the planting out of POS APZ areas to a shrubland vegetation classification in accordance with a custom landscape design. Given the predominant BAL impacts to the site are being received from forest areas under slope, these BAL impacts far outweigh those from a shrubland classification that may be situated closer to the site than the affecting forest areas. A similar approach was adopted for the Dalyellup Coastal precinct Structure Plan and subdivision (which was ultimately endorsed by WAPC and the Shire) and had the desired effect of addressing the ongoing management issue without impeding on habitable development with any BAL-40/FZ impacts. Essentially, instead of establishing APZs that require ongoing maintenance, these areas are instead planted out with species that adhere to a shrubland classification and are left to grow out, hence removing any ongoing management burden.

Through this review, Strategen-JBS&G reiterates that Version 3 of the Greenpatch Structure Plan can deliver compliance with the updated Version 1.4 of the Guidelines and that options exist to treat the APZs in certain ways that remove the ongoing management burden should the Shire refuse to commit to formal APZ establishment throughout POS. These issues can be adequately addressed as part of a more detailed Bushfire Management Plan (including a BAL contour map) prepared to accompany subdivision application.

Should you require clarification, please contact the undersigned on 08 9792 4797 or by email at zcockerill@jbsg.com.au.

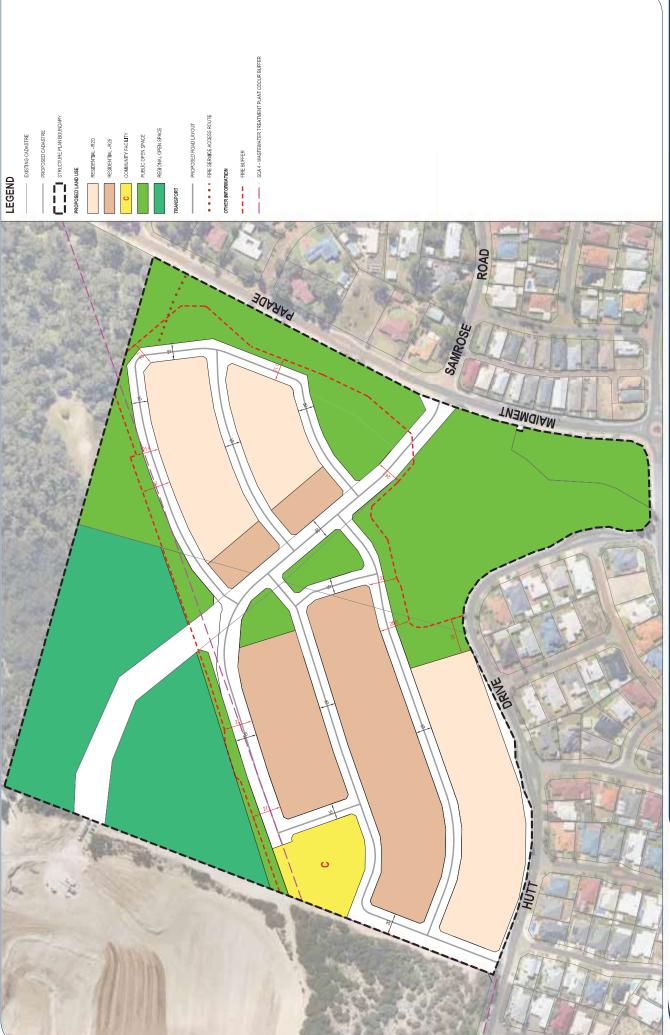
Yours sincerely:

Zac Cockerill

Senior Associate and Level 2 accredited bushfire practitioner

Strategen-JBS&G

Attachment A - Greenpatch Structure Plan Version 3



Plan No: 11453P-SP-06

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STRUCTURE PLAN
Lots 8019, 9076 and 9105, Dalyellup Beach Estate

Appendix Seven: Traffic Assessment

NOTE:

Shawmac Traffic Note 23 June 2017 is addended (after page 34)



CONSULTING CIVIL & TRAFFIC ENGINEERS, RISK MANAGERS.



Project: Transport Assessment, Dalyellup Beach Estate, Dalyellup,

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1 Summary

Calibre Consulting has prepared a Structure Plan for the land adjacent to Hutt Drive and Maidment Parade, known as Dalyellup Beach Estate, located within the locality of Dalyellup in the Shire of Capel. As part of the preparation of the Structure Plan, the developers of the project (Satterley Group) commissioned Shawmac to prepare a Transport Assessment for the site.

The site comprises a mixture R20, R25, R30, R50, R60, Community Purposes, Public Open Space (POS) and Drainage POS and covers an area of 13 ha.

The land at the site is principally vacant land. The adjoining properties to the south and east are zoned and developed for residential purposes with the area to the west between the site and beach under construction as a recreational facility that will accommodate various sports such as soccer football and cricket.

Maidment Parade is classified as a Local Distributor road under the MRWA regional hierarchy and has an urban speed zone of 50 km/hr. Hutt Drive is classified as an Access Road under the MRWA regional hierarchy and has an urban speed zone of 50km/hr.

A review of the pedestrian and cycle facilities indicate that the extension of the internal footpath network will be required to provide connections to the bus stop located within Norton Parade and that separate on-road cycle facilities may be required for Road 1, Road 4 and Maidment Parade to facilitate access to the adjacent recreational facility.

The trip volumes per day are generated based on planning codes and land use type and have been derived from the ITE Guide. The predicted flows generated within the site and sporting fields along Road 1 onto Maidment Parade is expected to be 1,751 vpd.

Traffic hierarchy based on 2015 daily volumes indicates that the midblock cross section for Maidment Parade is a Neighbourhood Connector A and that Road 1 is an Access Street A and as such may require the addition of a median/traffic calming to control traffic movements.

Traffic projections to 2031 for Maidment Parade indicate that it will continue to operate as a Neighbourhood Connector A once Dalyellup is at full development.

On the basis of the assessment undertaken, it is concluded that the proposed street network will provide an acceptable range of choices for travel and ensure that traffic volumes on individual streets can be kept below threshold levels to ensure the amenity of the area is preserved and safe movement options exist for pedestrians, cyclists and local traffic.



2 Introduction and Background

Calibre Consulting has prepared a Structure Plan for the land adjacent to Hutt Drive and Maidment Parade, known as Dalyellup Beach Estate, located within the locality of Dalyellup in the Shire of Capel. As part of the preparation of the Structure Plan, the developers of the project (Satterley Group) commissioned Shawmac to prepare a Transport Assessment for the site.

The intent of this transport assessment is to clearly demonstrate to the approving authority that the subdivision would:

- provide safe and efficient access for all transport modes;
- be well integrated with the surrounding land uses;
- not adversely impact on the surrounding area; and
- not adversely impact on the surrounding transport networks and the users of those networks.

This version of the Transport Assessment has been prepared for review by the Shire of Capel.

2.1 Proposed Structure Plan

The location of the Structure Plan (site) is shown on Figure 1.



Figure 1: Locality Plan (Source Google Maps)



The site comprises a mixture R20, R25, R30, R50, R60, Community Purposes, Public Open Space (POS) and Drainage POS. An extract of the Structure Plan is shown on **Figure 2** and a full version of the plan is shown Appendix C.



Figure 2: Extract of Proposed Outline Development Plan (Source: Calibre Consulting Plan No 11453P-SP-02W)

Proposed land use has been estimated from the Structure Plan and is summarised in Table 1.

Table 1: Proposed Land Use

Land Use	Quantum (ha)
R20	2.52
R25	2.83
R30	0.66
R50	0.99
R60	0.15, 0.14 (Total 0.29)
Community Purposes	0.56
Public Open Space (POS) and Drainage	2.8, 2.11, 0.26, 0.53 & 0.13 (Total 5.83)
POS	0.11



Existing uses include:

Vacant land.

Proposed use includes:

- Residential lots;
- Community use;
- Drainage; and
- POS.

2.2 Subdivision Proposal

2.2.1 Regional Context

The site is located within the locality of Dalyellup approximately 10km from the City of Bunbury Central Business District (CBD) and approximately 15km from the Capel Townsite. **Figure 3** shows the site and its regional context.



Figure 3: Regional Context



2.2.2 Town Planning Scheme (TPS)

The site is shown on the Shire of Capel Town Planning Scheme No 7 as a residential area which is currently zoned "Urban Development". An extract from the planning scheme is shown below in **Figure 4**.

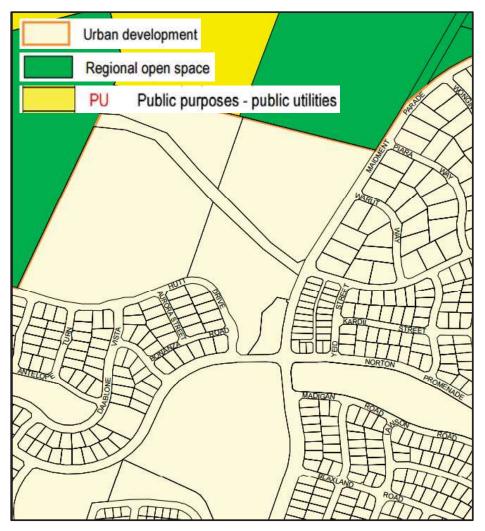


Figure 4: Extract of Shire of Capel TPS No 7

2.2.3 Proposed Land Uses

The proposed land uses are detailed in section 2.1 of this report. The number of dwellings for each land use type has been derived from the Calibre Consulting Plan No 11453P-SP-02W and is summarised in Table 2.

Table 2: Proposed Land Use and Number of Dwellings

Land Use	R20	R25	R30	R50	R60
Area (m²)	25,228	28,287	6,550	9,946	2,889
Dwellings	52	66	20	42	2



3 Existing situation

3.1 Land Use

The land at the site is principally vacant land. The adjoining properties to the south and east are zoned and developed for residential purposes with the area to the west between the site and beach under construction as a recreational facility that will accommodate various sports such as soccer football and cricket. **Figure 5** shows the site location and existing situation.



Figure 5: Existing Site (Source Google Earth)

3.2 Existing Road Network

Maidment Parade forms the eastern boundary of the site and provides the main connection to the school and shopping centre located in Dalyellup. Additionally it connects to Bussell Highway via Norton Parade which is the preferred route to facilities located within Bunbury.

Maidment Parade is classified as a Local Distributor road under the MRWA regional hierarchy and at the site is described as a 6m wide sealed and kerbed single carriageway road with parking and 2m wide concrete footpaths located within the adjacent verge on both sides of the road.

Maidment Parade has an urban speed zone of 50 km/hr.

Hutt Drive forms the southern boundary of the site and provides adjacent properties with connection to local distribution roads, (Norton Parade and Maidment Parade).



Hutt Drive is classified as an Access Road under the MRWA regional hierarchy and is described as a 6m wide sealed and kerbed single carriageway road with a 2m wide concrete footpath located within the northern most verge.

Hutt Drive has an urban speed zone of 50km/hr.

Figure 6 shows the regional hierarchy of the adjacent road network.

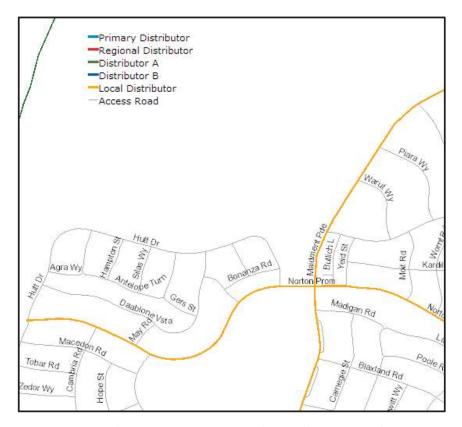


Figure 6: Regional Road Hierarchy (source MRWA website)

3.3 Crash History

A review of the crash history for the 5 years ended 31 December 2014 indicates that no crashes have been recorded for Maidment Parade and Hutt Drive.



4 Proposed Internal Transport Networks

Figure 7 below indicates the proposed internal transport route and intersection types that have been developed from predicted flows. Road 1 and 4 will require appropriate traffic calming measure as they connect to the sport facilities located between the site and the beach.

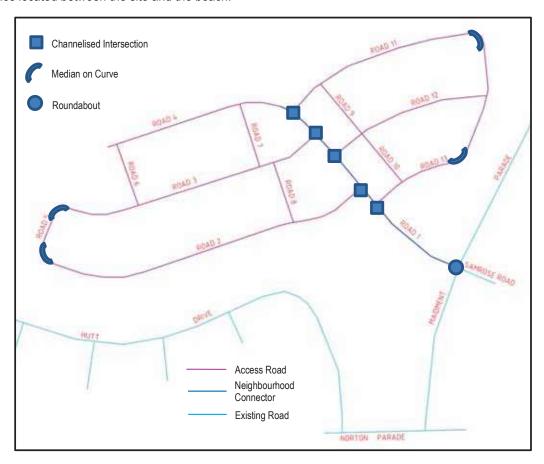


Figure 7: Proposed Road Network

The road network junctions have been reviewed in accordance with Liveable Neighbourhoods which provides guidance on the movement network and junction spacing, an extract of which is shown **Figure 8**. The road network and junction spacing are assessed as appropriate and as providing a safe and permeable road network.

Street type	L/R stappers (to avoid overlapping right turns)	R/L staggers To provide for left-turn deceleration lanes arterials and to avoid corner cutting on local streets	Junctions on same side of street
Local streets			
Laneway Access street* Neighbourhood connector	NA 20 m 40 m	NA 20 m 40 m	20 m 40 m
Arterials			
Integrator B Integrator A – 60 km/hr** Integrator A – 70 km/hr**	60 m 150 m 190 m	40 m 110 m 130 m	40 m 110 m 130 m

Figure 8: Junction Spacing (Source: Liveable Neighbourhoods - Table 5)

5 External Transport Networks

5.1 Change to External Transport Networks

The traffic analysis undertaken by Jacobs of behalf of the Satterley Group which updates the Dalyellup Strategic Traffic Model (DTIS) indicates changes to the external road network with additional connections from Dalyellup to Bussell Highway at Ferndale Road north of Norton Promenade and the other connecting from Norton Promenade to Bussell Highway south of Norton Promenade.

The connection at Ferndale Road will reduce the reliance on Norton Parade which is currently the most direct route to Bussell Highway and may increase traffic volumes from the site north along Maidment Parade.

5.2 Major Attractors and Generators

Major attractors and generators are shown on Figure 9.

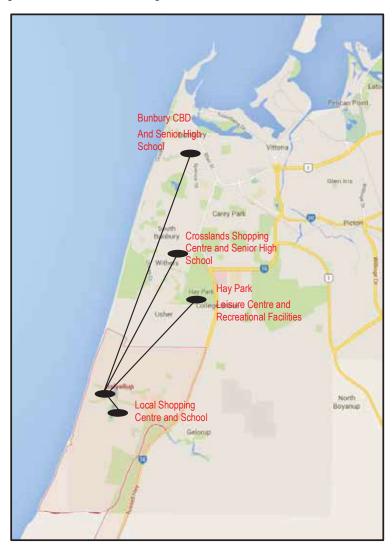


Figure 9: Attractors and Generators



Key attractors are likely to be:

- Bunbury CBD via Bussell Highway and Blair Street;
- Dalyellup Shopping Centre and Primary school;
- Community and recreational facilities located at Hay Park; and
- Nearby residential areas.

5.3 Main Desire Lines

The desire lines are based on traffic attractors and generators shown in section 5.2 with 30% of traffic estimated to use the Bussell Highway connection to the north at Centenary Road and 62% of traffic to use the more direct route to Bussell Highway via Norton Parade. The assumed split is shown on **Figure 10**.

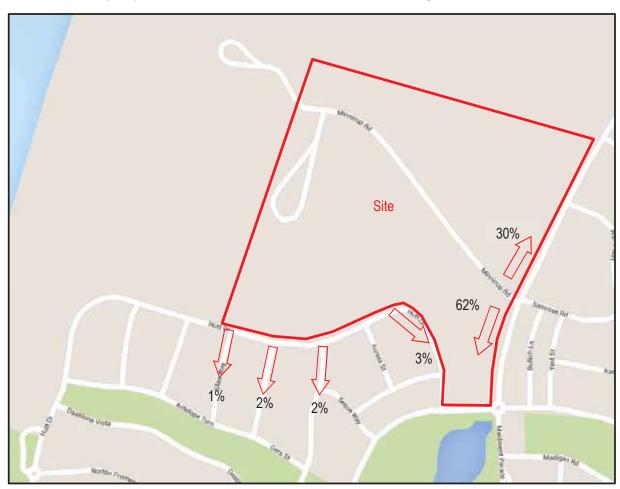


Figure 10: Assumed Traffic Split



5.4 Gap Analysis.

An assessment was carried out to determine whether or not the existing transport networks, plus any proposed changes, would adequately match predicted desire lines, particularly for pedestrians, cyclists and public transport.

Dalyellup is a relatively new development which has pedestrian facilities that provide excellent connections to parks and playground facilities. Dedicated cycle facilities are generally not warranted along access roads with less than 3,000 vpd, however it is noted that there is no provision for on-road or off-road cycle facilities along local distributor roads such as Maidment Parade and Norton Parade where long distance commuter cycling and recreation cycling is likely.

6 Analysis of Transport Networks

6.1 Introduction

Section 2 of the assessment provides a description and an inventory of the proposal and surrounding area with respect to land uses and transport networks. The following sections provide a more detailed quantitative analysis of the proposed internal and external transport networks to demonstrate that they will provide a high level of accessibility and safety for all modes.

6.2 Assessment Years

Assessment is based on the full development of the site and is taken as being 2016.

6.3 Time Periods for Assessment

The assessment is based on analysis of expected peak traffic flows for the site. Additionally an analysis has been undertaken to ensure increased traffic flow can be accommodated into the future and this has been compared to 2031 traffic volumes provided by the Shire of Capel within the Dalyellup Strategic Traffic Model (DSTM).



7 Analysis of Internal Transport Networks

7.1 Subdivision Generated Traffic

Vehicle trip generation rates are based on the following recognised land use traffic generation databases:

- Land Use Traffic Generation Guidelines, March 1987 Director General of Transport, South Australia;
- Guide to Traffic Generating Developments Version 2.2, October 2002 Roads and Traffic Authority,
 New South Wales; and
- Trip Generation 7th edition, 2003 Institute of Transportation Engineers, Washington, USA.

Assessed generation is shown on Table 3 based on Traffic Assessment Zones (TAZ's) shown on Figure 11.



Figure 11: Transport Assessment Zones (TAZ)



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The trip volumes per day are generated based on planning codes and land use type and have been derived from the ITE Guide. Trip volumes are shown in **Table 3**.

Table 3: Estimated Daily Traffic

Traffic Assessment Zone (TAZ)	Land use R code	No of Dwellings	Trip Rate Per Dwelling	Trips per day
1	30	4	9	36
	25	6	9	54
2	30	2	9	18
	50	2	9	18
	25	6	9	54
3	30	2	9	18
	50	2	6	12
4	50	7	6	42
	25	15	9	135
5	30	2	9	18
	50	2	9	18
	25	17	9	153
6	30	2	9	18
	50	2	9	18
7	30	4	9	36
8	20	19	9	171
9	20	18	9	162
10	50	9	6	54
11	50	9	6	54
12	50	9	6	54
13	25	11	9	99
14	30	11	9	99
15	30	4	9	36
16	20	6	9	54
17	20	4	9	36
18	20	5	9	45
19	60	17	6	104
*20	Fields	-	-	500
Total		197		2,116

^{*7} fields at an average rate of 71.33 trips/field/day.

Using the QRS II software, traffic flows were assigned to the network as shown on Figure 12.

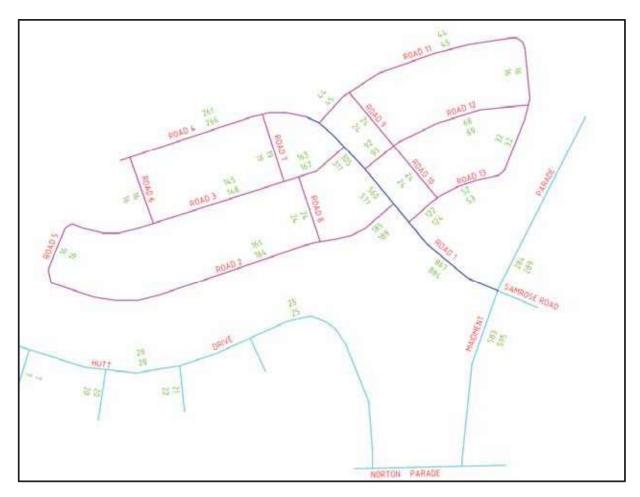


Figure 12: Subdivision Generated Daily Traffic

7.2 Non Subdivision Traffic

Traffic data obtained from the Shire of Capel, are shown in Appendix B. These indicate daily traffic volumes along Maidment Parade between Piara Way and Warnut Way of 1,456 vehicles per day (November 2015). No traffic counts are available for Hutt Drive, Daablone Vista, Antelope Turn and Silas Way and traffic volumes have been estimate based on 9 movements a day for each lot fronting the roadway. Table 4 shows the increase of traffic associated with each external road adjacent to the development. Peak hour volumes are estimated based on 10% of the daily estimated traffic volume.

Table 4: Order of Mid Block Traffic

Location	Daily	AM Peak	PM Peak
Maidment Parade South (Current)	1,456	144	155
Maidment Parade South (Predicted)	1,178	120	120
Maidment Parade South (Total predicted flows)	3,866	410	420
Maidment Parade North (Current)	1,456	144	155
Maidment Parade North (Predicted)	573	57	57
Maidment Parade North (Total predicted flows)	2,029	201	212
Hutt Road Current (Estimated)	423	42	42
Hutt Drive (Predicted)	56	6	6
Hutt Drive (Total predicted flows)	479	48	48
Daablone Vista Current (Estimated)	423	42	42
Daablone Vista (Predicted)	43	4	4
Daablone Vista (Total Predicted flows)	466	46	46
Antelope Turn Current (Estimated)	81	8	8
Antelope Turn (Predicted)	40	4	4
Antelope Turn (Total Predicted flows)	121	12	12
Silas Way Current (Estimated)	72	7	7
Silas Way (Predicted)	14	2	2
Silas Way (Total Predicted flows)	86	9	9

7.3 Future Design Traffic Flows

The Shire of Capel provided a preliminary report undertaken by Jacobs of behalf of the Satterley Group which updates the Dalyellup Strategic Traffic Model (DTIS). The modelling looks to future traffic scenarios and provides guidance on the implementation and timing of strategic external road network connections from Dalyellup to Bussell Highway. The report indicates that full build of Dalyellup is expected prior to 2021 and that two additional connections are required within that time, one to Ferndale Road north of Norton Promenade and the other connecting from Norton Promenade to Bussell Highway south of Norton Promenade.

As part of the analysis, observed and modelled counts for 2014 are provided for the road network adjacent to the site as follows:

Norton Parade west of Maidment Parade (Modelled 2,870 vpd, Observed 2,484 vpd); and



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Maidment parade west of Dalyellup Boulevard (Modelled 2,644 vpd, Observed 2,195 vpd).

The Shire of Capel advises that there has been an 11.8% growth in population (over a 9 year period) within Dalyellup, from June 2006 to June 2015.

Full development of the Dalyellup locality will be prior to 2021, thus a percentage growth of 9% has been adopted for this period to determine 2031 traffic volumes on the adjacent road network. Maidment Parade is the only road adjacent to the site affected by future traffic increases. Table 5 shows projected traffic volumes predicted within this report and those predicted within the Jacobs report.

Table 5: 2031 Predicted Traffic Volumes

Road Name	Predicted (vpd) 2015	Predicted (vpd) 2031	Source
Maidment Parade	2,644 (modelled), 2195 (observed)	2,882 (modelled), 2,393 (observed)	Jacob Report: PB506634, May 2015
(North)	2,029	2,212	Shawmac
Maidment Parade	-	-	*Jacob Report: PB506634, May 2015
(South)	3,866	4,214	Shawmac

^{*}No available data with the report

The difference between the volumes modelled within the Jacobs report and that predicted within this report for Maidment Parade north is not considered significant as its capacity is not exceeded when compared to its hierarchal status as a Local Distributor.

7.4 Roads and Intersections

7.4.1 Mid Block Cross Sections

Road cross section requirements have been based on recommendations contained within Livable Neighborhoods and the Austroads Guide to Traffic Engineering Practice which requires the following:

Table 6: Road Hierarchy Criteria

Indicative volume.	Route type / name.	Indicative Reserve Width.	Indicative Carriageway Width.	
50,000.	Primary Distributor.		Determined by Main Roads WA	
35,000.	Primary Distributor.		Determined by Main Roads WA	
15,000 to 35,000.	Integrator Arterial A (District Distributor A).	50.6 – 52.6 metres.	2 x 8.2 metre carriageways including bike lane and 2 x 5.5 metre service roads containing parking.	
<25,000	Integrator Arterial A (District Distributor A).	35.6 metres.	2 x 10.7 metre carriageways including combined on street parking and bike lane.	
7,000 to 15,000.	Integrator Arterial B (District Distributor B).	29.2 metres.	2 x 7.5 metre carriageways with on street parking and bike lane.	
15,000.	Integrator Arterial B (District Distributor B).	25.2 metres.	2 x 7.5 metre carriageways with on street parking.	
7,000.	Neighborhood Connector A.	24.4 metres	2 x 7.1 metres including parking, on street bike lane, median plus shared path on one verge.	



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Indicative volume.	Route type / name.	Indicative Reserve Width.	Indicative Carriageway Width.	
3,000.	Neighborhood Connector B.	19.4 metres	11.2 metres including parking plus shared path on one verge.	
3,000.	Access Street A (Avenue).	20 - 24 metres.	2 x 3.5 metre lanes plus indented parking.	
3,000.	Access Street B (Wider street).	16.5 - 18 metres.	9.7 metre lane.	
3,000.	Access Street C (Yield or give way street).	15.4 - 16 metres.	7.2 (7.0 – 7.5) metre lane.	
1,000.	Access Street D (Narrow yield or give way street).	14.2 metres.	5.5 – 6.0 meter lane.	
150	Access Street D (Narrow yield or give way street).	14.2 metres.	3.5 metre lane plus parking indents.	
3,000.	Access Street D (Wider street).	16.5 - 18 metres.	9.7 metre lane.	

Based on these criteria, road requirements are as shown on Table 7. Note the cross sections have been modified from the indicative widths shown on Table 6; however the capacity and has been maintained consistent with the intent of the Livable Neighborhoods Criteria.

Table 7: Road Cross Sections

Road	Predicted Volume (vpd).	Reserve Requirement.	Carriageway Requirement.	Recommended Road Reserve Width 9 (from Table 4)
Maidment Parade	Up to 3,866	Neighborhood Connector A	24.4 metres.	2 x 7.1 metres including parking, on street bike lane, median plus shared path on one verge.
Road 1	Up to 1,751	Access Street A (Avenue).	20 - 24 metres.	2 x 3.5 metre lanes plus indented parking.
Remaining roads	Up to 500	Access Street D (Narrow yield or give way street).	5.5 - 6.0 meter lane.	14m

The indicative widths shown in Table 7 are subject to change and may vary dependent on the Shire of Capel Requirements.

7.4.2 Intersection Analysis

Warrants for analysis for each intersection as shown in Table 8.1 of Austroads Guide to Engineering Practice Part 2, Roadway Capacity were applied to determine which intersections required capacity analysis. Peak hour traffic volumes were assumed to be approximately 10% of predicted daily traffic.

Table 8: Analysis Warrants

Intersection	Hourly volume major road	Hourly volume minor road	Comment.
Warrants as per Table 8.1 of Austroads Guide to Engineering Practice Part 2, Roadway Capacity - Two Lane Major Road Cross Road	400 vph 500 vph 650 vph	250 vph 200 vph 100 vph	Table details flows that initiate intersection analysis. As major flows increase, there is reduced capacity to accept minor flows.
Maidment Parade and Road 1	387 vph	175 vph	4 way intersection – Analysis not required (proposed roundabout)
All others intersections	<100 vph	<100 vph	Analysis not required.



7.5 Pedestrian / Cycle Networks

The site is accessible to the surrounding footpath network with facilities located along both sides of Maidment Parade and the north side of Hutt Drive. A separate cycle path for Hutt Drive and the site road network is not necessary as they are access roads and not likely to carry more than 3,000 vpd, thus a mix of vehicle and cycle traffic is considered acceptable.

However Road 1 and Road 4 provide direct access to the adjacent recreational facility thus in this instance it is considered appropriate to provided separate on-road cycling lanes to facilitate access to the recreational facility and improve cycling safety.

Maidment Parade is a local distributor road that will carry over 3,000 vpd and in accordance with Liveable Neighbourhood Guidelines may require separate cycle facilities. An extract of the Google Earth showing the current footpath network is shown below Figure 13.



Figure 13: Footpath Network near the Site



7.6 Access to Public Transport

Liveable Neighbourhoods indicates that a distance of 400m to 800m is an appropriate distance to access local facilities as part of daily activities including access to a train station or town centre. The Dalyellup area is serviced via Bus Routes 831 and 843 with the nearest bus stop for these routes located on Norton Parade approximately 1,000m southwest of the site as shown on **Figure 14**.

The bus stop is not located close enough to the site to facilitate regular use. Additional bus stops and the extension of the existing bus route may be required as Dalyellup continues to grow.

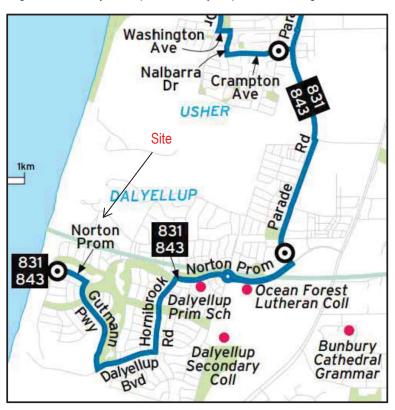


Figure 14: Regional Town Bus Services Bus Route 831 and 834



8 Analysis of External Transport Networks

8.1 Design Traffic Flows on External Road Network

Design traffic flows on the external network as affected by the proposal are covered in section 7.

8.2 Impact on External Roads

The impacts of design traffic flows on the external network as affected by the proposal are covered in section 7.

8.3 Impact on External Intersections

Impacts on external intersections are not expected.

8.4 Pedestrian / Cycle Networks

Extension of the new internal footpath is recommended as development occurs to allow access to the Bus Stop located within Norton Parade and cycle lanes should be considered as part of any upgrade to Maidment Parade.

9 Safety Issues

A review of the overall transport proposal for the site did not identify any specific issues that present unacceptable risks to the road user or that cannot be managed through appropriate design protocols.

Road hazards are typically present at intersections and may be manifested through inadequate sight distance, inappropriate geometry or substandard capacity that promotes undesirable and potentially hazardous movements.

For the new roads, the allocation of adequate road reservation width and truncation of corners will generally allow sight distance requirements to be accommodated in the detailed design phase of the project. Geometric standards prescribed by Austroads and Main Roads WA guidelines will ensure that no unacceptable risk is introduced into the road environment. Assessment of the operational performance of intersections undertaken in this study prescribes appropriate geometry and lane allocation to minimise delay and optimise performance.

Detailed design undertaken as part of the Development Application process would need to define at least the following elements:

- Road cross sections including lane widths, on-road cycle lanes, path widths and provisions for people with disabilities;
- Intersection geometries;
- Pedestrian and cycle facilities (cross sections, crossing requirements and ramps).



10 Noise

There is potential for noise impact to residential areas from the traffic using Maidment Parade, however the impact is minimised by the requirement to provide POS between the site and Maidment Parade.

11 Conclusions

The traffic generation and distribution exercise undertaken to quantify the traffic impact of the site indicate that site will have minimal impact on the function of the adjacent network.

A review of the pedestrian and cycle facilities indicate that the extension of the internal footpath network will be required to provide connections to the bus stop located within Norton Parade and that separate on-road cycle facilities may be required for Road 1, Road 4 and Maidment Parade to facilitate access to the adjacent recreational facility.

The trip volumes per day are generated based on planning codes and land use type and have been derived from the ITE Guide, thus the predicted weekday flows generated within the site and sporting fields along Road 1 onto Maidment Parade is expected to be 1,751 vpd.

Traffic Hierarchy based on 2015 daily volumes indicates that the midblock cross section for Maidment Parade is a Neighbourhood Connector A and that Road 1 is an Access Street A and as such may require the addition of a median/traffic calming to control traffic movements.

Traffic projections to 2031 for Maidment Parade indicate that it will continue to operate as a Neighbourhood Connector A once Dalyellup is at full development.

On the basis of the assessment undertaken, it is concluded that the proposed street network will provide an acceptable range of choices for travel and ensure that traffic volumes on individual streets can be kept below threshold levels to ensure the amenity of the area is preserved and safe movement options exist for pedestrians, cyclists and local traffic.



Appendix A Checklist



Item	Section	Comments/Proposals
Summary	1	
Introduction/Background	2	
name of applicant and consultant	2	
subdivision location and context	2.1	
brief description of subdivision	2.2	
key issues	2.2	
background information	3	
Subdivision proposal	2.1	
regional context	2.2.1	
proposed land uses	2.2.3	
table of land uses and quantities	2.2.3	
major attractors/generators	5.2	
any specific issues		
Existing situation	3	
existing land uses within structure plan	3.1	
existing land uses surrounding the subdivision	3.1	
existing road network within subdivision	3.2	
existing road network surrounding the subdivision	3.2	
traffic flows on roads within subdivision (AM and PM peak hours)	7.2	
traffic flows on roads surrounding the subdivision (AM and PM peak hours)	7.2	
existing pedestrian/cycle networks within the subdivision		
existing pedestrian/cycle networks surrounding the subdivision	7.5	
existing public transport services within the subdivision		
existing public transport services surrounding the subdivision	7.6	
Proposed internal transport networks	4.0	
changes/additions to existing road network	5.0	
road reservation widths	7.4.1	
road cross-sections & speed limits	7.4.1	
intersection controls	7.5.2	
pedestrian/cycle networks and crossing facilities	7.5	
public transport routes	8.6	
Changes to external transport networks	5	
road network	5	
intersection controls	4	
pedestrian/cycle networks and crossing facilities	8.4	
public transport services	7.6	
Integration with surrounding area	5	
surrounding attractors/generators	5.1	
proposed changes to surrounding land uses	5.2	



Item	Section	Comments/Proposals
travel desire lines from subdivision to these attractors/generators	5.2	
adequacy of existing transport networks	5.3	
deficiencies in existing transport networks	7.3	
remedial measures to address deficiencies	7.3	
Analysis of internal transport networks	7	
assessment years and time periods	6.2	
subdivision generated traffic	7.1	
extraneous (through) traffic	7.2	
design traffic flows	7.1	
road cross-sections	7.4.1	
intersection sight distances	9	
intersection operation and method of control	7.4.3	
frontage access strategy		
pedestrian / cycle networks	7.5	
safe walk/cycle to school		
pedestrian permeability & efficiency		
access to public transport	7.6	
Analysis of external transport networks	8	
base flows for assessment years	8	
total traffic flows	-	
road cross-sections	-	
intersection operation	-	
pedestrian/cycle networks	-	
Safety issues	-	
identify issues	-	
remedial measures	-	
Conclusions	11	

Proponent's Name: Satterley Group

Signature: Date:

Transport Assessor's Name: Shaun Millen

Company: Shawmac

Signature: Date: 1 February, 2016



Appendix B Traffic Counts



Weeklyvenicie-265 F

Weekly Vehicle Counts

WeeklyVehicle-265

206_000241_001225.0.0NS Site:

Description:

Maidment Parade (between Piara Way and Warut Way SLK 1225)
10:00 Wednesday, 18 November 2015 => 10:00 Sunday, 22 November 2015
Vehicle classification (AustRoads94) Filter time:

Scheme:

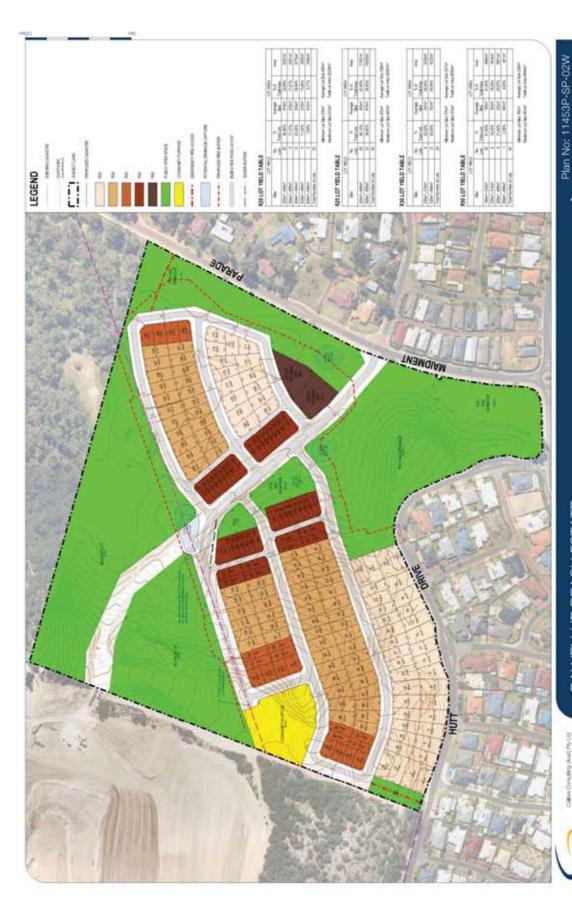
Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0) Filter:

		Mon		Tue		Wed		Thu		Fri		Sat		Sun	Av	erages			
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Hour															1				
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0100-0200		*		*		*		2		1		6		6	1	1.5		3	. 8
0200-0300		*		*		*		4		4		4		3	1	4.0		3	. 8
0300-0400		*		*		*		0		1		3		8	1	0.5		3	. 0
0400-0500		*		*		*		4		5		1		2	1	4.5		3	.0
0500-0600		*		*		*		31		19		6		11	1 2	5.0		16	. 8
0600-0700		*		*		*		44		42		18		24	1 4	3.0		32	.0
0700-0800		*		*		*		108		104		72		41	1 10	6.0	-	81	. 3
0800-0900		*		*		*		147<		141<		81		42	1 14	4.0<			.8<
0900-1000		*		*		*		60		85		91		91	1 7	2.5		81	. 8
1000-1100		*		*		64		84		81		106		*	1 7	6.3		83	. 8
1100-1200		*		*		75		62		74		116<		*	1 7	0.3		81	. 8
1200-1300		*		*		83		66		77		122<		*		5.3		87	
1300-1400		*		*		59		57		67		87		*	1 6	1.0		67	
1400-1500		*		*		99		95		115		100		*	1 10	3.0	1	02	. 3
1500-1600		*		*		127		122		134		87		*	1 12	7.7	1	17	. 5
1600-1700		*		*		141		143		103		87		*	1 12	9.0		18	
1700-1800		*		*		155<		146<		163<		87		*		4.7<			.8<
1800-1900		*		*		89		94		115		73		*	1 9	9.3		92	. 8
1900-2000		*		*		45		79		51		45		*	1 5	8.3		55	.0
2000-2100		*		*		31		56		47		30		*	4	4.7		41	. 0
2100-2200		*		*		13		24		39		30		*	1 2	5.3		26	. 5
2200-2300		*		*		15		17		18		24		*		6.7		18	
2300-2400		*		*		13		8		11		19		*		0.7		12	
Totals																			
0700-1900		*		*		*		1184	15	1259		1109		*	1 121	9.2	11	54	. 5
0600-2200		*		*		*		1387		1438		1232		*	1 139	0.5	13	09	. 0
0600-0000		*		*		*		1412		1467		1275		*	1 141		13		
0000-0000		*		*		*		1453		1502		1303		*	145		13		
AM Peak		*		*		*	3	0800		0800		1100		*	1				
		*		*		*		147		141		116		*	1				
PM Peak		*		*		1700		1700	19	1700		1200		*	1				
		*		*		155		146		163		122		*	1				

^{* -} No data.

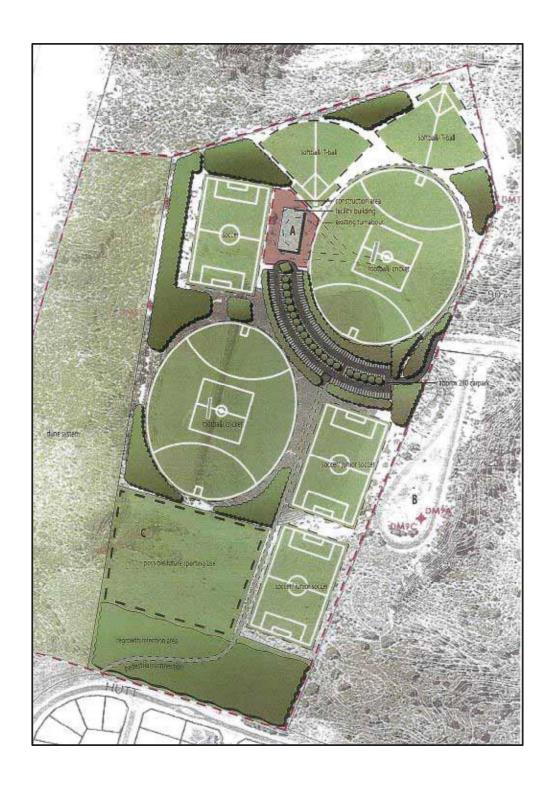
Figure 15: Maidment Parade Traffic Counts

Appendix C - Latest Structure Plan and Adjacent Recreational Facility



DALYELLUP BEACH ESTATE Lots 9102, 9075 and 8019







Technical Note

NOTE: Addendum to Shawmac Traffic Report 4 February 2016

Subject: Lots 8019, 9076 and 9105 Maidment Parade, Dalyellup

Greenpatch Local Structure Plan

Date: 23rd June 2017

Author: Paul Nguyen

Attention: Satterley Property Group

1□ Introduction and Background

Shawmac was engaged by Satterley Property Group in 2016 to prepare a transport impact assessment supporting the proposed Local Structure Plan (LSP) of Lots 8019, 9076 and 9105 Maidment Parade in Dalyellup. The initial LSP submitted included two road connections to the development area including a connection from Maidment Parade to form a four-way intersection with Samrose Road and a secondary connection from Hutt Drive as a T-intersection. On advice from the Shire of Capel, connection to Hutt Drive was deleted from the structure plan due to concerns regarding:

"Increased traffic on a section of Hutt Drive that has a steep gradient and increased intersection demand at Norton Promenade".

An Emergency Access Way (EAW) to both Hutt Drive and Maidment Parade was then planned to accommodate emergency access requirements.

A Bushfire Management Plan was prepared in September 2016 by BPP Group. The WAPC *Guidelines for Planning in Bushfire Prone Areas* states the following regarding EAWs:

"An access way that does not provide through access to a public road is to be avoided in bushfire prone areas. Where no alternative exists (this will need to be demonstrated by the proponent), an EAW is to be provided as an alternative link to a public road during emergencies."

The plan also notes that it is essential that residents, as well as emergency services, have save access and egress from the subdivision plan area and that reliance on an EAW to achieve two access routes is not acceptable.

This technical note is a supplementary assessment addressing the traffic impact of providing the initially planned secondary connection to Hutt Drive and to identify any safety issues associated with the connection. This note should be read in conjunction with the transport impact assessment as attached.



2□ Traffic Distribution

The traffic model for the development area has been modified to include the secondary road connection to Hutt Drive. The predicted daily traffic volumes on the road network generated by the development area with and without the Hutt Road connection are shown in **Figure 1**.

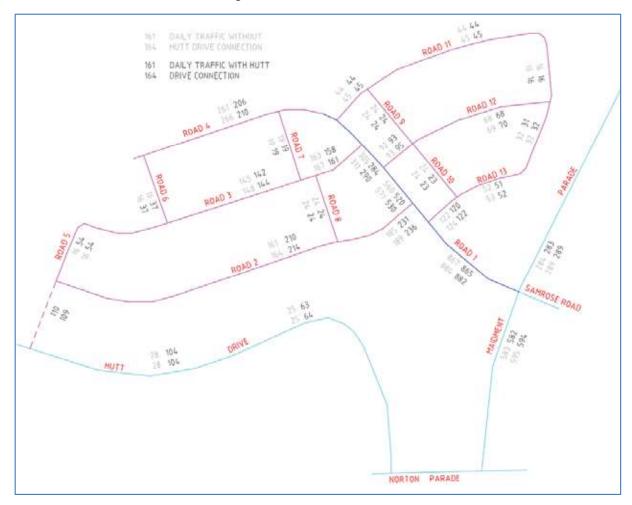


Figure 1: Predicted Daily Traffic Flows

As shown in **Figure 1**, the predicted daily traffic volume along the road connection to Hutt Drive and along Hutt Drive is approximately 219 vehicles per day (vpd). Assuming that the peak hour traffic is 10% of the daily traffic, the peak hour traffic flow along the connection would be approximately 22 vehicles per hour (vph) The increase in traffic along Hutt Drive and through the Norton Promenade / Hutt Drive intersection resulting from providing a road connection to Hutt Drive is minimal and would have negligible impact on the road network.



3 ☐ Road Geometry and Gradients

The proposed road connection to Hutt Drive will create a left-right stagger with Silas Way on the south side of Hutt Drive. The WAPC *Liveable Neighbourhoods* guidelines requires that the junction spacing between left-right staggered access streets is a minimum of 20 metres between centrelines. The proposed junction spacing is approximately 30 metres which is compliant with this requirement.

It is assumed that the Shire's concerns regarding steep gradients is related to the grade along the proposed Hutt Drive road connection. A concept design for the Hutt Drive road connection indicating the proposed finished levels was produced when it had initially been considered as shown in **Figure 2**. The design indicated an average grade of 7.7% along the road connection.

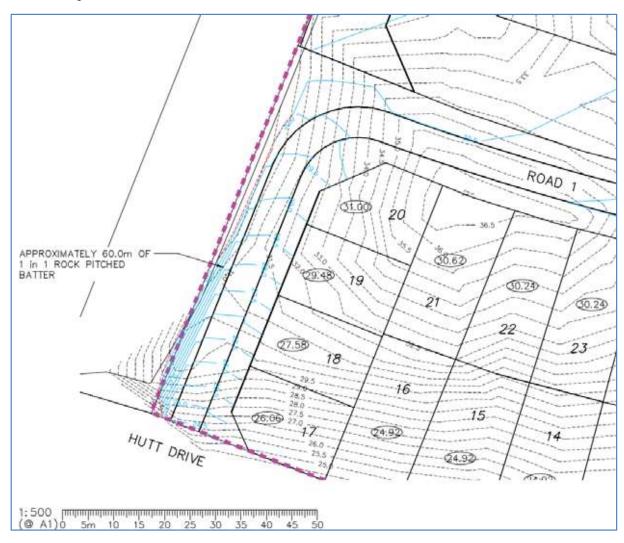


Figure 2: Hutt Drive Road Connection Concept Design Levels



Austroads *Guide to Road Design Part 3: Geometric Design* provides advice on the effect of grades on vehicles. Table 8.2 of the Austroads guidelines is shown in **Figure 3**.

Grade %	Reduction	on in vehicle spee					
	Ü	phill	D	ownhill	Road type suitability		
	Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle	523		
0-3	Minimal	Minimal	Minimal	Minimal	For use on all roads		
3–6	Minimal	Some reduction on high speed roads	Minimal	Minimal	For use on low-moderate speed roads (incl. high traffic volume roads)		
6–9	Largely unaffected	Significantly slower	Minimal	Minimal for straight alignment. Substantial for winding alignment	For use on roads in mountainous terrain. Usually need to provide auxiliary lanes if high traffic volumes		
9–12	Slower	Much slower	Slower	Significantly slower for straight alignment. Much slower for winding alignment	Need to provide auxiliary lanes for moderate – high traffic volumes. Need to consider run-away vehicle facilities if proportion of commercial vehicles is high		
12–15	10–15 km/h Slower	15% max. Negotiable	10–15 km/h Slower	Extremely slow	Satisfactory on low volume roads (very few or no commercial vehicles)		
15–33	Very slow	Not negotiable	Very slow	Not negotiable	Only to be used in extreme cases and be of short lengths (no commercial vehicles)		

Figure 3: Effect of Grade on Vehicle Type (Austroads, 2016)

As shown in **Figure 3**, the proposed road grade of 7.7% will have little effect on light vehicles. The effect on heavy vehicles will be minimal in the downhill direction but heavy vehicles will travel significantly slower in the uphill direction. The proposed road grade is considered to be acceptable for the following reasons:

- ☐ The connection to Maidment Parade will be the primary vehicle access. The volume of light and heavy vehicles using the Hutt Road connection will be minimal.
- The Hutt Drive connection is very short (approximately 65m). In the unlikely event that a heavy vehicle will need to travel uphill along this connection, it will not need to travel a long distance uphill.
- □ The intersection with Road 2 and Road 5 (see Figure 1) will be designed to achieve appropriate sight distance and Road 2 will be priority controlled.

Based on the predicted traffic volumes, the Hutt Drive road connection should be classified as an Access Street D (narrow yield or give way street) with a 14 metre road reserve to accommodate a 5.5 to 6.0 metre road pavement.



4 ☐ Conclusion

A review of the impact of providing a secondary road connection on Hutt Drive to the Greenpatch Local Structure Plan concluded the following:

- □ The secondary connection on Hutt Drive is estimated to attract approximately 219 vehicles per day (22 vehicles per hour during the peak periods). The increase in volume along Hutt Drive and through the Hutt Drive / Norton Promenade intersection is minimal and will have negligible effect on the traffic capacity.
- •□ A concept design of the Hutt Drive connection shows that a gradient of 7.7% along the road. A review of Austroads guidelines indicates that this grade will have little effect on light vehicles and heavy vehicles in the downhill direction. Although heavy vehicles may slow down significantly in the uphill direction, the length of this road is very short and unlikely to pose an issue for heavy vehicles needing to use this road.
- ☐ It is recommended that a 14 metre wide road reserve is set aside for this connection.
- □ The intersection of the proposed Hutt Road connection with Road 2 and Road 5 will be designed to achieve appropriate sight distance and Road 2 will be priority controlled.



Attachment 1 - Shawmac Transport Impact Assessment (February 2016)



CONSULTING CIVIL & TRAFFIC ENGINEERS, RISK MANAGERS.



Project: Transport Assessment, Dalyellup Beach Estate, Dalyellup,

Shire of Capel.

Client: Satterley Group

Author: S Millen

Signature:

Date: 4 February 2016

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1 Summary

Calibre Consulting has prepared a Structure Plan for the land adjacent to Hutt Drive and Maidment Parade, known as Dalyellup Beach Estate, located within the locality of Dalyellup in the Shire of Capel. As part of the preparation of the Structure Plan, the developers of the project (Satterley Group) commissioned Shawmac to prepare a Transport Assessment for the site.

The site comprises a mixture R20, R25, R30, R50, R60, Community Purposes, Public Open Space (POS) and Drainage POS and covers an area of 13 ha.

The land at the site is principally vacant land. The adjoining properties to the south and east are zoned and developed for residential purposes with the area to the west between the site and beach under construction as a recreational facility that will accommodate various sports such as soccer football and cricket.

Maidment Parade is classified as a Local Distributor road under the MRWA regional hierarchy and has an urban speed zone of 50 km/hr. Hutt Drive is classified as an Access Road under the MRWA regional hierarchy and has an urban speed zone of 50km/hr.

A review of the pedestrian and cycle facilities indicate that the extension of the internal footpath network will be required to provide connections to the bus stop located within Norton Parade and that separate on-road cycle facilities may be required for Road 1, Road 4 and Maidment Parade to facilitate access to the adjacent recreational facility.

The trip volumes per day are generated based on planning codes and land use type and have been derived from the ITE Guide. The predicted flows generated within the site and sporting fields along Road 1 onto Maidment Parade is expected to be 1,751 vpd.

Traffic hierarchy based on 2015 daily volumes indicates that the midblock cross section for Maidment Parade is a Neighbourhood Connector A and that Road 1 is an Access Street A and as such may require the addition of a median/traffic calming to control traffic movements.

Traffic projections to 2031 for Maidment Parade indicate that it will continue to operate as a Neighbourhood Connector A once Dalyellup is at full development.

On the basis of the assessment undertaken, it is concluded that the proposed street network will provide an acceptable range of choices for travel and ensure that traffic volumes on individual streets can be kept below threshold levels to ensure the amenity of the area is preserved and safe movement options exist for pedestrians, cyclists and local traffic.



2 Introduction and Background

Calibre Consulting has prepared a Structure Plan for the land adjacent to Hutt Drive and Maidment Parade, known as Dalyellup Beach Estate, located within the locality of Dalyellup in the Shire of Capel. As part of the preparation of the Structure Plan, the developers of the project (Satterley Group) commissioned Shawmac to prepare a Transport Assessment for the site.

The intent of this transport assessment is to clearly demonstrate to the approving authority that the subdivision would:

- provide safe and efficient access for all transport modes;
- be well integrated with the surrounding land uses;
- not adversely impact on the surrounding area; and
- not adversely impact on the surrounding transport networks and the users of those networks.

This version of the Transport Assessment has been prepared for review by the Shire of Capel.

2.1 Proposed Structure Plan

The location of the Structure Plan (site) is shown on Figure 1.



Figure 1: Locality Plan (Source Google Maps)



The site comprises a mixture R20, R25, R30, R50, R60, Community Purposes, Public Open Space (POS) and Drainage POS. An extract of the Structure Plan is shown on **Figure 2** and a full version of the plan is shown Appendix C.



Figure 2: Extract of Proposed Outline Development Plan (Source: Calibre Consulting Plan No 11453P-SP-02W)

Proposed land use has been estimated from the Structure Plan and is summarised in Table 1.

Table 1: Proposed Land Use

Land Use	Quantum (ha)
R20	2.52
R25	2.83
R30	0.66
R50	0.99
R60	0.15, 0.14 (Total 0.29)
Community Purposes	0.56
Public Open Space (POS) and Drainage	2.8, 2.11, 0.26, 0.53 & 0.13 (Total 5.83)
POS	0.11



Existing uses include:

Vacant land.

Proposed use includes:

- Residential lots;
- Community use;
- Drainage; and
- POS.

2.2 Subdivision Proposal

2.2.1 Regional Context

The site is located within the locality of Dalyellup approximately 10km from the City of Bunbury Central Business District (CBD) and approximately 15km from the Capel Townsite. **Figure 3** shows the site and its regional context.



Figure 3: Regional Context



2.2.2 Town Planning Scheme (TPS)

The site is shown on the Shire of Capel Town Planning Scheme No 7 as a residential area which is currently zoned "Urban Development". An extract from the planning scheme is shown below in **Figure 4**.

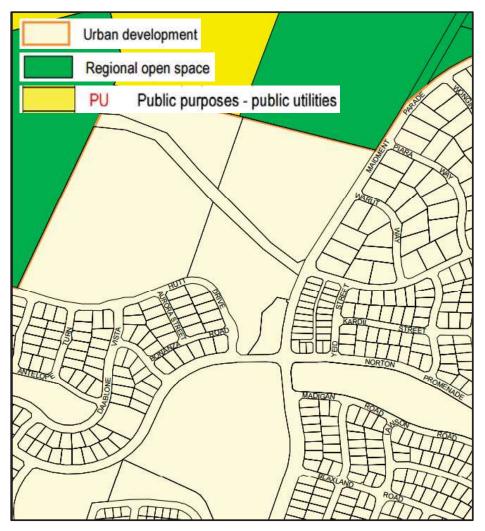


Figure 4: Extract of Shire of Capel TPS No 7

2.2.3 Proposed Land Uses

The proposed land uses are detailed in section 2.1 of this report. The number of dwellings for each land use type has been derived from the Calibre Consulting Plan No 11453P-SP-02W and is summarised in Table 2.

Table 2: Proposed Land Use and Number of Dwellings

Land Use	R20	R25	R30	R50	R60
Area (m ²)	25,228	28,287	6,550	9,946	2,889
Dwellings	52	66	20	42	2



3 Existing situation

3.1 Land Use

The land at the site is principally vacant land. The adjoining properties to the south and east are zoned and developed for residential purposes with the area to the west between the site and beach under construction as a recreational facility that will accommodate various sports such as soccer football and cricket. **Figure 5** shows the site location and existing situation.



Figure 5: Existing Site (Source Google Earth)

3.2 Existing Road Network

Maidment Parade forms the eastern boundary of the site and provides the main connection to the school and shopping centre located in Dalyellup. Additionally it connects to Bussell Highway via Norton Parade which is the preferred route to facilities located within Bunbury.

Maidment Parade is classified as a Local Distributor road under the MRWA regional hierarchy and at the site is described as a 6m wide sealed and kerbed single carriageway road with parking and 2m wide concrete footpaths located within the adjacent verge on both sides of the road.

Maidment Parade has an urban speed zone of 50 km/hr.

Hutt Drive forms the southern boundary of the site and provides adjacent properties with connection to local distribution roads, (Norton Parade and Maidment Parade).



Hutt Drive is classified as an Access Road under the MRWA regional hierarchy and is described as a 6m wide sealed and kerbed single carriageway road with a 2m wide concrete footpath located within the northern most verge.

Hutt Drive has an urban speed zone of 50km/hr.

Figure 6 shows the regional hierarchy of the adjacent road network.

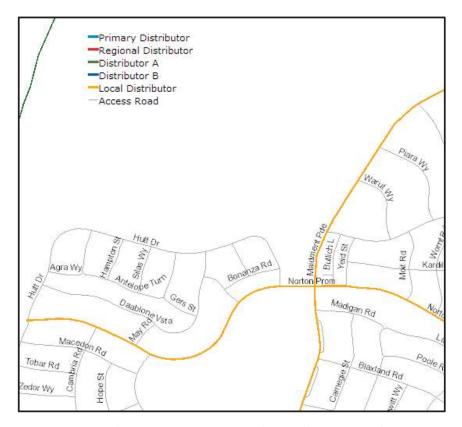


Figure 6: Regional Road Hierarchy (source MRWA website)

3.3 Crash History

A review of the crash history for the 5 years ended 31 December 2014 indicates that no crashes have been recorded for Maidment Parade and Hutt Drive.



4 Proposed Internal Transport Networks

Figure 7 below indicates the proposed internal transport route and intersection types that have been developed from predicted flows. Road 1 and 4 will require appropriate traffic calming measure as they connect to the sport facilities located between the site and the beach.

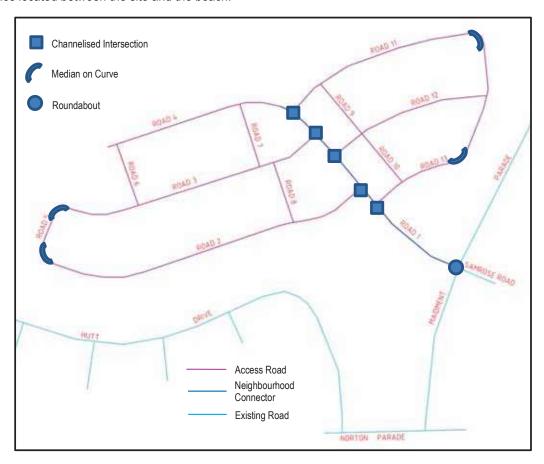


Figure 7: Proposed Road Network

The road network junctions have been reviewed in accordance with Liveable Neighbourhoods which provides guidance on the movement network and junction spacing, an extract of which is shown **Figure 8**. The road network and junction spacing are assessed as appropriate and as providing a safe and permeable road network.

Street type	L/R stappers (to avoid overlapping right turns)	R/L staggers To provide for left-turn deceleration lanes arterials and to avoid corner cutting on local streets	Junctions on same side of street
Local streets			
Laneway Access street* Neighbourhood connector	NA 20 m 40 m	NA 20 m 40 m	20 m 40 m
Arterials			
Integrator B Integrator A – 60 km/hr** Integrator A – 70 km/hr**	60 m 150 m 190 m	40 m 110 m 130 m	40 m 110 m 130 m

Figure 8: Junction Spacing (Source: Liveable Neighbourhoods - Table 5)

5 External Transport Networks

5.1 Change to External Transport Networks

The traffic analysis undertaken by Jacobs of behalf of the Satterley Group which updates the Dalyellup Strategic Traffic Model (DTIS) indicates changes to the external road network with additional connections from Dalyellup to Bussell Highway at Ferndale Road north of Norton Promenade and the other connecting from Norton Promenade to Bussell Highway south of Norton Promenade.

The connection at Ferndale Road will reduce the reliance on Norton Parade which is currently the most direct route to Bussell Highway and may increase traffic volumes from the site north along Maidment Parade.

5.2 Major Attractors and Generators

Major attractors and generators are shown on Figure 9.

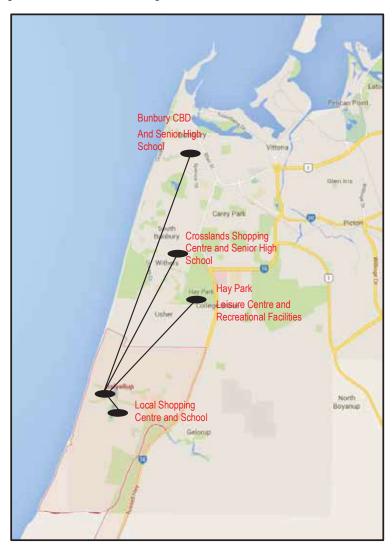


Figure 9: Attractors and Generators



Key attractors are likely to be:

- Bunbury CBD via Bussell Highway and Blair Street;
- Dalyellup Shopping Centre and Primary school;
- Community and recreational facilities located at Hay Park; and
- Nearby residential areas.

5.3 Main Desire Lines

The desire lines are based on traffic attractors and generators shown in section 5.2 with 30% of traffic estimated to use the Bussell Highway connection to the north at Centenary Road and 62% of traffic to use the more direct route to Bussell Highway via Norton Parade. The assumed split is shown on **Figure 10.**

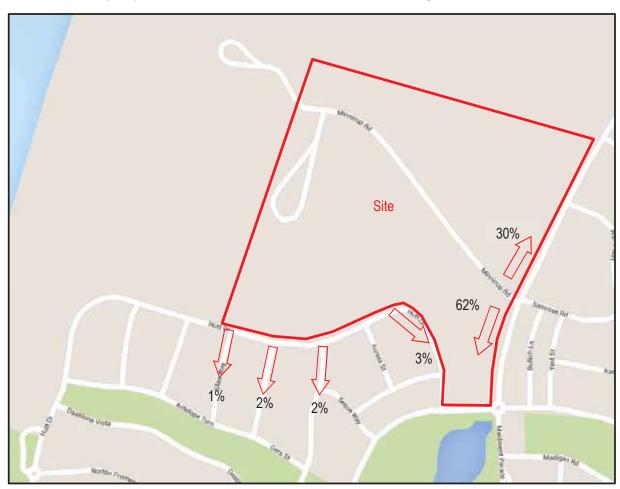


Figure 10: Assumed Traffic Split



5.4 Gap Analysis.

An assessment was carried out to determine whether or not the existing transport networks, plus any proposed changes, would adequately match predicted desire lines, particularly for pedestrians, cyclists and public transport.

Dalyellup is a relatively new development which has pedestrian facilities that provide excellent connections to parks and playground facilities. Dedicated cycle facilities are generally not warranted along access roads with less than 3,000 vpd, however it is noted that there is no provision for on-road or off-road cycle facilities along local distributor roads such as Maidment Parade and Norton Parade where long distance commuter cycling and recreation cycling is likely.

6 Analysis of Transport Networks

6.1 Introduction

Section 2 of the assessment provides a description and an inventory of the proposal and surrounding area with respect to land uses and transport networks. The following sections provide a more detailed quantitative analysis of the proposed internal and external transport networks to demonstrate that they will provide a high level of accessibility and safety for all modes.

6.2 Assessment Years

Assessment is based on the full development of the site and is taken as being 2016.

6.3 Time Periods for Assessment

The assessment is based on analysis of expected peak traffic flows for the site. Additionally an analysis has been undertaken to ensure increased traffic flow can be accommodated into the future and this has been compared to 2031 traffic volumes provided by the Shire of Capel within the Dalyellup Strategic Traffic Model (DSTM).



7 Analysis of Internal Transport Networks

7.1 Subdivision Generated Traffic

Vehicle trip generation rates are based on the following recognised land use traffic generation databases:

- Land Use Traffic Generation Guidelines, March 1987 Director General of Transport, South Australia;
- Guide to Traffic Generating Developments Version 2.2, October 2002 Roads and Traffic Authority,
 New South Wales; and
- Trip Generation 7th edition, 2003 Institute of Transportation Engineers, Washington, USA.

Assessed generation is shown on Table 3 based on Traffic Assessment Zones (TAZ's) shown on Figure 11.



Figure 11: Transport Assessment Zones (TAZ)



The trip volumes per day are generated based on planning codes and land use type and have been derived from the ITE Guide. Trip volumes are shown in **Table 3**.

Table 3: Estimated Daily Traffic

Traffic Assessment Zone (TAZ)	Land use R code	No of Dwellings	Trip Rate Per Dwelling	Trips per day
1	30	4	9	36
	25	6	9	54
2	30	2	9	18
	50	2	9	18
	25	6	9	54
3	30	2	9	18
	50	2	6	12
4	50	7	6	42
	25	15	9	135
5	30	2	9	18
	50	2	9	18
	25	17	9	153
6	30	2	9	18
	50	2	9	18
7	30	4	9	36
8	20	19	9	171
9	20	18	9	162
10	50	9	6	54
11	50	9	6	54
12	50	9	6	54
13	25	11	9	99
14	30	11	9	99
15	30	4	9	36
16	20	6	9	54
17	20	4	9	36
18	20	5	9	45
19	60	17	6	104
*20	Fields	-	-	500
Total		197		2,116

^{*7} fields at an average rate of 71.33 trips/field/day.

Using the QRS II software, traffic flows were assigned to the network as shown on Figure 12.

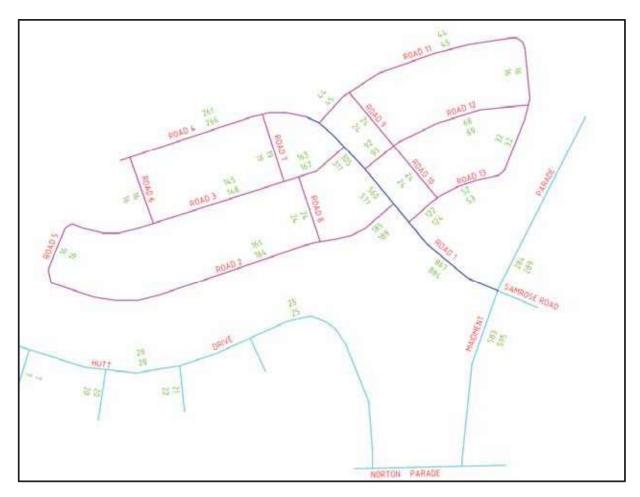


Figure 12: Subdivision Generated Daily Traffic

7.2 Non Subdivision Traffic

Traffic data obtained from the Shire of Capel, are shown in Appendix B. These indicate daily traffic volumes along Maidment Parade between Piara Way and Warnut Way of 1,456 vehicles per day (November 2015). No traffic counts are available for Hutt Drive, Daablone Vista, Antelope Turn and Silas Way and traffic volumes have been estimate based on 9 movements a day for each lot fronting the roadway. Table 4 shows the increase of traffic associated with each external road adjacent to the development. Peak hour volumes are estimated based on 10% of the daily estimated traffic volume.

Table 4: Order of Mid Block Traffic

Location	Daily	AM Peak	PM Peak
Maidment Parade South (Current)	1,456	144	155
Maidment Parade South (Predicted)	1,178	120	120
Maidment Parade South (Total predicted flows)	3,866	410	420
Maidment Parade North (Current)	1,456	144	155
Maidment Parade North (Predicted)	573	57	57
Maidment Parade North (Total predicted flows)	2,029	201	212
Hutt Road Current (Estimated)	423	42	42
Hutt Drive (Predicted)	56	6	6
Hutt Drive (Total predicted flows)	479	48	48
Daablone Vista Current (Estimated)	423	42	42
Daablone Vista (Predicted)	43	4	4
Daablone Vista (Total Predicted flows)	466	46	46
Antelope Turn Current (Estimated)	81	8	8
Antelope Turn (Predicted)	40	4	4
Antelope Turn (Total Predicted flows)	121	12	12
Silas Way Current (Estimated)	72	7	7
Silas Way (Predicted)	14	2	2
Silas Way (Total Predicted flows)	86	9	9

7.3 Future Design Traffic Flows

The Shire of Capel provided a preliminary report undertaken by Jacobs of behalf of the Satterley Group which updates the Dalyellup Strategic Traffic Model (DTIS). The modelling looks to future traffic scenarios and provides guidance on the implementation and timing of strategic external road network connections from Dalyellup to Bussell Highway. The report indicates that full build of Dalyellup is expected prior to 2021 and that two additional connections are required within that time, one to Ferndale Road north of Norton Promenade and the other connecting from Norton Promenade to Bussell Highway south of Norton Promenade.

As part of the analysis, observed and modelled counts for 2014 are provided for the road network adjacent to the site as follows:

Norton Parade west of Maidment Parade (Modelled 2,870 vpd, Observed 2,484 vpd); and



Maidment parade west of Dalyellup Boulevard (Modelled 2,644 vpd, Observed 2,195 vpd).

The Shire of Capel advises that there has been an 11.8% growth in population (over a 9 year period) within Dalyellup, from June 2006 to June 2015.

Full development of the Dalyellup locality will be prior to 2021, thus a percentage growth of 9% has been adopted for this period to determine 2031 traffic volumes on the adjacent road network. Maidment Parade is the only road adjacent to the site affected by future traffic increases. Table 5 shows projected traffic volumes predicted within this report and those predicted within the Jacobs report.

Table 5: 2031 Predicted Traffic Volumes

Road Name	Predicted (vpd) 2015	Predicted (vpd) 2031	Source
Maidment Parade	2,644 (modelled), 2195 (observed)	2,882 (modelled), 2,393 (observed)	Jacob Report: PB506634, May 2015
(North)	2,029	2,212	Shawmac
Maidment Parade (South)	-	-	*Jacob Report: PB506634, May 2015
	3,866	4,214	Shawmac

^{*}No available data with the report

The difference between the volumes modelled within the Jacobs report and that predicted within this report for Maidment Parade north is not considered significant as its capacity is not exceeded when compared to its hierarchal status as a Local Distributor.

7.4 Roads and Intersections

7.4.1 Mid Block Cross Sections

Road cross section requirements have been based on recommendations contained within Livable Neighborhoods and the Austroads Guide to Traffic Engineering Practice which requires the following:

Table 6: Road Hierarchy Criteria

Indicative volume.	Route type / name.	Indicative Reserve Width.	Indicative Carriageway Width.
50,000.	Primary Distributor.		Determined by Main Roads WA
35,000.	Primary Distributor.		Determined by Main Roads WA
15,000 to 35,000.	Integrator Arterial A (District Distributor A).	50.6 – 52.6 metres.	2 x 8.2 metre carriageways including bike lane and 2 x 5.5 metre service roads containing parking.
<25,000	Integrator Arterial A (District Distributor A).	35.6 metres.	2 x 10.7 metre carriageways including combined on street parking and bike lane.
7,000 to 15,000.	Integrator Arterial B (District Distributor B).	29.2 metres.	2 x 7.5 metre carriageways with on street parking and bike lane.
15,000.	Integrator Arterial B (District Distributor B).	25.2 metres.	2 x 7.5 metre carriageways with on street parking.
7,000.	Neighborhood Connector A.	24.4 metres	2 x 7.1 metres including parking, on street bike lane, median plus shared path on one verge.



Indicative volume.	Route type / name.	Indicative Reserve Width.	Indicative Carriageway Width.
3,000.	Neighborhood Connector B.	19.4 metres	11.2 metres including parking plus shared path on one verge.
3,000.	Access Street A (Avenue).	20 - 24 metres.	2 x 3.5 metre lanes plus indented parking.
3,000.	Access Street B (Wider street).	16.5 - 18 metres.	9.7 metre lane.
3,000.	Access Street C (Yield or give way street).	15.4 - 16 metres.	7.2 (7.0 – 7.5) metre lane.
1,000.	Access Street D (Narrow yield or give way street).	14.2 metres.	5.5 – 6.0 meter lane.
150	Access Street D (Narrow yield or give way street).	14.2 metres.	3.5 metre lane plus parking indents.
3,000.	Access Street D (Wider street).	16.5 - 18 metres.	9.7 metre lane.

Based on these criteria, road requirements are as shown on Table 7. Note the cross sections have been modified from the indicative widths shown on Table 6; however the capacity and has been maintained consistent with the intent of the Livable Neighborhoods Criteria.

Table 7: Road Cross Sections

Road	Predicted Volume (vpd).	Reserve Requirement.	Carriageway Requirement.	Recommended Road Reserve Width 9 (from Table 4)
Maidment Parade	Up to 3,866	Neighborhood Connector A	24.4 metres.	2 x 7.1 metres including parking, on street bike lane, median plus shared path on one verge.
Road 1	Up to 1,751	Access Street A (Avenue).	20 - 24 metres.	2 x 3.5 metre lanes plus indented parking.
Remaining roads	Up to 500	Access Street D (Narrow yield or give way street).	5.5 - 6.0 meter lane.	14m

The indicative widths shown in Table 7 are subject to change and may vary dependent on the Shire of Capel Requirements.

7.4.2 Intersection Analysis

Warrants for analysis for each intersection as shown in Table 8.1 of Austroads Guide to Engineering Practice Part 2, Roadway Capacity were applied to determine which intersections required capacity analysis. Peak hour traffic volumes were assumed to be approximately 10% of predicted daily traffic.

Table 8: Analysis Warrants

Intersection	Hourly volume major road	Hourly volume minor road	Comment.
Warrants as per Table 8.1 of Austroads Guide to Engineering Practice Part 2, Roadway Capacity - Two Lane Major Road Cross Road	400 vph 500 vph 650 vph	250 vph 200 vph 100 vph	Table details flows that initiate intersection analysis. As major flows increase, there is reduced capacity to accept minor flows.
Maidment Parade and Road 1	387 vph	175 vph	4 way intersection – Analysis not required (proposed roundabout)
All others intersections	<100 vph	<100 vph	Analysis not required.



7.5 Pedestrian / Cycle Networks

The site is accessible to the surrounding footpath network with facilities located along both sides of Maidment Parade and the north side of Hutt Drive. A separate cycle path for Hutt Drive and the site road network is not necessary as they are access roads and not likely to carry more than 3,000 vpd, thus a mix of vehicle and cycle traffic is considered acceptable.

However Road 1 and Road 4 provide direct access to the adjacent recreational facility thus in this instance it is considered appropriate to provided separate on-road cycling lanes to facilitate access to the recreational facility and improve cycling safety.

Maidment Parade is a local distributor road that will carry over 3,000 vpd and in accordance with Liveable Neighbourhood Guidelines may require separate cycle facilities. An extract of the Google Earth showing the current footpath network is shown below Figure 13.



Figure 13: Footpath Network near the Site



7.6 Access to Public Transport

Liveable Neighbourhoods indicates that a distance of 400m to 800m is an appropriate distance to access local facilities as part of daily activities including access to a train station or town centre. The Dalyellup area is serviced via Bus Routes 831 and 843 with the nearest bus stop for these routes located on Norton Parade approximately 1,000m southwest of the site as shown on **Figure 14**.

The bus stop is not located close enough to the site to facilitate regular use. Additional bus stops and the extension of the existing bus route may be required as Dalyellup continues to grow.

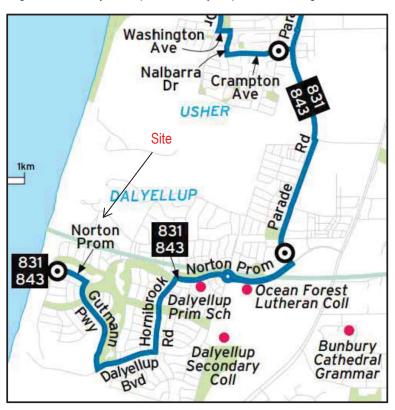


Figure 14: Regional Town Bus Services Bus Route 831 and 834



8 Analysis of External Transport Networks

8.1 Design Traffic Flows on External Road Network

Design traffic flows on the external network as affected by the proposal are covered in section 7.

8.2 Impact on External Roads

The impacts of design traffic flows on the external network as affected by the proposal are covered in section 7.

8.3 Impact on External Intersections

Impacts on external intersections are not expected.

8.4 Pedestrian / Cycle Networks

Extension of the new internal footpath is recommended as development occurs to allow access to the Bus Stop located within Norton Parade and cycle lanes should be considered as part of any upgrade to Maidment Parade.

9 Safety Issues

A review of the overall transport proposal for the site did not identify any specific issues that present unacceptable risks to the road user or that cannot be managed through appropriate design protocols.

Road hazards are typically present at intersections and may be manifested through inadequate sight distance, inappropriate geometry or substandard capacity that promotes undesirable and potentially hazardous movements.

For the new roads, the allocation of adequate road reservation width and truncation of corners will generally allow sight distance requirements to be accommodated in the detailed design phase of the project. Geometric standards prescribed by Austroads and Main Roads WA guidelines will ensure that no unacceptable risk is introduced into the road environment. Assessment of the operational performance of intersections undertaken in this study prescribes appropriate geometry and lane allocation to minimise delay and optimise performance.

Detailed design undertaken as part of the Development Application process would need to define at least the following elements:

- Road cross sections including lane widths, on-road cycle lanes, path widths and provisions for people with disabilities;
- Intersection geometries;
- Pedestrian and cycle facilities (cross sections, crossing requirements and ramps).



10 Noise

There is potential for noise impact to residential areas from the traffic using Maidment Parade, however the impact is minimised by the requirement to provide POS between the site and Maidment Parade.

11 Conclusions

The traffic generation and distribution exercise undertaken to quantify the traffic impact of the site indicate that site will have minimal impact on the function of the adjacent network.

A review of the pedestrian and cycle facilities indicate that the extension of the internal footpath network will be required to provide connections to the bus stop located within Norton Parade and that separate on-road cycle facilities may be required for Road 1, Road 4 and Maidment Parade to facilitate access to the adjacent recreational facility.

The trip volumes per day are generated based on planning codes and land use type and have been derived from the ITE Guide, thus the predicted weekday flows generated within the site and sporting fields along Road 1 onto Maidment Parade is expected to be 1,751 vpd.

Traffic Hierarchy based on 2015 daily volumes indicates that the midblock cross section for Maidment Parade is a Neighbourhood Connector A and that Road 1 is an Access Street A and as such may require the addition of a median/traffic calming to control traffic movements.

Traffic projections to 2031 for Maidment Parade indicate that it will continue to operate as a Neighbourhood Connector A once Dalyellup is at full development.

On the basis of the assessment undertaken, it is concluded that the proposed street network will provide an acceptable range of choices for travel and ensure that traffic volumes on individual streets can be kept below threshold levels to ensure the amenity of the area is preserved and safe movement options exist for pedestrians, cyclists and local traffic.



Appendix A Checklist



Consulting Civil and Traffic Engineers, Risk Managers

Item	Section	Comments/Proposals
Summary	1	
Introduction/Background	2	
name of applicant and consultant	2	
subdivision location and context	2.1	
brief description of subdivision	2.2	
key issues	2.2	
background information	3	
Subdivision proposal	2.1	
regional context	2.2.1	
proposed land uses	2.2.3	
table of land uses and quantities	2.2.3	
major attractors/generators	5.2	
any specific issues		
Existing situation	3	
existing land uses within structure plan	3.1	
existing land uses surrounding the subdivision	3.1	
existing road network within subdivision	3.2	
existing road network surrounding the subdivision	3.2	
traffic flows on roads within subdivision (AM and PM peak hours)	7.2	
traffic flows on roads surrounding the subdivision (AM and PM peak hours)	7.2	
existing pedestrian/cycle networks within the subdivision		
existing pedestrian/cycle networks surrounding the subdivision	7.5	
existing public transport services within the subdivision		
existing public transport services surrounding the subdivision	7.6	
Proposed internal transport networks	4.0	
changes/additions to existing road network	5.0	
road reservation widths	7.4.1	
road cross-sections & speed limits	7.4.1	
intersection controls	7.5.2	
pedestrian/cycle networks and crossing facilities	7.5	
public transport routes	8.6	
Changes to external transport networks	5	
road network	5	
intersection controls	4	
pedestrian/cycle networks and crossing facilities	8.4	
public transport services	7.6	
Integration with surrounding area	5	
surrounding attractors/generators	5.1	
proposed changes to surrounding land uses	5.2	



Consulting Civil and Traffic Engineers, Risk Managers

Item	Section	Comments/Proposals
travel desire lines from subdivision to these attractors/generators	5.2	
adequacy of existing transport networks	5.3	
deficiencies in existing transport networks	7.3	
remedial measures to address deficiencies	7.3	
Analysis of internal transport networks	7	
assessment years and time periods	6.2	
subdivision generated traffic	7.1	
extraneous (through) traffic	7.2	
design traffic flows	7.1	
road cross-sections	7.4.1	
intersection sight distances	9	
intersection operation and method of control	7.4.3	
frontage access strategy		
pedestrian / cycle networks	7.5	
safe walk/cycle to school		
pedestrian permeability & efficiency		
access to public transport	7.6	
Analysis of external transport networks	8	
base flows for assessment years	8	
total traffic flows	-	
road cross-sections	-	
intersection operation	-	
pedestrian/cycle networks	-	
Safety issues	-	
identify issues	-	
remedial measures	-	
Conclusions	11	

Proponent's Name: Satterley Group

Signature: Date:

Transport Assessor's Name: Shaun Millen

Company: Shawmac

Signature: Date: 1 February, 2016



Appendix B Traffic Counts



Weeklyvenicie-265 F

Weekly Vehicle Counts

WeeklyVehicle-265

206_000241_001225.0.0NS Site:

Description:

Maidment Parade (between Piara Way and Warut Way SLK 1225)
10:00 Wednesday, 18 November 2015 => 10:00 Sunday, 22 November 2015
Vehicle classification (AustRoads94) Filter time:

Scheme:

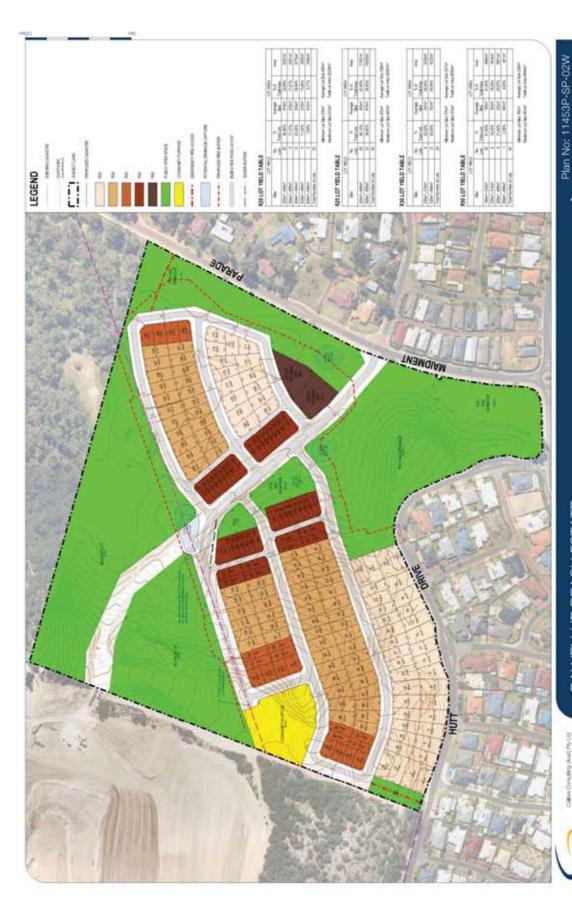
Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0) Filter:

		Mon		Tue		Wed		Thu		Fri		Sat		Sun	Av	erages			
	16	Nov	17	Nov	18	Nov	19	Nov	20	Nov	21	Nov	22	Nov	1	- 5	1	-	7
Hour															1				
0000-0100		*		*		*		0		5		8		11	1	2.5		6	.0
0100-0200		*		*		*		2		1		6		6	1	1.5		3	. 8
0200-0300		*		*		*		4		4		4		3	1	4.0		3	. 8
0300-0400		*		*		*		0		1		3		8	1	0.5		3	. 0
0400-0500		*		*		*		4		5		1		2	1	4.5		3	.0
0500-0600		*		*		*		31		19		6		11	1 2	5.0		16	. 8
0600-0700		*		*		*		44		42		18		24	1 4	3.0		32	. 0
0700-0800		*		*		*		108		104		72		41	1 10	6.0	-	81	. 3
0800-0900		*		*		*		147<		141<		81		42	1 14	4.0<			.8<
0900-1000		*		*		*		60		85		91		91	1 7	2.5		81	. 8
1000-1100		*		*		64		84		81		106		*	1 7	6.3		83	. 8
1100-1200		*		*		75		62		74		116<		*	1 7	0.3		81	. 8
1200-1300		*		*		83		66		77		122<		*		5.3		87	
1300-1400		*		*		59		57		67		87		*	1 6	1.0		67	
1400-1500		*		*		99		95		115		100		*	1 10	3.0	1	02	. 3
1500-1600		*		*		127		122		134		87		*	1 12	7.7	1	17	. 5
1600-1700		*		*		141		143		103		87		*	1 12	9.0		18	
1700-1800		*		*		155<		146<		163<		87		*		4.7<			.8<
1800-1900		*		*		89		94		115		73		*	1 9	9.3		92	. 8
1900-2000		*		*		45		79		51		45		*	1 5	8.3		55	.0
2000-2100		*		*		31		56		47		30		*	4	4.7		41	. 0
2100-2200		*		*		13		24		39		30		*	1 2	5.3		26	. 5
2200-2300		*		*		15		17		18		24		*		6.7		18	
2300-2400		*		*		13		8		11		19		*		0.7		12	
Totals																			
0700-1900		*		*		*		1184	15	1259		1109		*	1 121	9.2	11	54	. 5
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^{* -} No data.

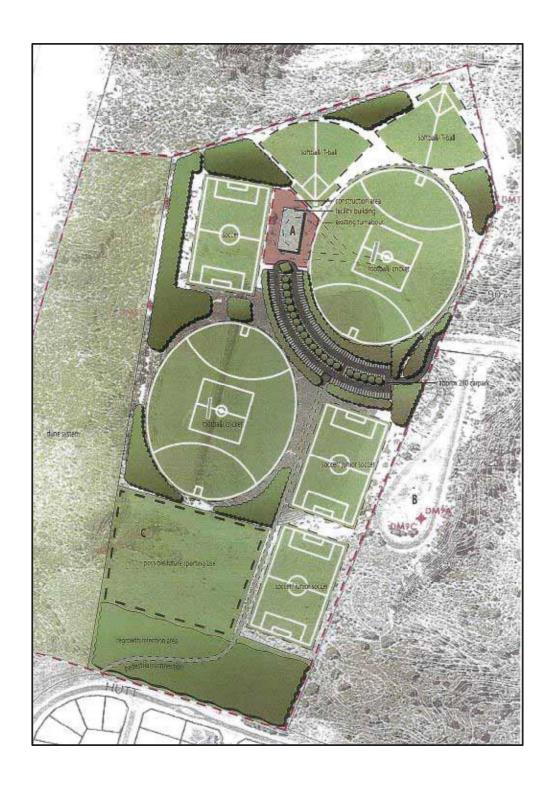
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DALYELLUP BEACH ESTATE Lots 9102, 9075 and 8019





Appendix Eight: Detailed Site Investigation



COMBINED PRELIMINARY SITE INVESTIGATION AND DETAILED SITE INVESTIGATION

Greenpatch – Lots 9109, 9076, and 8019



Docume	Document status						
Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date		
Draft A	Internal review	ZakLan	ColCor	n/a	15/02/2021		
Draft B	For auditor review	KatStu/ZakLan	ColCor	ColCor	22/02/2021		
Rev 0	Final for issue	ZakLan	AlaFol	AlaFol	17/03/2021		
Rev 1	Revised final for issue	AlaFol	ColCor	ColCor	28/06/2021		
Rev 2	Revised	ColCor	ColCor	ColCor	15/10/2021		

Approval for issue			
Colm Corcoran	The.	le en	15 October 2021

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EXECUTIVE SUMMARY

Satterley Property Group Ltd (Satterley) has commissioned RPS Australia West Pty Ltd (RPS) to undertake a contamination investigation and risk assessment which includes soil sampling for contamination across portions of the Greenpatch Development (hereafter as "the site").

The site occupies approximately 22.5 hectares (ha) comprising of Lots 8019, 9109 (previously 9105), 9076 and a portion of 9077 (Minninup Road) in Dalyellup (Figure A), located approximately 11 km south of Bunbury in the south-west region of Western Australia.

RPS has previously been engaged by Satterley to complete a Preliminary Site Investigation (PSI) (RPS, 2016) with a limited soil and groundwater assessment in 2016. The findings of the report were accepted by the Department of Water and Environmental Regulation (DWER, formerly DER), and DWER classified the site as "report not substantiated" in March 2018. The site was subsequently reported to the DWER by a member of the community who claimed to have visually identified treated solid residue (TSR) from the Cristal site located on a portion of Greenpatch. A member of the public appealed the DWER classification of the site and the project was referred to the Contaminated Sites Committee.

In October 2020 the Contaminated Sites Committee determined that further investigation on site was required to address classification and the site was classified as *possibly contaminated - investigation required*. DWER reclassified the site on 6 November 2020.

RPS prepared a Sampling and Analysis Quality Plan (SAQP) (RPS, 2021) to specifically address whether TSR is present within the ETC and Area 8 and to assess the groundwater and surface water contamination status within Greenpatch Development. This report presents the results of the proposed DSI completed between 14 to 17 December 2020, including detailed discussion of groundwater, surface water and soil sampling results, sampling methodology, data quality objectives and assessment criteria.

The findings from the investigation are summarised below.

- With the exception of isolated exceedances of metals (Mg, Ni) and radionuclides (Th) in two of 24 locations (TP14 and TP18), soils typically complied with adopted guidelines. All guideline exceedances were observed in a dark brown clayey silt layer visually distinct from natural soils and the capping layer within Lot 9109. Based on investigation results impacted soils are suspected to be a blend (1:9 ratio TSR to sand) of TSR and sands and not straight TSR. Impacted soils at TP14 and TP18 were not considered a risk to human health in their current condition. However, soils may present a risk during the proposed development of Lot 9109 if the material is exposed during earthworks. On this basis removal of the impacted material from Lot 9109 is recommended.
- No TSR was observed elsewhere onsite based upon the site walkover and review of historical aerials.
 The blended TSR would also pose significantly lower radiation risk then straight TSR due to the lower concentrations of radionuclides.
- Exceedances of ecological guidelines in groundwater were observed for metals (Cr(VI) and Fe) and
 nutrients. With the exception of hexavalent chromium, dissolved metal concentrations are relatively
 consistent across the site and of those in the Perth's superficial aquifer. However, with the exception of
 Cr(VI) in one bore (DM9S) groundwater quality entering and exiting the site were comparable.
- Groundwater is not suitable for long-term irrigation or domestic non-potable use without treatment. Groundwater is not currently used and a moratorium on groundwater abstraction is anticipated for the development, prohibiting the abstraction of groundwater for potable / non-potable use.
- The proposed excavation of the contaminated soils at TP14 and TP18 within Lot 9109 will remove the source of potential contamination and Cr(VI) impacts in the shallow aquifer may reduce via attenuation. Therefore, groundwater quality was not considered to be a human or ecological health risk. Being a strong oxidising agent, Cr(VI) will be readily reduced to the significantly less toxic Cr(III) through reactions with organic matter, (ferrous) iron carbonate, iron hydroxides or sulfides potentially present in the superficial aquifer. As such, any potential impacts associated with Cr(VI) are likely localised through natural processes. Tronox ongoing monitoring for the former Waste Residue Facility identifies that Cr(VI) concentrations in DM9 have stabilised and decreased. Tronox will continue to monitor this location and report findings to the regulator as part of their ongoing monitoring program.
- Surface water in Lot 9076 and Lot 8019 marginally exceeded ecological guidelines for pH, total nitrogen
 and phosphorous. However, surface water was not considered a risk to human or ecological health no
 exceedances of human health criteria were noted, use of the surface water bodies for recreational

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purposes is not promoted and nutrients are required for plant growth. The pH exceedances were not considered a risk to marine environments as surface water is not connected directly to the marine environment.

- Lot 9109 was deemed to pose low risk to the human health and local ecology based upon the current site use, i.e. public open space natural bushland, and future proposed residential use, however ongoing management is required to ensure the potential risks to human health are minimised.
- Lot 9076 and 8019 were deemed to present no risk to human health or the local ecology based on the current and future site use.

To manage the potential increased risk to human health should impacted soils at TP14 and TP18 be exposed during development or groundwater abstracted RPS recommends:

- Impacted soils at and adjacent to TP14 and TP18 are excavated and disposed of at an appropriate landfill.
- A moratorium on groundwater abstraction from the shallow aquifer is acquired to prevent portable / nonportable groundwater use.

Preparation of a Remediation Action Plan (RAP) is recommended to facilitate remediation of Lot 9109 and will document the type and extent of remediation required to ensure that the site is suitable for its intended future use. The RAP will detail the clean-up techniques proposed to achieve the remedial objectives and criteria for assessing the effectiveness of the clean-up in the validation process. Remediation of Lot 9109 will be reported on in the form of a Site Remediation and Validation (SRV) report following completion of the works. All reporting will be submitted to the Contaminated Sites Auditor for independent review and endorsement prior to submission to DWER to support reclassification of Lot 9109.

The site is current classified as "possibly contaminated - investigation required". Lot 9076 and Lot 8019 can be reclassified as "not contaminated – unrestricted use" under the Contaminated Site Act 2003, without any remedial action.

After remediation, it is recommended that Lot 9109 is classified as "Decontaminated" under the Contaminated Site Act 2003 and suitable for the proposed land end use as residential and open space.

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1 INTRODUCTION

1.1 Background

Satterley Property Group Ltd (Satterley) has commissioned RPS Australia West Pty Ltd (RPS) to undertake a contamination investigation and risk assessment which includes soil sampling for contamination across portions of the Greenpatch Development (hereafter as "the site").

The site occupies approximately 22.5 hectares (ha) comprising of Lots 8019, 9109 (previously 9105), 9076 and a portion of 9077 (Minninup Road) in Dalyellup (Figure A), located approximately 11 km south of Bunbury in the south-west region of Western Australia. The majority of the site comprises of remnant vegetation while the north-eastern portion has historically been cleared of native vegetation. The Dalyellup Waste Residue Disposal Facility (DWRDF) formerly operated by Cristal Pigments Australia Ltd (Cristal), which contains treated solid residue (TSR) from the processing of mineral sands, was located to the west site (Figure B). The proposed future land use for the site comprises of residential end use lots with associated roads and some public open space.

RPS has previously been engaged by Satterley to complete a Preliminary Site Investigation (PSI) (RPS, 2016) with a limited soil and groundwater assessment in 2016. This assessment was completed on behalf of Satterley to identify any potential contamination issues associated with the site and was completed in accordance with the Department of Environment Regulation (DER), Assessment and Management of Contaminated Sites – Contaminated Sites Guidelines, 2014 (DER, 2014).

The investigation identified that:

- A portion of the site was formerly leased by Cristal to form the Eastern Turning Circle (ETC) and comprised
 a bitumen road with treated solid residue from Cristal used as road base. DER confirmed that this material
 was removed in 2013.
- Sampling undertaken in an area of disturbed land to the south of the ETC and identified no evidence of contamination.

The findings of the report were accepted by the Department of Water and Environmental Regulation (DWER, formerly DER), and DWER classified the site as "report not substantiated" in March 2018 with no further management of the site required in relation to contamination. The site was subsequently reported to the DWER by a member of the community who claimed to have visually identified treated solid residue (TSR) from the Cristal site located on a portion of Greenpatch identified as "Area 8", located to the south of the ETC (Figure B) and previously investigated by RPS in 2016 and GHD on behalf of Cristal.

As a result of this, DWER attended the site and visually identified TSR in localised areas within Area 8 and ETC including a band of TSR measuring 10 cm in thickness identified along the open face of the rehabilitated dunes (DWER, 2020), as shown in Figure B.

The presentation of this new information and the appeal of the classification by a member of the public has triggered the involvement of the Contaminated Sites Committee (CSC). An appeal report was submitted to the CSC by DWER on 2 December 2018. In October 2020 the committee determined that there was sufficient evidence to conclude that there should be further investigation on site and that the appeal should be upheld and the site classified as *possibly contaminated - investigation required* (CSC, 2020) (Appendix A). Subsequent to this the DWER reclassified the site on 6 November 2020 (DWER, 2020). However, the classification does not cover Minninup Road (Figure B) as there was "no evidence that TSR was used for its construction or repair" (DWER 2020), which supports the DWER reclassification of *not contaminated - unrestricted use* in 2019 (DWER 2019) (Appendix A). DWER however has requested that visual confirmation that TSR was not used in Minninup Road is undertaken.

RPS prepared a Sampling and Analysis Quality Plan (SAQP) (RPS, 2021) to specifically address whether TSR is present within the ETC and Area 8 and the groundwater and surface water contamination status within Greenpatch Development, and if present, does it pose an acceptable risk to human health and or the environment based upon the proposed residential/public open space land use.

The SAQP (RPS, 2021) served to present the proposed objectives of the Detailed Site Investigation (DSI), outlining the scope and objective of the DSI, including detailed discussion of sampling locations, sampling methodology, data quality objectives and assessment criteria in accordance with the *National Environmental*

Protection Measure [NEPM], 1999, as amended 2013 (NEPC, 2013) and DER Assessment and management of contaminated sites, Contaminated sites guidelines (DER, 2014).

This report presents the results of the proposed DSI completed between 14 to 17 December 2020, including detailed discussion of groundwater, surface water and soil sampling results, sampling methodology, data quality objectives and assessment criteria.

This report requires review and endorsement by the Contaminated Sites Auditor (CSA), Jason Clay of Senversa, as part of a Mandatory Audit Report (MAR) required for reclassification of the site.

It should be noted that a radiation survey will not be considered within this report. The Mandatory Auditor's Report - Dalyellup Tailing Facility (AECOM, 2015) indicates that for the ETC, rehabilitation of the area has been successful in returning the gamma radiation levels to within the natural background of the area (0.10 μ Gy/h). In addition, a radiation survey of Area 8 in 2018 (Radiation Professionals, 2018), indicated that gamma radiation levels were within the natural background of the area and consistent with those on the Swan Coastal Plain. As such, with respect to radiation exposure, the site is considered suitable for the proposed land use of residential and public open space.

1.2 Briefing

In order for the soil and groundwater assessment to be undertaken in accordance with the DER Contaminated Sites Guidelines (DER 2014), a SAQP (RPS December 2020) was compiled to document the objectives and sampling protocols for this DSI.

This report presents the findings of the DSI, specific to Lot 9109 on Deposited Plan 419061, Lot 8019, 9076 on Plan 55511 and Lot 9077 on Plan 60716 and provides recommendations for further works required to render the site suitable for use as residential end use lots with associated roads and some public open space.

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2 **OBJECTIVES AND SCOPE**

2.1 **Objectives**

The overall objectives of the DSI for contamination are to:

- Summarise the findings of the PSI (RPS, 2017).
- Undertake the program identified in the SAQP (RPS, 2020).
- Assess the potential presence, nature and extent of any contamination at the site.
- Assess the results of the soil, groundwater and surface water investigations against guidelines as defined in the SAQP and presented within this DSI.
- Assess the human health and environmental risks from any identified contamination.
- Assess the suitability of the site, and if necessary provide recommendations for further works required to render the site suitable for the proposed end use as residential lots and public open space.

2.2 Scope of Work

The scope of works included the following:

- Summarise the findings of the PSI (RPS, 2017) comprising:
 - Review of historical aerials
 - Site identification and desktop review
 - Review of previous investigations
 - Construction of preliminary conceptual site model
 - Develop TSR inspection, soil, surface, and groundwater sampling program
- Undertake the sampling program detailed in the SAQP (RPS, 2021) comprising:
 - TSR inspection
 - Soil sampling program involving the collection of samples from a series of 24 test pits within the ETC and Area 8
 - Surface water sampling from surface water bodies positioned in the south east and north east corners of the site
 - Groundwater sampling from seven monitoring wells located across the site, all installed during previous assessments into the superficial aquifer
- Assess the results of the groundwater investigations against guidelines as defined in the SAQP (RPS, 2021) and presented within this DSI
- Assess the human health and environmental risks from any identified contamination
- Assess the suitability of the site, and if necessary provide recommendations for further works required to render the site suitable for the proposed end use as residential and public open space

The DSI has been developed in accordance with the following guidance:

- National Environment Protection (Assessment of Site Contamination) Measure [NEPM] 1999, Schedule B – General Guidelines for the Assessment of Site Contamination (NEPC, 2013)
- Assessment and Management of Contaminated Sites Contaminated Sites Guidelines (DER, 2014).

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3 SITE IDENTIFICATION

3.1 Setting

A detailed site summary is provided in Table 1, with the current certificates of title provided in Appendix B. The site locality is provided in Figure A, while Figure B provides a site layout and reference locations detailing the layout and various features of the site.

Table 1: Site Summary

Reference Name	Greenpatch – ETC, Are	a 8 and Minninu	p Road	
Address	Lot (Number)	Street	Suburb	
	8019	No street	Dalyellu	ρ
	9109	address information		
	9076	— imormation		
	9077	Minninup Road	d	
Certificate of Title and	Lot (Number)	Volume	Folio	Owners
Owners	Lot 8019 on Plan 55511	LR3154	141	State of Western Australia
	Lot 9109 on DP 419061	2984	1000	Housing Authority
	Lot 9076 on DP 55511	2696	377	
	Lot 9077 on Plan 60716	2717	207	Cristal Pigment Australia Ltd
Local Government Area	Shire of Capel			
Zoning	"Residential" under the Loca Town Planning Scheme No			opment Zone - Shire of Capel
Area and Elevation	Area (Greenpatch)	E	levation	
	~22.5 ha	~	10 to 40 m	AHD
Site Location and	Reference Point	Easting	Northing	g
Coordinates (Greenpatch) GDA 94 Zone 50	North-west	370,818	6,304,46	55
ODA 34 Zone 30	South-west	370,641	6,304,00)8
	North-east	371,314	6,304,32	26
	South-east	371,136	6,303,86	88
Site Layout and References	Figure B			

^{*} mAHD: metres Australian Height Datum

3.2 Regional Setting

The site is located within Dalyellup, part of the Shire of Capel and is approximately 162 km south of Perth's Central Business District (CBD). The site is surrounded by the following:

- North: Sand dunes / native vegetation, Dalyellup Wastewater Treatment Plant (~ 550 m) and the City of Bunbury urban residential area (~ 1,500 m)
- East: Dalyellup urban residential area (houses, public open spaces and commercial areas) and Bussell Highway (~ 2,200 m)
- South: Dalyellup urban residential area (houses, public open spaces and beaches)
- West: The former Dalyellup Waste Residue Disposal Facility (<50 m), partially cleared sand dunes and the Indian Ocean (~500 m).

3.3 Planning

The site is located within the Shire of Capel and forms part of the Shire of Capel Local Planning Scheme No. 7 (Gelorup Locality North). The plans indicate that the site is situated in an area zoned as "Residential".

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Different zones surround the site including: "Regional Open Space" (north and west), "Public Purposes – Public Utility" (North) with residential zones extending to the east and south.

The town planning map which shows the site and surrounding area zoning is provided Appendix C.

3.4 Heritage

3.4.1 National

A search of the Department of Agriculture, Water and the Environment (DAWE) *Australian Heritage Database* (DAWE 2020) confirmed that the site is not a nationally listed heritage site.

The search identified that there is one place having national heritage significance within the area of Dalyellup: Minninup Dunes Area (Place ID 9507) a series of dunes containing wetlands of importance to waterfowl and other water birds in the Bunbury / Capel area.

The Minninup Dunes Area is located approximately 1.8 km to the south of site. Therefore, given the relatively large distance and the direction of groundwater flow, the presence of contamination on the site would not be considered likely to have an impact on the heritage listed places.

The search results are provided in Appendix D.

3.4.2 State

A search of the Heritage Council WA *State Register of Heritage Places* (Heritage of Western Australia Act 1990) InHerit portal (Heritage Council 2020) confirmed the site was not listed on the heritage list.

A search did not identify any registered places within a 2 km radius of the site.

Therefore, the presence of contamination on the site would not be considered likely to have an impact on any heritage listed places.

3.4.3 Indigenous

A search of the Department of Planning Land and Heritage *Aboriginal Heritage Inquiry System* (DPLH 2020) database was undertaken and did not indicate the presence of any registered sites or other heritage places within the site boundary.

The search was expanded to a 2 km radius of the site however, no registered sites or other heritage places were identified.

The Aboriginal Heritage Act 1972 preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. As such, should any doubts exist or suspect artefacts/indications be identified, site disturbing activities should cease and the Department of Planning, Lands and Heritage contacted for further advice. Sites classified as 'Stored Data / Not a Site' do not require Section 18 approval under the Act.

The search results are provided in Appendix D.

3.5 Protected Areas

Table 2 provides details on environmentally sensitive or protected areas within the vicinity of the subject site.

Table 2: Sensitive areas, protected areas and specified ecosystems

Item	Description
Wetlands	Department of Biodiversity, Conservation and Attractions (DBCA) wetland mapping indicates that there are no significant wetlands located within the site.
	A search of a 2 km radius around the site identified the following important wetlands (DBCA-019):
	 A Multiple Use wetland (UFI 1006) is located to the south of the site (approximately 100 m), a drainage reserve at the south-eastern portion of the site that is man-made in nature and forms part of the central lake associated with the Dalyellup Beach estate, and a man-made sump present at the north-east portion of Lot 9076.

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• A Resource enhancement wetland (UFI 13943) located 1.8 km south east of site. A Multiple Use wetland (UFI 15500) located 2 km east of site. A Resource Enhancement wetland (UFI 15821) located 1.7 km south of site. The Multiple use wetland that is present to the south of the site is a potentially sensitive land use; however, the Environment Protection Agency (EPA) of WA considers Multiple Use wetlands to be those that score poorly on both natural and human use attributes. MU wetlands are recommended to be used, developed and managed in the context of water, town and environmental planning to retain the values, functions and attributes associated with the wetland. Additionally, there are no Ramsar wetlands of national importance within the site or in close proximity to the site (DBCA-045). Based on the Groundwater Dependant Ecosystems Atlas (BoM 2021), there are no aquatic Groundwater Dependant groundwater dependant ecosystems within the site. Additionally, the search showed that there are **Ecosystems** no studies that have been undertaken regarding subterranean GDE. The search did identify the site as having a moderate potential for terrestrial groundwater dependant ecosystems. The search results are provided in Appendix E. Vegetation and The site consists of partially cleared native vegetation with a cleared area in the north eastern portion Fauna of the site. A search of the online NatureMap Mapping Western Australia's Biodiversity database (DBCA 2021b) on 15 January 2020 was undertaken to identify conservation listed fauna and flora species that exist within a 2 km radius of the site. A total of 165 species were listed, of which 159 are not listed as having a current conservation status. Of the six listed with a conservation status, two species are "rare or likely to become extinct", one is "specially protected fauna", one species is considered 'Priority 3' and two species are considered 'Priority 4': Rare or likely extinct Eubalaena australis (Southern Right Whale) Pseudocheirus occidentalis (Western Ringtail Possum, ngwayir) Specially protected fauna Phascogale tapoatafa subsp. wambenger (South-western Brush-tailed Phascogale, Wambenger) Priority 3 Idiosoma sigillatum (Swan Coastal Plain shield-backed trapdoor spider) Priority 4 Acacia flagelliformis Isoodon fusciventer (Quenda, southwestern brown bandicoot) The search results are provided in Appendix F. **Bush Forever** Bush Forever sites are only located within the Perth Metropolitan area, therefore no Bush Forever sites are located within the Town Base Reserve or within the surrounding area. **Marine Waters** The Indian Ocean is located approximately 500 m west of the site boundary. **Drinking Water** The site is situated within a Public Drinking Water Source Area (Bunbury Water Reserve) which extends approximately 12 km along the coast from Bunbury to the south of Dalyellup. The reserve

2008).

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supplies water to Bunbury and Dalyellup. Drinking water bores source water from the Yarragadee aquifer, an unconfined aquifer which ranges in depth from 34 to 270 m below ground level (Bunbury Water Reserve drinking water source protection plan: Bunbury and Dalyellup water supplies, DoW

4 GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

Table 3 presents a summary of the geology and hydrogeology of the site, some information was sourced from the *Environmental Assessment Report Green Patch*, *Dalyellup* (RPS, 2012) and updated where required.

Table 3: Geology, Hydrogeology and Hydrology

IUD	ic o. Ocology	, Hydrogeology and Hydrology
Iten	n	Description
Тор	ography	The WA Atlas indicates that the topography of the site comprises an undulating coastal dune system, with land elevation ranging from approximately 5 m AHD in the south-eastern section of the site to 44 m AHD in the north-west portion (Figure C).
Reg	ional Geology	Geological mapping of surficial soils for the region, provided by the Department of Mines, Industry Regulation and Safety (https://geoview.dmp.wa.gov.au, 2019), indicates the site comprises of three soil units associated with the Quindalup Dune System, these are discussed below (Figure C):
		• Safety Bay Sands (Qhs) of calcareous quartz sand dunes to the west and comprising the majority of the site.
		• Swamp deposits (Qhw) in the eastern and south-eastern sections of the site. These correspond with a low-lying depression on the site.
		Tamala limestone (Qts) which consists predominantly of sand in the north-eastern corner of the site.
	d Sulfate Soil pping	Acid Sulfate Soil (ASS) Risk Mapping (www.nationalmap.gov.au) indicates the eastern portion of the site, associated with the swamp deposits, is classified as "high to moderate risk of ASS occurring within 3 m of natural soil surface", with no identified risk in the remainder of the site (Figure D). Consequently, ASS investigations prior to any soil or groundwater disturbance may be required in future stages of the development if disturbance to the soil or dewatering in the eastern portion of the site is required.
	Underlying Aquifer	The superficial formations in the region are the Leederville Formation, Yarragadee Formation and the Cockleshell Gully Formation. These formations are generally thin and comprise predominantly sands, forming an unconfined aquifer that is recharged by direct infiltration of rainfall (RPS, 2012).
	Groundwater Protection	Australian Planning Commissions Statement of Planning Policy No. 2.7 – Public Drinking Water Source Policy 2003 (RPS, 2012) and DWER Perth Groundwater Atlas (DWER, 2020). Priority 3 (P3) classification areas are defined to manage the risk of pollution to the water source from catchment activities. Protection of P3 areas is mainly achieved through guided or regulated
d Hydrology		environmental (risk) management for land use activities. P3 areas are declared over land where water supply sources coexist with other land uses such as residential, commercial and light industrial development. Land uses considered to have significant pollution potential are nonetheless opposed or constrained. Residential development including housing and grouped dwellings are acceptable land uses within a P3 area. However, development must be connected to deep sewerage (except where exceptions apply under State Government Sewerage Policy).
rogeology and Hydrology	Depth to Groundwater	east of Greenpatch and has identified that groundwater occurs approximately 2.5 to 3.5 metres below ground level (mbgl), with an average seasonal variation in groundwater levels of 1.0 m (RPS, 2012).
Hydi		Groundwater monitoring undertaken at the disposal facility directly to the west identified that groundwater flow within the superficial formation is in a westerly direction towards the Indian Ocean (RPS, 2012).
		Groundwater was encountered between \sim 2 mbgl (\sim 4.5 mAHD) in the east and 31 mbgl (2.75 mAHD), in the west of the site in 2016 (RPS, 2016), with the change in depth corresponding with changes in topography.
	Water Quality	Groundwater across the site and outside the site is relatively consistent in pH, being slightly acidic to neutral, with salinity being fresh to marginal to the west of the site. With the exception of hexavalent chromium, dissolved metal concentrations are relatively consistent across the site and of those in the Perth's superficial aquifer ¹ , and as such are considered reflective of natural conditions on site.

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¹ Compared to levels referenced for shallow groundwater on Perth's Swan Coastal Plain – refer Davidson (1995).

Low pH in groundwater was observed across the site with concentrations slightly below FWG (Freshwater Guidelines) and MEPG (Marine Ecosystem Protection Guidelines) from ANZECC (2000).

All organic contaminants, i.e. TRH and BTEX were below the limits of reporting and as such below relevant guidelines (RPS, 2016)

Monitoring WIN/Bores

There are five Department of Water and Environmental Regulation (DWER) registered monitoring bores located within the site (Water Information (WIN) Sites 23035238, 23035239, 23061274, 23061275 and 23061276) and 11 are present approximately 50–300 m west and north of the site (WIN Sites; 23035332, 23061262, 23061263, 23061272, 23061273, 23061266, 23061267, 23061270, 23061271, 23061264 and 23061265) (Figure E).

Two of the site bores (WIN sites 23035238 and 23035239) located in the eastern section of the site are used for irrigation purposes and owned by the Dalyellup Beach Estate Pty Ltd. The remaining three site bores located in the west of the site (WIN sites 23061274, 23061275 and 23061276) are owned by Cristal Mining Australia Ltd and Cristal Pigment Australia Ltd and are for unknown use. Given their proximity to the former Millennium Solid Waste Residue disposal facility it is likely the bores were installed for monitoring purposes (Figure E).

The 11 bores situated outside of the site are privately owned, one (WIN site 23035332) is owned by Millennium Inorganic Chemicals Ltd while the remaining 10 are owned by Cristal Mining Australia Ltd and Cristal Pigment Australia Ltd. There are no indications of the purpose of the bores however given the bores are situated where the former Millennium Solid Waste Residue disposal facility it is again likely the bores were installed for monitoring purposes.

Refer to Appendix 4 of the PSI (Appendix B) for full details.

Nearest Surface Water Body

A Multiple Use wetland (UFI 1006) is located to the south of the site (approximately 100 m), a drainage reserve at the south-eastern portion of the site that is man-made in nature and forms part of the central lake associated with the Dalyellup Beach estate, and a man-made sump present at the north-east portion of Lot 9076 (Figure E). The drainage reserve in the south east of the site is connected to the lakes offsite to the south. The offsite lakes are used for irrigation of the Dalyellup Beach Estate and receive stormwater and subsoil drainage from the surrounding estate, (JDA 2010).

The Indian Ocean is present, approximately 500 m to the west of the site.

5 SITE HISTORY

5.1 Overview

A review of the historic Certificates of Title (CoT) was undertaken as part of the PSI (RPS, 2016) in order to identify any previous site owners and potentially contaminating former land uses. A summary of the CoT changes since 2016 is presented below:

Table 4: Historical Certificates of Title

Lot/Plan	Volume/Folio	Registered Proprietor(s)	Date	Summary of Key Information
Current tenure:	Lot 9109 on Depos	sited Plan 419061		
9109/DP419061	2984/1000	Housing Authority	24/11/2020	Previously 9105/DP404839. Memorial (O563993) added to site to site as part of Contaminated Site Act 2003.

The current certificates of title are provided in Appendix B.

5.2 Review of Existing Literature and Databases

5.2.1 Contaminated Sites

5.2.1.1 Subject Site

The DWER Detailed Summary of Records (DSR) was obtained for the site during the PSI (RPS, 2016). The DWER identified several historical reports for the site. The DSR showed that the site has not previously been reported to the DWER as a known or suspected contaminated site. The DSR identified three reports that contain relevant environmental information relating to the site, these being:

- Dalyellup Facility Interim Site Management Plan, Site Consolidation Earthmoving Works. Cristal Global, August 2013
- Radiation Site Survey for Eastern Turning Circle, Dalyellup. Radiation Professionals, October 2013
- Dalyellup Waste Residue Disposal Facility, Eastern Turning Circle Validation. GHD Pty Ltd, February 2014
- Mandatory Auditor's Report (MAR), Dalyellup Tailings Facility. AECOM Pty Ltd, July 2015.

Minninup Road, which is part of Lot 9077 (Dalyellup Waste Disposal Facility), was reclassified in August 2019. The DWER reclassification notice dated correspondence dated 2 August 2019 advised that the site had been reclassified as "not contaminated – unrestricted use" as "multiple lines of evidence indicate that TSR was unlikely to have been used in the construction and maintenance of the road. The information acquired indicates that the road was constructed from virgin quarried materials in February 1989. The facility was not constructed until March 1989, further indicating that TSR was unlikely to have been used". Further information regarding the classification of Minninup Road of Lot 9077 is found in Appendix A (DMO 10753).

In a letter dated 30 October 2014 from the then DER to the Western Australian Planning Commission (WAPC), in response to the proposed subdivision (Application Number 150720) of Lot 9109 on Deposited Plan 419061 (formerly known as Lot 9105 on Deposited Plan 404839) to create a foreshore reserve, the DER disclosed information regarding part of Lot 9109. Lot 9109 was reported to the DER under Section 11 of the Contaminated Sites Act 2003 (the Act) in May 2013.

A portion of Lot 9109 (approximately 1.14 hectares), formerly known as the Eastern Turning Circle (ETC), was sub-leased by Cristal Pigment Australia Ltd (Cristal) and comprised of a bituminised road which was utilised by trucks accessing the former Waste Residue Disposal Facility. The DER reported that TSR from the Waste Residue Disposal Facility was previously used as road base along the ETC. As such, in 2013 all road base, and up to one metre of natural soils located beneath the road base was removed from Lot 9109. The disposal of this material was undertaken in compliance with the Interim Site Management Plan (ISMP) associated with Lot 9077 and supporting documentation (including Auditor correspondence) entitled "Dalyellup Facility, Interim

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Site Management Plan (v.8): Site Consolidation – Earthmoving works, August 2013". Based on conclusions provided by the auditor's report the DER concurred that no further investigations or management of contamination was required at Lot 9109.

The PSI (RPS, 2016) was completed, and the findings accepted by the DWER who classified the site as "report not substantiated" in March 2018. The site was subsequently reported to the DWER by a member of the community who claimed to have visually identified TSR in Area 8. DWER attended site and confirmed the presence of the TSR in localised areas within Area 8 and ETC as shown in Figure B (DWER, 2020) (Appendix A). The presentation of this new information and the appeal of the classification by a member of the public triggered the involvement of the CSC. An appeal report was submitted to the CSC by DWER on 2 December 2018. In October 2020 the committee determined that there was sufficient evidence to conclude that there should be further investigation on site and that the appeal should be upheld and the site classified as *possibly contaminated - investigation required* (CSC, 2020) (Appendix A). Subsequent to this the DWER reclassified the site on 6 November 2020 (DWER, 2020). However, the classification does not cover Minninup Road (Figure B) as there was "no evidence that TSR was used for its construction or repair" (DWER 2020), which supports the DWER reclassification of *not contaminated – unrestricted use* in 2019 (DWER 2019) (Appendix A). DWER however has requested that visual confirmation that TSR was not used in Minninup Road is undertaken.

The DSR search results together with documentation related to WAPC Application and the DWER Contaminated search database results are provided in Appendix 6 of the PSI (RPS, 2016). The Basic Summary of Records (BSR) for the reclassification of Lot 9077 is presented in Appendix G.

5.2.1.2 Surrounding Land

A search of the DWER online Contaminated Sites Database within a 1 km radius of the site identified one registered contaminated site:

Lot 9077 was historically used as the Dalyellup Waste Residue Disposal Facility from 1989, which was licenced for the disposal of Treated Solid Residue (TSR) from the production of titanium dioxide pigment. A closure notice was issued from DWER in May 2013. Lot 9077 was found to have impacts within soils and groundwater and remedial activities were undertaken. The site was subsequently reclassified by DWER in February 2018 as "remediated for restricted use". The search results are presented in Appendix 6 of the PSI (RPS, 2016).

5.2.2 Prescribed Licences Search

No historical or current land uses have been identified that would require prescribed licences.

5.2.3 Controlled Waste

A request was placed with the DWER to conduct a Historical Controlled Waste Licence Record Search for the site, and the response indicates that there are no known such records of relevance to the site. Search results are presented in the PSI/SAQP (RPS, December 2017).

5.2.4 Dangerous Goods Licences

A search of the Department of Mines, Industry Regulation and Safety (DMIRS) *Dangerous Goods Site Report* viewer system indicated that there are no current or former dangerous goods licences registered to the site.

A search of nearby dangerous goods licenses was completed, which identified two dangerous goods licenses in close proximity to the site:

- Minninup Road located approximately 650 m north of the site held by Water Corporation for the storage of toxic gases (chlorine) and corrosive substances (sodium hydroxide) used in the treatment of wastewater.
- Minninup Road South located approximately 500 m north of site held by Water Corporation for the storage of toxic gases (chlorine). The license was closed in 2009.

The search results are presented in Appendix H.

5.3 Historic Photographs

A review of historic aerial photography held by Landgate was undertaken, which yielded aerials of the site dating back to 1977. The observed historic development and activities at the site are summarised in Table 5 below and photographs are presented in Appendix I.

Table 5: Historical aerial summary

Year	Onsite	Surrounding Area
1977	Site consists of undeveloped remanent bushland.	Surrounding land is undeveloped with some clearing towards the east.
1982	No significant changes from 1977.	No significant changes from 1977.
1983	No significant changes from 1982.	No significant changes from 1982.
1988	No significant changes from 1983.	No significant changes from 1983.
1996	The north-eastern section of the site has been cleared of native vegetation. A sump is present on the north-west section of Lot 9076, which appears to be man-made as it was not present when site was undeveloped. Several tracks are present within the site. The ETC area has been cleared. No evidence of TSR disposal onsite observed	North: uncleared native vegetation and further north the Dalyellup Wastewater Treatment Plant present. West: Vegetation has been cleared for the DWRDF. Several stockpiles of waste are observed within the cleared area.
2001	South-east: Maidment Parade is present and appears to be sealed. The communications tower and ancillary building have been constructed, along with an access track. No evidence of TSR disposal onsite observed	South and east: Significant clearing for urban residential development is observed. South: A man-made lake can be observed directly south east of the site. West: Pipework for discharge of the TSR slurry is evident on the DWRDF
2003	South: Minninup Road is present and appears to be unsealed, further south uncleared native vegetation. South-east: The man-made wetland appears to be constructed. No evidence of TSR disposal onsite observed	South and east: Significant urban residential development is observed. West: Southern ponds on the DWRDF have been rehabilitated.
2006	East: uncleared native vegetation. Area 8 south of the eastern turning circle appears to be revegetated. No evidence of TSR disposal onsite observed	North: Two wastewater storage tanks associated have been constructed north of the site. South and east: Significant urban residential development is observed.
2008	Vegetation has regrown in Area 8. ETC is still in use and no areas of disturbance are noted from 2006. No evidence of TSR disposal onsite observed	South and east: Significant urban residential development is observed. West: DWRDF is present with tailings ponds evident. Tailings appear to be confined to this area.
2010	A track is present in the eastern section of Lot 9076 running in a north to south direction just off Minninup Road. Another track is present ending in a turning circle just off Maidment Parade with some earthmoving equipment and stockpiles of soil around the sump which may potentially indicate filling has potentially occurred in the area. No evidence of TSR disposal onsite observed	No significant changes
2013	The ETC has been removed and now consists of unsealed sands with several stockpiles present in the southernmost area. Stockpiles appear to contain some organic matter (branches and roots). A dump truck is observed moving in the ETC. Firebreak has been cut to the western side of Area 8 No evidence of TSR disposal onsite observed	West: The DWRDF has been decommissioned and the waste stockpiles have been capped with clean sands. Telecommunications tower has been constructed north of the ETC and Minninup Road.

2015	Stockpiles located at the southern end of the ETC are no longer visible. Material is likely to have been used during rehabilitation works for the DWRDF. ETC has been covered in organic matter, regrowth has started in the ETC.	West: The DWRDF capping has been completed. No further activity is visible in aerials.
2017	Slow plant regrowth visible in Area 8 and ETC.	Minor urban development in surrounding areas. No further activity is visible in aerials.
2019	Slow plant regrowth visible in Area 8 and ETC.	Minor urban development in surrounding areas. No further activity is visible in aerials.

Based upon the historical aerial review, no further area could be identified where tailings from the DWRDF may have been used and as such no additional areas of the site are considered to require investigation.

5.4 Previous Investigations

5.4.1 Interim Site Management Plan, Site Consolidation – Earthmoving Works (Cristal, August 2013)

The following key points are noted from this report:

- Cristal ceased operations at the Dalyellup residue disposal facility on 1 March 2013. The Shire of Capel
 had commissioned a human health and ecological risk assessment to determine if the facility could be
 redeveloped into sporting fields.
- The primary objective of the Interim Site management Plan was to consolidate the site using a preliminary earthworks program which included returning the ETC to its former state as required by the lease agreement. The works included removal of the ETC road and groundwater bores were left on site as ongoing groundwater monitoring was required.
- Appendix L of the report included a Hydrogeological Assessment (HA) conducted by Environmental Resources Management Australia Pty Ltd (ERM) in June 2012. The HA summarised hydrogeological conditions at the former Dalyellup residue disposal facility. Chromium and chloride concentrations above screening levels exist in the shallow portion of the aquifer.

5.4.2 Radiation Site Survey for the Eastern Turning Circle, Dalyellup (Radiation Professionals, 2013)

The following key points are noted from this report:

- Radiation Professionals completed a gamma survey to assess radiation levels in the ETC area following the remediation works. The objective of the radiation survey was to "determine the success (or lack of) for the rehabilitation of the area".
- The scope of work for the gamma survey comprised gamma radiation monitoring across the area on a 20 m × 20 m grid spacing, with the southern portion of the survey area being undertaken on 10 m × 10 m grid spacing.
- The results from the gamma survey show that "rehabilitation of the area has been successful in returning the gamma radiation levels to within the natural background of the area (0.10 µGy h⁻¹)".

5.4.3 Dalyellup Waste Residue Disposal Facility, Eastern Turning Circle Validation (GHD, February 2014)

The following key points are noted from this report:

GHD Pty Ltd (GHD) was engaged by Cristal to complete validation sampling at the ETC. The validation
was required to characterise the final cover material (sand) which was intended to be used on the ETC
where treated solid residue (TSR) was previously used as road base material.

- The objective of the validation program was to investigate whether the final cover material of the ETC was of natural origin/background condition.
- During the Dalyellup Waste Residue Disposal Facility operational phase, the ETC being bitumen sealed, was used by incoming trucks to dispose of the TSR. The road base on the ETC comprised of potentially contaminating material including TSR. Prior to the validation sampling, the top 1 m of material (including the bitumen surface and road base) was excavated.
- Soil investigations were undertaken with 23 grid-based boreholes advanced to a maximum depth of 0.5 mbgl within the ETC area (approximately 1.14 ha). Soil samples were collected at each sampling location at two intervals, at 0.1 mbgl and at 0.5 mbgl.
- During soil sampling, no evidence of TSR was noted on soil or bitumen. No visual or olfactory signs of contamination were observed. The report mentioned about Photoionisation Detector (PID) readings being provided on bore logs, however no readings were recorded on logs.
- Samples were sent to the laboratory for metals analysis (aluminium, arsenic, barium, beryllium, cadmium, cobalt, chromium (III+VI), chromium (hexavalent), copper, lead, manganese, nickel, selenium, thorium, tin, titanium, uranium, vanadium and zinc). Laboratory results confirmed that no analyte concentrations exceeded the NEPM (NEPC, 2013) adopted criteria for ecological investigation levels for urban residential public open space and human investigation levels for public open space such as parks, playgrounds, playing field, secondary schools and footpath (HIL-C).
- Based on the results from validation sampling it was concluded that the surface materials to a depth of 0.5 mbgl, were representative of natural material. No further investigation or management of this area was required.

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Figure 1 Borehole locations reproduced from Figure 2, GHD February 2014

5.4.4 Mandatory Auditor's Report, Dalyellup Tailings Facility (AECOM, July 2015)

The following key points are noted from this report:

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- Jason Clay was commissioned by Cristal to present a Mandatory Auditor's Report (MAR) associated with the contaminated site investigations undertaken at the Dalyellup Tailings Facility located on Lot 9077 on Deposited Plan 60716 and Part Lot 9102 on Deposited Plan 401230.
- The MAR overall purpose was to confirm that the investigations undertaken adequately characterised the
 contamination status of "the site"; to confirm whether potentially significant risks to human health, the
 environment or environmental values exist on or off site; to confirm the suitability of the ETC for the then
 proposed end use (i.e. recreational public open space) and recommend a classification under the
 Contaminated Sites Act 2003.
- A number of potential sources of contamination were identified associated with the TSR material, which
 was used within the ponds at the site. At the ETC, no analytes were detected at concentrations exceeding
 the adopted ecological and human health guidelines.
- The Auditor was satisfied that the information provided within the report was generally complete, accurate and sufficiently compliant with relevant guidelines and regulations.

5.4.5 Preliminary Site Investigation Lots 8019, 9105 and 9076, Greenpatch Development (RPS, November 2016)

The following key points are noted from this report:

- Soil results
 - Trial pit locations were targeted to areas of potential based on historical aerial review and visual observation while on site. Trial pit locations and correlated site features are shown in Figure I to the rear of this report.
 - All samples analysed for metals and metalloids were below assessment criteria. All samples analysed for BTEX and TRH were below LOR. No ACM was identified within soils analysed from the potential filling area therefore no samples were submitted for laboratory analysis for asbestos fibres.
 - No physical or analytical evidence of contamination was identified.

Groundwater

- Groundwater across the site and outside the site is relatively consistent in pH, being slightly acidic to neutral, with salinity being fresh to marginal at bore location CRISTAL to the west of the site. With the exception of hexavalent chromium, dissolved metal concentrations are relatively consistent across the site and of those in the Perth's superficial aquifer2, and as such are considered reflective of natural conditions on site.
- Low pH in groundwater was observed across the site with concentrations slightly below FWG (Freshwater Guidelines) and MEPG (Marine Ecosystem Protection Guidelines).
- All organic contaminants, i.e. TRH and BTEX were below the limits of reporting and as such below relevant guidelines.

Conclusions

- Total chromium in groundwater was identified above long-term irrigation guidelines (LIWG). Given LIWG was exceeded for total chromium concentrations groundwater abstraction shall be restricted. In the context of the proposed development, it was considered unlikely that individual premises will operate domestic groundwater abstraction, it was considered more likely that scheme/mains water will be utilised by future residents for this purpose. In the event that groundwater shall be used for the purpose of irrigation of landscaped areas/gardens, it is recommended that additional groundwater sampling is undertaken to determine its suitability for the proposed use.
- Based on the findings of the soil and groundwater sampling, RPS consider that the site is suitable for the proposed residential development, with the recommendation that further groundwater sampling is completed should groundwater be proposed for irrigation or construction purposes.

5.4.6 Area 8 Former TSR Waste Facility in Dalyellup, Western Australia Capping Material Validation Sampling (GHD, 2018)

The following key points are noted from this report:

- The investigation was undertaken after a member of the public indicated the potential presence of TSR within the site.
- Based upon aerial photography, the northern portion of the Area 8 may have been used for stockpiling activities. The management requirements for the waste facility require at least 2 m of capping over any TSR
- Eight boreholes (Figure 2 below) were advanced to 3.5 mbgl and no evidence of clay/TSR was identified
 in bore holes.
- No chemical analysis was undertaken during the assessment.



Figure 2 Area 8 sampling locations (GHD, 2018)

5.4.7 Survey of Dalyellup Site Area 8 (Radiation Professionals, 2018)

The following key points are noted from this report:

- The radiation survey of Area 8 returned a mean dose rate of 0.12 \pm 0.03 μ Gy/h, with results ranging between 0.1 μ Gy/h and 0.16 μ Gy/h.
- These levels are in line with the background gamma dose rates for the area (0.13 \pm 0.03 μ Gy/h) and consistent with the range for the Swan Coastal Plain.
- Two samples of "tailings material" were collected during the survey and were analysed for radiation activity. The samples returned a total activity of 16.6 ± 4 Bq/g and 16.2 ± 4.2 Bq/g and as such are not classified as radioactive material (>30 Bq/g) in Western Australia under the Radiation Safety (General) Regulations 1983 (Government of Western Australia, 1983).
- The sampling locations are not noted in the report although a gamma measurement location is noted as being "near exposed tailings". This location recorded the highest gamma radiation dose rate (0.16 μGy/h). The location of the measurement point, based upon the GPS coordinates in the report, is presented below in Figure 3.

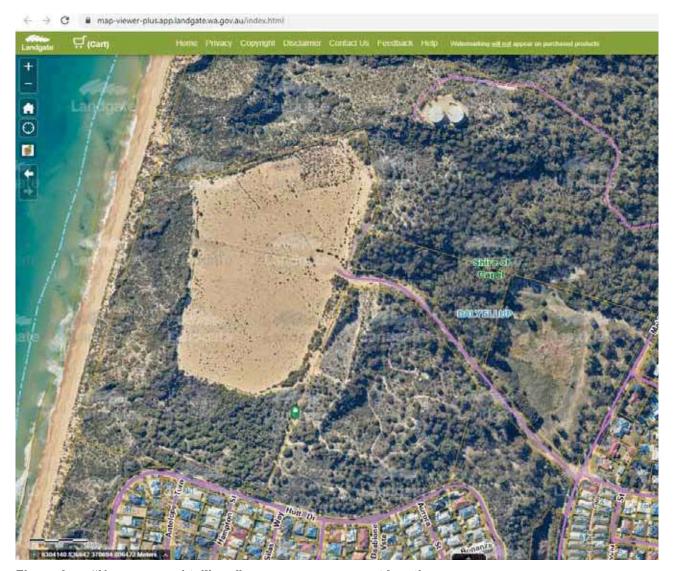


Figure 3 "Near exposed tailings" gamma measurement location

5.4.8 Tronox Pigments Bunbury Ltd: Former Dalyellup Waste Residue Facility Site Management Plan (SMP) (GHD, October 2019 Rev.8)

Monitoring of radiation, soil and groundwater has been undertaken at the site since the early 1990s, along with other investigations and risk assessments since 2001. These assessments have identified the following:

- The TSR is generating saline leachate with a salt plume migrating from the site. There is no evidence of an adverse impact to the relevant marine receptor.
- Potential for sustained discharge of metals (Chromium VI and vanadium) at concentrations above the relevant ecological assessment criteria is considered very low.
- Concentrations of contaminants of potential concern within capping material were below relevant Health Investigation levels for public open space.
- Concentrations of metals in capping material exceeded relevant Ecological Investigation Levels however are unlikely to enter the marine environment at elevated levels.

The purpose of the SMP is to document the overall management framework for the site to address the residual risks (human and ecological) associated with the ongoing intended use of the site as endemic bushland. The SMP set out the following ongoing monitoring and reporting requirements to support the management framework:

Groundwater monitoring

- Bi-annual monitoring of shallow (14 bores) and quarterly monitoring of single deep bore (Yarragadee aquifer). Monitoring to include an annual radiation survey across all wells.
- Annual gamma radiation survey of the site.
- Annual targeted weed spraying.
- Quarterly visual inspection of the capping surface to monitor capping layer integrity and dune stabilisation.

An annual environmental report including all ongoing monitoring results to be prepared by Tronox and submitted to DWER.

5.4.9 Dalyellup Annual Environmental Report-2019 (Tronox, 2019)

As part of the SMP (GHD, 2019 Rev.8) and the DWRDF Ministerial Conditions, an annual environmental report (EAR) is to be prepared and submitted to DWER, reporting on the findings of the work, assessment of groundwater flow and quality, any trends and ongoing risks. The EAR reported the following key findings:

- Assessment of monitoring data, including from bores DM9D and DM9S, located on the site, indicates that
 the operation of the solid residue facility results in minimal environmental impacts.
- No significant levels of dioxins and furans were found in the groundwater samples, however an anomalous sample in a background bore requires further review.
- The main drinking water supply from the Yarragadee aquifer remains unaffected by the site.
- Since the cessation of the facility in 2013, monitoring bores down-gradient of the leachate plume are generally trending to lower concentrations of contaminants. The plume is moving slowly, with natural attenuation predicted to be achieved within the next 25-30 years.
- Trends, as reported in Table 1 of the EAR, show that DM9D had peaked levels of Chromium VI in 2012-2014 and 2016, however the past few years the levels have decreased and stabilised. The concentrations remain above the ADWG.
- Hydrological studies have confirmed that the groundwater flow is towards the sea and therefore any contamination is moving away from the residential areas to the east and south of the site.

The EAR also provides evidence that Tronox is undertaking ongoing groundwater monitoring in accordance with the ongoing site management plan for the former DWRDF. Monitoring for 2020 has also been completed by Tronox and will be present in the next EAR for the DWRDF prepared by Tronox. This was an action required under the DWER site reclassification letter (DWER, DMO 10781, 6 November 2020).

Radiological monitoring conducted in 2019 is also discussed in the report, with the following key findings noted;

- Independent consultants, Radiation Professionals, conduct an annual survey of the site. A Radiological Council Western Australia (RCWA) approved radiation monitoring program has been implemented by Tronox.
- A rehabilitation program was initiated which includes periodic radiation surveys to ensure that the site is returned to natural background radiation levels for the area.
- Based on the most recent gamma dose rate-in-air, the results clearly show that the gamma radiation levels are consistent with the natural background gamma radiation levels expected in the area and pose no radiological health issues to the public or the environment.
- The average gamma dose rate for the rehabilitated area was 0.13 μGy/h. The results are within the statistical variation of last years' results and are typical for the background gamma dose rate levels for the Perth Coastal Plain.
- The maximum radon and thoron airborne activity concentrations measured, < 20 Bq/m3 (radon) and 29 ± 14 Bq/m3 (thoron) up to August 2019, do not indicate any correlation between summer and winter sampling periods. Overall, concentrations indicate that radon and thoron activity levels are low and pose no radiological health issues to members of the public or the environment.
- The highest recorded reading of Ra-226 was 0.157 Bq/L for monitoring bore DM9-A and the highest recorded reading for Ra-228 was 0.270 Bq/L for monitoring bore DM2C. These results do not exceed the National Water Quality Guideline trigger value of 0.5 Bq/L [5]. Data gathered during the routine monitoring for 2019 suggests that there is no leaching of radionuclides into the surrounding areas.

• The Radiological Council of Western Australia (RCWA) have reiterated that the radiological risk to the community is low and does not support a buffer zone to the east of the site.

5.5 Integrity Assessment

The information used to determine the history of the site was sourced from reputable reference documents. The databases maintained by various governments and agencies can often contain high quality information however it should also be noted that sometimes these databases contain no information relevant to the project.

Aerial photographs provide high quality information that is generally independent of memory or documentation. They are only available at intervals of several years, so some gaps exist in the information from this source.

Specific features visible in the photography are open to different interpretations and can be affected by the time of day and time of year at which they are taken, as well as specific events such as flooding. Care has been taken to consider different possible interpretations of aerial photographs and to consider them in conjunction with other lines of evidence.

6 CONTAMINATION STATUS

6.1 Potential Sources of Contamination and Contaminants of Concern

Information collected from historical data review and site activities has identified the following sources and associated contaminants of concern. The metal suite has been derived metals that are associated with TSR as discussed in the *Dalyellup Facility, Final Closure Plan Remediation-Validation-Ongoing Management Closure Report* (Cristal, 2013).

Additionally, radionuclides can be concentrated in certain tailings from mineral sand processing, which have been used/disposed at the site. Given the presence of the Dalyellup WWTP and the presence of a low-lying swamp area with known filling, nutrients were considered potential contaminants of concern.

Therefore, the potential contaminants of concern are:

- Metals (Ag, Al, As, B, Ba, Be, Cd, Co, Cr (speciated), Cu, Hg, Mn, Mo, Ni, Pb, Se, V, Zn)
- Radionuclides Thorium and Uranium
- Hydrocarbons (groundwater and surface only)
- Radiation
- Total Nitrogen (TN), Total Kjeldahl Nitrogen (TKN), ammonia, Total Phosphorous (TP), Reactive Phosphorous (RP), nitrite and NO_X

6.2 Radiation

Radiation surveys have also been previously completed within the site and the surrounding the site. The Mandatory Auditor's Report - Dalyellup Tailing Facility (AECOM, 2015) indicates that for the ETC, rehabilitation of the area has been successful in returning the gamma radiation levels to within the natural background of the area (0.10 μ Gy/h). In addition, a radiation survey of Area 8 in 2018 (Radiation Professionals, 2018), indicated that gamma radiation levels were within the natural background of the area and consistent with those on the Swan Coastal Plain and samples of TSR assessed as part of the study were not classed as radioactive.

A radiation survey has not been considered within this report, however, as detailed in the SAQP (RPS, 2021) if abundant TSR or TSR products were identified onsite during the investigation, RPS would re-assess the radiation risk and complete a survey or radiation activity analysis if necessary. If a radiation survey was required the Radiological Council was provided a copy of all relevant reports for review, prior to submission to DWER.

The site walkover and the soil investigation identified (further information is presented in Sections 9.1 and 9.2), no TSR during the site walkover, only a small volume of dilute blended TSR (1:9 TSR to sand ratio) in Area 8 and ETC and sand was identified at the southern end of the ETC. The blended TSR contains significantly concentrations lower radionuclides and therefore a lower radiation exposure risk. As such the potential risk for radiation is considered low and acceptable and the findings of previous radiation surveys are supported by the findings of the onsite investigation. Therefore, no additional radiation surveys are considered to be required and the site is considered suitable for the proposed land use of residential and public open space.

However, after discussions with the CSA RPS has completed radiation activity analysis on two samples taken from the blended TSR identified during the DSI field program. The results of the analysis supported the above approach. Results are presented in Section 9.2.4.3.

Based upon the above information, radiation will not form part of the conceptual site model and not considered further within the report.

6.3 Preliminary Conceptual Site Model and Risk Assessment

Consistent with NEPM (NEPC, 2013), a preliminary conceptual cite model (CSM) has been developed for the site for human health and ecological risks as presented in Table 6.

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RPS has adopted a risk-based approach to the assessment of the site. An important thread throughout the overall process of risk assessment is the need to formulate and develop a conceptual model, which supports the identification and assessment of pollutant linkages. A CSM represents the characteristics of the site in a diagrammatic or written form that shows the possible relationships between contaminants, pathways and receptors (pollutant linkages). In this context, the following definitions apply:

- **Contaminant source** a substance that is in, on or under the land and has the potential to cause harm to human health or the environment, or cause pollution of controlled waters.
- Pathway a route or means by which a receptor can be exposed to, or affected by, a contaminant.
- **Receptor** in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body.

Each of these elements can exist independently, however they create a risk only in instances where a plausible linkage exists, such that a particular contaminant may affects a particular receptor through a particular pathway; referred as a pollutant linkage.

Table 6: Preliminary Conceptual Site Model – Greenpatch

Source	Pathway	Receptor	Comments
Human Health Risk			
Soil Contamination Metals Radionuclides	Soil ingestion	On-site current / future users (construction	Incidental ingestion of contaminated soil is a potential pathway for on-site human receptors
	Dermal contact	workers and residents)	Dermal contact with contaminated soils is a potential pathway for site users including future construction workers and residents
	Dust inhalation	On-site current / future users (construction workers and residents)	Contaminated soils may become airborne providing a potential pathway for onsite and localised off-site workers and residents
	Migration to groundwater and or surface water	Off-site current / future users	Contaminated soils may leach to the superficial aquifer providing a pathway for migration off-site and subsequent direct contact / uptake and ingestion by off-site human receptors.
Groundwater Contamination Metals Radionuclides	Incidental ingestion/dermal contact (irrigation)	On-site current / future users (construction workers and residents)	Incidental ingestion and dermal contact are potential pathways for site users including future construction workers and residents, via abstraction of groundwater for irrigation purposes
HydrocarbonsNutrients	Consumption of contaminated groundwater	Current and Future site residents Off-site residents	Site will be connected to Water Corporation scheme/mains water supply
	contaminated	Consumers (future/current) of produce	 A moratorium on groundwater abstraction is anticipated for the development, prohibiting the abstraction of groundwater for potable / non- potable use. This would be consistent with the surrounding development.
			 Groundwater should not be consumed without tested and or treatment (DoH, 2016)
			 There are currently no residents and due the restricted future land use of the rehabilitated Dalyellup Solid Waste Residue Facility, will be no residents down hydraulic gradient of the site to abstract water.
Surface water Contamination Metals Radionuclides Hydrocarbons Nutrients	Incidental ingestion/dermal contact	Current and Future site residents	Incidental ingestion and dermal contact are potential pathways for site users including future residents, via contact with surface water bodies. This risk is considered low as use of the surface water body to the south east for recreational purposes will not be promoted, and no other surface water body will remain on the site following development, thus limiting the potential for primary or secondary contact with the surface water.
Ecological Risk			
Soil Contamination Metals Radionuclides	Vertical migration to groundwater and or surface	Underlying aquifer	Previous RPS investigations (RPS, 2016) identified the soil to be generally sand. As such, soils contaminated with metals and radionuclides have the potential to leach into the underlying superficial aquifer and or surface water bodies.
	Lateral migration of impacted soil via surface water runoff	Wetlands	The site has varied topography due to being comprised of a dune system. It is therefore possible that impacted soil can migrate on-site and off-site through surface water runoff.
	Plant uptake	Flora (on and off site)	The presence of metals and radionuclides within soils at the site may present a pollutant linkage to terrestrial flora via uptake within the rootzone.

	Ingestion (following plant uptake)	Fauna (on and off site)	The subsequent consumption of contaminated flora may present a pollutant linkage to terrestrial fauna. Exposure via ingestion contaminated soil may biomagnify through the food chain impacting higher order predators.	
	Soil ingestion / dermal contact	Fauna (on and off site)	The presence of metals and radionuclides within soils may present a pollutant linkage to terrestrial fauna via ingestion and direct dermal contact with soil.	
Groundwater Contamination Metals Radionuclides Hydrocarbons	Lateral migration through underlying aquifer	Off-site aquifers/Indian Ocean Aquatic flora and fauna	groundwater may pose a risk to aquatic flora and fau	
	Plant uptake Ingestion (following plant uptake)	Terrestrial flora and fauna	The presence of metals and radionuclides within groundwater may present a pollutant linkage to terrestrial fauna via ingestion of contaminated vegetation which have interacted with contaminated groundwater.	
	Bioaccumulation and biomagnification in the food chain	Aquatic flora and fauna Terrestrial flora and fauna	There is the potential for bioaccumulation and biomagnification of contaminants in aquatic and or terrestrial flora and fauna as a result of leaching of contaminants from soil into groundwater.	
Surface water Contamination • Metals • Radionuclides • Hydrocarbons	Uptake / consumption by aquatic flora and fauna.	Aquatic flora and fauna	The presence of metals and radionuclides within groundwater may pose a risk to aquatic flora and fauna in surface waters.	
	Bioaccumulation and biomagnification in the food chain		There is the potential for bioaccumulation and biomagnification of contaminants in aquatic flora and fauna as a result of leaching of contaminants from soil into groundwater, which discharges into surface water.	

7 DATA QUALITY OBJECTIVES

This section provides an overview of the data quality objectives (DQO) for the soil and groundwater sampling program in accordance with the guidance provided in NEPC 2013 and AS 4482.1. The DQO process should:

- Clarify study objectives.
- Define appropriate types of data to collect.
- Specify the tolerable levels of potential decision-making errors.

The assessment of the DQO is centred on seven distinct steps based upon the USEPA (2006) Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4, which is provided in Table 5 below. The objectives are in accordance with the PARCC (Precision, Accuracy, Representation, Completeness and Comparability) principles and indicators.

Table 7: Data Quality Objectives

DQO Description

Step 1: State the problem

RPS has been previously engaged by Satterley to complete a Preliminary Site Investigation with limited soil and groundwater assessment in 2016. The findings of the report were accepted by DWER and classified as *report not substantiated* with no further management of the site required in relation to contamination.

A member of the community claimed to have visually identified TSR from the Cristal site located within the Cristal ETC, subsequently the site was reported to DWER. As a result of this, DWER attended the site and visually identified TSR in localised areas within Area 8 and ETC including a band of TSR measuring 10 cm in thickness was identified along the open face of the rehabilitated dunes (DWER, 2020). The site classification was appealed and in October 2020 the Contaminated Sites Committee determined that there was sufficient evidence to conclude that there should be further investigation on site and that the appeal should be upheld and the site was reclassified as *possibly contaminated investigation required* (CSC, 2020). The classification does however not cover Minninup Road as there was "no evidence that TSR was used for its construction or repair" (CSC, 2020), which supports the DWER reclassification of not contaminated – unrestricted use in 2019 (DWER, 2019) (Appendix A).

The DQOs were to:

- review historical aerials for any potential areas of disturbance on site prior to any works to inform the
 development of the SAQP and ensure all areas of concern are investigated no additional areas
 were identified
- complete visual survey to confirm the absence of TSR
- ensure sufficient soil samples are collected to determine whether TSR was present within the ETC and Area 8 and.
- if TSR was present, ensure that adequate samples are collected to assess the potential risk to human health and the environment (if any) from the site receptors i.e. current and future site uses (residential and construction workers)
- visually assess soil beneath Minninup Road to determine the presence/absence of TSR
- ensure sufficient groundwater and surface water samples were collected to assess the potential risk to human health and the environment (if any) from the site receptors i.e. current and future site uses (residential and construction workers)

In accordance with the NEPM (NEPC, 2013) reporting requirements for a SAQP, it was necessary to identify team members and project task scheduling as part of the DQO process. This has been addressed in Section 5 of the SAQP (RPS, 2021).

Step 2: Identify the decision/goal of the study

The purpose of this investigation was to assess for potential contamination of TSR within the ETC and Area 8 and Minninup Road and impacts to groundwater from onsite and offsite sources within the Greenpatch development from potentially contaminating activities by Cristal.

- If TSR was determined to be located on site, the following study question has been identified:
 - Does the contamination at the site currently present an unacceptable risk to human and ecological receptors (current and future users)?
- If contaminated groundwater and or surface water is determined to be located on site, the following study question has been identified:
 - Does the contamination at the site currently present an unacceptable risk to human and ecological receptors (current and future users)?

In the event that plausible pollutant linkages exist, management measures will be required to mitigate the risk to an acceptable standard.

RPS recognises that the DSI is a dynamic document, and as such findings on site may require adjustment to the proposed sampling locations, depths, methodologies and or laboratory analytical suite. Any variations to the SAQP will be addressed and implemented in consultation with the CSA where considered relevant.

Step 3: Identify inputs into the decision

Does the contamination at the site currently present an unacceptable risk to human and ecological receptors (current and future users)?

To address the above the following data was considered necessary:

- 1. A review of the historical aerial photography to direct the field sampling program. No additional areas were identified
- 2. Undertake trial pitting within the ETC and Area 8 to natural soils and visually inspect each wall of the trial pit for the presence of TSR.
- 3. Take samples of the soil for laboratory analysis as per Section 8.4.
- 4. Assess the soil analysis to determine whether concentration of relevant contaminants of concern exceed relevant guidelines and if this potentially presents an unacceptable risk to human and ecological receptors.
- 5. Undertake soil cores within Minninup Road and visually inspect each core for the presence of TSR.
- 6. Sample groundwater and surface water for laboratory analysis as per Section 8.6 and 8.7, respectively.

Appropriate analytical methods used by National Association of Testing Authorities (NATA) accredited laboratories exist which provide the necessary data to resolve the principal study question. Detailed discussion of field and laboratory quality assurance and quality control (QAQC) measures that will ensure that the data collected is representative of site conditions is presented in Section 8.8.

Step 4: Define the Study Boundaries

Based upon the previous PSI (RPS, 2016) and communications from the DWER, the study boundary is comprised of Lots 8019, 9109 (previously 9105), 9076 and a portion of 9077 (Minninup Road) in Dalyellup (Figure A). However, based upon the previous PSI (RPS, 2016) and communications from the DWER, the onsite investigations will be limited to underlying soils of the Eastern Turing Circle, Area 8 and Minninup Road within the Greenpatch development (Figure B).

Step 5: Develop a decision rule

A component of the DQO process for the soil, surface water and groundwater assessment was to compare analytical results with criteria provided in the following guidance:

- National Environmental Protection (Assessment of Site Contamination) Measure 1999 Guideline on Investigation Levels for Soil, surface water and groundwater (NEPC, 2013)
- Health Screening Levels for Petroleum Hydrocarbons in Soils and Groundwater (CRC CARE, 2011)
- Assessment and management of contaminated sites (DWER, 2014)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)
- Canadian Soil Quality for the Protection of Environmental and Human Health, (Canadian Council of Ministers for the Environment, 2016).

Soil samples were collected utilising a mechanical excavator to complete test pits.

Groundwater samples were collected from existing groundwater bores using low-flow techniques (bladder pump).

Surface water samples were collected from surface water bodies onsite using grab methods.

Analysis was undertaken at National Association of Testing Authorities (NATA) accredited laboratories, using NATA accredited analytical methods where available (Appendix J).

To enable application of the aforementioned guideline values, further soil characterisation data was required to develop site-specific assessment criteria for various analytes. The additional soil characterisation data that was collected included; soil pH (calcium chloride extraction), cation exchange capacity (CEC) and clay content. Such site-specific data aids to reduce the conservative aspect of NEPM screening levels.

Where a sample exceeded the adopted criteria, a site-specific assessment was made as to the risk posed by the identified contaminant(s). Following completion of the DSI assessment, it may be necessary to undertaken additional assessment/s in order to fully delineate the extent of the soil impact. RPS proposed sampling methodology however aims to reduce the potential for additional assessments.

Step 6: Specify performance or acceptance

criteria

Initial comparisons were with individual data, then summary statistics (including mean, standard deviation and 95% upper confidence limits, UCLs of the mean (NEPC, 2013) to assess potential risks posed by soil contamination.

Quality control results were assessed according to their Relative Per cent Difference (RPD) values. For field duplicates, triplicates and laboratory duplicates, RPDs should generally be below 30%; for field blanks and rinsates values should be at or less than the limits of reporting (Standards Australia, 2005, NEPC, 2013).

Two types of decision errors exist:

Two types of decision entries exis

- Sampling Error; where the sampling program does not adequately detect the variability of a contaminant across the site, i.e. samples are not representative of site conditions
- Measurement Error; during sample collection, handling, preparation, analysis and data reduction.

The combination of both types of error is referred to as "total study error". Decision error can be controlled through the use of hypothesis testing so as to show either that the baseline condition is false (and therefore the alternative condition is true) or that there is insufficient evidence to indicate that the baseline condition is false (therefore, by default the baseline condition is true). The burden of proof is placed on rejecting the baseline condition, as the test hypothesis structure maintains the baseline condition as being true until evidence indicates otherwise. The null hypothesis is an assumption assumed to be true in the absence of contrary evidence, e.g. that impact at the site is present unless demonstrated otherwise by soil, surface water and groundwater data complying with defined assessment criteria.

If a hypothesis that is proven is rejected, a Type 1 error is made.

If a hypothesis is accepted when otherwise evidence suggests it should be rejected, a Type 2 error is made.

Step 7: Develop the plan for obtaining data

The purpose of the sampling program was to document the nature and extent of TSR contamination with soil with the ETC, Area 8 and Minninup Road of the site, determine the contamination status of groundwater and surface water and ultimately to understand potential contamination risks both on site and to the surrounding areas, resulting from current and historical site activities.

The assessment program was reliant on professional judgement to identify and sample the potentially affected areas. In order to ensure that the requirements of NEPM (NEPC, 2013) and DER 2014 are fully addressed by the proposed investigation, the SAQP (RPS, 2020) was subjected to assessment by the CSA prior to the investigation works proceeding.

Further details regarding the proposed sampling plan for soil, groundwater, surface water and the Quality Control and Quality Assurance (QAQC) requirements are presented in Section 8.

8 SAMPLING AND ANALYSIS QUALITY PLAN

8.1 Overview

The SAQP (RPS, 2021) detailed the overall objectives of the investigation, providing methodologies and guidance to ensure that the data collected was representative of the site and addressed potential data gaps and uncertainties that were encountered. The SAQP included the development of DQOs and guidance for adequate quality assurance and quality control (QAQC) such that the data collected was reliable and able to be utilised to confirm or eliminate potential pollutant linkages that were identified during the PSI as detailed in the preliminary CSM (Section 6.3).

8.2 Guidelines

The sampling has been undertaken in accordance with the SAQP (RPS, 2021), developed with reference to the following documents:

- Assessment and management of contaminated sites (DER, 2014)
- National Environment Protection (Assessment of Site Contamination) Measure. Schedule B (2) Guideline on Data Collection, Sample Design and Reporting 1999, As Amended 2013 (NEPC, 2013).

8.3 Variation to the Sampling and Analysis Quality Plan

For various reasons, it was considered necessary to modify the procedures and methodologies that were detailed in the SAQP (RPS, 2020). While the variations to the SAQP were necessary, RPS considers that the overall objectives of the DSI were met. The variations are summarised in Table 8 below.

Table 8: Variations to the SAQP

Item	Description
Bore MW01	During the onsite investigation bore MW01 could not be located as the area surrounding the bore had been covered by sand. Therefore, groundwater samples were not collected from MW01.
Bores PB8 (JDA01), PB10 (JDA02) and MW02	Groundwater samples from three bores: PB8 (JDA01), PB10 (JDA02) and MW02, were collected using 1 L bailer because the bladder pump could not fit in the monitoring bore. At two bores (PB8 and PB10) the stick-ups were slightly bent at ground level, which prevented the bladder from passing. At the remaining bore (MW02) the PVC pipe was too narrow to fit the bladder pump.
Minninup Road	The SAQP proposed a visual inspection of soils underlying Minninup Road via soil cores. However, Tronox the owners of Minninup Road did not provide permission for RPS to complete the proposed soil cores prior to mobilisation to complete the balance of the site investigation. No assessment has been completed of Minninup Road, however it is noted that the road has been reclassified by DWER as "not contaminated – unrestricted use" as of August 2019 and on this basis the absence of further assessment of the road is not considered to impacted on the completeness of the investigation.
Presence of Light Non- aqueous Phase Liquids	An interface probe for determining the presence of LNAPLs was only used on bores DM1RS, DM1RD, DM9S and DM9D.
(LNAPLs)	A bailer was required to be used on the remaining bores (PB8 (JDA01), PB10 (JDA02) and MW02) and therefore any potential LNAPLs would have been observed in the bailer, during sampling. In addition, no physical evidence of hydrocarbons (visual or olfactory) was observed on any sampling equipment during the monitoring program.

8.4 Detailed Aerial Photography Review

Prior to undertaking the works onsite, as per the DQO (Table 7), a detailed review of aerial photography review was undertaken (Table 5).

No further area could be identified where tailings from the DWRDF may have been used and as such no additional areas of the site are considered to require investigation. Therefore no variations to the SAQP (RPS, 2021) in terms of additional investigation locations were required.

8.5 Soil Sampling

8.5.1 Sampling Objectives/Strategy

The objective of the soil sampling program was to assess the presence, nature, extent and magnitude of potential contamination associated with site activities, specifically the potential use of TSR within onsite soils. Soil samples were collected via a series of 24 test pits within the ETC and Area 8. The soil investigation was undertaken by experienced RPS Environmental Scientists briefed on the physical characteristics of TSR to assist in onsite identification. The lead scientist supervising the field investigation has over fifteen years experience in the assessment and remediation of contaminated land in Western Australia.

Soil sampling and analysis was undertaken in accordance with current international, national, state, local and company standards including but not limited to:

- Assessment and management of contaminated sites (DWER, 2014)
- National Environmental Protection (Assessment of Site Contamination) Measure: Investigation Levels for Soil and Groundwater (NEPC, 2013).
- Guide to the Sampling and Investigation of Potentially Contaminated Soil. Part 1: Non-volatile and Semi-volatile Compounds. AS 4482.1 (Standards Australia, 2005).

Soil sampling locations were primarily grid-based targeting the ETC and Area 8 within the site considered to be potentially impacted by TSR. Targeted sampling areas were identified based upon results of the site history information compiled through the desktop assessment, in combination with anecdotal information, laboratory data, and visual observations from the site walk overs by a community member. Sampling locations are presented on Figure F at the rear of this report.

During the trial pitting exercise, sampling locations where suspect TSR was identified were subject to an onsite soil sieving assessment, to identify any tailings or debris within the soil profile. A single 10 L sample per suspect TSR horizon within test pits was collected and passed through a 7 mm screen.

TSR is described as being a dark brown fine-grained clay and was considered to be visually distinct from the local geology of coarse to medium sands (GHD, 2018). A visual inspection of the site for the presence of TSR was also undertaken during the onsite investigations.

8.5.2 Sampling Intervals

Soil samples were proposed for collection utilising an excavator at the following depths:

- 0.00 to 0.15 mbgl
- 0.15 to 0.40 mbgl
- 0.40 to 0.70 mbgl
- 0.70 to 1.00 mbgl

The sampling intervals beyond 1.0 mbgl were 0.5 m, i.e. 1.0 to 1.5 mbgl.

Where geological units did not conform to the sampling intervals outlined above, one sample per lithological unit was collected with additional samples taken where visual or olfactory evidence of contamination be identified.

8.5.3 Sampling Depths

Trial pits were excavated to the proposed depth of 3.0 m bgl, or to 0.5 m below the base of any fill soils. The soil assessment was terminated once the Field Scientist was confident that the base of the fill has been proven and where possible the minimum 0.5 m of underlying natural virgin soil profile encountered. Sampling depths are detailed in Appendix K at the rear of this report.

On occasions where visual or olfactory evidence of soil contamination was observed or the soil profile exhibited stratification outside the proposed soil sample frequency, sampling ranges were modified accordingly. Soil sample depths were amended in order to target areas of observed potential contamination within the soil profile.

8.5.4 **Selection of Samples for Analysis**

The selection process for sample analysis was proposed (RPS, 2021):

- A minimum of one sample submitted for laboratory analysis from each proposed sampling location for associated contaminants of concern as presented in Section 6.1.
- The uppermost sample submitted for laboratory analysis at each location, typically representing the interval where the greatest level of contamination was expected or where TSR or discoloration of the soil was observed.
- Samples collected and not initially submitted for analysis were placed on hold and submitted for additional analysis where vertical delineation was considered necessary. All samples were held in storage by the laboratory under appropriate conditions.
- Where visual or olfactory evidence of contamination was identified, a specific sample of that material was collected and analysed.

8.5.5 Soil Analysis Program

The analytical suite is presented in Table 9. The primary laboratory was MPL with ALS assuming the role of the secondary laboratory. NATA accreditation, limits of reporting and relevant holding time information is present in Appendix J.

Table 9: Analytical Suite

Area

Eastern Turning Circle and Area 8

Analytical Suite •

- Metals (Ag, Al, As, B, Ba, Be, Cd, Co, Cr (speciated), Cu, Hg, Mn, Mo, Ni, Pb, Se, V, Zn)
- Radionuclides Thorium and Uranium

Additionally, select samples from each type of soil profile encountered onsite were submitted for the following analysis suite to determine relevant site-specific assessment levels as per NEPC (2013):

The additional soil characterisation data that will be collected soil pH (calcium chloride extraction),

- cation exchange capacity (CEC), and
- clay content.

The above analysis was undertaken on seven primary samples to characterise soil across the investigation areas.

Two samples with elevated radionuclide concentrations were selected for radiation analysis of the following radionuclides:

- Total activity
- Radionuclides (Ra-226, Ra-228, Th-228 and Pb-210)

8.5.6 Soil Assessment Levels

In accordance with the SAQP (RPS, 2020), soil results were compared to the following criteria adopted from the current investigation:

- National Environment Protection (Assessment of Site Contamination) Measure. Schedule B1 Guideline on Investigation Levels for Soils and Groundwater (NEPC, 2013)
 - Human Health Investigation Levels Residential sites with garden/accessible soil (HIL-A)
 - Ecological Investigations Levels urban residential/public open space (EIL-A)

As NEPM contains no guidelines for Th and U, guidelines for these contaminants will be sourced from:

- Canadian Soil Guidelines (2016) for residential/parkland use Uranium
- Mean background concentration of Thorium (Wollenberg and Smith, 1990).

Total radiation activity concentrations were compared to values from:

Radiation Safety (General) Regulations 1983 (Government of Western Australia, 1983).

Where other contaminants did not have assessment levels and or alternative assessment levels could not be sourced, i.e. international guidance from Canada or the Netherlands (ANZECC, 2000), contaminant levels within the site were compared with results from the background sampling locations and or reported literature concentrations for the area.

Additionally, the results of the heavy metal and radionuclide analysis will be compared to the mean chemical composition of TSR produced by the Cristal Kemerton Plant from 2003 – 2009 (RPS, 2020). The TSR composition is provided in Table A-1 at the rear of this report.

8.5.7 Sampling Uncertainty

The soil sampling program was designed to minimise sampling uncertainty at the site by undertaking a targeted/judgemental sampling program from site history. Throughout the investigation process, an ongoing assessment was made as to whether any additional sampling and/or analytical testing was required when visual or olfactory evidence of contamination was observed during site works.

8.6 Groundwater Sampling

8.6.1 Sampling Objectives/Strategy

The objective of the groundwater sampling program was to assess the underlying groundwater quality across the site, and aims to assess the presence, nature, and magnitude of any potential groundwater contamination, to determine both groundwater levels and water quality. Groundwater samples were collected from a total of seven onsite groundwater bores.

Groundwater sampling and analysis was undertaken in accordance with current international, national, state, local and company standards including but not limited to:

- Water Quality—Sampling. Part 11: Guidance on Sampling of Groundwaters (Standards Australia. 1998. AS/NZS 5667.11:1998)
- Water Quality—Sampling. Part 1: Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples (Standards Australia. 1998. AS/NZS 5667.1:1998)
- Groundwater Sampling Guidelines (VEPA 2000).
- Assessment and management of contaminated sites (DER, 2014)
- National Environment Protection (Assessment of Site Contamination) Measure. Schedule B (2) Guideline on Data Collection, Sample Design and Reporting 1999, As Amended 2013 (NEPC, 2013)

Once established the groundwater quality was compared to published guidelines (NEPM 2013) in order to determine if the groundwater represents a potential risk to human health or the environmental which needs to be considered/managed in the context of the proposed land use.

8.6.2 Bore Construction and Location

RPS undertook groundwater monitoring from seven on site monitoring wells. The groundwater sampling locations included three bores (PB8 (JDA01), PB10 (JDA02) and DM9S (Cristal)) completed during the PSI (RPS, 2016) in addition to the following bores:

- DM9D
- DM1RS
- DM1RD

MW02

One bore (MW01) located adjacent to the Minninup Road was not sampled during the onsite investigation as the bore could not be located. Two bores (MW01 and MW02) were installed as part of Geotechnical Investigation conducted onsite (Galt, 2016), with DM09D, DM1RS and DM1RD forming part of the Dalyellup Waste Residue Disposal Facility ongoing groundwater monitoring program.

The screening levels of all groundwater bores sampled during the investigation were within the superficial aquifer. Groundwater screens in the western portion (DM9RS, DM9RD, DM1RS and DM1RD) of the site were placed between 39 to 46 mbgl. Screens were placed from 3 to 9 mbgl in bores on the eastern (PB8, PB10 and MW02) portion of the site (RPS, 2021). The groundwater well locations are presented on Figure F at the rear of this report. Construction details for the groundwater bores are presented in Appendix L.

8.6.3 Groundwater Level Measurement and Survey

Prior to groundwater purging and sampling, the groundwater level in each bore were measured using an electronic probe. The groundwater levels were used in the hydrogeological assessment of the site, including a contour diagram for the direction of groundwater flow across the site and are presented in Figure G at the rear of this report.

The seven groundwater bores sampled for this investigation were installed by:

- JDA PB8 and PB10.
- Galt MW01 and MW02 and
- GHD DM1RS, DM1RD, DM9S and DM9D,

All groundwater bores used during the investigation were previously installed by other consultants, however survey data for MW01 and MW02 was not detailed in the Galt report (Galt, 2016) and therefore were not used to determine groundwater contours (Figure G).

8.6.4 Presence of Light Non-aqueous Phase Liquids (LNAPLs)

Prior to groundwater purging and sampling, bores DM1RS, DM1RD, DM9S and DM9D were monitored for the presence of LNAPLs or separate phase product using an oil/water interface probe. The interface probe was not used on the remaining bores (PB8 (JDA01), PB10 (JDA02) and MW02) as a bailer was required to sample them due to kinks in the bores (PB8, PB10) and MW02 being to narrow for a bladder pump. The bailer was inspected for any LNAPLs and no LNAPLs were observed in any of the sampled bores. Additionally, no physical evidence of hydrocarbons (visual or olfactory) was observed on any sampling equipment during the monitoring program. Therefore, the fact that an interface probe was not used on these bores is not considered a significant issue or to have changed the outcomes or recommendations in the report.

8.6.5 Purging

Groundwater was purged and sampled at less than 1 L per minute using a low-flow bladder-pump or bailer, prior to sample collection. Purging was undertaken until the groundwater field parameters had stabilised (generally within 10%) measured with a multi-parameter meter. The following groundwater field parameters were collected onsite during purging:

- pH
- electrical conductivity (EC)
- oxidation-reduction (redox) potential
- dissolved oxygen (DO)
- temperature.

Low-stress (low-flow) purging, and sampling is recommended by VEPA (2000) as it returns samples that are considered most representative of aquifer conditions as disturbances that affect inorganic and organic contaminants are minimised. All purge water was collected in buckets and returned to the bore after sampling was completed. The groundwater stabilisation data was recorded on the groundwater sampling logs which are presented in Appendix M at the rear of this document.

Analysis was undertaken at a NATA accredited laboratory, using NATA accredited analytical methods. The primary laboratory was MPL with ALS assuming the role of the secondary laboratory.

8.6.6 Groundwater Analysis Program

The analytical suite was selected based on the suite identified in the SMP (GHD, 2018) and is presented in Table 10. The primary laboratory was MPL with ALS assuming the role of the secondary laboratory. NATA accreditation, limits of reporting and relevant holding time information is present in Appendix J.

Table 10: Analytical Suite

Groundwater Bores

Analytical Suite •

- Dissolved metals¹ (Ag, Al, As, B, Ba, Be, Cd, Co, Cr (speciated), Cu, Hg, Mn, Mo, Ni, Pb, Se, V, Zn)
- . Anions and cations calcium, magnesium, potassium, sodium, chloride, sulfate and alkalinity
- Radionuclides Thorium and Uranium
- Total recoverable hydrocarbons (TRH)
- Benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN).
- Total Nitrogen (TN), Total Kjeldahl Nitrogen (TKN), total ammonia, Total Phosphorous (TP), Reactive Phosphorous (RP), nitrate as N, nitrite as N and nitrate and nitrite as N (NOx-N)

8.6.7 Groundwater Assessment Levels

Groundwater analytical results were compared to select criteria presented in the following:

- Assessment and Management of Contaminated Sites (DWER, 2014)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)
- Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (CRC CARE, 2011)
- National Environmental Protection (Assessment of Site Contamination) Measure: Investigation Levels for Soil and Groundwater (NEPC, 2013).

The assessment of groundwater was based on the beneficial use and management objectives of the proposed end use. The assessment levels adopted were selected to determine the potential human health risk through direct contact with contaminated groundwater due to abstraction or vapour intrusion.

In addition, the potential impact to ecological receptors located down hydraulic gradient was assessed, inclusive of irrigation bores associated with residential properties and public open spaces. As such, groundwater data will be compared to the following guidance criteria:

- Fresh Water Guidelines 95% Protection Level (FWG-95)
- Long-term Irrigation Water Guidelines (LIWG)
- Domestic Non-potable Guidelines (DNPG)
- Marine Water Guidelines 95% Protection Level (MWG-95)
- Health Screening Levels for Vapour Intrusion (HSL A&B).

The analyte concentrations were assessed against the ecological freshwater guidelines for a slightly moderately disturbed ecosystem (95% species protection). A slightly to moderately disturbed ecosystem was considered to best represent the prevailing ecosystem.

The Indian Ocean is located approximately 500 m hydraulically downgradient of the site and is a potential ecological receptor. Therefore, groundwater results were compared to marine water guidelines (95% species protection).

As the site and surrounding suburbs are connected to scheme water the use of groundwater as a potable water source was not considered a significant exposure pathway. Groundwater analytical results were

¹Groundwater samples were field filtered except at MW02 where filtration was not practical. When field filtering could not be completed samples were laboratory filtered.

therefore assessed against the non-potable and recreational use criteria, as this is most applicable to the potential receptors associated with ground water use for irrigation.

Groundwater was also compared against the HSLs for vapour intrusion in a residential setting, specifically between 2 to <4 m, considered the most relevant given the proposed residential end site use. A HSL checklist is included in Appendix N.

8.7 **Surface Water Sampling**

8.7.1 Sampling Objectives/Strategy

The objective of the surface water sampling program was to assess the underlying surface water quality across the site, and aims to assess the presence, nature, and magnitude of any potential surface water contamination. Surface water samples were collected from a total of two locations (SW01 and SW02) across the site.

Surface water sampling and analysis was undertaken in accordance with current international, national, state, local and company standards including but not limited to:

- Water Quality—Sampling. Part 1: Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples (Standards Australia, 1998, AS/NZS 5667.1:1998)
- Water Quality—Sampling. Part 4: Guidance on sampling from lakes, natural and man-made (Standards Australia. 1998. AS/NZS 5667.4:1998);
- Assessment and management of contaminated sites (DER, 2014)
- National Environment Protection (Assessment of Site Contamination) Measure. Schedule B (2) Guideline on Data Collection, Sample Design and Reporting 1999, As Amended 2013 (NEPC, 2013)

Once established the surface water quality was compared to published guidelines (NEPM 2013) in order to determine if the surface water represents a potential risk to human health or the environment which will need to be considered/managed in the context of the proposed land use.

8.7.2 **Surface Water Sampling Locations**

RPS collected surface water samples from a total of two locations from surface water bodies in the south east (SW01) and north east (SW02) corners of the site. Surface water sampling was undertaken using a grab sampler, with samples collected approximately 0.5 m below the surface of each water body. A multi-parameter meter was used to measure the following surface water field parameters:

- Hq
- Electrical conductivity (EC)
- Oxidation-reduction (redox) potential
- Dissolved oxygen (DO)
- Temperature
- Depth of the water column.

The surface water sampling locations are present in Figure F at the rear of this document and sampling logs presented in Appendix M.

8.7.3 **Surface Water Analysis Program**

The analytical suite is presented in Table 11. The primary laboratory was MPL with ALS assuming the role of the secondary laboratory. NATA accreditation, limits of reporting and relevant holding time information is present in Appendix J.

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Table 11: Analytical Suite

Surface Water

Analytical Suite

- Dissolved metals¹ (Ag, Al, As, B, Ba, Be, Cd, Co, Cr (speciated), Cu, Hg, Mn, Mo, Ni, Pb, Se, V, Zn)
- · Anions and cations calcium, magnesium, potassium, sodium, chloride, sulfate and alkalinity
- · Radionuclides Thorium and Uranium
- Total recoverable hydrocarbons (TRH)
- Benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN).
- Total Nitrogen (TN), Total Kjeldahl Nitrogen (TKN), total ammonia, Total Phosphorous (TP), Reactive Phosphorous (RP), nitrate as N, nitrite as N and nitrate and nitrite as N (NOx-N).

8.7.4 Surface Water Assessment Levels

Surface water analytical results were compared to select criteria presented in the following:

- Assessment and Management of Contaminated Sites (DWER, 2014)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)

Additionally, as surface water at the site was primarily considered to be an expression of local groundwater, the following guidelines were considered as part of the surface water assessment:

 National Environmental Protection (Assessment of Site Contamination) Measure: Investigation Levels for Soil and Groundwater (NEPC, 2013).

The assessment of surface water was based on the beneficial use and management objectives of the proposed end use. The assessment levels adopted will determine whether a potential human health or ecological risks exist through direct contact with contaminated groundwater due to surface water expression. As such, surface water data will be compared to the following guidance criteria:

- Fresh Water Guidelines 95% Protection Level (FWG-95)
- Long-term Irrigation Water Guidelines (LIWG)
- Domestic Non-potable Guidelines (DNPG)
- Marine Water Guidelines 95% Protection Level (MWG-95)

The analyte concentrations will be assessed against the ecological freshwater guidelines for a slightly moderately disturbed ecosystem (95% species protection). A slightly to moderately disturbed ecosystem is considered to best represent the prevailing ecosystem.

8.8 TSR Visual and Chemical Assessment

8.8.1 Insitu Soils

TSR is described as a being dark brown fine grained clay and is considered to be visually distinct from the local geology of coarse to medium sands (GHD, 2018). This description as used to visually identify TSR onsite with the any chemical analysis results compared to mean concentrations for the TSR deposited at the site, to determine whether material is TSR. A photo of each test pit has been included on the relevant soil log.

8.8.2 Site Walkover

Grid based site walkover was undertaken to determine the presence of TSR in any areas of disturbance areas on site or from potential areas identified in the historical aerial review. Areas assessed included Minninup Road, Area 8 the ETC and north eastern corner previously subject to trial pitting by RPS. Figure H shows the area of visual assessment.

¹ All surface water samples were field filtered.

8.9 Field and Laboratory QAQC

Details on project field and laboratory QAQC for all sampling is presented in Appendix O and is in line with the SAQP (RPS, 2021).

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9 INVESTIGATION RESULTS

9.1 Site walkover

RPS attended the site to complete a site walkover for visual indications of the presence of TSR outside of the ETC and Area 8 between 14 and 17 December 2020. The inspection was undertaken following completion of a detailed review of historical aerial photography to identify areas of disturbance onsite where TSR may have potentially been placed. The walkover was completed by experienced RPS Environmental Scientists and comprised of a walk over of the vacant land and an inspection of the tracks throughout the site.

The site characteristics were assessed in line with RPS' Standard Operating Procedures and completed in accordance with RPS' Health and Safety guidelines. The principal objectives of the TSR inspection were to document:

- Visual or olfactory evidence of possible contamination, with a focus on TSR
- Physical evidence of backfill / use of fill within the site
- Evidence of fly tipping / dumping, including possibly hazardous materials.

Figure A shows the location of the site, while Figure B shows the general site layout. At the time of inspection, the site features and characteristics observed were consistent with those identified from aerial imagery and available desktop information.

No visual indication of the presence of TSR was identified anywhere on the site outside of the ETC and Area 8

The general observations of the inspection are summarised in Table 12 below:

Table 12: TSR Inspection Summary

Observations

Plate

Area 8 and ETC

Area 8 and ETC consisted of regrowing natural vegetation. Some evidence of driving and unsealed tracks was present throughout. The ETC was sloped up towards the south. A large mound was observed within Area 8 on which vegetation was growing.



Plate 1 Area 8 mound, facing north west.

No surface expressions of TSR were observed during the site inspection.

No fly tipping was observed within either area.



Plate 2 ETC, facing north.

Remainder of site

Several unsealed tracks were observed throughout the site. The tracks were likely used by the local community for leisure.

The north east corner of the site had several unidentified mounds. This may indicate historic fill being brought onto site. However this area was previously assessed via trial pitting as part of the RPS PSI 2016 and no evidence visual or analytical was identified for the presence of any TSR or other contamination.



Plate 3 Unsealed track and mounds in north east corner, facing south west.

Limited fly tipping was observed across the site. Fly tipping consisted of general waste and car parts. Fly tipping was most common near Minninup road and within the cleared north east portion of the site.



Plate 4 Dumped car parts in north east corner, facing east

Some pieces of non-asbestos containing hardifence were observed throughout the north eastern corner of the site.



Plate 5 Hardifence in north east corner of site

9.2 Soil

9.2.1 Overview

A summary of the results of the soil investigation and laboratory analysis is provided below. Sampling was completed based on a desktop assessment of historical aerial photography supported by grid-based sampling.

Table A at the rear of this document presents the analytical results collected from test pitting locations, with the laboratory reporting in Appendix P and soil profile logs in Appendix K.

9.2.2 Synopsis

RPS attended site on 15 and 16 December 2020 to complete soil sampling within the ETC and Area 8. A summary of the soil sampling program completed is presented in Table 13 below:

Table 13: Soil Sampling Summary

Section	Sampling Locations	Analysis		
	Trial Pits (#)	Metals / Radionuclides	Metal Leachates	Soil Characterisation
ETC	15	19	1	5
Area 8	9	14	1	2
Total	24	33	2	7

A total of 33 samples, in addition to QAQC samples, were analysed for the following suite of contaminants:

- Heavy metals and metal leachates (As, B, Ba, Be, Cd, Cr, Co, Cu, Hg, Mo, Mn, Ni, Pb, Sb, Se, Sn, and Zn)
- Radionuclides (Th, U)

Two soil samples (TP14-S01 and TP18-S08) with elevated metal and radionuclide concentrations were submitted for the following metal leachate and radiation analysis:

Cr(VI), Ni, Pb and Se

- Total activity
- Radionuclides (Ra-226, Ra-228, Th-228 and Pb-210)

Additionally, select samples from each type of soil profile encountered onsite were submitted for the following analysis suite to determine relevant site-specific assessment levels as per NEPC (2013):

- soil pH (calcium chloride extraction),
- cation exchange capacity (CEC) and
- clay content.

The above analysis was undertaken on seven primary samples to characterise soil across the investigation areas. Where visual and or olfactory evidence of subject TSR was present, soils were subject to an on-site sieving assessment, to identify any tailings or debris within the soil profile. Results are provided in Table A-1 to A-3 at the rear of this report, with sample locations provided in Figure F.

9.2.3 Field Observations

The general soil profile encountered within the site during the soil investigation is given in Table 14 below with examples shown in Plate 6 to Plate 9. Detailed soil logs are presented in Appendix K.

Table 14: Soil Profile Observations

Area	Description
Eastern Turning Circle (ETC)	Yellow calcareous sand $(0.00-3.00 \text{ mbgl})$ occasionally overlaid by a pale brown (topsoil) layer up to 0.50 m thick, with some organics throughout. Some disturbed mixed grey / yellow sand profiles $(0.25-3.00 \text{ mbgl})$ were observed at the southern end of the ETC.
Area 8	Pale grey to brown topsoil $(0.00 - 0.50 \text{ mbgl})$ overlying mixed profiles of brown, grey and yellow sands $(0.50 - 3.00 \text{ mbgl})$.

Layers of a dark brown clayey silt were observed at six locations:TP14, TP15, TP17, TP18, TP19 and TP21 within the ETC and Area 8, with descriptions provided below:

- TP14: A lens of dark brown clayey silt was observed from 0.15 0.20 mbgl overlying mixed pale grey / yellow sands.
- TP15: A thin intermitted lens of brown slightly silty clayey sands from 1.00 1.10 mbgl overlying pale brown sands.
- TP17: A lens of dark brown clayey silt was observed from 0.40 0.70 mbgl overlying mixed yellow sands.
- TP19: A thin intermitted lens of dark brown clayey silt from 0.50 0.60 mbgl overlying pale grey sands.
- TP18: A layer of dark brown clayey silt was observed at depth (2.00 2.80 mbgl) between two layers of pale grey calcareous sands.
- TP21: A layer of dark brown clayey silt was observed from 1.60 2.00 mbgl overlying pale grey sands.



Plate 8 Yellow sands at TP01

Plate 9 Yellow sands at TP15

9.2.4 Contamination Assessment

9.2.4.1 Heavy Metals

All results were below the adopted guidelines with the exception of the following:

- The concentration of manganese exceeded the HIL-A guideline (3,800 mg/kg) in one sample; TP14-S01 at a depth of 0.15 0.20 m bgl with a concentration of 3,900 mg/kg. The manganese concentration in samples analysed directly below TP14-S01, TP14-S02 (0.2 0.4 m bgl) and TP14-S03 (0.4 0.7 m bgl) were below all adopted guidelines with concentrations of 80 mg/kg and 19 mg/kg respectively.
- The concentration of nickel exceeded the EIL-A guideline (30 mg/kg) in two samples; TP14-S01 (45 mg/kg) and TP18-S08 (37 mg/kg) at depths of 0.15 0.20 m bgl and 2.5 2.8 m bgl respectively. The nickel concentration in samples directly above and below TP14-S01, TP14-S02 (0.2 0.4 m bgl) and TP14-S03 (0.4 0.7 m bgl) were 2 mg/kg and 1 mg/kg respectively. Samples analysed above (TP18-S07, 2.0 2.5 m bgl) and below (TP18-S09, 2.8 3.1 m bgl) and TP18-S08 were below all adopted guidelines with concentrations of 6 mg/kg and 3 mg/kg respectively.

9.2.4.2 Radionuclides

All results were below the adopted guidelines except for the following:

 The concentration of thorium exceeded the mean background concentration (8.6 mg/kg) in two samples; TP14-S01 (80 mg/kg) and TP18-S08 (65 mg/kg) at depths of 0.15 – 0.20 m bgl and 2.5 – 2.8 m bgl respectively. The thorium concentration in samples below TP14-S01, i.e. TP14-S02 (0.2 – 0.4 m bgl) and TP14-S03 (0.4 – 0.7 m bgl) were 1 mg/kg and <0.5 mg/kg respectively. Samples analysed above (TP18-

S07, 2.0 – 2.5 m bgl) and below (TP18-S09, 2.8 – 3.1 m bgl) TP18-S08 were below all adopted guidelines with concentrations of 6 mg/kg and 3 mg/kg respectively.

9.2.4.3 Radiation assessment

A summary of the total radiation activity results of potential TSR compared to TSR tailing concentrations (Radiation Professionals, 2018) are presented in Table 15 below.

Table 15: Radionuclide results comparison

Analyte (Bq/g) ¹	Sample ID			
	Tailing 1	Tailing 2	TP14-S01	TP18-S08
Total activity	16.6±4.0	16.2±4.2	8.71 ²	4.74 ²
Radium-228	1.02±0.05	1.31±0.12	0.647	0.506
Radium-226	0.25±0.07	0.16±0.04	0.0852	0.0656
Lead-210	<0.10	<0.10	0.0298	0.0283
Thorium-228	1.8±0.49	1.74±0.42	0.64	0.527

¹ Becquerel (Bq). ² Total activity was calculated by summing the gross alpha and beta activity. Gamma radiation accounts for <1 % of total radiation activity in the relevant radionuclides (HPS, 2021).

The key information is summarised below:

- The tested material (TP14-S01 and TP18-S08) is not considered radioactive material as the total activity in both samples are significantly below the 30 Bq/g limit (Radiation Safety Regulations, 1983)
- Total activity concentrations observed in TP14-S01 and TP18-S08 are significantly lower than TSR tailing concentrations.
- Individual radionuclide activity concentrations in TP14-S01 and TP18-S08 are significantly lower than TSR tailing concentrations.

As the material at TP14-S01 and TP18-S08 contains significantly lower radionuclide activity, the material would therefore pose a lower radiation risk then straight TSR tailings. Laboratory analytical reports for this analysis are presented in Appendix P.

9.2.4.4 TSR Composition

The heavy metal and radionuclide composition of the dark brown clayey silt observed at TP14 and TP18 was compared to the average composition of TSR produced by the Cristal Kemerton Plant from 2003 – 2009 (RPS, 2021). The comparison is presented in Table 16 below.

Table 16: Potential TSR Comparison

Analyte	TSR*	TP14-S01	TP18-S08
	mg/kg	mg/kg	mg/kg
Al	34,000	3,900	3,300
As	3.5	8	7
Ва	540	46	34
В	20	5	5
Cd	0.6	<0.4	<0.4
Cr	3,090	250	230
Cr (IV)	8	46	60
Со	120	10	8
Cu	100	14	8
Hg	1.4	<0.1	<0.1

Mn	45,000	3,900	3,500
Ni	610	45	37
Pb	17	7	6
Se	3.1	3	3
V	9,070	610	530
Zn	70	23	15
Th	790	80	65
Ur	80	5	4

^{*} TSR produced by the Cristal Kemerton Plant between 2003 and 2009 (DEC, 2009)

The key information is summarised below:

- The ratio of heavy metal and radionuclide composition of TSR, TP14-S01 and TP18-S08 were comparable.
- The heavy metal and radionuclide concentrations observed in TP14-S01 and TP18-S08 were approximately 10% of TSR.
- Based on the observed concentrations, the dark brown clayey silt identified at TP14-S01 and TP18-S08 is likely a ~ 1:9 blended mixture of TSR:sand and not straight TSR.
- As the material contains significantly lower concentrations of U and Th, the material would therefore pose a lower radiation risk then straight TSR.

9.2.4.5 Landfill Classification

Impacted soils exceeding adopted guidelines were identified at two locations; TP14-S01 and TP18-S08. Both samples were compared to landfill guidelines (DWER, 2019) and submitted for Australian Standard Leachate Procedure (ASLP) analysis to determine the landfill classification of the material if offsite disposal was necessary. A summary of the landfill classification (Tables A-2 and A-3) is presented below:

- Concentrations of Cr(VI), Ni, Pb and Se at TP14-S01 and TP18-S08 exceeded the Concentration Threshold (CT) 1&2 criteria. Additionally, Ni concentrations exceeded the CT3 criteria at TP14-S01.
- Two samples; TP14-S01 and TP18-S08 were submitted for ASLP analysis of Cr (VI), Ni, Pb and Se.
- The concentration of Cr(VI) exceeded the ASLP1&2 criteria (0.5 mg/L) in TP18-S08 (0.87 mg/L).
- All other metal leachate results were below the relevant ASLP1&2 criteria for landfill classification. Therefore, the impacted soils at TP14-S01 and TP18-S08 are considered suitable for Class 1 and Class 3 disposal respectively and dependant on acceptance by the receiving landfill site.

9.2.5 Soil Contamination Summary

No significant widespread evidence of TSR and or soil contamination was observed within the ETC and Area 8, with exceedances of adopted guidelines limited to heavy metal (manganese and nickel) and radionuclide (thorium) impacts at two discrete locations (TP14 and TP18) within Lot 9109. Both exceedances occurred within layers of a dark brown clayey silt observed at TP14 and TP18. The observed concentrations of the materials metals and radionuclides were approximately 10% of the average TSR concentrations. In addition, as the blended TSR contains significantly lower concentrations of radionuclides and lower radiation activity, the material would therefore pose a lower radiation risk then straight TSR. Therefore, the observed material is likely the remnants a 1:9 mixture blend of TSR and sands that was not removed by Tronox when the remainder of the ETC and Area 8 was cleared and capped.

Whilst minor, isolated exceedances of the adopted guidelines for heavy metals and radionuclides were observed, the soils within the site do not present any human or ecological health risk in their current condition. However, the material may present a human health risk if it is disturbed during future developments of the site.

Fly tipped material identified during the site inspection is not considered a significant source of contamination, however materials will be removed during the initial phase of development earth works and is therefore not considered further in this report.

9.3 Groundwater

9.3.1 Overview

A summary of the results of the groundwater investigation and laboratory analysis is provided below.

Tables B and C at the rear of this document present the groundwater analytical results, with the laboratory reporting in Appendix O and groundwater stabilisation logs in Appendix M.

9.3.2 Synopsis

RPS attended site on 14 December 2020 to complete the proposed groundwater sampling program. A total of seven samples, in addition to QAQC samples, were analysed for the following suite of contaminants:

- Anions and cations calcium, magnesium, potassium, sodium, chloride, sulfate and alkalinity
- Radionuclides Thorium and Uranium
- Total recoverable hydrocarbons (TRH)
- Benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN).
- Total Nitrogen (TN), Total Kjeldahl Nitrogen (TKN), total ammonia, Total Phosphorous (TP), Reactive Phosphorous (RP), nitrate as N, nitrite as N and nitrate and nitrite as N (NOx-N).

Prior to sampling each groundwater bore was purged, with purging undertaken until the groundwater field parameters had stabilised. The groundwater stabilisation data was recorded on the groundwater sampling logs which are presented in Appendix L at the rear of this document. Laboratory results are provided in Tables B and C at the rear of this report, with sample locations provided in Figure F.

9.3.3 Groundwater Elevation and Flow Direction

Groundwater flow is in a generally westerly direction, with groundwater at 3.89 mAHD (PB8) in the eastern portion of the site and 1.75 mAHD (DM9S) located in the west of the site (Figure G). Hydrological studies from the AER (Tronox, 2019) confirmed that groundwater flow was in a westerly direction towards the coast. Survey data is presented in Appendix L.

9.3.4 Presence of LNAPL

No evidence of LNAPL was identified in any of the bores, via the use of an interface probe (bores DM1RS, DM1RD, DM9S and DM9D) or upon inspection of the water recovered in the bailer on bores PB8 (JDA01), PB10 (JDA02) and MW02. In addition, no physical evidence of hydrocarbons (visual or olfactory) was observed on any sampling equipment used during the monitoring program.

9.3.5 Physical Parameters

A summary of the relevant physical parameters observed during the December 2020 monitoring event are presented:

- Groundwater was noted to be marginally acidic to neutral, ranging between 6.38 (DM9D) and 7.36 pH units (PB10). The average pH of bores on the eastern portion of the site (PB8, PB10 and MW02) was marginally higher than bores on the western portion of the site (DM9S. DM9D, DM1RS, DM1RD) with average values of 7.26 and 6.74 pH units respectively. The pH in all bores was below the MWG-95 criteria (8.0 8.4 pH units) with four bores (DM1RS, DM1RD, DM9S and DM9D) falling below the FWG-95 criteria (7.0 8.0 pH units).
- Electrical conductivity measurements of groundwater on site ranged from marginal to brackish with values from 780 (PB8) to 3,000 μS/cm (DM1RS). A mean of 1,454 μS/cm was observed across site indicating groundwater salinity is marginal (DoE, 2005). Based upon the observed measurements there is potential for saline water ingress within the western bores, especially around DM1RS. All measurements observed onsite are considered a reflective of natural groundwater conditions.

• Variable dissolved oxygen concentrations were observed throughout the bores network with values ranging from 0.42 mg/L (DM9D) to 5.54 mg/L (PB10). DO concentrations were marginally higher on the eastern boundary and were typically anaerobic with the exception of DM9D. Redox values were typically positive with lower negative value observed in two bores; DM1RD (-99 mV) and DM9D (-62 mV).

9.3.6 Dissolved Metals and Metalloids

A summary of the dissolved metals and metalloids results for the groundwater monitoring event is presented below:

- The concentrations of aluminium, arsenic, boron, barium, beryllium, cadmium, cobalt, chromium (total and III), copper, mercury, manganese, molybdenum, nickel, lead, selenium, silver, vanadium and zinc concentrations were below the adopted guidelines during the monitoring event.
- The concentration of Cr (VI) exceeded the FWG-95 (0.001 mg/L), MWG-95 (0.0044 mg/L) and LIWG (0.1 mg/L) criteria in one bore (DM9S) with a concentration of 0.18 mg/L. Elevated Cr (VI) concentrations (0.12 mg/L) have been observed in DM9S during previous monitoring events (RPS, 2016). All concentrations were below the DNPG (0.5 mg/L). The Cr (VI) concentrations in all other bores were below the laboratory LOR
- The concentration of iron exceeded the LIWG (0.2 mg/L) in two bores; DM1RD (0.57 mg/L) and DM9D (20 mg/L).

9.3.7 Radionuclides

A summary of the radionuclide results for the groundwater monitoring event is presented below:

- Thorium concentrations were below the relevant limit of reporting (0.0005 mg/L) within all bores.
- Uranium concentrations were below all adopted criteria.

9.3.8 Anions and Cations

A summary of the anion and cation results for the groundwater monitoring event is presented below:

• The concentration of chloride exceeded the DNPG (250 mg/L) in two bores; DM1RS (600 mg/L) and DM9D (260 mg/L). The average concentration across all bores was 237 mg/L.

9.3.9 Nutrients

A summary of the nutrient results for the groundwater monitoring event is presented below:

- The concentration of total nitrogen exceeded the MWG-95 (0.23 mg/L) in all bores during the monitoring event. Additionally, the FWG-95 (1.5 mg/L) was exceeded in three bores; DM1RS, DM9S and MW02 with MW02 also exceeding the LIWG (5 mg/L). Total nitrogen concentrations ranged from 0.3 mg/L (DM9D) to 8.5 mg/L (MW02) with an average of 2.2 mg/L across all bores, which exceeds the MWG-95 and FWG-95.
- The concentration of NO_x as N exceeded the MWG-95 (0.005 mg/L) in all bores except DM9D (<0.005 mg/L). Additionally, the FGW-95 (0.1 mg/L) was exceeded in four bores; DM1RS, DM9S, MW02, PB10(JDA02) with a maximum concentration of 2.3 mg/L (MW02) and an average of 1.0 mg/L across all bores, which exceeds the MWG-95 and FWG-95.
- The concentration of total ammonia as N complied with the relevant guidelines in all bores. An average concentration of 0.083 mg/L was observed across the site with a maximum concentration of 0.33 mg/L (DM1RD).
- The concentration of total phosphorous exceeded the MWG-95 (0.02 mg/L) and FWG-95 (0.06 mg/L) criteria in all bores except DM9S (0.005 mg/L). A mean concentration of 0.28 mg/L was observed across all bores with a maximum of 1.4 mg/L (MW02), both of which exceed the MWG-95 and FWG-95.

• The concentration of phosphate as P exceeded the MWG-95 (0.005 mg/L) in all bores except three: DM1RD, DM9D and MW02 (all <0.005 mg/L). Additionally, DM1RS (0.056 mg/L) and DM9S (0.033 mg/L) and exceeded the FWG-95 (0.03 mg/L), with DM1RS also exceeding the LIWG (0.05 mg/L).

9.3.10 BTEXN and TRH

All BTEXN and TRH concentrations were below or marginally higher than the laboratory LOR and thus below all adopted guidelines.

9.3.11 Groundwater Summary

Groundwater is marginally acidic to neutral and marginal to brackish in salinity. Metals are typically below the relevant guidelines with the exception of Cr(VI) (DM9S) and iron (DM1RD and DM9D). Elevated nitrogen and phosphorus concentrations exceeding LIWG, FWG and MWG were observed in all bores. No hydrocarbon species were identified in any of the bores.

Based on the results of this investigation, groundwater is not suitable for long term irrigation or domestic non-potable use.

9.4 Surface Water

9.4.1 Overview

A summary of the results of the surface water investigation and laboratory analysis is provided below.

Table D and E at the rear of this document presents the surface water analytical results, with the laboratory reporting in Appendix P and surface water stabilisation logs in Appendix M.

9.4.2 Synopsis

RPS attended site on 17 December 2020 to complete the proposed surface water sampling program. A total of two samples, in addition to QAQC samples, were analysed for the following suite of contaminants:

- Dissolved metals (Ag, Al, As, B, Ba, Be, Cd, Co, Cr (speciated), Cu, Hg, Mn, Mo, Ni, Pb, Se, V, Zn)
- Anions and cations calcium, magnesium, potassium, sodium, chloride, sulfate and alkalinity
- Radionuclides Thorium and Uranium
- Total recoverable hydrocarbons (TRH)
- Benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN).
- Total Nitrogen (TN), Total Kjeldahl Nitrogen (TKN), total ammonia, Total Phosphorous (TP), Reactive Phosphorous (RP), nitrate as N, nitrite as N and nitrate and nitrite as N (NO_X-N)

The surface water stabilisation data was recorded on the sampling logs which are presented in Appendix M at the rear of this document. Laboratory results are provided in Tables D and E at the rear of this report, with sample locations provided in Figure F

9.4.3 Physical Parameters

A summary of the relevant physical parameters observed during the December 2020 monitoring event are presented:

- Surface water was noted to be marginally alkaline and consistent between surface water sampling locations ranging from 7.45 (SW01) to 7.55 pH units (SW02). The pH in both surface water sampling locations was below the MWG-95 criteria (8.0 8.4 pH units).
- Electrical conductivity measurements of surface water on site ranged from fresh to marginal with values from 320 (SW01) to 1,200 (SW02) μS/cm. A mean of 760 μS/cm was observed across site indicating surface water is fresh (DoE, 2005).

• Surface water was anaerobic with dissolved oxygen concentrations ranging from 3.23 mg/L (SW01) to 6.86 mg/L (SW02). Redox values were positive at both surface water sampling locations with concentrations of 4 mV (SW02) and 59 mV (SW01) observed.

9.4.4 Dissolved Metals and Metalloids

A summary of the dissolved metals and metalloids results for the surface water monitoring event is presented below:

- The concentrations of aluminium, arsenic, boron, barium, beryllium, cadmium, cobalt, chromium (total, III and VI), copper, mercury, manganese, molybdenum, nickel, lead, selenium, silver, vanadium and zinc concentrations were below the adopted guidelines during the monitoring event.
- The concentration of iron exceeded the LIWG (0.2 mg/L) at SW01 with a concentration of 0.44 mg/L.

9.4.5 Radionuclides

The concentration of thorium and uranium were below the laboratory LOR and therefore all adopted guidelines in both surface water samples.

9.4.6 Anions and Cations

The concentrations of all anions and cations were below all adopted guidelines.

9.4.7 Nutrients

A summary of the nutrient results for the surface water monitoring event is presented below:

- The concentration of total nitrogen exceeded the MWG-95 (0.23 mg/L) in both sampling locations and the FWG-95 (1.5 mg/L) in one location (SW01) with a concentration of 1.6 mg/L.
- The concentration of total phosphorous exceeded the MWG-95 (0.02 mg/L) and FWG-95 (0.06 mg/L) in one location (SW01) with a concentration of 0.19 mg/L.
- All other nutrient concentrations were below relevant guidelines.

9.4.8 BTEXN and TRH

All BTEXN and TRH concentrations were below all relevant limits of reporting and thus below all adopted quidelines.

9.4.9 Surface Water Summary

Surface water is neutral to slightly alkaline and fresh to marginal in salinity. Metals were typically below the relevant guidelines with the exception of iron in SW01. No radionuclides were observed in surface water samples. Some elevated nutrient concentrations were observed at SW01. Based on these results surface water does not appear to have been significantly impacted from surrounding landuses including the pump station, from a contaminant perspective.

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10 REVISED RISK ASSESSMENT

10.1 Contaminants Identified

10.1.1 Guideline Exceedances

A summary of the analytes that were found to exceed the adopted guideline criteria for soil, surface and groundwater are provided in Table 17 below:

Table 17: Summary of Guideline Exceedances

Section	Location	COPC	Criteria Exceeded	Concentration
Soils				
ETC – Lot	TP14-S01	Manganese	HIL-A (3800 mg/kg)	3,900 mg/kg
9109		Nickel	EIL-A (30 mg/kg)	45 mg/kg
		Thorium	MBC (8.6 mg/kg)	80 mg/kg
Area 8 – Lot	TP18-S08	Nickel	EIL-A (30 mg/kg)	37 mg/kg
9109		Thorium	MBC (8.6 mg/kg)	65 mg/kg
Groundwater				
Upgradient -	MW02	Iron	LIWG (0.2 mg/L)	20 mg/L
Lot 9076 and Lot 8019		Total Nitrogen	LIWG (5 mg/L) FWG-95 (1.5 mg/L) MWG-95 (0.23 mg/L)	8.5 mg/L
		NO _x as N	FWG-95 (0.1 mg/L) MWG-95 (0.005 mg/L)	2.3 mg/L
		Total Phosphorous	FWG-95 (0.06 mg/L) MWG-95 (0.02 mg/L)	1.4 mg/L
		рН	MWG-95 (8.0-8.4 pH units)	7.23
	PB8(JDA01)	Total Nitrogen	MWG-95 (0.23 mg/L)	0.7 mg/L
		NO _x as N	MWG-95 (0.005 mg/L)	0.059 mg/L
		Total Phosphorous	FWG-95 (0.06 mg/L) MWG-95 (0.02 mg/L)	0.11 mg/L
		Phosphate as	MWG-95 (0.005 mg/L)	0.012 mg/L
		рН	MWG-95 (8.0-8.4 pH units)	7.18
	PB10(JDA02)	Total Nitrogen	MWG-95 (0.23 mg/L)	1.2 mg/L
		NO _x as N	FWG-95 (0.1 mg/L) MWG-95 (0.005 mg/L)	0.94 mg/L
		Total Phosphorous	FWG-95 (0.06 mg/L) MWG-95 (0.02 mg/L)	0.1 mg/L
		Phosphate as P	MWG-95 (0.005 mg/L)	0.011 mg/L
		рН	MWG-95 (8.0-8.4 pH units)	7.3
Downgradient	DM1RS	Chloride	DNPG (250 mg/L)	600 mg/L
– Lot 9109		Total Nitrogen	FWG-95 (1.5 mg/L) MWG-95 (0.23 mg/L)	2.1 mg/L
		NO _x as N	FWG-95 (0.1 mg/L) MWG-95 (0.005 mg/L)	2.0 mg/L
		Total Phosphorous	FWG-95 (0.06 mg/L) MWG-95 (0.02 mg/L)	0.08 mg/L
		Phosphate as P	LIWG (0.05 mg/L) FWG-95 (0.03 mg/L)	0.056 mg/L

			MWG-95 (0.005 mg/L)	
		pH	FWG-95 (7.0–8.0 pH units)	6.9
		Pii	MWG-95 (8.0-8.4 pH units)	0.0
	DM1RD	Iron	LIWG (0.2 mg/L)	0.57 mg/L
		Total Nitrogen	MWG-95 (0.23 mg/L)	0.8 mg/L
		NO _x as N	MWG-95 (0.005 mg/L)	0.006 mg/L
		Total Phosphorous	FWG-95 (0.06 mg/L) MWG-95 (0.02 mg/L)	0.09 mg/L
		рН	FWG-95 (7.0-8.0 pH units) MWG-95 (8.0-8.4 pH units)	6.9
	DM9S	Chromium (VI)	FWG-95 (0.001 mg/L) MWG-95 (0.0044 mg/L) LIWG (0.1 mg/L)	0.18 mg/L
		Total Nitrogen	FWG-95 (1.2 mg/L) MWG-95 (0.23 mg/L)	1.9 mg/L
		NO _x as N	FWG-95 (0.1 mg/L) MWG-95 (0.005 mg/L)	1.9 mg/L
		Phosphate as P	FWG-95 (0.03 mg/L) MWG-95 (0.005 mg/L)	0.033 mg/L
		рН	FWG-95 (7.0-8.0 pH units) MWG-95 (8.0-8.4 pH units)	6.9
	DM9D	Chloride	DNPG (250 mg/L)	260 mg/L
		Iron	LIWG (0.2 mg/L)	20 mg/L
		Total Nitrogen	MWG-95 (0.23 mg/L)	0.30 mg/L
		Total Phosphorous	FWG-95 (0.06 mg/L) MWG-95 (0.02 mg/L)	0.16 mg/L
		рН	FWG-95 (7.0-8.0 pH units) MWG-95 (8.0-8.4 pH units)	6.4
Surface Water				
South – Lot 8019	SW01	Iron	LIWG (0.2 mg/L)	0.44 mg/L
		Total Nitrogen	FWG-95 (1.5 mg/L) MWG-95 (0.23 mg/L)	1.6 mg/L
		Total Phosphorous	FWG-95 (0.06 mg/L) MWG-95 (0.02 mg/L)	0.19 mg/L
		рН	MWG-95 (8.0-8.4 pH units)	7.5
North - Lot	SW02	Total Nitrogen	MWG-95 (0.23 mg/L)	0.5 mg/L
9076		рН	MWG-95 (8.0-8.4 pH units)	7.6

10.1.2 TSR

RPS completed a site inspection between 14 and 17 December 2020. The inspection was undertaken by experienced RPS Environmental Scientists and comprised of a walk over of the vacant land and an inspection of the tracks throughout the site. No evidence of surface expressions of TSR outside of the ETC and Area 8 (Lot 9109) was observed during the inspection.

10.1.2.1 Lot 9109

During the soil investigation, material resembling TSR was identified at six locations: TP14-S01, TP15-S05, TP17-S03, TP18-S08, TP19-S03 and TP21-S06. The material consisted of a dark brown clayey silt observed as a discrete layer near the surface (TP14, TP17 and TP19) and at depth (TP15, TP18 and TP21). However, only soils at TP14 and TP18 exceeded adopted guidelines for contaminants associated with TSR. Heavy metal and radionuclide concentrations at TP15, TP17, TP19 and TP21 were relatively consistent with natural and

capping layer soils. The concentrations of heavy metals and radionuclides within TP14-S01 and TP18-S08 were approximately 10% of concentrations observed in TSR. Total radiation activity in TP14-S01 and TP18-S04 were significantly lower than TSR tailings. As such the material observed is considered likely to be a blended mixture of TSR and sands, not pure TSR material and therefore poses a lower risk, including that from radiation exposure than TSR.

The site inspection and soil investigation findings are also supported by the fact TSR was trucked to the DWRDF in tanks as a slurry and gravity feed from tanker truck through pipelines from the northern end of the ETC to the waste residue cells, thereby limiting the potential for TSR to be used elsewhere onsite (GHD, 2018). In addition, the Ministerial conditions for the DWRDF dictate that the final waste height of TSR must be RL 24 m (GHD, 2018). As such, liquid TSR could not have been disposed of at the ETC and or Area 8 in the top 2-3 m given Area 8 has an elevation of ~33 mAHD and the lowest section of the ETC ~26 mAHD, and therefore any disposal would have been in breach of the Ministerial conditions for the DWRDF.

10.1.2.2 Lot 9076 and Lot 8019

No evidence of surface expressions of TSR were observed during the inspection.

10.2 Human Health Risk Assessment

10.2.1 Soil

10.2.1.1 Lot 9109

Elevated concentrations of thorium and manganese were observed in two locations across the site (TP14-S01 and TP18-S08).

These impacted soils are not considered a risk to human health in their current condition as the exceedances were isolated and / or identified at depth, thereby limiting exposure, and therefore the risk of exposure is considered low. However, impacted materials may be disturbed during the proposed development of the site which would provide a pathway for the contaminants to affect on-site users. RPS recommends that impacted soils are excavated and disposed off-site to remove the potential future risk.

Given the marginal nature of the non-conformances, no significant human health risk has been identified in onsite soils with Area 8 and the ETC.

10.2.1.2 Lot 9076 and Lot 8019

No evidence of TSR was observed during the site inspection of Lot 9076 and Lot 8019. Additionally, based on desktop review of historical aerials and previous investigations it is unlikely that TSR is present within the eastern lots (9076 and 8019).

Therefore, in Lots 9076 and 8019 there is no human health risk associated with onsite soils.

10.2.2 Groundwater

10.2.2.1 Lot 9109

The concentration of chloride exceeded non-potable use guidelines in two bores, DM1RS and DM9D. Therefore, groundwater is not suitable for domestic non-potable use without prior treatment for salinity. However, the exceedance of NPUG (chloride) is associated with aesthetic values of the water and therefore the potential risk to human health is low.

In addition, groundwater was not considered to pose a risk to human health as the source-pathway-receptor was considered incomplete for the following reasons:

- The site will be connected to Water Corporation scheme/mains water supply
- A moratorium on groundwater abstraction from the shallow superficial aquifer is anticipated for the development, prohibiting the abstraction of groundwater, including for construction. This would be consistent with the surrounding development.

There are currently no residents on the site and due to the restricted future land use of the rehabilitated DWRDF, there will be no residents down hydraulic gradient of the site to abstract water.

10.2.2.2 Lot 9076 and Lot 8019

No human health quidelines were exceeded in any bores within Lot 9076 or Lot 8019.

10.2.3 Surface Water

No surface water bodies are located within Lot 9109, therefore no samples were taken and there is no associated risk.

10.2.3.1 Lot 9076 and Lot 8019

Surface water is not considered a human health risk as no relevant human health guidelines were exceeded in surface water samples during the investigation. The risk of incidental ingestion and dermal contact, via contact with surface water bodies is considered low as use of the surface water body to the south east for recreational purposes will not be promoted. Additionally, with the exception of the irrigation link in the south east corner of the site, no other surface water body will remain on the site following development, thus limiting the potential for primary or secondary contact with the surface water.

10.3 Environmental Risk Assessment

10.3.1 Soil

10.3.1.1 Lot 9109

The concentration of nickel in soils marginally exceeded ecological health guidelines at two locations (TP14-S01 and TP18-S08). The exceedances were not considered an ecological health risk given the following considerations:

- The lowest environmental soil quality guidelines are based on soil contact data, relevant to the most sensitive ecological receptors being plants and invertebrates (CCME 2014).
- The elevated nickel concentrations in soils were both marginal and isolated in nature and were not observed within the natural sands across the ETC and Area 8. This suggests that any contamination is restricted to the dark brown clayey silt layer.
- The area where the exceedances were identified will be cleared of vegetation during development.
- RPS recommends that impacted soils are excavated and disposed off-site, thereby removing any
 potential ecological risk.

10.3.1.2 Lot 9076 and Lot 8019

No ecological exceedances in soil were observed within Lot 9076 and Lot 8019. Therefore there is no ecological risk associated with soils in Lot 9076 and Lot 8019.

10.3.2 Groundwater

10.3.2.1 Lot 9109

Concentrations of Cr(VI) exceeded the MWG-95, FWG-95 and LIWG guideline criteria at a single location (DM9S) with iron exceeding the LIWG at two locations (DM1RD and DM9D). Nutrients exceeded ecological guidelines in bores across the site. Additionally, all bores ((DM1RS, DM1RD, DM9S and DM9D) within Lot 9109 were below the pH criteria for marine water and freshwater criteria.

Groundwater is not suitable for long-term irrigation; however, these exceedances were not considered an ecological risk for the following reasons:

- The long-term irrigation screening levels are generally based on maintaining agricultural productivity and minimising off-farm movement or leaching of potential aquatic contaminants. No commercial produce will be grown on the site. The LIWG for iron is based on fouling of irrigation infrastructure through a growth of bacteria and iron staining, and as such does not present an environmental risk.
- With the exception of the Cr(VI) concentration in DM9S, groundwater conditions were consistent entering
 and leaving the site. Buried blended TSR products within the site may be leaching into the superficial
 aquifer as, the concentration of Cr(VI) in DM9S is comparable to leachate concentrations of nearby soils
 (TP14-S01 and TP18-S08). Therefore, the results are considered a reflection of local groundwater quality.
- However, this pathway is considered incomplete as chromium concentrations of all other bores including
 the adjacent bore DM9D, were below the laboratory LOR which suggests that the chromium impacts are
 localised.
- The Cr(VI) impacts are likely localised as Cr(VI) is a strong oxidising agent and readily converted to significantly less toxic Cr(III). Substances that would assist these reduction processes include by organic matter, (ferrous) iron carbonate, iron hydroxides or sulfides potentially present in the superficial aquifer and associated calcareous soils present beneath the site.
- Based on previous hydrogeological reports completed for the DWRDF migration of heavy metals to marine waters via groundwater is slow and the risk to offsite (marine) receptors is very low (Oceanica, 2009).
- Based on a review of the available information, and the concentrations observed beneath the site, nitrogen in groundwater does not present a significant risk to offsite wetlands or groundwater dependant ecosystems. Nitrogen is a primary plant nutrient and at the concentrations observed will not impact flora through plant uptake or ingestion of plants following plant uptake.

Groundwater quality entering and leaving the site is generally reflective of up hydraulic gradient groundwater quality, i.e. nutrients above relevant guidelines, and as such the site is not increasing the risk to the onsite environment and or down hydraulic gradient marine environment from groundwater discharge. Being a strong oxidising agent, any potential impacts associated with Cr(VI) are likely localised through natural processes. The site does not pose a risk to ecological receptors onsite and or down hydraulic gradient of the site.

10.3.2.2 Lot 9076 and Lot 8019

Nutrient concentrations and pH exceeded MWG-95, FWG-95 and LIWG in all bores within Lot 9076 and Lot 8019. Additionally, iron exceeded the LIWG in one bore (MW02). These exceedances were not considered an ecological risk as presented in Section 10.3.2.1.

10.3.3 Surface water

No surface water bodies are located within Lot 9109, therefore no samples were taken and there is no associated risk.

10.3.3.1 Lot 9076 and Lot 8019

Surface water exceeded ecological guidelines for several analytes: Fe, pH, total nitrogen and phosphorous. However, these exceedances were not considered an ecological risk for the following reasons:

- Nutrient concentrations are not considered strong indicators of marine water quality and the surface water
 is not directly connected the marine environment. In addition, the surface water bodies are not natural
 wetlands and therefore not reflective of a sensitive environment. Therefore, surface water does not
 present an ecological risk to aquatic flora or fauna via uptake.
- The pH of the surface water was noted to not comply with the lower range of the MWG, typically by ~0.5 pH units. This is not considered to pose an unacceptable ecological risk, as the surface water is not directly linked to the marine environment, being separated by calcareous sands that would naturally increase the pH of the connected groundwater.
- Exceedances of the LIWG for iron are not considered to pose an environmental risk, as the screening level is based on fouling of irrigation infrastructure through a growth of bacteria and iron staining, and not applicable in a surface water setting.

10.4 Revised Conceptual Site Model

The preliminary CSM (Section 6.3) has been revised based upon the findings of the onsite investigations (Table 18).

Table 18: Revised Conceptual Site Model

Source	Pathway	Receptor	SPR Linkage Status	Comments
Human Health F	Risk			
Soil Contamination Metals (Mn) Radionuclides (Th)	Soil ingestion Dermal contact Dust inhalation	On-site current / future users (construction workers and residents)	Potentially complete	Impacted soils were identified at two locations. This material is not considered to pose a human health risk at this time as exceedances of the guideline are located in areas which are not currently subject to disturbance and / or were identified at depth. In the absence of a valid pathway site users cannot currently inhale, ingest or come in contact with the material. However, impacted materials may be disturbed during the proposed development of the site which would provide a pathway for the contaminants to affect onsite users. As such it is recommended that impacted soils are excavated and disposed offsite to remove the potential future risk to onsite users.
	Migration to groundwater and or surface water	On-site current / future users (construction workers and residents) Off-site current / future users		Concentrations of Mn and Th exceeded HIL-A guidelines in two locations: TP14 and TP18. However, this pathway is not considered to be complete due to: • Mn and Th concentrations were below human health guidelines at all other locations. Therefore, exceedances are isolated and the volume of impacted material is small. • Groundwater occurs at >30 mbgl within the ETC and Area 8, significantly deeper than the depth of exceedances (maximum 2.8 mbgl). Therefore, leaching into groundwater is unlikely. • No manganese or thorium were identified in groundwater above the relevant criteria. • Additionally, groundwater flow is generally in a westward direct away from potential offsite users. • There are currently no residents and due the restricted future land use of the rehabilitated DWRDF, will be no residents down hydraulic gradient of the site to abstract water. • A moratorium on groundwater abstraction is anticipated for the development, prohibiting the abstraction of groundwater for potable / nonpotable use. This would be consistent with the surrounding development. Therefore, in the absence of a valid pathway, migration of soil contamination to surface or groundwater is not considered to pose a human health risk to site users current or future.
Groundwater Contamination • Chloride	Incidental ingestion/dermal contact (irrigation)	On-site current / future users (construction workers and residents)	Incomplete	Elevated chloride concentrations in groundwater were identified within the shallow aquifer. However, the pathways are not considered complete, due to: Site will be connected to Water Corporation scheme/mains water supply The shallow aquifer is unlikely to be used for groundwater abstraction purposes including construction water

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- A moratorium on groundwater abstraction is anticipated for the development, prohibiting the abstraction of groundwater for potable / nonpotable use. This would be consistent with the surrounding development.
- Groundwater should not be consumed without testing and or treatment (DoH, 2016)
- There are currently no residents and due the restricted future land use of the rehabilitated Dalyellup Solid Waste Residue Facility, will be no residents down hydraulic gradient of the site to abstract water.

Therefore, RPS does not consider groundwater contamination a risk to human health.

Surface water Contamination

Incidental ingestion/dermal Future site contact

Current and residents

Incomplete Human health guidelines were not exceeded in surface water.

> Additionally, the risk of incidental ingestion and dermal contact, via contact with surface water bodies is considered low as use of the surface water body to the south east for recreational purposes will not be promoted.

No other surface water body will remain on the site following development, thus limiting the potential for primary or secondary contact with the surface water.

Ecological Risk

Soil Contamination Metals (Ni)

Vertical migration to groundwater and or surface Underlying aguifer/Indian Ocean

Incomplete RPS does not consider the pathway complete as the concentrations of contaminants in soils were below all ecological guidelines except for isolated nickel exceedances at two locations. Additionally, nickel concentrations in groundwater and surface water are at or below laboratory LOR and as such are significantly below ecological guidelines.

Lateral migration of impacted soil via surface water runoff

Wetlands

Exceedances of guidelines for nickel were observed however, they were not considered an ecological risk as they were marginally above the guideline and isolated in nature. Additionally, concentrations of nickel in surface waters were typically below ecological guidelines and there are no wetlands down hydraulic gradient of the exceedance and or site.

Plant uptake

Flora (on and off site)

Exceedances of guidelines for nickel were observed. however they were not considered an ecological risk as they were marginally above the guideline and isolated in nature. Therefore, the risk of uptake via the root zone is low.

In addition, the areas where exceedances were identified in the soil are proposed to be cleared of vegetation during development of the site.

Ingestion Fauna (on and (following plant off site) uptake)

Contamination via plant uptake was not considered a reasonable contamination pathway therefore fauna ingesting contaminated plants is not considered an ecological risk.

Soil ingestion / Fauna (on and dermal contact off site)

Exceedances of the ecological guidelines were observed in isolated locations only and are not considered widespread based on the numerous investigations in the area completed to date. Therefore, the ecological risk by dermal contact is considered low.

In addition, the areas where exceedances were identified in the soil are proposed to be cleared of vegetation during development of the site.

Groundwater Contamination

- Metals (Cr (VI) and Fe)
- **Nutrients**
- рΗ

Latera migration through underlying

aquifer

Off-site aquifers/Indian Ocean Aquatic flora

and fauna

Incomplete Exceedances of ecological guidelines in groundwater were observed for metals (Cr(VI) and Fe), pH and nutrients. With the exception of hexavalent chromium, dissolved metal concentrations are relatively consistent across the site and of those in the Perth's superficial aquifer2, and as such are considered reflective of natural conditions on site. This suggests that groundwater onsite is not contributing to contaminant concentrations in groundwater and the results are generally a reflection of local groundwater

> Buried blended TSR products within the site may be leaching into the superficial aquifer as, the concentration of Cr(VI) in DM9S is comparable to leachate concentrations of nearby soils (TP14-S01 and TP18-S08).

> However, this pathway is considered incomplete due

- Chromium concentrations of all other bores including the adjacent bore DM9D, were below the laboratory LOR which suggests that the chromium impacts are localised.
- Being a strong oxidising agent, Cr(VI) will be readily reduced to the significantly less toxic Cr(III) through reactions with organic matter, (ferrous) iron carbonate, iron hydroxides or sulfides potentially present in the superficial aquifer. As such, any potential impacts associated with Cr(VI) are likely localised through natural processes.
- Based on previous hydrogeological reports completed for the DWRDF migration of heavy metals to marine waters via groundwater is slow and the risk to offsite (marine) receptors is very low (Oceanica, 2009).

Additionally, contaminants are unlikely to pose a risk to down hydraulic gradient aquifers, as the groundwater beneath DWRDF, located immediately down hydraulic gradient, is already impacted, with similar contaminants.

Plant uptake Ingestion (following plant uptake)

fauna

Terrestrial flora and

Incomplete Exceedances of ecological guidelines in groundwater were observed for metals (Cr(VI) and Fe) and nutrients. The depth to groundwater is significant (>30 m) in the vicinity of the Cr(VI) exceedance and lower pH values and therefore is significantly below the rootzone as such the risk of uptake via plants is low. The LIWG Fe exceedance is also only applicable to the clogging of irrigation pipe and not a risk to ecological health. Nutrient concentrations are elevated above guidelines entering the site from up hydraulic gradient and therefore reflective of regional conditions.

> Contamination via plant uptake was not considered a valid contamination pathway therefore fauna ingesting contaminated plants is not considered a significant risk.

Any potential impacts associated with Cr(VI) are likely localised through natural processes.

Bioaccumulation Aquatic flora and fauna and

There is the no potential for bioaccumulation and biomagnification of contaminants in aquatic and or terrestrial flora and fauna as plant uptake and fauna

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² Compared to levels referenced for shallow groundwater on Perth's Swan Coastal Plain – refer Davidson (1995).

	biomagnification in the food chain			ingestion were not considered a complete pathway. In addition to noted contaminants are not know to bioaccumulate and or biomagnify in the food chain.
Surface water Contamination Nutrients pH	Uptake / consumption by aquatic flora and fauna.	Aquatic flora and fauna	Incomplete	Contaminant concentrations were generally below ecological guidelines in surface water except for nutrient, pH and iron no compliances. Nutrient concentrations are not considered strong indicators of
• iron	Bioaccumulation and biomagnification in the food chain			marine water quality. In addition, the surface water bodies are not natural wetlands and therefore not reflective of a sensitive environment and not connected to the marine environment. The low surface water pH was not considered to pose an unacceptable ecological risk, as the surface water
				is not directly linked to the marine environment, being separated by calcareous sands that would naturally increase the pH of the connected groundwater.
				Iron exceedances were not considered to pose an environmental risk, as the screening level is based on fouling of irrigation infrastructure through a growth of bacteria and iron staining, and not applicable in a surface water setting.
				Therefore, surface water does not present an ecological risk to aquatic flora or fauna via uptake.
				There is the no potential for bioaccumulation and biomagnification of contaminants in aquatic flora and fauna as the potential for the initial pathway for uptake by plants is incomplete. In addition to noted contaminants are not know to bioaccumulate and or biomagnify in the food chain.

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11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Summary of Findings

With the exception of isolated exceedances of metals (Mg, Ni) and radionuclides (Th) in two of 24 locations (TP14 and TP18), soils typically complied with adopted guidelines. All guideline exceedances were observed in a dark brown clayey silt layer visually distinct from natural soils and the capping layer found in Lot 9109. Based on investigation results impacted soils in the ETC and Area 8 (Lot 9109) are suspected to be a blend (1:9 ratio TSR to sand) of TSR and sands and not straight TSR. Impacted soils at TP14 and TP18 were not considered a risk to human health in their current condition. However, soils may present a risk during the proposed development of Lot 9109 if the material is exposed during earthworks. On this basis removal of the impacted material from Lot 9109 is recommended.

No TSR was observed elsewhere onsite based upon the site walkover and review of historical aerials. The blended TSR would also pose significantly lower radiation risk then straight TSR due to the lower concentrations of radionuclides.

Exceedances of ecological guidelines in groundwater were observed for metals (Cr(VI) and Fe) and nutrients across the site. With the exception of hexavalent chromium, dissolved metal concentrations are relatively consistent across the site and of those in the Perth's superficial aquifer. However, with the exception of Cr(VI) in one bore (DM9S) within Lot 9109, groundwater quality entering and exiting the site were comparable.

Groundwater is not suitable for long-term irrigation or domestic non-potable use without treatment. Groundwater is not currently used and a moratorium on groundwater abstraction is anticipated for the development, prohibiting the abstraction of groundwater for potable / non-potable use.

The proposed excavation of the contaminated soils at TP14 and TP18 within Lot 9109 will remove the source of potential contamination and Cr(VI) impacts in the shallow aquifer may reduce via attenuation. Therefore, groundwater quality was not considered to be a human or ecological health risk. Being a strong oxidising agent, Cr(VI) will be readily reduced to the significantly less toxic Cr(III) through reactions with organic matter, (ferrous) iron carbonate, iron hydroxides or sulfides potentially present in the superficial aquifer. As such, any potential impacts associated with Cr(VI) are likely localised through natural processes. Tronox ongoing monitoring for the former Waste Residue Facility identifies that Cr(VI) concentrations in DM9 have stabilised and decreased. Tronox will continue to monitor this location and report findings to the regulator as part of their ongoing monitoring program.

Surface water in Lot 9076 and Lot 8109 marginally exceeded ecological guidelines for pH, total nitrogen and phosphorous. However, surface water was not considered a risk to human or ecological health as no exceedances of human health criteria were noted, use of the surface water bodies for recreational purposes is not promoted and nutrients are required for plant growth. The pH exceedances were not considered a risk to marine environments as surface water is not connected directly to the marine environment.

Lot 9109 was deemed to pose low risk to the human health and local ecology based upon the current site use, i.e. public open space natural bushland, and future proposed residential use, however ongoing management is required to ensure the potential risks to human health are minimised.

Lot 9076 and 8019 were deemed to present no risk to human health or the local ecology based on the current and future site use.

11.2 Recommendations

11.2.1 Site Suitability

11.2.1.1 Lot 9109

Based upon the findings of the DSI, Lot 9109 is deemed to be suitable for the proposed end use as residential and public open space, on the basis that a remedial action plan (refer below) is prepared and completed for Lot 9109 and groundwater memorial restricting abstraction placed on the site.

11.2.1.2 Lot 9076 and Lot 8019

Based upon the findings of the DSI, Lot 9076 and Lot 8019 are deemed suitable for the proposed end use as residential development and public open space.

11.2.2 Remedial Action Plan – Lot 9109

The current risk to human health onsite is low however, RPS has identified the following contamination issues within Lot 9109:

- Heavy metal and radionuclide impacted soils, dark brown clayey silts, at TP14 (ETC) and TP18 (Area 8).
- Heavy metal (Cr(VI)) impacted groundwater within the shallow aquifer (DM9S).

To manage the potential increase risk to human health should impacted soils at TP14 and TP18 be exposed during development or groundwater abstracted RPS recommends:

- Impacted soils at and adjacent to TP14 and TP18 are excavated and disposed of at an appropriate landfill.
- A moratorium on groundwater abstraction from the shallow aquifer is acquired to prevent portable / nonportable groundwater use.

Preparation of a Remediation Action Plan (RAP) is recommended to facilitate remediation of Lot 9109 and will document the type and extent of remediation required to ensure that the site is suitable for its intended future use. The RAP will detail the clean-up techniques proposed to achieve the remedial objectives and criteria for assessing the effectiveness of the clean-up in the validation process.

Remediation of Lot 9109 will be reported on in the form of a Site Remediation and Validation (SRV) report following completion of the works. All reporting will be submitted to the Contaminated Sites Auditor for independent review and endorsement prior to submission to DWER to support reclassification of Lot 9109.

11.2.3 Site Classification

The site is currently classified as "possibly contaminated - investigation required". Lot 9076 and Lot 8019 can be reclassified as "not contaminated – unrestricted use" under the Contaminated Site Act 2003, without any remedial action.

After remediation, it is recommended that Lot 9109 is classified as "Decontaminated" under the Contaminated Site Act 2003 and suitable for the proposed land end use as residential and open space.

11.3 Assumptions and Uncertainties

The conclusions drawn and recommendations made here have been developed on the assumption that the data collected accurately represents the conditions at the site.

Uncertainties pertaining to the data collected include the following:

- Data gaps: Bore MW01 was not found and therefore could not be sampled. RPS considers that the seven remaining bores sampled provide adequate information to characterise groundwater quality onsite.
- Visual inspection of soils beneath Minninup Road via soil cores was not completed due to access issues.
 However, there was no historic evidence that TSR was used Minninup Roads construction or repair and
 the road has been reclassified by the regulator as "not contaminated unrestricted use" based on
 numerous lines of evidence provided by Tronox (DWER, 2020). On this basis, the absence of further
 assessment of Minninup Road is not considered to have impacted the outcome of the investigation.
- Temporal uncertainty: Contaminants may not have been present in the tested medium at the time of sampling, however, may be present within the site at other times.
- Spatial uncertainty: No sampling program can provide complete certainty that no contamination exists anywhere on the site. Investigation locations were situated where works could be undertaken in a safe manner.

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- Contamination may potentially be present between sampling locations, and that this may not have been identified, however RPS considers that the site has been sufficiently assessed and the data may be used to broadly characterise the contamination status of the site.
- Assumptions pertaining to the data collected include the following:
 - Acceptable analysis has been undertaken as part of this investigation in accordance with SAQP (RPS, 2021) prepared for the works.
 - Soil, surface water and groundwater samples were taken at a density, and to a depth, sufficient to allow an adequate spatial characterisation of the groundwater on the site. This assumption is based on statistical methods that allow reasonable confidence levels to be determined.

Although reasonable uncertainties exist, the assumptions made are well founded and provide confidence that the conclusions and recommendations reached regarding the site are considered sound.

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Tables



Table A-1

Eastern Turning Circle and Area 8 - Metals and NEPM Characteristics

Definitions:
LOR (Linguist Investigation Levels) - A (Residential Low Density), HIL (Health Investigation Level) - A (Residential Low Density), HIC (Health Investigation Level) - A (Residential Low Density), HIC (Residential Low Density), HIC (Nean Background Concentration), CSOO (Canadian Sol Quality Goldential Parkland), TSR (Treated Solid Residue)
- Leonotes no guideline — denotes not tested. Advantage to recover a concentration of the Concentration of STO mgL (externet) hard,
- Leonotes no guideline based on an average clay content of S% www.

Notes:

Table uses only go accept for metal leachtate results, Cuidelines derived based on sandy sole, depths 0-1 mbgl, pH of 7, CEC of 5.

Table uses obour coding for data interpretation, avoid black and white reproduction.

TSR values are develored from the sanger composition of Cristal's Kernerton plant TSR.

All guideline values are adopted from:

- National Environment Protection (Assessment of Site Contamination) Measure 1899, Guideline on Investigation Levels for Soil and Groundwater (NEPC 2013)

- Assessment and Measurement Protection (Assessment of Site Contaminated Sites (WRR 2014)

- Canadara Council of Ministers of the Environment Canadara Soil during Guidelines for the Protection of Environmental and Human Health (CCME 2016)

- Canadara Curic of Ministers of the Environment Canadara Soil during and Smith 1990)

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Soil Type	Clayey Sit - Dark Brown Sand - Pale Brown Sand - Pale Grey	Sand - Pale Brown	Sand - Pale Grey Sand - Yellow Brown Lens Sand - Pale Brown / Yellow	Sand - Pale Grey Clayey Sift - Dark Brown Sand - Yellow Sand - Pale Brown	Sand - Pale Grey Glayey Sift - Dark Brown Sand - Pale Grey	Sand - Pale Grey Sand - Grey Sand - Yellow	Sand - Grey Sand - Yellow Sand - Pale Brown
Depth (mbgl)	2.00 - 2.50 2.50 - 2.70 0.15 - 0.20 0.20 - 0.40 0.40 - 0.70 1.00 - 1.50 1.50 - 2.00	0.00 - 0.15 0.15 - 0.50 0.50 - 0.70 0.70 - 1.00 1.00 - 1.50 2.00 - 2.50		0.00 - 0.15 0.15 - 0.40 0.040 - 0.70 0.70 - 1.00 1.50 - 2.50 2.50 - 3.00 0.00 - 0.20 0.00 - 0.20	0.40 - 0.70 0.70 - 1.00 1.00 - 1.50 1.50 - 2.00 2.00 - 2.50 2.50 - 2.80 2.80 - 3.10	0.00 - 0.15 0.15 - 0.40 0.40 - 0.60 0.60 - 0.90 0.90 - 1.30 1.30 - 1.90 1.90 - 2.50 2.50 - 3.00	0.00 - 0.20 0.20 - 0.50 0.40 - 0.70 1.00 - 1.50 1.50 - 2.00 2.00 - 2.80 0.00 - 0.15
	15/12/2020 2 15/12/2020 2 15/12/2020 0 15/12/2020 0 15/12/2020 0 15/12/2020 1 15/12/2020 1 15/12/2020 1	16/12/2020 0 16/12/2020 0 16/12/2020 0 16/12/2020 1 16/12/2020 1 16/12/2020 2 16/12/2020 2		16/12/2020 0 16/12/2020 0 16/12/2020 0 16/12/2020 16/12/2020 16/12/2020 2 16/12/2020 2 16/12/2020 0 16/12/2020 0 16/12/2020 0 16/12/2020 0 16/12/2020 0 16/12/2020 0	16/12/2020 0 16/12/2020 1 16/12/2020 1 16/12/2020 2 16/12/2020 2 16/12/2020 2		16/12/2020 0 16/12/2020 0 16/12/2020 0 16/12/2020 1 16/12/2020 1 16/12/2020 2 16/12/2020 2
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	iger		MBC	CSQG-A	HL4	EIL⊅		LOR		\		\		\		\						1	1	1	1	\		\		\		\		1	1	1	\forall
	Trigger								\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	1	1		\	\	\	\	\	\	\	\	1	
	Soil Type									Sand - Pale Grev	(20)		Clayey Silt - Dark Brown	Sand - Pale Grev	650 25	Sand - Pale Brown		Sand - Pale Grey		Sand - Dark Grev		Sand - Pale Grey		100	ale dey		Sand - Dark Grey		Sand - Pale Grev	ale Gey		Sand - Pale Grey			Sand - Grey	Sand - Dark Grev	Sand - Yellow
	Soil									Sand.	3		Clayey Silt -	Sand.	2	Sand - P.		Sand - F		Sand - D		Sand - F		3	2000		Sand - L		Sand -	2 200		Sand - F			Sand	Sand.	- Sand -
	Depth (mbgl)								0.15 0.40	10 - 0.70	70 - 1.00	_	_	70 - 2.50	20 - 3.00	20 - 0.15	15 - 0.40	40 - 0.70	70 - 1.00	00-1.50	50 - 2.00	00 - 2.50	20 - 3 00	00 -0.15	0.40	70 1 00	05.1 - 00	50 - 1.80	30 - 2 40	40 - 3.00	30 - 0, 15	15 - 0.40	40 - 0 70	70 - 1.00	00-1-20	0 2 00	20 - 3.00
	Date (16/12/2020 0.1	16/12/2020 0.40 -0.70	16/12/2020 0.70 1.00	16/12/2020 1.00 - 1.60	16/12/2020 1.60 - 2.00	16/12/2020 2.00 - 2.50	16/12/2020 2:50 -3:00	16/12/2020 0.00 -0.15	16/12/2020 0.15 - 0.40	16/12/2020 0.40 -0.70	16/12/2020 0.70 - 1.00	16/12/2020 1.00 - 1.50	16/12/2020 1.50 - 2.00	16/12/2020 2:00 - 2:50	16/12/2020 2:50 -3:00	16/12/2020 0.00 -0.15	16/12/2020 0.19 0.40	16/12/2020 0.70 -1.00	16/12/2020 1.00 - 1.50	16/12/2020 1.50 - 1.80	16/12/2020 1.80 - 2.40	16/12/2020 2.40 - 3.00	16/12/2020 0.00 -0.15	16/12/2020 0.15 0.40	16/12/2020 0.40 0.70	16/12/2020 0.70 -1.00	16/12/2020 1.00 1.50	16/12/2020 1.50 -2.00	16/12/2020 2.50 -3.00
	Sample ID D								\Box	TP21-S03 16/1	\neg	TP21-S05 16/1	\neg	TP21-S07 16/1			\neg	\neg	\neg	\neg	\rightarrow	\neg	\rightarrow	TP23-S01 16/1	-	-	TP23-S05 16/1		П	\Box	Н	Н		\rightarrow	\rightarrow	TP24_S07 16/1	\vdash
									. • 1	41	÷	÷.	÷	÷	÷	Ö	٠i	24.1	A .	201	ALI.	AL.	oi L	مادم	الدانة	السان			الخت			الحا		4	4	414	141



Table A-2 Eastern Turning Circle and Area 8 - Soil Landfill Assessment

Definitions: LOR (Limits of Reporting); NG (no guideline)	CT (Concentration Threshold in the Absense CL (Concentration Limit for Landfill Acceptan * denotes guideline for hexavalent chromium Notes:	All values in mg/kg unless specified otherwise. Table uses colour coding for data interpretation. All guideline values from Landfill Waste Classific	- Delines	Sample ID Date (n									Eastern Turning Circle	TP14-S01 15/12/2020 0.15 - 0.20	Area 8	TP18_S08 16/12/2020 2.50
(no guideline)	Of (Concentration Threshold in the Absense of Leachate Analysis) - 182 (Class 1 and Class 2), 3 (Class 3), 4 (Class 4), C. (Concentration Limit for Landfill Acceptance) - 182 (Class 1 and Class 2), 3 (Class 3), 4 (Class 4) - denotes guideline for hexavalent chromium Notes:	All values in mg/kg unless specified otherwise. Table uses colour coding for data interpretation. All guideline values from Landfill Waste Clessification and Waste Definitions 1996 (as amended). (DWER 2019)		Depth Soil Type										5 - 0.20 Clayey Silt - Dark Brown		16/12/2020 2.50 - 2.80 Clavev Silt - Dark Brown
) - 1&2 (Class 1 and 0 d Class 2), 3 (Class 3	lefinitions 1996 (as ar		Trigger		CT4	CT3	CT18.2	CL4	CL3	CL182	LOR		\		
	Class 2), 3 (Cl. 3), 4 (Class 4)	ımended) (DWI		muinimulA	mg/kg	NG	NG	NG	200,000	100,000	50,000	10		3900		3300
	ass 3), 4 (Clas	ER 2019)		Arsenic	mg/kg	1,400	140	14	20,000	5,000	200	2		8		7
	ss 4)			muineB	mg/kg	200,000	100,000	20,000	200,000	100,000	50,000	-		46		34
				Beryllium	5	200	20	2	4,000	1,000	100	-		-1		V
				Boron	H					H	NG			2		2
				muimbs0	H					H	100 NG	0.4		<0.4		<0.4
				Сһготіит (III)	H						G NG	-		250 210		230 170
				(IV) шиіотон	Н		100*		2	H	\$00°	-		46		09
			×	lledoO	\vdash		NG	NG		Г	50,000	-		10		00
			Metals and Metalloids	Соррег	mg/kg	200,000	100,000	50,000			50,000	-		14		00
			alloids	Мегсигу	mg/kg	20	2	0.2	3,000	750	75	0.1		<0.1		<0.1
				อรอนยดินยพู	Н		100,000	20,000		Ë	50,000	-		3900		3500
				Molybdenum	\vdash		100	10	40,000 120	10,000 30	1,000 3,	-		2		9
				Nickel	\vdash		40 20	4 2	120,000 60,000	30,000 15,000	3,000 1,500	-		45 7		37 6
				muinələ2	\vdash				00 200	H	0 20	2		3		e
				Silver	mg/kg	2,000	200	20	7,200	1,800	180	-		2		-
				muibeneV	mg/kg	200,000	100,000	20,000	200,000	100,000	50,000	-		610		530
				SulZ	H			50,000	200,000	100,000	50,000	-		23		15
				muirodT	\vdash					H		9.0		80		92
				muins1U	ng/kg	NG	NG	NG	NG	NG	NG	0.1		2		4



Table A-3 Eastern Turning Circle and Area 8 - Soil Leachate Assessment

Definitions:
LOR (Lunia of Reporting)
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		muinestU	mg/L	NG	NG	NG			1		
		muirodT	mg/L	NG	NG	NG			i		
		Zinc	mg/L	NG	NG	NG			ı		
		muibeneV	mg/L						!		
		Silver	mg/L	100	10	-			-		
		muinələ8	mg/L	50	2	0.5	0.001		<0.001		<0.004
		реәд	mg/L	10	-	1.0	0.001		<0.001		<0.00 A
		Иіске!	mg/L	20	2	0.2	0.001		0.001		V0 004
		wolybdenum	mg/L	20	2	0.5			-		
		อรอนะชินะพู	mg/L	NG	NG	NG			1		
	alloids	Мегсигу	mg/L	-	1.0	0.01			i		
	Metals and Metalloids	Copper	mg/L	NG	NG	NG			ı		
	Met	Cobalt	mg/L	NG	NG	NG			1		
		(VI) muimon1)	mg/L	*05	2*	.5*	0.005		0.18		0.87
		Chromium (III)	mg/L	NG	NG	NG			1		
		Сһготіит	mg/L	NG	NG	NG			ı		
		muimbeƏ	mg/L	10	-	1.0			i		
		Вогоп	mg/L	NG	NG	NG			1		
		Beryllium	mg/L	10	-	1.0			i		
		muise8	mg/L	NG	NG	NG			1		
		oinae1A	mg/L	20	2	9.0			ı		
		muinimulA	mg/L	NG	NG	NG			1		
		Trigger		ASLP4	ASLP3	ASLP1&2	LOR				
		-		4	4	AS			nwo		0///
		Soil Type							15/12/2020 0.15 - 0.20 Clayey Silt - Dark Brown		TD18_S08 16/12/2020 2 50 - 2 80 Clayer Silt - Dark Brown
		Depth (mbgl)							15-0.20		150-280
200000		Date						ng Circle	5/12/2020 C		5/10/2020
		Sample ID						Eastern Turning Circle	IP14-S01 18	Area 8	TD18_S08 1

Table B
Groundwater Results - Wetals, Radionuclides, Nutrients and Physicals
Groundwater Results - Wetals, Radionuclides, Nutrients and Physicals
Groundwater Results - Wetals, Radionuclides, Nutrients and Physicals
Groundwater Results - Groundwater Groundwat

	Dissolved Oxygen	mg/L	·			·	0.1	1,58	121	4.97	0,42	4.08	4.39	5.54
Parameters	noitsubeRinoitsbixO Isimetof		·			ŀ	10	16	-00	111	-62	106	901	113
Freed Para	Electrical Conductivity	hSicm				ŀ	10	3000	1503	1303	1200	1300	780	1100
	На	pH units	6,0+6,5	7.016.0	8.0-6.4	Ī		683	88'9	6,922	6.38	7,23	7,18	7.36
	Groundwater Elevvation	mAHD				Ī		2,33	2.28	22	2.13	1	3.69	3.76
	9 se atsriqeori	mg/L	900	0,00	90000	Ī	9000	950*0	40.005	0,033	40.005	40.005	0,012	0.011
	suroriqeoriq [stoT	mgilL		0,05	0.02	Ī	6.05	80.0	6,03	-0.06	0,16	2	6,11	5
	N as sinommA listoT	mg/L		2,18	4,83	6,5	0,005	0.048	0.33	-0.005	0.18	<0.000	9000	0.011
}	N as xON	mg/L		5	90070		9007	2	9000	1.9	-0,005	2,3	0,059	0.94
Nutrients	M zu odiniM	mg/L r				9,1	9000	-0.000	-0.005	-0.005	90000-	67070	9000-	1200
	M es otaniM	mg/L m				113	0.005	2	9000	1.9	-0.000	2.2 0	9900	0 280
	TKN by Discrete Analyser	mg/L r				Ī	6.1	170	0.8	4.1	613	6.3	0.7	00
	Total Nitrogen	mg/L r	90	1.5	0.23		1.0	21	3.0	4.0	0.3	8,5	0.7	4.2
	wnipos						620	380	160	110	120	140	2	110
	Potassium	mg/L m					50	3	1 6.8	1 99	1 9.6	16	a	14
Cations	шпјевибеј	ng/L mg	,				0.5	1 1	29	9 09	17 8	1 20	5	20
	muia k S	mgil. m					0 50	160	110	110	70	110	20	36
	Chloride	ng/L m	,			550	-	600	150	180	260	190		140
Anions		mg/L m	,			1000	-	230 6	84	88	41 2	12	30	93
	abilo 8 bavlosai Ollato T	mg/L m						1800	890	820	292	850	910	710
	ViinilioiliA listoT	mg/L r						400	370	330	160	410	280	280
sep	mulnesU		1000			0,17	0.0005	970070	970000	93000	-0.0006	0,0012	0.0017	80000
Radionuclides	muitodī	mg/L -					0 5000	0.0005	92000	-0.0006 -1	-0,0006	0 920070:	-0.0006	90000
	uoj	mg/L	3				0,01	> 20'0	> 250	-0.01	8	> 10.0	> 9000	100
	oulz	mg/L	2	22000	0,015		0,001	0.002	0.002	90000	0.003	+0.001	0.000	9000
	mulbeneV	mg/L	5		5		0,001	0.001	-0.001	0.001	-0.001	9000	9000	0,003
	sevilis	mgilL		5010070	Q0014	-	1400	100.00	40.001	-0.001	100.00	40.001	-0.031	10.001
	muineleč	mg/L		0,011		50	0,001	-0.001	+07001	-0.001	-0.001	0.002	-0201	0.001
	реод	mg/L	2	#870E9.	0,0044	0.1	0000	-0000	10000	-0000	-00.00	-0.001	-0.001	10001
	losiol	mg/L	6,2	0 26800	70.0	0,2	1400	100.00	0.001	-0.001	10.001	40.001	-0.001	10,001
	unuapq/qoy	mg/L	10.0	3,034	0.023	0.5	0.001	100.0	-0.001	-0.001	-0.001	0.001	-0.001	-0.001
	озоиебием		2	1,9		2	5000	60070	0.15	- 90000-	10	<0.000	0.012	0,007
		mg/L r	20070	93000	0,0004	100	0,40005	-0.00000	-0.00000-	- 9030000-	<0.000005	> 5010000	9030000-	200000-
Dissolved Metals	Copper	mg/L n	0,2	0.0126	0.0013 0.	20	0 0 140 0	40.001 40.	-0.001 -0	-0.001 -0	40,001 40.	40.001 40.	-0.001 -0	0.001
ŝ					H		_	H	Н	H	H	Н	Н	H
	Chromium (VI)		073	72* 0.001	27 0,0044	6.9	00.00	500'0- 901	500.0> -0.005	35" 0,18	200.0> -0.005	500.0> -0.005	9000- 90002	2000-
	Chromium (III)			0,02772*	120027		1 0,005	40,006	21 ~0.005	0 0.026°	200'0> HE	10,000	-0.005	20000
	muimontO						1000	1 0.001	1 40.001	1 0.200	1 -0.001	1 40.001	1 -0.001	10,001
	Совый			\$140°0 ×	0,001	·	0.001	1 <0,001	1 ~0.001	1 -0.001	1 <0.001	1 <0.001	1 -0.001	1 -0,001
	muimbeO	mg/L	10,0	0,002**	0,0055	6,02	0.0001	100001	100001	100001-	100000>	100000-	100000-	100001
	Beryllium	mgil	17			9.0	00000	<0.0005	<0.0005	-0.0005	<0.0005	<0.0005	+0.0005	500000
	muined	mg/L	•			2	0.001	0.051	0.170	0.028	0.490	0.023	0.019	2100
	nonoB	mg/L	50	0.37		40	0.02	0.200	0600	06010	0.040	70.0	09010	0900
	oinestA	mg/L	1,7	60013		1,0	190'9	0,002	800'0	0.002	0,003	0.002	40.001	100.00
	muinimulA	mg/L		95070		0,2	10.0	10.0>	-0.01	-0.01	10.0>	+0.01	-0.01	1001
	Trigger		LMG	FWG-65	MWG-65	DANG	LOR	\	1	1	1	1	1	1
	Location			_	_		_	Downgradent	Downgradient	Downgradient	Downgradient	Upgradent	Upgradent	Domadient
	Date							4/12/2020 Dow	14/12/2020 Dow	14/12/2020 Dow	14/12/2020 Dow	4/12/2020 Upg	14/12/2020 Upg	14/12/2020 1/00
								5	5	5	5	15	15	12



Table C

Groundwater Results - TRH and BTEXN

LOR (Limits of Reporting), FWG (Freshwater Guidelines), LIWG (Long Term Irrigation Water Guidelines), DNPG (Domestic non-potable groundwater use), HSL (Health Screening Level) - A&B (Low and High Density Residential), LIWG (Long Term Irrigation Guidelines)

denotes no guideline. --- denotes not tested.

denotes aesthetic guideline has been applied in the absence of a health based guideline. * denotes duplicate / triplicate value has been adopted. " denotes triplicate result in absence in primary result.

A denotes interim screening level has been adopted.

Notes:
All values in mg/L unless specified otherwise
All guideline values are adopted from:

- National Environment Protection (Assessment of Site Contamination) Measure 1999, Guideline on Investigation Levels for Soil and Groundwater (NEPC 2013)

- Assessment and Management of Contaminated Sites (DWER 2014)

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)

Where applicable, the following surface water characterisites have been applied, South-west Australia, Lowland Rivers (ANZECC and ARMCANZ 2000)

Table uses colour coding for data interpretation, avoid black and white reproduction.

- Denotes <LOR

	ТВН С29 - С36	mg/L						0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	178H C15 - C28	mg/L						0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	17H >C10 - C16	mg/L						0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	690.0
S	TRH C10 - C14	mg/L						0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Recoverable Hydrocarbons	01⊃-9⊃НЯТ	mg/L						0,001	<0.01	<0.01	<0.01	<0.01	<0.01	<50	<50
Recoverable	ер - 69	mg/L						0,001	<0.01	<0.01	<0.01	<0.01	<0.01	<50	<50
Total	Ł¢: C>3 ⊄- C¢0	mg/L						0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	E3: C>1e-C3 1	mg/L						0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	F2: C>10-C16 minus M	mg/L					1.1	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	690.0
	F1: C6-C10 minus BTEX	mg/L					1.0	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05
	Naphthalene	mg/L		0,016	0.07			0,001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003	<0.003
	əuəļ/x-o	mg/L		0,35	0,35	0,02		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003	<0.003
	euel-xylene	mg/L		0,075	0,075	0,02		0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.006	<0.006
BTEX	Ethylbenzene	mg/L		80"0	0,005	0,003		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003	<0.003
	To l uene	mg/L		0,18	0,18	0,025		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003	<0.003
	Benzene	mg/L		0,95	0.7	0,01	0.78	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003	<0.003
	38TM	mg/L				0.02^		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003	<0.003
	Trigger		LIWG	FWG-95	MWG-95	DAND	HSL-A&B	LOR							
	Location								Downgradient	Downgradient	Downgradient	Downgradient	Upgradient	Upgradient	Upgradient
	Date								14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020 L		
	Sample ID								DM1RS 1	DM1RD 1	DM9S 1	DM9D 1	MW02 1	PB10(JDA02) 14/12/2020	PB8(JDA01) 14/12/2020

Table D

Surface Water Results - Metals, Radionuclides, Nutrients and Physicals

Definition:

Lot lines account of the properties of the p

	Dissolved Oxygen	lg m	ľ	ı		ľ	0.1	3,23	
	Ielfriefoq nottanbe/RinottebixO	À		ŀ			10	99	ŀ
CINAL PRINCIPLE	Electrical Conductivity	mayert		ŀ			10	320	ŀ
	Hq	pH units	6.048.5	7.0-8.0	8.0-8.4		1.0	7,45	
	9 es etsiqued	mg/L	90*0	0,03	0,005		0,005	<0.005	
	eusoriqeoriq IstoT	mg/L		90'0	20,0		900	0,19	ı
	N se sinommA	mg/L		1.61	2,15	0.5	0,005	<0.005	
ALC: FOLLOW	N as XON	mg/L		5	0,005		0,005	<0.005	
	N as ofiniN	mg/L		·		30	0,005	<0.005	
	N es elstiiN	mg/L		ŀ		200	9000	>0.006	
	TKN by Discrete Analyser	mg/L		ŀ			0,1	1.6	
	negotiki listoT	mg/L	ç	1.5	0,23		0.1	1,6	
	mulbos	mgıl		i			0.5	18	
Carrolle	mulsstrod	mg/L		ŀ			979	970	
5	เมกเรจนซิยพู	mg/L		ŀ			0.5	6.2	
	muloleS	mg/L		·			0.5	35	
	Chloride	mg/L		i		250	-	35	
•	Suffate	mg/L		·		1000	-	7	
	ebilo8 bevioeei0 listoT	mg/L		·			2	190	
	Total Alkalinity	mg/L	•	ŀ			9	100	
Namio Inches	mulnssU	mg/L	0.01	i		0,17	0.0005	< <0.0005	
101	muirodī	mg/L	•	i	٠	•	0,0005	<0.0005	
	non	mg/L	0,2			•	0.01	0,44	
	Sinc	mg/L	2	0.0728	0,015	0	0.001	1 0,003	
	mulbeneV	mg/L	5		1,0	•	0,001	1 <0.001	
	101/16	mgif	ŀ	0,00005	0,0014	-	0,001	<0.001	
	mulnida8	mg/L	·	8 0,011	•	0,1	0,001	<0.001	
	рвод	mg/L	2	0.09078	0,0044	5	0,001	<0.001	
	Nickel	Шg/L	0,2	0,0996	70,0	0,2	0,001	<0.001	
	wojApqeunu	mg/L	0.01	0,034	0,023	0,5	0,001	<0.001	
	ysaussusse	шg/L	0.2	1.9		2	0,005	0.054	
	Мегсигу	mg/L	0,002	0,0006	0,0004	0.01	0,00005	<0.00005	
Discount new Property	Copper	mg/L	075	0.0126	0,0013	20	0,001	100.0>	
3	(VI) muimord)	mg/L	5	0,001	0.0044	0,5	0,001	<0.005	
	(III) mulmord⊃	mgilL		9Z11Z00	0,027		0,005	<0.006	
	mulmond	mg/L		Ī			0,001	<0.001	
	¶eqo⊃	mg/L	9070	0,0014	0,001		0,001	<0.001	l
	muimbe⊃	mg/L	0.01	0,002 [®]	0,0055	0,02	0,0001	-0.0001	l
	աոյլլու	mg/L	5			9*0	90000	<0.0006	
	muise	mg/L				50	0.001	0.019	
	notoB	mg/L	53	0,37		40	2000	0.030	
	SinserA	mg/L r	130	0.013		1,0	0.001	0.004	
	mulnimu l A	mg/L n	9	0.055 0		0,2	0.01	0,01	
	Trigger	•	LIMG	FWG-85 0.	MWG-85	DANG	LOR	1	
	Date				4			2020	
	<u> </u>							17/12/2020	
	1								



Table E

Surface Water Results - TRH and BTEXN

Definitions:

LOR (Limits of Reporting), FWG (Freshwater Guidelines), LIWG (Long Term Irrigation Water Guidelines), DNPG (Domestic non-potable groundwater use),

HSL (Health Screening Level) -A&B (Low and High Density Residential), LIWG (Long Term Irrigation Guidelines)

-denotes no guideline. --- denotes not tested.

denotes aesthetic guideline has been applied in the absence of a health based guideline. * denotes duplicate / triplicate value has been adopted.

denotes interim screening level has been adopted.

Notes:

All values in mg/L unless specified otherwise All guideline values are adopted from:

- Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes (DER 2015b)
- National Environment Protection (Assessment of Site Contamination) Measure 1999, Guideline on Investigation Levels for Soil and Groundwater (NEPC 2013)

- Assessment and Management of Contaminated Sites (DWER 2014)
Where applicable, the following characterisitcs have been applied - South-west Australia, wetlands (ANZECC and ARMCANZ 2000)

Table uses colour coding for data interpretation, avoid black and white reproduction.

- Denotes <LOR

	7FH C29 - C36	mg/L					0.1	<0.1	<u>0,1</u>
	1КН С15 - С28	mg/L					0.1	<0.1	\$0.1 1.0
	7KH >C10 - C16	mg/L					0.05	<0.05	<0.05
ns	1RH C10 - C14	mg/L					0.05	<0.05	<0.05
Hydrocarbo	015 - 61	mg/L					0.001	<0.05	<0.01
Total Recoverable Hydrocarbons	65 - 69	mg/L					0.001	<0.05	<0.01
Total	E4: C>34-C40	mg/L					0.1	<0.1	<0.1
	E3: C>16-C34	mg/L					0.1	<0.1	<u><0.1</u>
	F2: C>10-C16 minus <i>N</i>	mg/L					0.05	<0.05	<0.05
	F1: C6-C10 minus BTEX	mg/L					0.01	<0.05	<0.01
	Naphthalene	mg/L		0.016	0,07		0.001	<0.003	<0.001
	əuəj/x-o	mg/L		0.35	0,35	0.02	0.001	<0.003	<0.001
	eue+b-xλ eue	mg/L		0.075	0,075	0.02	0.002	<0.006	<0.002
BTEX	Ethylbenzene	mg/L		0.08	0,005	0.003	0.001	<0.003	<0.001
	eneulo⊺	mg/L		0.18	0,18	0.025	0.001	<0.003	<0.001
	Benzene	mg/L		0.95	0.7	0.01	0,001	<0.003	<0.001
	38TM	mg/L				0.02^	0.001	<0.003	<0.001
	Trigger		PIMG	FWG-95	MWG-95	DNPG	LOR	\setminus	
	Date							17/12/2020	17/12/2020
	Sample ID							SW01	SW02



Table F

Soil QAQC Results - Metals

Definitions:

LOR 1º (Limit of Reporting, Primary Laboratory), LOR 2º (Limit of Reporting, Secondary Laboratory), — denotes not tested, # denoted not calculated.

Notes:

All values in mg/kg unless specified otherwise

Table uses colour coding for data interpretation, avoid black and white reproduction,
denotes <-LOR (primary Jaboratory)
denotes <-LOR (secondary Jaboratory)
denotes <-LOR (primary Jaboratory)
denotes <-Sx LOR (primary Jaboratory)
denotes <-Sx LOR (secondary Jaboratory)
denotes exceedance of acceptance criteria (30%) where sample(s) >5x LOR
denotes exceedance of acceptance criteria (30%) where sample(s) >5x LOR

muinsıU	mg/kg	0.1	0,1		0.3	0.2	40	0.4	0.5	22		0.3	0.4	29	0.4	0.5	22
muirodT	mg/kg	0.5	0,1		<0.5	<0.5	0	2	2	0		<0.5	8.0	46	2	3.3	49
Zinc	mg/kg	-	2		7	<1	0	-	2	67		₹	<5	0	1	<5	0
muibensV	mg/kg	-	22		3	2	40	16	22	32		3	\$	0	16	15	9
Silver	mg/kg	-	2		₹	<۱	0	₹	₽	0		₹	0	0	₹	<2	0
muinalə2	mg/kg	2	2		\$	<2	0	2	<2	0		\$	<5	0	7	<5	0
реэд	mg/kg	-	22		3	2	40	3	3	0		3	<5	0	3	<5>	0
Иіске І	mg/kg	-	2		₹	۲>	0	2	3	40		₹	ζ-	0	2	<2	0
шпиәрqʎjo	mg/kg	-	2		₹	-1	0	٧	۷.	0		٧	\$	0	٧	<2	0
əsəuɐðuɐผ	mg/kg	-	ro.		19	21	10	110	150	31		19	16	17	110	86	12
Метсигу	mg/kg	0.1	0,1		<0.1	<0.1	0	<0.1	<0.1	0		<0.1	<0.1	0	<0.1	<0.1	0
Copper	mg/kg	-	ro.		₹	√	0	₹	۲,	0		₹	<5	0	₹	<5	0
Sobalt	mg/kg	-	2		₹	<1	0	₹	۲>	0		₹	7	0	₹	~	0
Chromium (VI)	mg/kg	-	0.5		₹	۷.	0	1	3	100		7	<0.5	0	1	1.2	18
Chromium (III)	mg/kg	-	2		22	5	0	11	12	6		2	7	33	11	11	0
muimondO	mg/kg	-	2		2	2	0	12	15	22		2	7	33	12	12	0
muimbeO	mg/kg	6.4	-		<0.4	<0.4	0	<0.4	<0.4	0		<0.4	7	0	<0.4	۲	0
Boron	mg/kg	က	20		9	4	40	7	7	0		9	<50	0	7	<50	0
Beryllium	mg/kg	-	-		₹	-1	0	₹	7	0		₹	7	0	₹	7	0
тиілев	G)	-	10		5	2	0	9	7	15		5	<10	0	9	<10	0
zines1A	5	2	2		9	5	18	9	7	15		9	<5	18	9	<5	18
muinimulA	G)	10	20		350	280	22	440	490	11		350	410	16	440	450	2
	Ē				<u>"</u>	,,	\	1	/	\		\ \	1		\	/	Ц
Trigger		LOR 1°	LOR 2°							\				\			
Date					45/42/2020	10121202		48/12/2020	10/12/2021			45/42/2020	13/12/2021		18/12/2020	10/12/2021	
Sample Type					Primary	Duplicate	RPD %	Primary	Duplicate	RPD %	tes	Primary	Triplicate	RPD %	Primary	Triplicate	RPD %
Sample ID				Field Duplicates	TP01-S06	TPZ1		TP21-S06	TPZ2		Field Triplicates	TP01-S06	TPZZ1		TP21-S06	TPZZ2	

Table G
Groundwater GAQC Results - Metals, , Radionuclides, Nutrients and Physicals
Definitions:
COST It fine of reporting Theory Loss 7 Limit of Reporting Secondary, Laboration). — denotes not trained, if denoted not calculated.
Notes:
All their integrations of the control o

	Electrical Conductivity	ms/sr	10	-		1300	1300	0		1300	1310	-
	Phosphate as P	mg/L	0,005	0.01		0,033	0,03	10		0,033	0,02	48
	euroriqeoria listoT	mg/L	0.05	0.01		<0.05	<0.05	0		<0.05	0,04	0
	N ze sinommA	mg/L	0,005	0.01		<0.005	<0.005	0		<0.006	<0.01	
Manne	N se xon	mg/L	0,005	0.01		1.9	1.9	0		1,9	1,85	8
	M as ofintiM	mg/L	0,005	0.01		<0.005	<0.005	0		<0.005	<0.01	
	N as etstilV	mg/L	0,005	0.01		1.9	1.9	0		1,9	1,85	0
	TKN by Discrete Analyser	mg/L	0.1	0.1		<0.1	<0.1	0		<0.1	0.5	133
	nagottiM listoT	mg/L	0.1	0.1		1.9	1.9	0		1,9	2.4	8
	muibo&	mg/L	9,0	-		110	110	0		110	112	67
Calibria	Potassium	mg/L	90	-		5.5	5.5	0		5,5	9	10
3	wnjsaußeW	mg/L	0.5	-		40	40	0		40	37	80
	muia l ic	mg/L	0.5	-		110	110	0		110	114	4
Allons	Chloride	mg/L	-	-		180	180	0		180	204	13
•	eteilus	mg/L	-	-		88	68	0		68	36	_
	sbilos bavlossid latoT	mg/L	so.	10		850	830	2		850	724	16
	Vinife # A feator	mg/L	10			330	330	0		330	302	00
Sanionnian Page	muinesU	Ë	0,0005	0.001		5 ×0,000€	200000	0		<0.000	<0.001	-
	muivofT	Ē	0,0005	0.001		<0.0005	<0.000	0		<0.000	<0.001	0
	uoı	mg/L	0.01	0.05		<0.01	<0,01	٥	L	<0.01	<0.05	٥
	DUIZ	Ë	0.001	0.005		0,008	0,007	13		900'0	0.01	22
	mulbeneV	- mg/L	1 0.00	1 0.01		1 0,001	1 0,001	0		00.00	1 <0.01	0
	194 S	L mg/l	1 0,001	0.001		100.001	100.001	0		M <0.001	1 <0.001	-
	muinales	L mg/L	10,00	10.01		01 <0.001	100.001	0		100.0> 10	10:0> 10	-
	реот	/L mg/L	1000	10000		100,001	100.001	0		100.0> 10	100.0> 10	-
	иско]	mg/L mg/l	00'0 10	01 0,001		100 <0.001	100 <0.001	0		100.001	100 <0.001	-
	эсанейнем	mg/L mg	0,005 0,001	0.001 0.001		<0.005 <0.001	<0.005 <0.001	0		<0.005 <0.001	<0.001 <0.001	
	Метсигу	F	0 00000	0.0001		<0.00005 <0.	<0.00005 <0.	0		<0.00005 <0.	<0.0001 <0.	
	Copper	١	0.001 0.0	0.001 0.0		<0.001 <0.0	<0.001 <0.0	0		<0.001 <0.1	<0.001 <0.	
Metalls	(VI) muimondO	F	0 001 0	0.001 0.		0,18 <0	0,18 <0	0		0,18 <0	0,152 <0	17
	Chromium (III)	 	0.005 0.0			0.016 0.	0.023 0.	36		0,016 0,	0.026 0.	
		F		10000							Н	48
	тітолід	•	10000	10000		0.2	0.2	0		0.2	0 178	12
	#sdo3	Ŀ	100,001	1 0,001		100,001	100,001	0		100.001	10,001	-
	muimbeO	-	0.0001	0,0001		5 ×0,0001	00001	0		00000>	100000>	-
	Beryllium	H	0,0005	0,001		<0.0005	<0.0005	0		<0.0008	<0.001	0
	muhed	mg/L	0,001	0,001		0,028	0,028	0		0,028	0,03	-
	Вогоп	mg/L	0,02	0.05		0000	90"0	12		00'0	0,11	8
	pinosrA	mg/L	0,001	0.001		0,002	0,002	0		0,002	0,002	
	mululmulA	mg/L	0.01	0.01		<0.01	<0.01	0		<0.01	<0.01	۰
	Trigge		LOR 1°	LOR 2"		\	\			1	1	1
	Date 1					m.m.m.	1	1		000000177	7	1
	Sample Type						П	RPD %		Г	П	RPD %
					Ouplicates	Primary	Duplicate	RPL	riplicates	Primary	Triplicate	RPL
	Ol ald mes				Field L	SWO	WZ1		Fledd T	DWSS	NZZ1	



Table H

Groundwater QAQC Results - TRH and BTEXN

Definitions:

LOR 1° (Limit of Reporting, Primary Laboratory), LOR 2° (Limit of Reporting, Secondary Laboratory). — denotes not tested. # denoted not calculated.

All values in mg/kg unless specified otherwise Table uses colour coding for data interpretation, avoid black and white reproduction.

denotes <LOR (primary laboratory)
denotes <LOR (secondary laboratory)
denotes <5x LOR (primary laboratory)
denotes <5x LOR (primary laboratory)
denotes <5x LOR (accondary laboratory)
denotes exceedance of acceptance criteria (30%) where samples <5x LOR
denotes exceedance of acceptance criteria (30%) where sample(s) >5x LOR

0, 0, 0 <0.05 36.0 - 629 - С36 година С29 - С36 година С29 - С36 от нат б<mark>р 2. 28 г. 28</mark> ٥<u>.</u>1 <0.1 0.1 °0. 9.0 g g/l Sign Scro - C16 <0.05 0.050.010 <0.05 ад нат да сто - Ст4 <0.05 <0.05 <0.05 Total Recoverable Hydrocarbons <0.07 лау/L 0.00 0.01 <0.01 <0.07 0.00 д НЯТ С6 - С9 <0.01 0.01 0.00 2 3 E4: C>34-C40 0.1 0.1 0.00 2 3 g F3: C>16-C34 ٥<u>.</u> <0.05 <0.05 <0.05 0.1 N suninus N 2: C>10-C16 minus N 2:00-C16 <0.07 <0.01 <0.01 S S F1: C6-C10 minus BTEX <0.001 mg/L 0.001 0.005 <0.001 <0.001 Naphthalene <0.001 <0.002 <0.001 0.002 ag/L 0.002 <0.001 0 <0.002 <0.002 <0.002 0.002 m+p-xylene 0 0000 <0.001 <0.001 <0.001 BTEX 0.002 Ethylbenzene 0 <0.001 <0.002 <0.001 0.001 mg/L Toluene 0.002 <0.001 <0.001 mg/L Benzene <0.001 <0.001 <0.001 0.001 0.001 <0.001 <0.001 <0.001 0 **BETM** LOR 1° Trigger 14/12/2020 14/12/2020 Date Sample Type RPD % Duplicate Triplicate Primary Primary Sample ID S6W0 S6MO NZZ1

RPD %

Table I

Table Water QAQC Results - Metals, , Radionuclides, Nutrients and Physicals
Definitions.
Definitions: The deficiency for 2° Line of Reporting Secondary, Lebosinory, — denotes not besied, a denoted for cloideted.

Modes: The major depoted per company on the depoted of the secondary Lebosinory, — denoted for cloideted.

Modes: The desired per company per company on the depoted of the secondary lebosinory, one that depoted one company per c

		ľ				ľ	ш			
euroriqeori¶ listoT	mg/L	0.05	0.01		<0.05	<0.05	0		<0.05	
N 28 SinommA	mg/L	0,005	0.01		<0.005	<0.005	0		<0.006	
N se xon	mg/L	0,005	0.01		<0.005	<0.005	0		<0.006	
N as ofitiN	mg/L	0,005	0.01		<0.005	<0.005	0		<0.005	
V as etstiv	mg/L	0,005	0.01		<0.005	<0.005	0		<0.005	
TKN by Discrete Analyser	mg/L	0,1	0.1		970	0.5	0		90	
nagottiM listoT	mg/L	0.1	0.1		0.5	0.5	۰		9,0	
muibo&	mg/L	9,0	-		150	160	8		150	
muissaton	mg/L	9,0	-		7.7	7.7	٥		7,7	
muisəngeM	mg/L	0.5	-		58	28	0		58	
muioleO	mg/L	0,5	-		63	62	2		63	
Chloride	mg/L	-	-		210	210	0		210	
eterlius	mg/L	-	-		09	09	0		99	
sbiloš bavlossiO listoT	mg/L	un	10		700	670	4		700	
yjini[s∦A [stoT	mg/L	u)	-		230	240	4		230	
muinesU	mg/L	0,0005	0.001		<0.0005	<0.0005	0		<0.0005	
muivoriT	mg/L	0,0005	0,001		<0.0005	<0.0005	0		<0.0005	
uoJ	mg/L	0.01	0.05		0,09	0.1	=		0,0	
ouiz	mg/L	0,001	0,005		0,004	0,011	93		0,004	
mulbensV	mg/L	0,001	0.01		<0.001	<0.001	0		<0.001	
194/IS		0,001	0.001		<0.001	<0.001	0		<0.001	
muinale2	Ė	0,001	10.0		<0.001	<0.001	0		<0.001	
proq	mg/L	0,001	0.001		<0.001	<0.001	0		<0.001	
Nickel		0,001	0.001		<0.001	<0.001	0		<0.001	
woj),расилш		0,001	0.001		<0.001	<0.001	0		<0.001	
увидвиез с		5 0,005	10000		5 0,012	6 0,012	0		20012	
Метсигу		0,00005	0.0001		<0.00005	0,00006	18		<0.00005	
Copper	mg/L	0,001	0.001		<0.001	<0.001	0		<0.001	
(VI) muimondO	mg/L	0,001	0.001		<0.005	<0.005	۰		<0.005	
Сһгомічт (III)	mg/L	0,005	0.001		<0.005	<0.005	0		<0.005	-
muimonfi	mg/L	0,001	0,001		<0.001	<0.001	٥		<0.001	
#edoD	mg/L	0,001	0,001		<0.001	<0.001	0		<0.001	
mulmbsO	mg/L	0,0001	0,0001		<0.0001	<0,0001	0		<0.0001	
Berylllum	mg/L	0.0005	0.001		<0.0006	<0.0005	0		<0.0006	
muised	mg/L	0.001	0,001		0,068	990 0	0		990'0	ľ
почов	mg/L	0,02	0.05		060*0	60"0	0		0600	
oinearA	mg/L	0,001	0.001		0,002	0,002	0		0,002	
muinimulA	mg/L	0.01	0.01		<0.01	<0.01	0		<0.01	
<u> </u>			4.5%		\	\	ľ		\	
Trigger		LOR 1°	LOR 2°		1		1		1	3
Date					OCCUPANTA	10.00			00000012	7277
Sample Type					Primary	Duplicate	RPD %	ficates	Primary	
Olad mes				Field Dup	SW02	SWZ1		Field Trip	SW02	



Table J

Surface Water QAQC Results - TRH and BTEXN
Definitions:

LOR 1° (Limit of Reporting, Primary Laboratory), LOR 2° (Limit of Reporting, Secondary Laboratory). --- denotes not tested. # denoted not calculated.

Notes:

All values in mg/kg unless specified otherwise

Table uses colour coding for data interpretation, avoid black and white reproduction.

denotes <LOR (primary laboratory)
denotes <LOR (primary laboratory)
denotes <Sx LOR (primary laboratory)
denotes <Sx LOR (secondary laboratory)
denotes <Sx LOR (secondary laboratory)
denotes exceedance of acceptance criteria (30%) where samples <5x LOR
denotes exceedance of acceptance criteria (30%) where sample(s) >5x LOR

1RH C29 - C36	mg/L	0.1	0.05		<0.1	<0.1	0		<0.1	<0.1	0
TRH C15 - C28	mg/L	0.1	0.1		<0.1	<0.1	0		<0.1	<0.1	0
510 - C16	mg/L	0.05	0.1		<0.05	<0.05	0		<0.05	<0.1	0
18H C10 - C14	mg/L	0.05	0.05		<0.05	<0.05	0		<0.05	<0.05	0
015-95 НЯТ	mg/L	0.001	0.02		<0.01	<0.01	0		<0.01	<0.02	0
60 - 80 НЯТ	mg/L	0.001	0.02		<0.01	<0.01	0		<0.01	<0.02	0
F4: C>34-C40	mg/L	0.1	0.1		<0.1	<0.1	0		<0.1	<0.1	0
F3: C>16-C34	mg/L	0.1	0.1		<0.1	<0.1	0		<0.1	<0.1	0
F2: C>10-C16 minus N	mg/L	0.05	0.1		<0.05	<0.05	0		<0.05	<0.1	0
F1: C6-C10 minus BTEX	mg/L	0.01	0.02		<0.01	<0.01	0		<0.01	<0.02	0
Naphthalene	mg/L	0.001	0.005		<0.001	<0.001	0		<0.001	<0.005	0
о-х/увив	mg/L	0.001	0.002		<0.001	<0.001	0		<0.001	<0.002	0
m+b-xylene	mg/L	0.002	0.002		<0.002	<0.002	0		<0.002	<0.002	0
Ethylbenzene	mg/L	0.001	0.002		<0.001	<0.001	0		<0.001	<0.002	0
eneuloT	mg/L	0.001	0.002		<0.001	<0.001	0		<0.001	<0.002	0
Benzene	mg/L	0.001	0.001		<0.001	<0.001	0		<0.001	<0.001	0
ЗӨТМ	mg/L	0.001	0.001		<0.001	<0.001	0		<0.001	<0.001	0
Trigger		LOR 1°	LOR 2°			\setminus	$\left[\right]$			\setminus	
Date					000000000000000000000000000000000000000	17.12/2020			47/42/2020	11122020	
Sample Type					Primary	Duplicate	RPD %	ates	Primary	Triplicate	RPD %
Sample ID				Field Duplic	SW02	SWZ1		Field Triplic	SW02	SWZZ1	
	TRH C16 - C16 TRH C10 - C14 TRH C6 - C9 TRH C6 - C9 Toluene Maphthalene O-xylene Toluene Ethylbenzene Benzene Toluene Toluene Toluene Toluene Toluene Toluene Toluene Toluene	Sample Date Trigger MTBEL Type Name Date Trigger Majl mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	Sample Date Trigger MTBEE Type MTBEE Nample Date Trigger MATRIELE Nample Date MATRIELE Nampl	Sample Name Date Trigger Trigger Matter May Laboration Maje Maje Maje Maje Maje Maje Maje Maje	Sample Trigger Trigger MT MT <th> Sample Date Trigger Trigger</th> <th> Sample Date Trigger Main Fig. Trigger Main Fig. /th> <th> Sample Date Trigger March Trigger March /th> <th> Figure Trigger Trigg</th> <th> Sample Date Trigger MIB Majt mgt m</th> <th> Figure Parish P</th>	Sample Date Trigger Sample Date Trigger Main Fig. Trigger Main Fig. Sample Date Trigger March Trigger March Figure Trigger Trigg	Sample Date Trigger MIB Majt mgt m	Figure Parish P			

Table K
Field QAQC Results - Metals, Radionuclides, Nutrients and Physicals
Lost and Chepture, -tender to the set of the

		_	_	_	_	_			_	_	_
	Electrical Conductivity	m2/srt	10	6	1	1	2		2	1	١
	9 ze steriqzori9	mg/L	0.005	<0.005	1	1	<0.005		<0.005	1	1
	suroriqeoria letoT	mg/L	0.05	<0.05	1	ı	<0.05		<0.05	1	ı
	N 26 SinommA	mg/L	0.005	<0.005	1	1	<0.005		<0.005	1	1
Tents	N SE XON	mg/L	0.005	<0.005	1	1	<0.005		<0.005	1	1
ğ	N ze alitiN	mg/L	0.005	<0.005	1	1	<0.005		<0.005	1	1
	M ze otestiW	mg/L	0.005	<0.005	1	1	<0.005		<0.005	1	1
	TKN by Discrete Analyser	mg/L	0.1	1.03	1	1	<0.1		-0.1	1	ı
	nagoziti listoT	mg/L	1.0	40.1	1	1	<0.1		0.1	1	1
	muibo&	mg/L	9.0	<0.5	1	1	<0.6		<0.5	1	1
mons	muissedo9	mg/L	9.0	<0.5	1	1	<0.6		970×	1	1
ڌ	шпізэпдем	mg/L	0.5	<0.5	1	1	<0.6		<0.0 0.0	1	1
	muioleO	mg/L	0.5	<0.5	1	1	<0.6		<0.5	1	1
Suons	Chloride	mg/L	-	2	1	1	5		£	1	1
•	Sulfate	mg/L	-	2	1	1	7			1	1
	sbijoS bavjossiG latoT	mgilt	2	9	1	1	9		90	1	1
	Total Alkalinity	mg/L	9	65	1	ı	9		99	1	ī
Sepiconuc	muinesU	mg/L	0.0005	<0.0005	<0.0005	<0.0006	<0.0006		<0.0005	<0.0006	<0.0005
Eex	muitodT	mg/L	0.0005	<0.0006	<0.0006	<0.0006	<0.0006		<0.0005	<0.0006	<0.0006
	иол	mg/L	0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
	Zinc	mg/L	0.001	<0.001	0,002	<0.001	0.002		0.002	0,004	0.004
	muibeneV	mg/L	0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
	Sāver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0,001	<0.001
	Selenium	mg/L	0.001	<0.001	<0.001	<0.001	100:0>		-00.00-1	<0.001	<0.001
	резд	mg/L	0000	1 <0.001	+00.001	1 <0.001	1 <0.001		100.001	100,001	<0.001
	Nickel	mg/L	00 0	1 <0.001	1 ×0.001	1 <0.001	1 <0.001		1 <0.001	1 <0.001	1 <0.001
	Molybdenum	L mg/	9 000	00.00	00:00	.00.00 -00.00	.00.00-		-00:00-	100.001	10:00
	әรәиебиеу	L mg/L	05 0,005	900'0> 900	00°0> <0.005	00:00 <0:008	900:0> 901		900'0> 901	900 < 0.005	<0.005
	Mercury	L mg/L	1 0,00005	-0 0000 H	<0.00006	-0.00006	-0.00006		-0.0000¢	<0.00005	<0.00005
Metals	Copper	mg/L	10001	100.001	<0.001	> <0.001	> 0.001		> <0.001	×0.001	<0.001
	Chromium (M)	mg/L	0.001	<0.005	<0.005	<0.006	<0.005		<0.005	<0.005	<0.005
	СМ тите	mg/L	0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0,005	<0.005
	Сһготіит	mg/L	0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0,001	<0.001
	#edo.D	mg/L	0,001	<0.001	×0.001	<0.001	<0.001		<0.001	<0,001	<0.001
	mulmbsO	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0,0001	<0.0001
	Beryllium	mg/L	0,0005	<0.0005	<0.0005	<0.0006	<0.0006		<0.0005	<0.0005	<0.0005
	muise8	mg/L	0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
	потоВ	mg/L	0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02
	oinserA	mg/L	0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
	muinimu l A	mg/L	10.0	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
	Trigger		LOR 1*	\	\	\	\		\		\
			3	020	020	020	020		020	020	020
	Date			14/12/2020	15/12/2020	16/12/2020	17/12/2020	Syc	14/12/2020	15/12/2020	16/12/2020

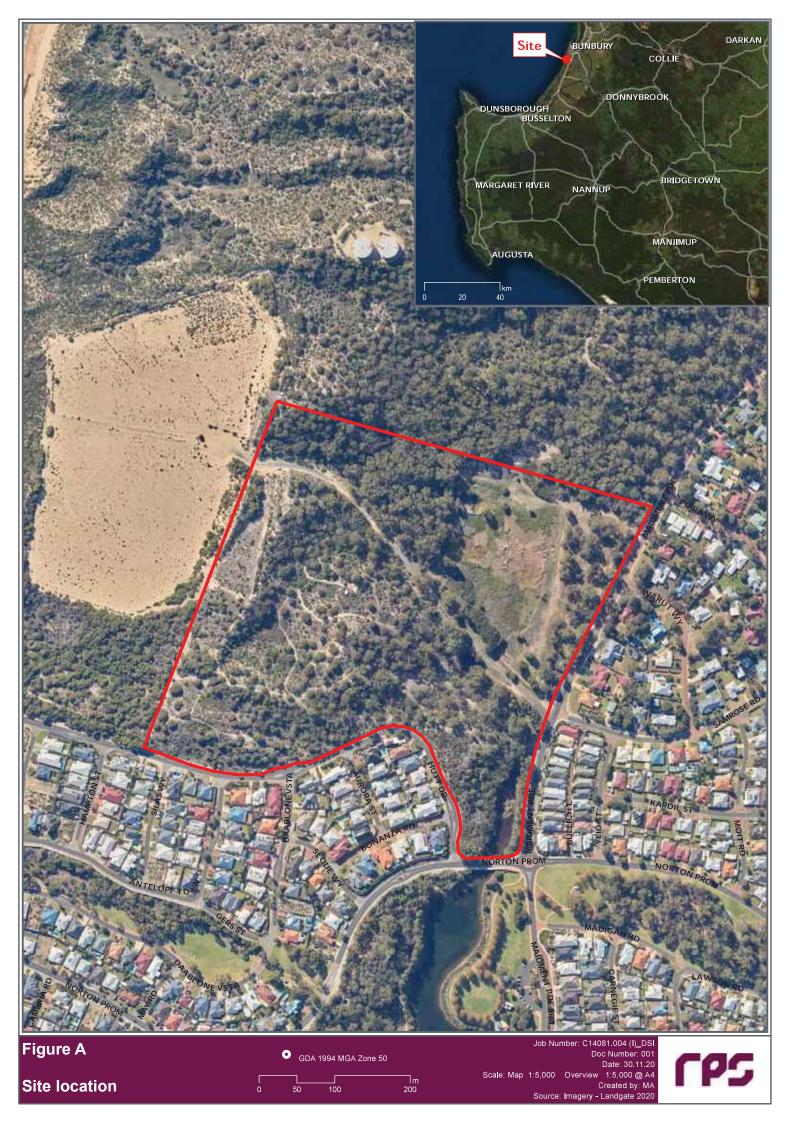


Field QAQC Results - TRH and BTEXN

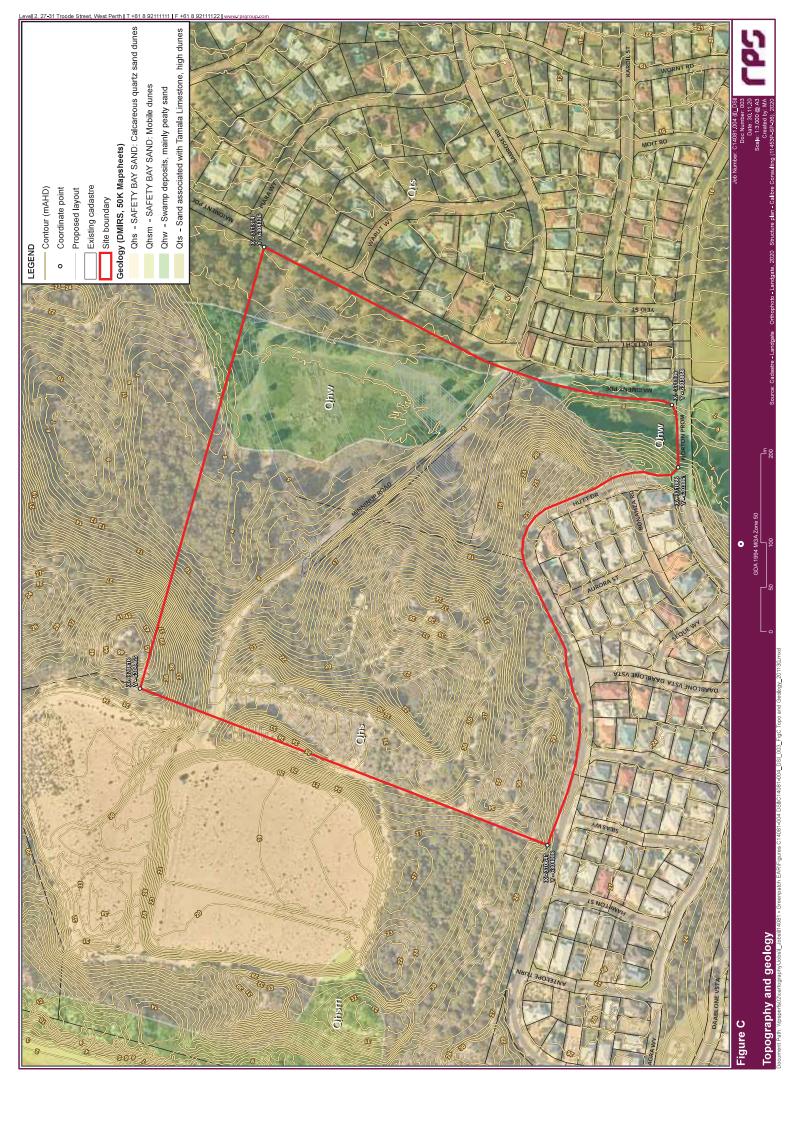
Definitions:
LOR (Limit of Reporting), — denotes not tested
Notes:
All values in mg/L unless specified otherwise
Table uses colour coding for data interpretation, avoid black and white reproduction.
denotes <LOR
denotes exceedance of acceptance criteria

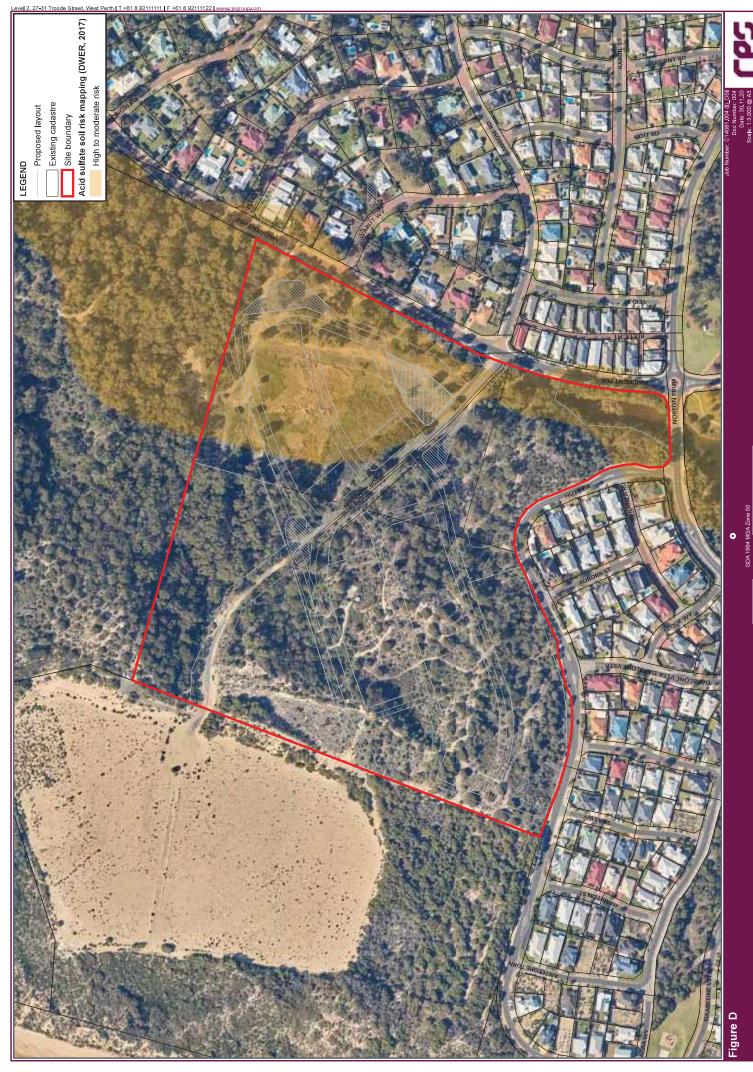
	529 - С36	mg/L	0.1		<0.1	<0.1		<0.1	<0.1		<0.1	<0.1	
	ТКН С15 - С28	mg/L	1.0		<0.1	<0.1		<0.1	<0.1		<0.1	<0.1	
	1RH >C10 - C16	mg/L	0.05		<0.05	<0.05		<0.05	<0.05		<0.05	<0.05	
ons	TRH C10 - C14	mg/L	0.05		<0.05	<0.05	<0.05	<0.05		<0.05	<0.05		
Total Recoverable Hydrocarbons	ткн се - с10	mg/L	0.001		<0.01	<0.01		<0.01	<0.01		<0.01	<0.01	
Recoverabl	65 - 69	mg/L	0,001		<0.1 <0.01 <0.01 <0.01		<0.01		<0.1 <0.01	<0.01		<0.01	<0.01
Total	E4: C>34-C40	mg/L	0.1				<0.1			<0.1		<0.1	<0.1
	E3: C>16-C34	mg/L	0.1		<0.1	<0.1	<0.05 <0.1	<0.1	<0.1		<0.1	<0.1	
	F2: C>10-C16 minus N	mg/L	0.05		<0.05	<0.05		<0.05	<0.05		<0.05	<0.05	
	F1: C6-C10 minus BTEX	mg/L 0.01	<0.01	<0.01		<0.01	<0.01		<0.01	<0.01			
	Maphthalene	mg/L	0,001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
	әиәј/х-о	mg/L	0.001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
	m+p-xylene	mg/L	0.002		<0.002	<0.002		<0.002	<0.002		<0.002	<0.002	
BTEX	Еगһуlbenzene	mg/L	0.001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
	eneulo T	mg/L	0,001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
	Benzene	mg/L	0,001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
	381M	mg/L	0.001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
Trigger													
Date					14/12/2020	17/12/2020		14/12/2020	17/12/2020	S)	14/12/2020	17/12/2020	
Sample ID						WB4	Trip Blanks	WTB1	WTB2	Rinsate Blanks	WR1	WR4	

Figures



Site layout

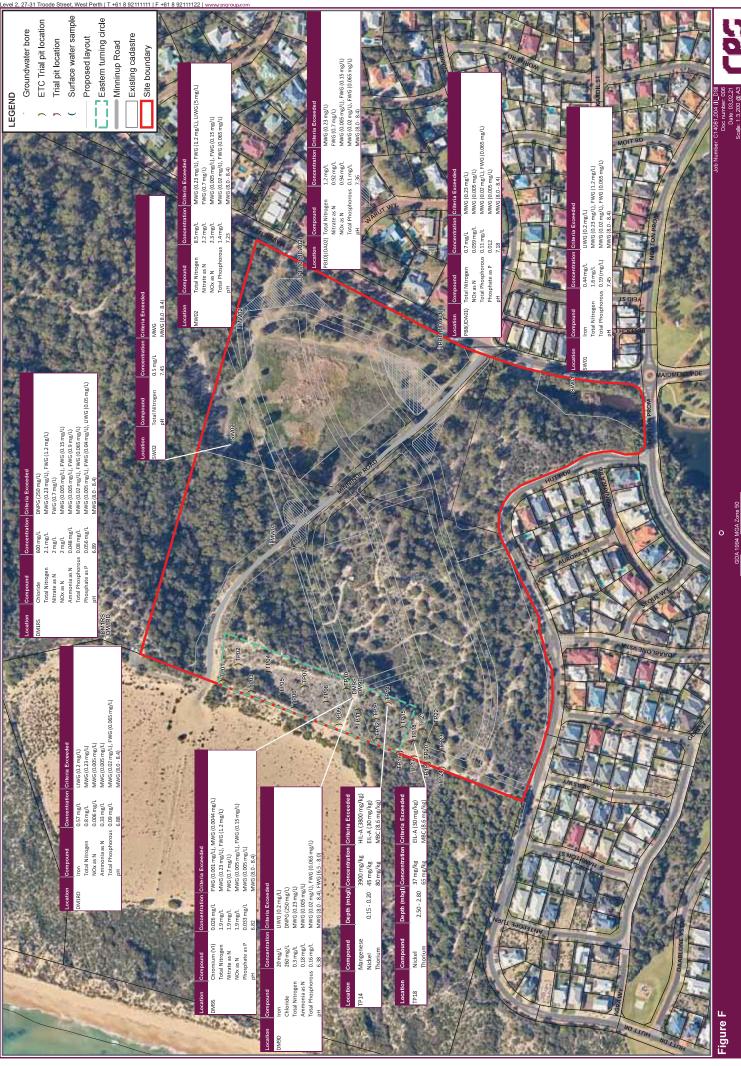


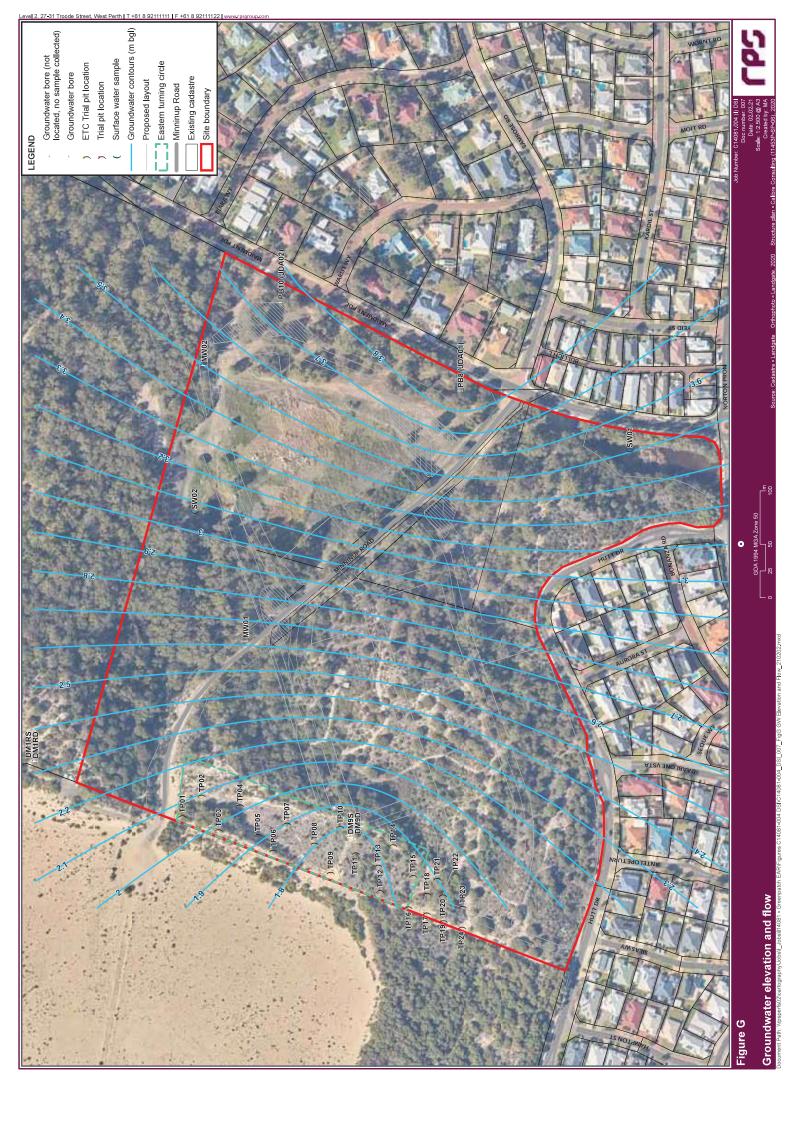


IIS TISK MAPPING organiya labeli labelitadiki a Greenmarch FARI Englishures (34 adet 2014 DSIC 4 adet 2014 DSIC)

Acid sulfate soils risk mapping

WIN bores and surface water bodies







Area of visual inspection

Teth: 6.Uobs_Jobs\14081 - Greenpatch EAR\Figures C14081-004 DS\C14081-004_DS_009_Fig_Trial Pits_211016

Appendix A DWER Classification



Decision in Respect of Appeal Against Classification

Contaminated Sites Committee (CSC 05/2018)

Contaminated Sites Act 2003, Part 8, Division 2

APPELLANT: Form 1 submitter

SITE: Maidment Parade and Hutt Drive, Dalyellup, otherwise known as the

Greenpatch development (the site), comprising:

 Lot 9105 on plan 404839 (Landgate PIN:12165612) as shown on certificate title 2871/951, Dalyellup, WA 6230;

 Lot 9105 on Plan 404839 (Landgate PIN:12165611) as shown on certificate of title 2871/951, Dalyellup, WA 6230;

 Lot 9076 on Plan 55511 (Landgate PIN:11693033) as shown on certificate of title 2696/377, Dalyellup, WA 6230;

 Lot 9076 on Plan 55511 (Landgate PIN:11693032) as shown on certificate of title 2696/377, Dalyellup, WA 6230 and

 Lot 8019 on Plan 55511 (Landgate PIN:11693031) as shown on certificate of title LR3154/141, Dalyellup, WA 6230.

DATE: 20 October 2020

- 1. This is an appeal against a notice of classification given by the Chief Executive Officer (CEO) of the Department of Water and Environmental Regulation (DWER)¹ under s15 of the Contaminated Sites Act 2003 (Act) on 27 March 2018. That notice of classification advised that the CEO had classified the site as report not substantiated. See Act, Sch 1 (Classification of sites). The site, known as Greenpatch, is Crown Land and is, in effect, owned by the Department of Housing.
- 2. The site is comprised of lot 9105 (which includes an area known as the Eastern Turning Circle (ETC), a former operational area (Area 8), lot 9076 and lot 8019. The site is east of the former Waste Residue Disposal Facility (WRDF) which is lot 9077. Part of the site (lots 9076 and 8019) is bisected by what appears to be a public access road leading from Maidment Parade to the WRDF.
- 3. For convenience of reference, a site map of the area is attached to these reasons.
- 4. The Reasons for Classification given by the CEO found that:
 "Based on the investigations undertaken and information provided to DWER, including DWER enquiries and site inspections, the site appears suitable for unrestricted use, including sensitive uses such as residential, primary schools and childcare centres"

¹ The Department of Water and Environmental Regulation (DWER) was established on 1 July 2017 following the amalgamation of the Department of Water, the Office of the Environmental Protection Agency and the Department of Environmental Regulation (DER). DER was separated from the former Department of Environment and Conservation (DEC) in June 2013. The use of the name 'DWER' is used in this document to refer to both DER and DEC. The CEO, herein refers to the CEO of DWER or its predecessors.

Background

Greenpatch Development

- 5. The Greenpatch development site (**Greenpatch**) was reported to DWER as a suspected contaminated site under the Act on 19 October 2017 and then again on 24 January 2018.
- Following the reporting of the site, DWER undertook a desktop study of all the available technical information, including environmental assessments for Greenpatch and for the former WRDF located adjacent and west of the site.
- 7. Portions of the Greenpatch Development referred to as the 'Eastern Turning Circle' (ETC) and 'Area 8' was understood at the time to have been used for minor operational activities as part of the operation of the WRDF. Based on all the available information at the time of classification, Area 8 and the ETC were not considered to be areas of potential concern.
- 8. On 16 March 2018, DWER undertook a site inspection of Greenpatch to verify the conclusions of the previous environmental assessments and to assess the presence of any visible waste or Treated Solid Residue (TSR) at Greenpatch. The inspection concluded that there was no substantial evidence that TSR had been disposed if on the Greenpatch site.
- 9. Chemicals of potential concern (hexavalent chromium) were present at concentrations below the relevant public health criteria and the risk to the environment was considered low. These findings were consistent with the conclusions of the Mandatory Auditor's Report (MAR) prepared for the adjacent WRDF in October 2013 and July 2015.
- 10. The Department of Health (DoH) and DWER concluded that there were no grounds to indicate that any significant contamination was present at Greenpatch. The site was then classified as 'report not substantiated' under the Act on 27 March 2018.
- 11. New information regarding the Greenpatch site was provided to DWER in May 2018. In response, a site inspection was conducted by DWER officers, the Radiological Council and Cristal Pigment Australia (Cristal) in June 2018. During this inspection treated solid residue (TSR) was visually identified in a number of localised areas within Area 8 and the ETC. A band of TSR measuring 10cm in thickness was identified along the open face of the rehabilitated dunes. This band was exposed after a firebreak was cut along the fence line dividing the former WRDF from the Greenpatch site. The majority of TSR appeared to be present as clay-like particles at the surface and at shallow depths across portions of Area 8 and the ETC. The material used to cap this area was validated as part of the works completed for the adjacent WRDF where it was noted that a small percentage of TSR was present in the capping layer. The potential risk to human health from the TSR is from radiological exposure via direct contact/ingestion/dust inhalation of radionuclides in the TSR material or from exposure to radiation. The Radiation Professionals undertook a gamma survey for Area 8 and ETC, which identified radiation to be comparable with background values for the area. It was concluded that the TSR present did not constitute radioactive material and was therefore exempt from regulation as specified in the Radiation (Safety) Regulations 1983.
- 12. DWER recommended that, based on this new information, a classification of 'possibly contaminated-investigations required' should be considered for the portion of Lot 9105 on Plan 404839, known as Area 8 and the ETC.

Former Waste Residue Disposal Facility

- 13. Historically, the WRDF comprised of several disposal ponds (two northern ponds, one central pond and two southern ponds) with the remainder of the site being access roads and coastal dunes. The WRDF is located directly adjacent to and to the west of the proposed Greenpatch site.
- 14. The WRDF was regulated during its operation under the *Environmental Protection Act* 1986 through Ministerial Statements and a Part 5 licence that allowed for the disposal of TSR from the production of titanium dioxide pigment between March 1989 and March 2013. A Closure Notice was served by the Department on 4 May 2013.

- 15. Monitoring of radiation, soil and groundwater had been undertaken at the WRDF since the early 1990's in accordance with its licence conditions. Human health and environmental investigations have been undertaken since 2001.
- 16. Rehabilitation of the southern ponds commenced in 2001 and rehabilitation of the northern and central ponds commenced in 2014, all in accordance with a final closure plan that was developed for the site.
- 17. Based on the information provided in the October 2013 and 2015 MAR, it was agreed between DWER, DoH and the Radiological Council that the WRDF appeared to be suitable for use as endemic bushland, but may not be suitable for more sensitive land uses including irrigated parkland or playing fields due to the potential for on-going irrigation to generate or increase leachate. Consequently, DWER classified the WRDF as remediated for restricted use on 21 February 2018, with the access road remaining classified as possibly contaminated—investigation required due to uncertainty regarding the material used beneath the roadway.

Appeal

18. On 24 May 2018, the Appellant provided the Contaminated Sites Committee (Committee) with an appeal application against the classification of the site as report not substantiated. The grounds of appeal and large volumes of technical reports were provided in support of the appeal.

Time limitation

19. An appeal against a site classification made under s13 of the Act is to be effected in accordance with s18 of the Act. An appeal is to be brought, dealt with and determined in accordance with Part 8 of the Act. By s79(2), a notice of appeal is to be lodged within 21 days after the day on which the appellant is given the notice or certificate which gives rise to the appeal, or such later time as may be specified in the notice. The notice the subject of this appeal was dated 24 May 2018 and specified a period of 45 days from the date of service of the notice as the period during which an appeal may be lodged. The Committee noted that the appeal was submitted late (lodged within 51 days) due to the time it took for the Department to provide the letter to the Appellant and the delays in postage. The Committee determined the appeal application was valid.

Grounds of appeal

- 20. The Appellant has requested the Committee to revoke the *report not substantiated* site classification and change it to *possibly contaminated investigation required* for the following reasons (in summary):
 - 1. Earthworked Area/Area 8 was part of the WRDF southern ponds.
 - 2. Area 8 was used to stockpile dried TSR.
 - 3. Area 8 was not assessed as part of the southern ponds closure.
 - 4. The Area 8 capping material validation sampling was not adequate due to location and analysis inaccuracies.
 - The Preliminary Site Investigation (PSI) only checked the top 2m of capping in Area 8.
 - 6. Hexavalent Chromium exceedances in Greenpatch bores (DM9A and DM9C) have highlighted the need for further investigation.
 - 7. There is an unconfirmed contamination pathway on the Greenpatch site.
 - 8. The Dalyellup WRDF has inconsistency in groundwater testing methodology.
 - 9. The Dalyellup WRDF data and reporting regarding the Greenpatch bores, DM9A and DM9C contain inconsistencies and discrepancies.
 - 10. There are discrepancies in the WRDF conceptual site model and the bore construction data.
 - 11. The guidelines for Total Chromium are provisional due to the high toxicity of hexavalent chromium.
 - 12. Sensitive Water receptors are present on the Greenpatch site.

- 13. Further hydrological modelling of the WRDF and Greenpatch site needs to be undertaken.
- 14. Reliability of Health Risk Assessment is questioned.
- 21. The Appellant sought that various additional studies be undertaken in relation to the site. The Committee has no power to order such further work, but the implementation of the Committee's decision might well lead to such fresh work.

DWER response to the Appeal

- 22. In response to the appeal, the CEO of DWER provided the Committee with a report under section 80(a) and (b) on 4 January 2019. After giving consideration to all of the Appellant's grounds of appeal, DWER recommended that grounds 1-5 be upheld and a classification of *possibly contaminated-investigation required* be considered for the portion of Lot 9105, known as the ETC. The CEO further recommended that the Appellant's grounds 6-14 be dismissed and the current classification of *report not substantiated* be retained for the balance of the Greenpatch site.
- 23. In response to the Appellant's further submissions, DWER advised the Committee on 12 August 2019 that, regarding radiological matters, DWER had relied upon advice from the Radiological Council. It was the Radiological Council's understanding that no disposal involving elevated levels of naturally-occurring radioactive material was undertaken on Greenpatch, therefore no management strategies were required with respect to radiation other than those pertaining to the existing management plans for the WRDF, including ongoing radiation monitoring and any potential mitigation requirements. There was no evidence of radiation levels above background over the areas surveyed. Thus, these areas could be considered for unrestricted use with respect to radiation. There was also uncertainty over whether the buffer zone had been established surrounding the tailings facility. The CEO reiterated that lot 9105 on Plan 4040839 (ETC and Area 8) should be re-classified from report not substantiated to possibility contaminated investigation required.
- 24. The Committee wrote to the CEO of DWER on 23 June 2020 requesting clarification of a number of issues.
 - i. Area 8 and ETC The CEO advised that the boundary of Area 8 and the ETC was based on historical aerial photos showing disturbed areas, combined with observations of TSR made by Departmental officers and Radiological Council officers on two site visits during June 2018. Since Area 8 and the ETC are wholly contained within the portion of lot 9105 located to the south of the access road, if there were concerns whether the boundaries encompassed all areas containing TSR, an alternative approach would be to classify the whole portion of lot 9105 south of the access road as *possibly contaminated investigation required.* The Department considered there were no grounds to indicate possible contamination by TSR or any other substance on any part of the appeal site other than the portion of lot 9105 south of the access road.
 - ii. Access Road The CEO advised that the access road is sealed and there is no evidence to suggest that TSR was used for its construction or repair. The Department considered that the access road, being portion of lot 9077 does not form part of the appeal site classified as *report not substantiated*.
 - iii. Radiological survey The CEO advised that the Committee has been provided with all relevant information in relation to radiological matters.

Committee's consideration of the appeal

- 25. The Committee has given consideration to all grounds of appeal and other matters raised in the correspondence and information that has been provided by the Appellant and the CEO.
- 26. Grounds of Appeal 1-5 submitted by the Appellant have been upheld in substance for the following reasons:

- i. The earth worked areas (including Area 8) were within operational areas used as part of the WRDF.
- ii. TSR could have migrated from the ETC, access road and Area 8 to other locations within the Greenpatch site.
- iii. The PSI has not fully assessed the contamination status of the Greenpatch site.
- iv. Area 8 and the ETC have not been adequately investigated.
- 27. The Committee noted that DWER has effectively conceded some of these points.
- 28. As to the balance of the Grounds of Appeal (numbered 6-14) submitted by the Appellant, the Committee has reached the conclusion that the appeal should be upheld in relation to Greenpatch for the following reasons:
 - i. There appears to be missing technical information and inadequate investigations conducted across the whole of the Greenpatch site.
 - ii. Further investigations may support or question the existing site boundaries, including the access road.
 - iii. Soil from the ETC, Area 8 and the access road may have migrated across portions of the Greenpatch site.
 - iv. It appears that the PSI has not adequately assessed the contamination status of the Greenpatch site. In particular, only a "Draft" PSI report was provided to the Committee. The Committee is not aware if a final report has been prepared upon which DWER based its decision for classification.
 - v. The Radiological Council has advised that its position in relation to possible risk at Greenpatch is based upon its understanding that: 1) there was no disposal of naturally-occurring radioactive material at Greenpatch; and 2) that a buffer zone would be defined (and managed either external to the WRDF upon agreement of the Capel Shire Council, developers of the Dalyellup Beach Estate and Cristal Pigment, or within bounds of the WRDF as part of an ongoing management plan. It is unclear whether these assumptions of the Radiological Council have been appropriately addressed.
 - vi. Historically, environmental consultants were not able to identify the presence of TSR at locations (the ETC and Area 8) where TSR was later visually identified by representatives from DWER and the Radiological Council during a site inspection.
 - vii. The PSI appears to rely heavily upon documentation pertaining to the investigation of the WRDF. However, the Greenpatch site was not included within the investigations of the WRDF and the Greenpatch site investigation reporting was not reviewed by an accredited Auditor.
- 29. By reason of all these matters, on balance there is enough evidence to conclude that there should be further investigation to determine the contamination present at the site.

Conclusion

30. For the reasons stated above, the appeal is upheld to the extent that the site is to be classified under the *Contaminated Sites Act 2003* as *possibly contaminated – investigation required.*

Note: section 82(2) of the Act provides that the Committee's decision under that section is final and without appeal. Section 83 of the Act provides that the CEO of the Department is to give effect to the outcome of the appeal as soon as practicable and to ensure that the details are published in the prescribed manner

Jim Malcolm Chairman

as agent for and on behalf of the Contaminated Sites Committee

Vanessa Bryant (Member) Anna Ciffolilli (Member) Warren Dodge (Member) Peter McNab (Member)

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Attachment 1 - Appeal site (Greenpatch)



Satterley Property Group PO Box 1346 West Perth WA 6872



DMO 10753

Michelle Brierley
1300 762 982
(08) 6364 7001

contaminated.sites@dwer.wa.gov.au

Dear Sir/Madam

NOTICE OF A CLASSIFICATION OF A KNOWN OR SUSPECTED CONTAMINATED SITE GIVEN UNDER SECTION 15 OF THE CONTAMINATED SITES ACT 2003

The site detailed below **(the site)**, was classified by the Department of Water and Environmental Regulation (DWER) under the *Contaminated Sites Act 2003* (the Act) on 10 December 2018 as 'possibly contaminated – investigation required':

 Parcel 72151 = That portion of Lot 9077 on Deposited Plan 60716 as shown as the road portion and excluding Subject A on Deposited Plan 412592 on certificate of title 2717/207, Dalyellup WA 6230

Following the submission of additional information, the site has been reclassified.

This notification is being sent to you in accordance with section 15(1) of the Act on the grounds that you, as the recipient, are one or more of the following:

- (a) owner of the site (contact details sourced from the current certificate of title);
- (b) occupier of the site;
- (c) relevant public authority;
- (d) person who, in the CEO's opinion, there is particular reason to notify;
- (e) person who made the report under section 11 or 12; and
- (f) person who, in the CEO's opinion, may be responsible for remediation of a site classified as contaminated remediation required.

Re-classification of the Site

Category of site classification: Not contaminated - unrestricted use

Date of site classification: 31/07/2019

Reasons for classification: This site was originally reported to the Department of Water and Environmental Regulation (DWER) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003' (the Act), which commenced on 1 December 2006. The site has been reported again under section 11 of the Act.

Prime House, 8 Davidson Terrace Joondalup Western Australia 6027 Locked Bag 10 Joondalup DC WA 6919

Telephone: 1300 762 982 Facsimile: 08 6364 7001

www.dwer.wa.gov.au

The site was first classified under section 13 of the Act based on information submitted to DWER by September 2009. The site was classified at the same time as the former Dalyellup 'Waste Residue Disposal Facility' (WRDF). The site classification was updated to reflect new information provided to DWER by November 2018. The site classification has been updated again to reflect new information provided to DWER by May 2019.

The site comprises a portion of Lot 9077 on Deposited Plan 60716 representing an access road which connects Maidment Parade to the former WRDF. The WRDF operated in accordance with a Part IV licence issued under the Environmental Protection Act 1986 (licence L6130/1989/12).

The WRDF operated as a licenced facility for the disposal of treated solid residue (TSR) from the production of titanium dioxide pigment between March 1989 and March 2013. TSR was transported from production facilities located in Kemerton and Australind to the WRDF via the access road for disposal.

DWER enquiries have confirmed that the access road did not form part of the licensed WRDF site, and that the access road was not assessed as part of the investigations completed for the WRDF. The balance of Lot 9077, which comprises the WRDF, has been classified separately under the Act.

DWER understands that land surrounding the access road is known as the Greenpatch development area and is proposed for development, which may include residential housing and public open space.

Information provided to DWER in 2018 based on documentation dating from 1994 that related to trials of TSR for pavement construction indicated that TSR had potentially been used as a road base and/or for maintenance purposes along the access road. However, new information provided to DWER in 2019 provides multiple lines of evidence that indicate that TSR was unlikely to have been used in either the construction or maintenance of the access road.

Available information indicates that material used in the construction of the access road was sourced from virgin quarried materials in February 1989. Furthermore, the Dalyellup disposal ponds were not constructed until March 1989, indicating that TSR was not available onsite for use as road base at the time of the road construction in February 1989.

Given that the access road is sealed, any historical maintenance of the access road is expected to have comprised small-scale repairs using commercial sources of asphalt or bitumen. There is no evidence to suggest TSR was used as a material for maintenance of the access road.

Groundwater quality has not been investigated below the access road. However, groundwater quality has been investigated in the adjacent Greenpatch development area. Chemicals of potential concern in groundwater collected from monitoring wells located on the Greenpatch site were below the assessment criteria for domestic non-potable use specified in 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014).

Based on the information provided, combined with assessments and enquiries undertaken by DWER, there appears to be no substantial evidence to support the alleged use of TSR material in the construction or maintenance of the access road. Therefore, the site appears suitable for unrestricted use, including sensitive uses such as residential, primary schools and childcare centres.

A review of available information and historical records has demonstrated that there is no reason to suspect that this site is contaminated. Therefore, the site is classified as 'not contaminated - unrestricted use'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

In accordance with Department of Health advice, if groundwater is being, or is proposed to be abstracted, DWER recommends that analytical testing should be carried out to determine whether the groundwater is suitable for its intended use.

Other Relevant Information:

Additional information included herein is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination described in the Reasons for Classification.

Action Required:

No further management of the site in relation to contamination is currently required.

General Information

The nature and extent of contamination and any restrictions on the use of the land, if applicable, are listed in Attachment A.

Information relating to the classification of the site is also available by submitting a request for a summary of records (using Form 2) to: Department of Water and Environmental Regulation, Locked Bag 10, Joondalup DC, WA 6919. A fee of \$30 currently applies for a Basic Summary of Records. Forms are available from www.der.wa.gov.au/contaminatedsites.

In some instances DWER has had to classify sites based on historical information. A site may be re-classified at any stage when additional information becomes available, for example where a new investigation or remediation report completed in accordance with DWER's 'Contaminated Sites Guidelines' and the *National Environment Protection (Assessment of Site Contamination) Measure* 1999, is submitted to DWER. The current site classification is the classification most recently conferred on the site.

Appealing the Site Classification

All site classifications given by DWER are appealable. However, only certain people can lodge a valid appeal. The people who can lodge a valid appeal varies, depending on the classification category, as detailed in Fact Sheet 4: *Site classifications and appeals*. Appeals need to be lodged in writing with the Contaminated Sites Committee at Forrest Centre, Level 22, 221 St Georges Terrace, Perth WA 6000, within **45 days** of being given this notification. The appeal should set out the appellant's relationship to the site, and must include the grounds and facts upon which it is based. An appeal fee (currently \$45) applies.

To find out more about the appeal process, see the Contaminated Sites Committee website at www.csc.wa.gov.au or contact the office of the Committee on (08) 6364 7264.

For further information on all aspects of site classification, please refer to Fact Sheet 4 and the 'Contaminated Sites Guidelines', which are available from DWER's website at www.der.wa.gov.au/contaminatedsites or by contacting the Contaminated Sites Information Line on 1300 762 982.

Yours sincerely

Paul Newell, Manager

CONTAMINATED SITES REGULATION Delegated Officer under section 91 of the *Contaminated Sites Act 2003*

02/08/2019

Enc. Attachment A – Nature and Extent and Restrictions on Use.

Fact Sheet 4: Site classifications and appeals
Fact Sheet 5: Buyer beware - buying and selling contaminated land

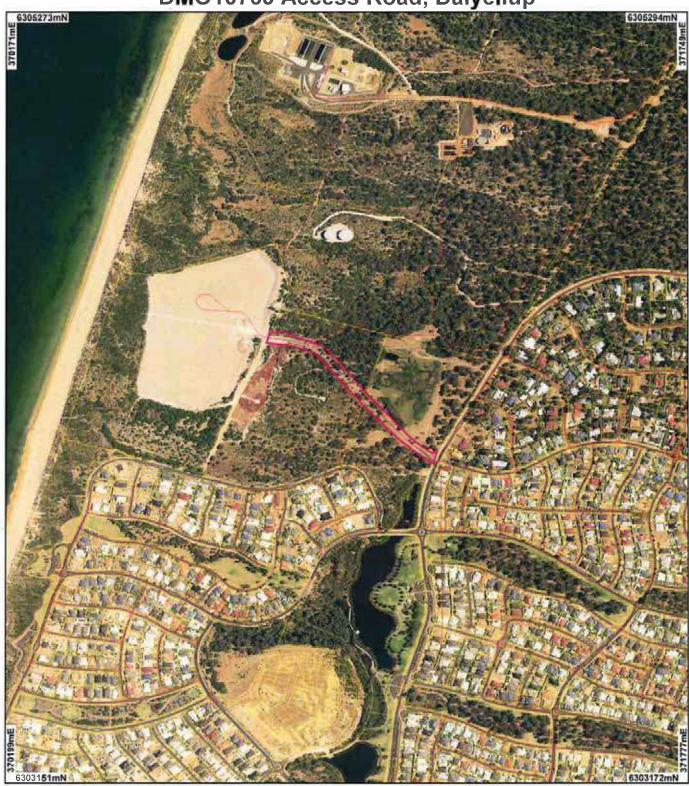
ATTACHMENT A - Nature and Extent and Restrictions on Use

• That portion of Lot 9077 on Deposited Plan 60716 as shown as the road portion and excluding Subject A on Deposited Plan 412592

Nature and Extent: Soil or groundwater investigations have not been undertaken at the site. However, a review of available information has found there are no reasonable grounds to suspect that contamination is present in the material comprising the road, or in soils beneath the road.

Restriction on Use: Please refer to Reasons for Classification for further information relevant to the use of the site.

DMO10753 Access Road, Dalyellup





// Road Centrelines Cadastre



Geocentric Datum Australia 1994

Note the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.

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Government of Western Australia Department of **Environment Regulation**

Buyer beware buying and selling contaminated land

Purpose

This fact sheet is designed to provide targeted information on buying and selling contaminated land in Western Australia.

Introduction

The Contaminated Sites Act 2003 (the Act) was introduced to identify, record, manage and clean up contamination. Under the Act, known or suspected contaminated sites must be reported to the Department of Environment Regulation (DER), investigated and, if necessary, cleaned up (remediated).

Investigating and cleaning up contaminated sites is, in most cases, the responsibility of the polluter or current site owner. DER administers and enforces the Act which includes classifying sites (in consultation with the Department of Health) and making information on contaminated sites available to the public.

It is not unusual for residential subdivisions to be built on land that was previously used for potentially contaminating activities, such as service stations, heavy industry and market gardens.

People buying, selling or leasing land need to know if the land being purchased was once a contaminated site and be aware of their obligations under the Act.

Failing to recognise that land is contaminated can have long term consequences for both the buyer and seller including potential prosecution and obligation to pay for remediation of the land in the future.

Thorough due diligence

Investigating and cleaning up contaminated sites can be expensive. Prospective purchasers should be aware of the risk of potential contamination and carry out careful, thorough pre-purchase enquiries (due diligence).

When buying, selling or leasing property, you and/or your real estate professional should search published contaminated sites information as part of any routine, prepurchase due diligence enquiry.

Steps to take before you buy

- 1. Search DER records check the contaminated sites database or submit a Form 2 to DER to find out if the property you are looking to buy has been reported as a known or suspected contaminated site.
- 2. Find out as much as you can about the property's history. How was the land used in the past?
 - Check local government records, historic certificates of title and aerial photographs (available from Landgate).
 - Talk to neighbours they may know the history of the property and what went on there in the past.
- 3. Search for information on properties nearby. Contamination on adjacent or surrounding sites may affect your property - for example, is there a service station nearby?
- 4. If you need a formal, thorough investigation for potential contamination, consider engaging an environmental consultant to carry out a preliminary site investigation

(PSI). See <u>Fact Sheet 3</u>, <u>Seeking help from</u> contaminated sites experts.

Potentially contaminating activities

DER's guideline, <u>Assessment and</u> management of contaminated sites includes a quick reference list of activities, industries and land uses which could lead to contamination. This list is not exhaustive and you should also consider surrounding and historical uses of the land which may have resulted in contamination at the property.

Who is responsible for remediation or cleaning up contamination?

If you are buying, selling or leasing contaminated land in Western Australia, you need to be aware of your obligations under the Act. It provides a hierarchy of responsibility for remediation and associated costs for investigating and cleaning up contamination. Under s 24 of the Act, a person is responsible for remediation of a site:

- a) if they have caused or contributed to the contamination of the site;
- b) if they are an owner or occupier of the site who has changed, or proposes to change, the use to which land that comprises all or part of the site is put; or
- c) if they are an owner of the site, or of a source site.

The term "owner" in the Act is defined to include a mortgagee in possession.

Under the Act, the person responsible for the remediation costs is responsible for cleaning up the land and water to make it safe and suitable for its current (zoned) use.

However, if you intend to change the land use, for example, develop a market garden into a residential housing estate, a land use that

requires the land to be cleaned up to a higher standard, it is the owner/occupier changing the land use who is responsible for any additional clean-up costs to ensure the site is fit for the new purpose.

Pre-sale disclosure requirements

Some site classifications require disclosure to potential new owners/occupiers when selling or leasing property. Disclosure is required for sites classified:

- contaminated remediation required;
- · contaminated restricted use; or
- remediated for restricted use.

Site owners are required to complete and sign a Form 6 and provide copies to a potential new owner, mortgagees or lessees and DER at least 14 days before transactions are completed – for example, 14 days before settlement date for a sale or date the mortgage is registered or lease is signed/commences. We suggest you also include a copy of the Basic Summary of Records which can be downloaded from DER's website. You must also disclose if a regulatory notice such as an investigation or clean-up notice has been served on your property.

If you fail to disclose this information, you are committing an offence and a penalty may apply.

Maximum Penalty: \$125,000.

Possible maximum daily penalty: \$25,000.

Although it is not mandatory to disclose information on sites classified *possibly* contaminated – investigation required, DER recommends that sellers advise potential purchasers of a property's contamination status.

False or misleading information

When reporting contamination, requesting information from DER, disclosing contamination under s 68 or providing information to the CEO or Contaminated Sites Committee, a person must not provide false or misleading information or fail to disclose all relevant information.

Maximum penalty: \$125,000.

Possible maximum daily penalty: \$25,000.

More information

For advice on contaminated sites or related matters, please contact DER's contaminated sites information line 1300 762 982 or email contaminated.sites@der.wa.gov.au

This document is available in alternative formats and other languages on request.

Related documents

Other fact sheets in this series:

- 1. Identifying and reporting contaminated sites
- 2. How to access information on contaminated sites
- 3. Seeking help from contaminated sites experts
- 4. Buyer beware buying and selling contaminated land

Guidelines relating to investigating and managing contaminated sites are available at www.der.wa.gov.au/contaminatedsites

Legislation

This document is provided for guidance only. It should not be relied upon to address every aspect of the relevant legislation. The full text of the *Contaminated Sites Act 2003* is available electronically from the State Law Publisher website at www.slp.wa.gov.au

Disclaimer

The information contained in this document is provided by DER in good faith as a public service. However, DER does not guarantee the accuracy of the information contained in this document and it is the responsibility of recipients to make their own enquiries as to its accuracy, currency and relevance. The State of Western Australia, DER and their servants and agents expressly disclaim liability, in negligence or otherwise, for any act or omission occurring in reliance on the information contained in this document or for any consequence of such act or omission.

Limitation

The Western Australian Government is committed to providing quality information to the community and makes every attempt to ensure accuracy, currency and reliability of the data contained in this document. However, changes in circumstances after the time of publication may impact on the quality of information. Confirmation of the information may be sought from the relevant originating bodies or the department providing the information. DER and the State of Western Australia reserve the right to amend the content of this document at any time without notice.

Legal advice

The information provided to you by DER in relation to this matter does not constitute legal advice. Due to the range of legal issues potentially involved in this matter, DER recommends that you obtain independent legal advice.

Site classifications and appeals

Purpose

This fact sheet is designed to provide targeted information on contaminated site classifications and appeals in Western Australia.

Introduction

The Contaminated Sites Act 2003 (the Act) was introduced to identify, record, manage and clean up contamination. Under the Act, known or suspected contaminated sites must be reported to the Department of Environment Regulation (DER), investigated and, if necessary, cleaned up (remediated).

Investigating and cleaning up contaminated sites is, in most cases, the responsibility of the polluter or current site owner. DER administers and enforces the Act which includes classifying sites (in consultation with the Department of Health) and making information on contaminated sites available to the public.

Site classifications – what do they mean?

A site classification is a description assigned to an area of land that has been reported to the DER under the Act, as a site that is known or suspected to be contaminated.

Contaminated – in relation to land, water or a site, means having a substance present in or on that land, water or site at above background concentrations that presents, or has the potential to present, a risk of harm to human health, the environment or any environmental value.

DER can allocate any one of seven possible classifications to sites:

- 1. Contaminated remediation required. The site is contaminated and needs to be investigated and cleaned up to ensure it does not present a risk to human health or the environment. This classification will remain until remediation is complete.
- 2. Contaminated restricted use. The site is contaminated but suitable for limited uses (e.g. the site may be suitable for commercial use, but not residential use: or for residential use provided groundwater bores are not used and soil is not accessed).
- 3. Remediated for restricted use. The site was contaminated but has been cleaned up to a standard where it is suitable for limited uses (e.g. the site may be suitable for an apartment block, but not for a kindergarten).
- 4. Possibly contaminated investigation required. There are grounds to indicate soil, groundwater and/or surface water at the site may be contaminated but further inquiry is needed to confirm or dismiss the possibility of contamination.
- 5. **Decontaminated.** The site has been remediated and is suitable for all uses. It does not pose a risk to the environment or human health.
- 6. Not contaminated unrestricted use. After investigation, no contamination was found at the site.
- 7. Report not substantiated. There is not enough information to indicate that the site could be contaminated.

According to the Act: 'remediation' in respect of a site that is contaminated includes –

- (a) the attempted restoration of the site to the state it was in before the contamination occurred;
- (b) the restriction, or prohibition, of access to, or use of, the site;
- (c) the removal, destruction, reduction, containment or dispersal of the substance causing the contamination, or the reduction or mitigation of the effect of the substance;
- (d) the protection of human health, the environment or any environmental value from the contamination.

How are sites classified?

All classification decisions are based on a thorough review and assessment of all information available to DER at the time and take into account relevant guidelines for site investigations and management.

Notification of classification

The Act requires DER to notify the following people of a site's classification:

- site owner;
- site occupier;
- relevant public authority, for example, Water Corporation, local government authority;
- person who reported the site; and
- those responsible for remediating the site (where classified contaminated – remediation required).

Can I appeal?

Under the Act, you may be able to appeal against a decision. Depending on the nature of the case, your appeal will be considered by either the Contaminated Sites Committee or on a point of law only to the Supreme Court.

You can appeal:

- a site classification assigned by DER;
- an investigation or clean up notice issued by DER;
- a responsibility for remediation determination by the Contaminated Sites Committee; and
- a notice relating to the recovery of costs incurred by the State on an orphan site (given to the person who would have been responsible for remediation).

You cannot appeal against receiving a hazard abatement notice. This notice addresses an immediate and serious risk to human health, the environment or any environmental value.

Contaminated Sites Committee

The <u>Contaminated Sites Committee</u> is an independent statutory body appointed by the Minister for Environment to:

- determine appeals against site classifications and regulatory notices;
- determine who is responsible for remediation; and
- decide the extent to which parties are responsible for remediation (more than one person may be responsible for remediating a site).

Who can appeal?

Depending on the nature of the classification, certain people can appeal against the classification to the <u>Contaminated Sites</u>

<u>Committee</u> (see table overleaf). An appeal must include the reasons why the person lodging the appeal disagrees with the site classification and include any relevant supporting information.

Appeals against site classifications

To lodge an appeal against a site classification, you must:

- submit reasons why you disagree with assigned site classification; and
- include any relevant supporting information.

An appeal must be lodged with the Committee within 21 days (or timeframe specified in the notice of classification). The Committee's decision on appeals against site classifications is final.

Appeals against an investigation or clean-up notice

To lodge an appeal against an investigation or clean-up notice, you must:

 submit the details of the case and grounds for appeal to the Committee.

An appeal must be lodged within 21 days of receiving the notice. The Committee's decision on an appeal against a notice is final.

Requests for a decision on responsibility for remediation

Where responsibility for remediation is in question, the Committee can determine who must clean up the site and to what extent.

You can appeal the Committee's decision to the Supreme Court on a point of law only. An appeal to the Supreme Court must be made in accordance with the rules of the court and be within 21 days of receiving the Committee's decision.

There is a \$45 fee to appeal against a site classification, investigation or clean-up notice. The disputed decision, classification or notice requirement applies while you are waiting for the outcome of the appeal.

Note: Appeal timeframes can be quite long as there are often multiple rounds of consultation between parties before the Committee makes its final decision.

False or misleading information (s 94)

When reporting contamination, requesting information from DER, disclosing contamination under s 68 or providing information to the CEO or Contaminated Sites Committee, a person must not provide false or misleading information or fail to disclose all relevant information.

Maximum penalty: \$125,000.

Possible maximum daily penalty: \$25,000.

More information on the appeal process

See the <u>Contaminated Sites Committee's</u> website.

Who can appeal?

Classification	Owner/occupier	Person responsible for remediation	Person who reported a suspected contaminated site
Contaminated – remediation required	Yes	Yes	
Contaminated – restricted use	Yes	Yes	
Remediated for restricted use	Yes	Yes	
Possibly contaminated – investigation required	Yes		
Decontaminated	Yes		
Not contaminated – unrestricted use	Yes		
Report not substantiated			Yes

More information

For advice on contaminated sites or related matters, please contact DER's contaminated sites information line 1300 762 982 or email contaminated.sites@der.wa.gov.au

This document is available in alternative formats and other languages on request.

Related documents

Other fact sheets in this series:

- 1. Identifying and reporting contaminated sites
- 2. How to access information on contaminated sites
- 3. Seeking help from contaminated sites experts
- 5. Buyer beware buying and selling contaminated land

Guidelines relating to investigating and managing contaminated sites are available at www.der.wa.gov.au/contaminatedsites

Legislation

This document is provided for guidance only. It should not be relied upon to address every aspect of the relevant legislation. The full text of the *Contaminated Sites Act 2003* is available electronically from the State Law Publisher website at www.slp.wa.gov.au

Disclaimer

The information contained in this document is provided by DER in good faith as a public service. However, DER does not guarantee the accuracy of the information contained in this document and it is the responsibility of recipients to make their own enquiries as to its accuracy, currency and relevance. The State of Western Australia, DER and their servants and agents expressly disclaim liability, in negligence or otherwise, for any act or omission occurring in reliance on the information contained in this document or for any consequence of such act or omission.

Limitation

The Western Australian Government is committed to providing quality information to the community and makes every attempt to ensure accuracy, currency and reliability of the data contained in this document.

However, changes in circumstances after the time of publication may impact on the quality of information. Confirmation of the information may be sought from the relevant originating bodies or the department providing the information. DER and the State of Western Australia reserve the right to amend the content of this document at any time without notice.

Legal advice

The information provided to you by DER in relation to this matter does not constitute legal advice. Due to the range of legal issues potentially involved in this matter, DER recommends that you obtain independent legal advice.

Our ref: DMO 10781

Enquiries: Michelle Brierley, Ph 6364 7187 Email: michelle.brierley@dwer.wa.gov.au

Mr J Silla Satterley Property Group Ltd PO Box 1346 West Perth, WA, 6872

By email: johns@satterley.com.au

Dear Mr Silla

LOT 9109, LOT 9076 AND LOT 8019 KNOWN AS 'GREENPATCH', DALYELLUP

The Department of Water and Environmental Regulation (the department) classified Lot 9109 on Plan 419061, Lot 9076 on Plan 55511 and Lot 8019 on Plan 55511 (i.e. "the site" and the area also known as "Greenpatch") as "report not substantiated" under the Contaminated Sites Act 2003 (the Act) on 27 March 2018.

On 24 May 2018, the Contaminated Sites Committee (the Committee) received an appeal application against the classification of the site as "report not substantiated".

The Committee determined on 20 October 2020 that, on balance, there is sufficient evidence to conclude that there should be further investigation at the site. The Committee therefore determined that the appeal is upheld to the extent that the site is to be classified under the Act as "possibly contaminated – investigation required".

The site has therefore been reclassified from "report not substantiated" to "possibly contaminated – investigation required".

Based on this reclassification, and consistent with the decision by the Committee, the requirements of the Act and the department's published contaminated sites guidelines, further investigation will be required to be undertaken at the site in order to demonstrate that the site is suitable for the previously proposed residential development. It is noted that the department has not been consulted in relation to the lodgement of a development application for the proposed development, but notes that the department is likely to recommend the placement of a contaminated sites condition, and engagement of a contaminated sites auditor as part of any planning approval process.

A copy of the Notice of Classification is enclosed herein for your records.

If you have any queries in relation to the above, please contact Senior Environmental Officer, Michelle Brierley, on 6364 7187.

Yours sincerely

Andrew Miller

SENIOR MANAGER CONTAMINATED SITES

Centillee

4 November 2020

cc. <u>Colm.Corcoran@rpsgroup.com.au</u> jason.clay@senversa.com.au

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Telephone: 1300 762 982 Facsimile: 08 6364 7001

Site Re-classification

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Date of site classification 105 112020
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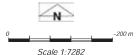
ATTACHMENT A – Nature and Extent and Restrictions on Use

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Lot 9105, Lot 9076 & Lot 8019 "Greenpatch", Dalyellup - DMO 10781







Scale 1:7282 (Approximate when reproduced at A4)

Geocentric Datum Australia 1994

Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.

Prepared by: Prepared for: Date: 29/10/2020 11:23:30 AM

Information derived from this map should be confirmed with the data custodian acknowleged by the agency acronym in the legend.



WA Crown Copyright 2002

Appendix B Certificates of Title





AUSTRALIA

REGISTER NUMBER
8019/DP55511

DUPLICATE EDITION
N/A
N/A
N/A

RECORD OF CERTIFICATE
OF

LR3154

141

CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893 AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.



LAND DESCRIPTION:

LOT 8019 ON DEPOSITED PLAN 55511

2.

STATUS ORDER AND PRIMARY INTEREST HOLDER:

(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE UNDER MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: SHIRE OF CAPEL OF PO BOX 369, CAPEL

(XE L420915) REGISTERED 7 SEPTEMBER 2010

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

T2756/1912 EASEMENT BENEFIT SEE TRANSFER 2756/1912. REGISTERED 10.1.1912.

L420914 RESERVE 50692 FOR THE PURPOSE OF DRAINAGE REGISTERED 7.9.2010.

L420915 MANAGEMENT ORDER. CONTAINS CONDITIONS TO BE OBSERVED.

REGISTERED 7.9.2010.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF CROWN LAND TITLE-----

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP55511.
PREVIOUS TITLE: 2656-245.

PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.

LOCAL GOVERNMENT AREA: SHIRE OF CAPEL.

RESPONSIBLE AGENCY: DEPARTMENT OF LANDS (SLSD).

NOTE 1: L420914 CORRESPONDENCE FILE 00649-2010-01RO

WESTERN



AUSTRALIA

register number 9109/DP419061

VOLUME

2984

DUPLICATE EDITION N/A DATE DUPLICATE ISSUED

N/A

FOLIO

1000

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BCROBETS
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9109 ON DEPOSITED PLAN 419061

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

HOUSING AUTHORITY OF 99 PLAIN STREET, EAST PERTH

(AF M972295) REGISTERED 30/4/2015

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. *H598929 EASEMENT BENEFIT FOR TELEVISION CABLING PURPOSES.SEE DEPOSITED PLAN 404839

REGISTERED 16/11/2000.

2. *O563993 MEMORIAL. CONTAMINATED SITES ACT 2003 REGISTERED 24/11/2020.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.

* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.

Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP419061 PREVIOUS TITLE: 2871-951

PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.

LOCAL GOVERNMENT AUTHORITY: SHIRE OF CAPEL

RESPONSIBLE AGENCY: DEPARTMENT OF COMMUNITIES (SSHC)

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING

L926889





AUSTRALIA

REGISTER NUMBER 9076/DP55511

1

29/7/2008

RECORD OF CERTIFICATE OF TITLE UNDER THE TRANSFER OF LAND ACT 1893

2696

377

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

LAND DESCRIPTION:

LOT 9076 ON DEPOSITED PLAN 55511

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

HOUSING AUTHORITY OF 99 PLAIN STREET, EAST PERTH

(AF K653100) REGISTERED 23 JULY 2008

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. T2756/1912 EASEMENT BENEFIT SEE TRANSFER 2756/1912. REGISTERED 10.1.1912.

H598929 2

EASEMENT BENEFIT AS TO THE PORTION OF LAND FORMERLY COMPRISED IN VOL

2516 FOL 780 ONLY - SEE INSTRUMENT H598929. REGISTERED 16.11.2000.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title. Lot as described in the land description may be a lot or location.

----END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP55511.

PREVIOUS TITLE: 2656-245, 2516-780,

PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.

LOCAL GOVERNMENT AREA: SHIRE OF CAPEL.

RESPONSIBLE AGENCY: DEPARTMENT OF HOUSING (SSHC). WESTERN



AUSTRALIA

REGISTER NUMBER 9077/DP60716

VOLUME

2717

DUPLICATE DATE DUPLICATE ISSUED EDITION 1

7/5/2009

FOLIO

207

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

LAND DESCRIPTION:

LOT 9077 ON DEPOSITED PLAN 60716

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

CRISTAL PIGMENT AUSTRALIA LTD OF LOT 4 OLD COAST ROAD, AUSTRALIND

(T M667801) REGISTERED 12/6/2014

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

EASEMENT BENEFIT REGISTERED 10/1/1912. T2756/1912 1.

2. H598929 EASEMENT BURDEN SEE SKETCH ON DEPOSITED PLAN 60716. REGISTERED 16/11/2000.

J066925 EASEMENT H598929 PARTIALLY SURRENDERED. AS TO THE LAND IN VOLUME 2210

FOLIO 558 ONLY. REGISTERED 28/10/2004.

*M379789 NOTIFICATION. ENVIRONMENTAL PROTECTION ACT 1986. REGISTERED 22/8/2013. 3.

MEMORIAL. CONTAMINATED SITES ACT 2003 AS TO PORTION ONLY - SEE DEPOSITED *N989531

PLAN 412592 REGISTERED 19/9/2018.

A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Warning:

* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.

Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----END OF CERTIFICATE

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP60716

PREVIOUS TITLE: 1894-495, 2696-378

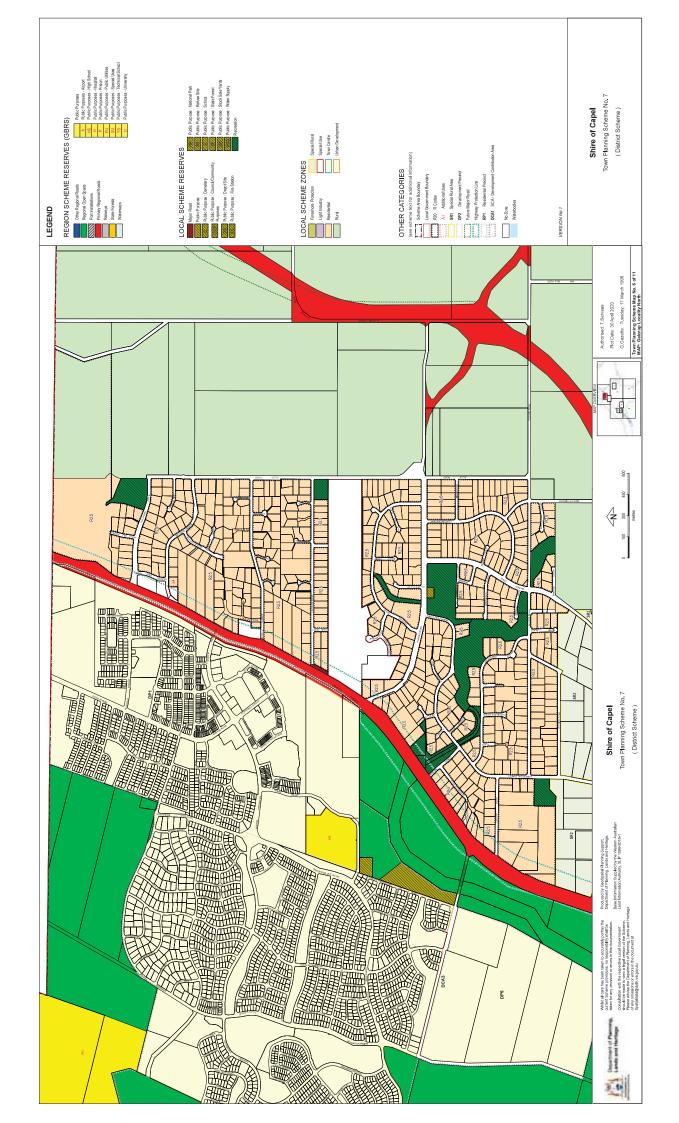
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LOCAL GOVERNMENT AUTHORITY: SHIRE OF CAPEL

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING

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Appendix CTown Planning



Appendix D Heritage Searches



List of Registered Aboriginal Sites

Search Criteria

No Registered Aboriginal Sites in Custom search area - Point with 2000m buffer - 115.612507253866°E, 33.3942316095408°S (GDA94)

Disclain

The Aboriginal Heritage Act 1972 preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, ncluding our maps, it would be appreciated if you email the details to the Department at AboriginalHeritage@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible. The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The

South West Settlement ILUA Disclaimer

Your heritage enquiry is on land within or adjacent to the following Indigenous Land Use Agreement(s): Gnaala Karla Booja Indigenous Land Use Agreement.

On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah #2 and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).

instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an 'Activity Notice' issued under the NSHA, if there is a risk that an activity will 'impact' (i.e. by excavating, damaging, destroying or altering in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines, Industry Regulation and Safety (DMIRS) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised. If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMIRS, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at nttps://www.wa.gov.au/organisation/department-of-the-premier-and-cabinet/south-west-native-title-settlement

Further advice can also be sought from the Department of Planning, Lands and Heritage at AboriginalHeritage@dplh.wa.gov.au.

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Coordinate Accuracy

Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.



List of Registered Aboriginal Sites

Basemap Copyright

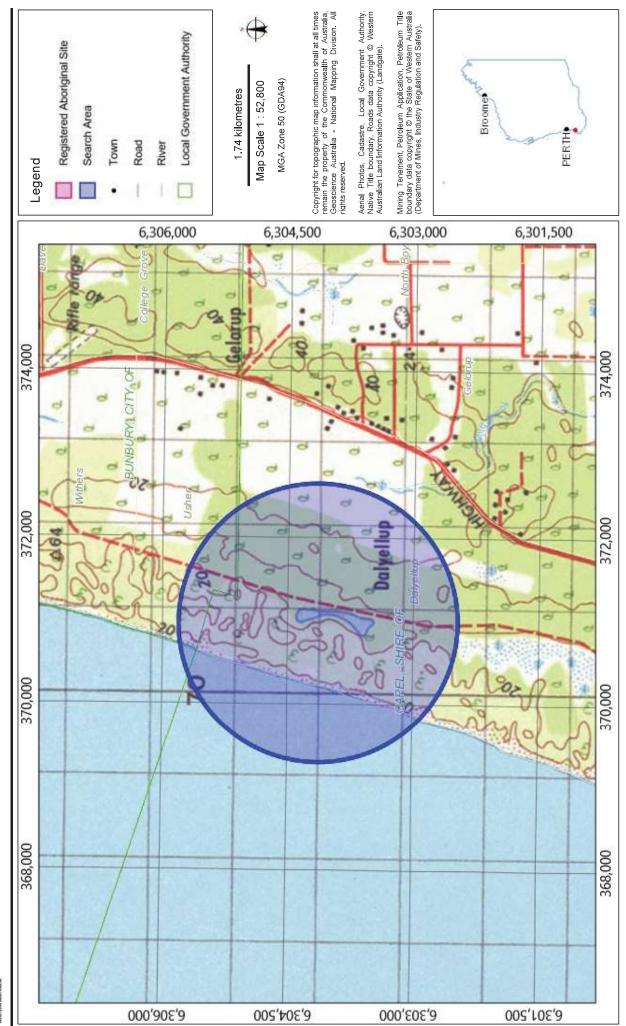
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Identifier: 502138



Department of Planning, Lands and Heritage

Map of Registered Aboriginal Sites



Place Details

Send Feedback

Minninup Dunes Area, Minninup Rd, Stratham via Capel, WA, Australia

Photographs



List	Register of the National Estate (Non-statutory archive)		
Class	Vatural		
Legal Status	<u>Indicative Place</u>		
Place ID	9507		
Place File No	5/02/047/0002		

Nominator's Statement of Significance

The vegetation surrounding the Minninup Wetlands and on the adjoining dunes is rich and diverse. Wildflowers are outstanding in September each year. Quokka and other small marsupials are common. There has been a suggestion, from tracks, that poteroo maybe present. The Wetlands are of prime importance to waterfowl and other water birds in the Bunbury/Capel area. There is concern that significant disturbance of the groundwater system could lead to the destruction of the Wetlands.

Indigenous values are known to exist in this area. As yet these have not been identified, documented or assessed for National Estate significance by the Australian Heritage Commission.

Official Values Not Available

Description

Minninup Wetlands are separated from the Indian Ocean by a series of low dunes which contain mineral sands. The dunes are covered by a mixture of woodland and scrub of the Quindalup complex. The adjoining wetlands involve vegetation of the Vasse complex, with MELALEUCA spp predominating. The Wetlands are permanent, contain sweet water and are drained by a channel running south-west to the floodgates.

History Not Available

Condition and Integrity

1982:

The vegetation is in good condition, being little disturbed. However, the foredune has been disturbed to some extent and the effect on the fragile foredune alliance is clear.

1987: 10-20% of dunes mined.

Location

About 120ha, Minninup Road, off Bussell Highway, 10km north of Capel, comprising Wellington Locations 394 and 637.

Bibliography

- 1) "ATLAS OF NATURAL RESOURCES DARLING SYSTEM WESTERN AUSTRALIA", DEPARTMENT OF CONSERVATION AND ENVIRONMENT, W.A. 1980.
- 2) "CONSERVATION RESERVES FOR WESTERN AUSTRALIA SYSTEMS 1, 2, 3, 5", ENVIRONMENTAL PROTECTION AUTHORITY, W.A. 1976.
- 3) "WETLANDS OF THE DARLING SYSTEM", K. MAJOR (4 BULLETINS),
- DEPARTMENT OF CONSERVATION AND ENVIRONMENT, W.A. 1979.

 4) "WESTERN LANDSCAPES" J. GENTILL (ED), UNIVERSITY OF W.A. PR.
- 4) "WESTERN LANDSCAPES", J. GENTILI (ED), UNIVERSITY OF W.A. PRESS, 1979.

Report Produced Fri Jan 15 17:10:48 2021

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List of Other Heritage Places

Search Criteria

No Other Heritage Places in Custom search area - Point with 2000m buffer - 115.612507253866°E, 33.3942316095408°S (GDA94)

Disclaim

The Aboriginal Heritage Act 1972 preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, ncluding our maps, it would be appreciated if you email the details to the Department at AboriginalHeritage@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible. The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The

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Coordinate Accuracy

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List of Other Heritage Places

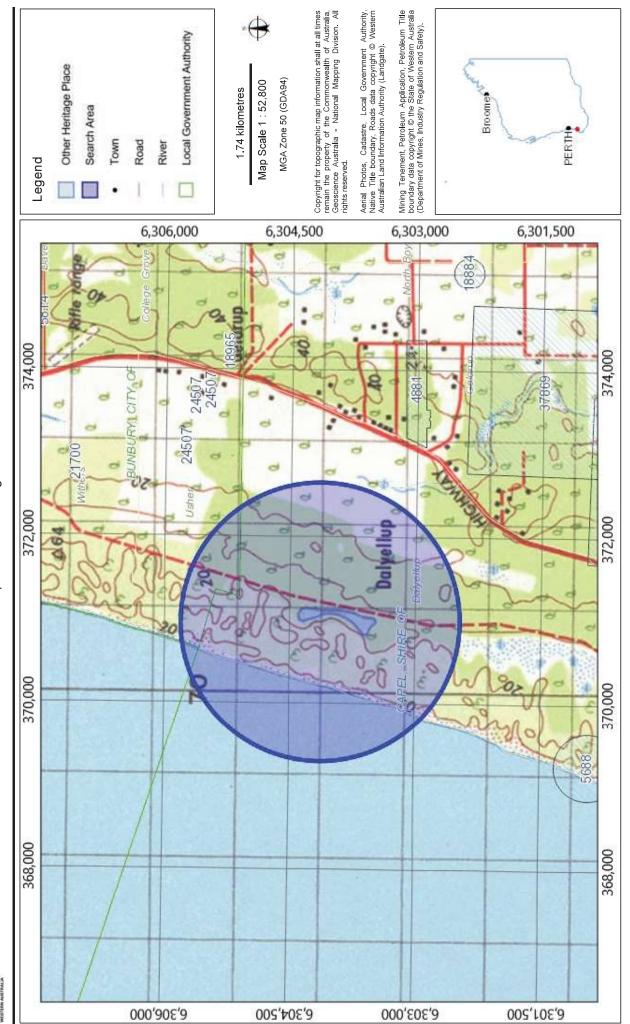
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Identifier: 502137



Map of Other Heritage Places

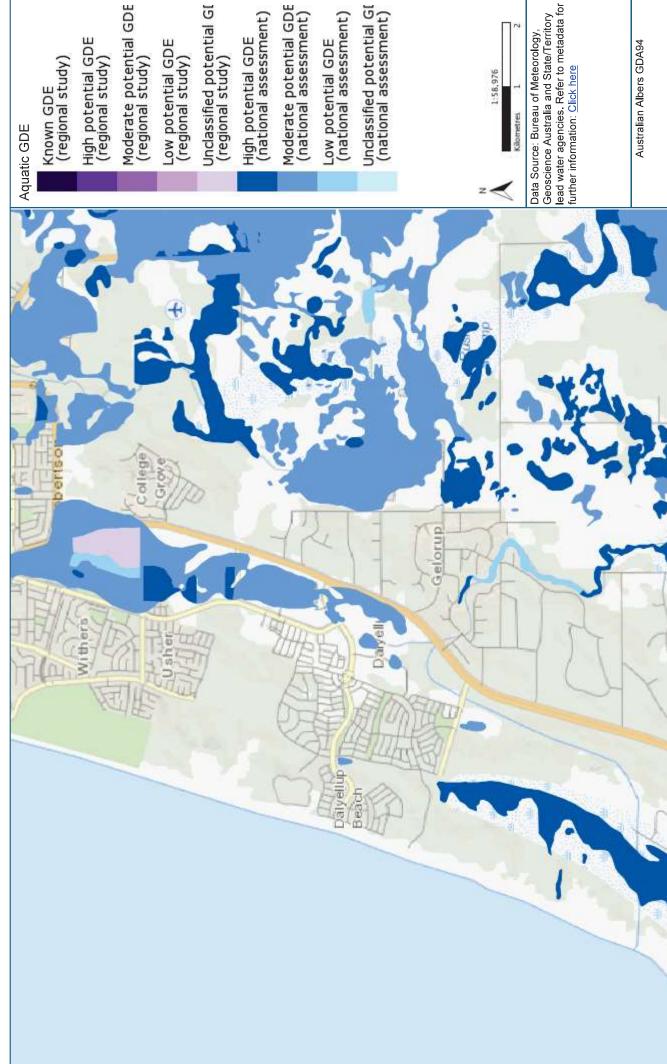


Identifier: 502137

Appendix E Groundwater Dependant Ecosystems

1. GDE Aquatic

Australian Government Bureau of Meteorology



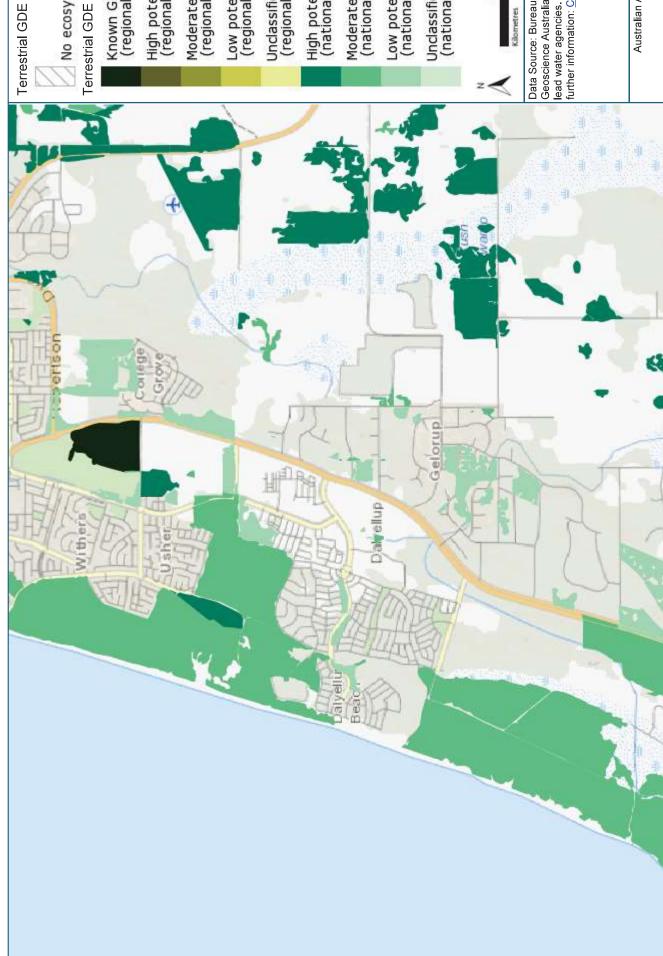
lead water agencies. Refer to metadata for further information: <u>Click here</u> Geoscience Australia and State/Territory Data Source: Bureau of Meteorology,

1:58,976

Australian Albers GDA94

2. GDE Terrestrial

Australian Government Bureau of Meteorology



Terrestrial GDE (no data)

No ecosystems analysed

Known GDE (regional study)

High potential GDE (regional study)

Moderate potential GDE (regional study)

Low potential GDE (regional study)

Unclassified potential GI (regional study)

High potential GDE (national assessment)

Moderate potential GDE (national assessment)

Low potential GDE (national assessment)

Unclassified potential GI (national assessment)



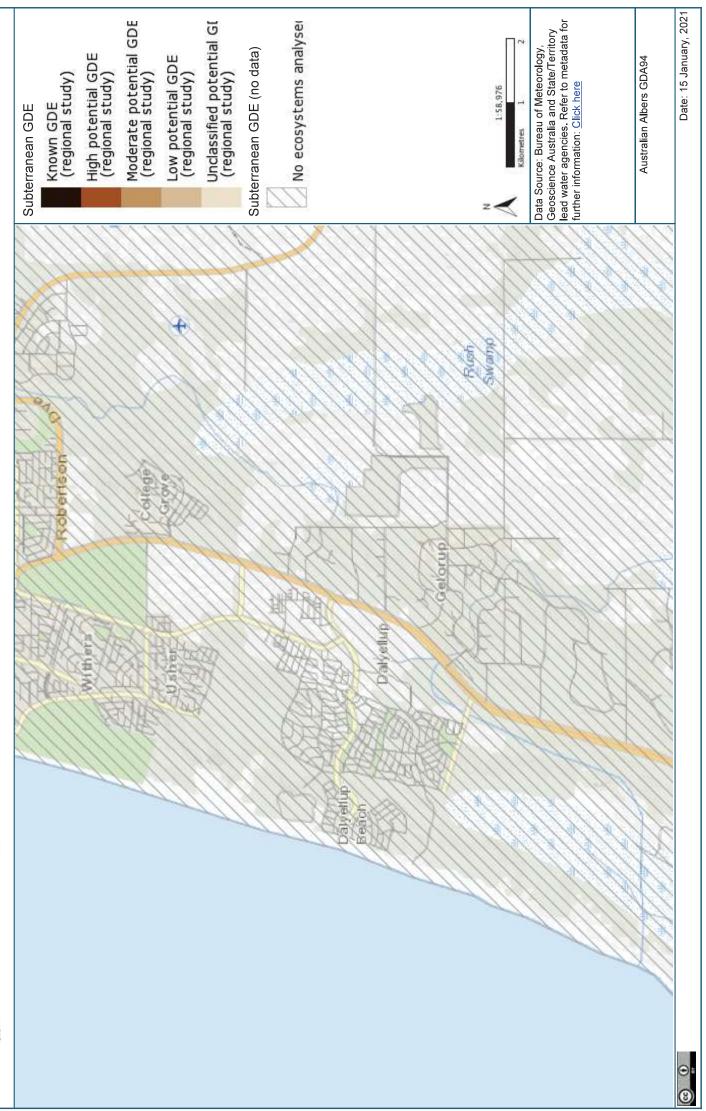
lead water agencies. Refer to metadata for further information: <u>Click here</u> Geoscience Australia and State/Territory Data Source: Bureau of Meteorology,

Australian Albers GDA94

Australian Government Bureau of Meteorology

Groundwater Dependent Ecosystems Atlas

3. GDE Subterranean



Appendix F Nature Map

1/15/2021 NatureMap



NatureMap - Conservation Species

Printed by Guest user on 15/1/2021

Query details: Current Names Only=Yes; Core Datasets Only=Yes; Method='By Circle'; Centre=115° 36' 42" E,33° 23' 38" S; Buffer=2km;



Search Results

Selected

Selected Species

All Results

- Default
- Confirmed
- Corrected
- Reported

Reference Layers

Major WA Towns

Major WA Towns

.

Major WA Towns

State Borders



NatureMap Species Report

Created By Guest user on 15/01/2021

Current Names Only Yes Core Datasets Only Yes

Method 'By Circle'

Centre 115° 36' 42" E,33° 23' 38" S

Buffer 2km

Area (ha)		1255.81
Taxa:	Naturalised	23
	Native	142
Endemics:		0
Families:		74
Genera:		132
Conservation Status:	-	159
	3	1
	Т	2
	S	1
	4	2
MS Status:	-	164
	MS	1
Rank:	-	154
	forma	1
	subsp.	7
	var.	3

Top Ten Families			Top Ten Genera		
	Species	Records		Species	Records
1. Fabaceae	18	23	1. Acacia	6	8
2. Poaceae	16	18	2. Hibbertia	4	5
Asparagaceae	8	8	3. Thysanotus	3	3
4. Cyperaceae	5	6	4. Sargassum	3	3
5. Asteraceae	5	6	5. Kennedia	3	3
6. Proteaceae	4	4	6. Lepidosperma	3	3
7. Apiaceae	4	4	7. Trichosurus	2	4
8. Dilleniaceae	4	5	8. Scaevola	2	3
9. Acanthizidae	4	7	9. Rhagodia	2	2
10. Orchidaceae	4	4	10. Opercularia	2	2

Endemic To Query Area

Name ID Species **Conservation Status**

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 2
4 - Priority 5
5 - Priority 5



¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.



NatureMap Species Report

Created By Guest user on 15/01/2021

Current Names Only Yes
Core Datasets Only Yes

Method 'By Circle'

Centre 115° 36' 42" E,33° 23' 38" S

Buffer 2km

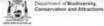
	Name ID	Species Name	Natural	ised Conservation Code	¹ Endemic To Query Area
1.	3262	Acacia cochlearis (Rigid Wattle)			
2.	3282	Acacia cyclops (Coastal Wattle)			
3.	3339	Acacia flagelliformis		P4	
4.	3374	Acacia huegelii			
5.		Acacia pulchella (Prickly Moses)			
6.		Acacia saligna subsp. stolonifera			
7.		Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)			
8.		Acanthocarpus preissii			
9.		Agonis flexuosa (Peppermint, Wonil)			
10.		Agonis flexuosa var. flexuosa			
11.		Agrostocrinum scabrum (Blue Grass Lily)			
12.		Alyxia buxifolia (Dysentery Bush)			
13.		Amphibromus nervosus			
14.	,0000	Aname mainae			
15.	6949	Anthocercis littorea (Yellow Tailflower)			
16.		Anthochaera carunculata (Red Wattlebird)			
17.					
18.		Aquila audax (Wedge-tailed Eagle) Austrostipa flavescens			
19.		Banksia attenuata (Slender Banksia, Piara)			
20.					
	1022	Banksia ilicifolia (Holly-leaved Banksia)			
21.	2740	Barnardius zonarius Regulaca gricogra (Comman Brown Book			
22.		Bossiaea eriocarpa (Common Brown Pea)			
23.		Brassica tournefortii (Mediterranean Turnip)	Y		
24.		Briza maxima (Blowfly Grass)	Y		
25.		Bromus arenarius (Sand Brome)			
26.		Bromus diandrus (Great Brome)	Y		
27.		Cacatua pastinator (Western Long-billed Corella)			
28.		Cacomantis flabelliformis (Fan-tailed Cuckoo)			
29.		Caesia micrantha (Pale Grass Lily)			
30.		Caesia occidentalis			
31.		Cakile maritima (Sea Rocket)	Υ		
32.		Caladenia latifolia (Pink Fairy Orchid)			
33.		Caladenia paludosa			
34.		Calandrinia brevipedata (Short-stalked Purslane)			
35.		Carpobrotus virescens (Coastal Pigface, Kolboko, Bain)			
36.		Cassytha racemosa forma racemosa			
37.	1121	Centrolepis aristata (Pointed Centrolepis)			
38.		Colluricincla harmonica (Grey Shrike-thrush)			
39.		Conostylis aculeata (Prickly Conostylis)			
40.	12109	Conostylis aculeata subsp. preissii			
41.		Cracticus tibicen (Australian Magpie)			
42.		Cracticus torquatus (Grey Butcherbird)			
43.		Crassula colorata (Dense Stonecrop)			
44.		Dacelo novaeguineae (Laughing Kookaburra)	Υ		
45.	1218	Dasypogon bromeliifolius (Pineapple Bush)			
46.	6218	Daucus glochidiatus (Australian Carrot)			
47.	16326	Dianella brevicaulis			
48.	306	Dichelachne crinita (Longhair Plumegrass)			
49.	4454	Diplolaena dampieri (Southern Diplolaena)			
50.	7054	Dischisma arenarium	Υ		
51.	3095	Drosera erythrorhiza (Red Ink Sundew)			
52.	347	Ehrharta calycina (Perennial Veldt Grass)	Υ		
53.	349	Ehrharta longiflora (Annual Veldt Grass)	Υ		
			100	Department of Bindiversity Consecution and Africanium	WESTERN

NatureMap is a collaborative project of the Department of Biodiversity, Conservation and Attractions and the Western Australian Museum.



N	ame ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Qu Area
54.		Eolophus roseicapillus			
55.	17175	Eremophila glabra subsp. albicans			
56.	4333	Erodium cicutarium (Common Storksbill)	Υ		
57.	24043	Eubalaena australis (Southern Right Whale)		Т	
58.	5708	Eucalyptus marginata (Jarrah, Djara)			
59.	4636	Euphorbia paralias (Sea Spurge)	Υ		
60.	10765	Exocarpos sparteus (Broom Ballart, Djuk)			
61.		Ficinia nodosa (Knotted Club Rush)			
62.		Galium spurium	Υ		
63.		Geranium retrorsum	•		
64.		Gerygone fusca (Western Gerygone)			
65.		Gompholobium tomentosum (Hairy Yellow Pea)			
66.					
		Haliastur sphenurus (Whistling Kite)			
67.		Hardenbergia comptoniana (Native Wisteria)			
68.		Hemiandra pungens (Snakebush)			
69.	5117	Hibbertia cuneiformis (Cutleaf Hibbertia)			
70.	5118	Hibbertia cunninghamii			
71.	5135	Hibbertia hypericoides (Yellow Buttercups)			
72.	5162	Hibbertia racemosa (Stalked Guinea Flower)			
73.	6222	Homalosciadium homalocarpum			
74.	12859	Hovea trisperma var. trisperma			
75.	11546	Hydrocotyle pilifera var. glabrata			
76.		Hypochaeris glabra (Smooth Catsear)	Υ		
77.		Hypolaena exsulca			
78.		Idiosoma sigillatum (Swan Coastal Plain shield-backed trapdoor spider)		P3	
79.		Isoodon fusciventer (Quenda, southwestern brown bandicoot)		P4	
80.		Isotropis cuneifolia (Granny Bonnets)		F4	
81.		Jacksonia furcellata (Grey Stinkwood)			
82.		Jacksonia sternbergiana (Stinkwood, Kapur)			
83.		Kennedia coccinea subsp. calcaria			
84.	4044	Kennedia prostrata (Scarlet Runner)			
85.		Kennedia rubicunda			
86.	467	Lagurus ovatus (Hare's Tail Grass)	Υ		
87.	925	Lepidosperma angustatum			
88.	42742	Lepidosperma calcicola			
89.	933	Lepidosperma gladiatum (Coast Sword-sedge, Kerbin)			
90.		Leporella fimbriata (Hare Orchid)			
91.		Leucopogon propinquus			
92.		Lichmera indistincta (Brown Honeyeater)			
93.		Lobelia tenuior (Slender Lobelia)			
94.		Lolium rigidum (Wimmera Ryegrass)	Υ		
95.			Y		
		Lolium x hybridum	Ť		
96.		Lomandra hermaphrodita			
97.		Lomandra preissii			
98.		Lyginia barbata			
99.	36375	Lysimachia arvensis (Pimpernel)	Υ		
100.	24132	Macropus fuliginosus (Western Grey Kangaroo)			
101.	85	Macrozamia riedlei (Zamia, Djiridji)			
102.	25654	Malurus splendens (Splendid Fairy-wren)			
103.	5980	Melaleuca thymoides			
104.		Melilotus indicus	Υ		
105.		Merops ornatus (Rainbow Bee-eater)			
106.		Microlaena stipoides (Weeping Grass)			
107.		Mirounga leonina (Southern Elephant Seal)			
		Monotaxis occidentalis			
108.					
109.		Olearia axillaris (Coastal Daisybush)			
110.		Opercularia apiciflora			
111.		Opercularia vaginata (Dog Weed)			
112.	20664	Ornithogalum longebracteatum	Υ		
113.	7122	Orobanche minor (Lesser Broomrape)	Υ		
114.	25682	Pardalotus striatus (Striated Pardalote)			
115.	1762	Parietaria debilis (Pellitory)			
116.	1550	Patersonia occidentalis (Purple Flag, Koma)			
117.		Petrophile linearis (Pixie Mops)			
118.		Phaps chalcoptera (Common Bronzewing)			
119.		Phascogale tapoatafa subsp. wambenger (South-western Brush-tailed Phascogale,			
	.5570	Wambenger)		S	
120.	1478	Phlebocarya ciliata			
		Phyllanthus calycinus (False Boronia)			
121	+u/ i	r rrymantinas caryonnas (r aisc Dorottia)			
121. 122.		Pithocarpa cordata			

NatureMap is a collaborative project of the Department of Biodiversity, Conservation and Attractions and the Western Australian Museum.







	Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
123.	6249	Platysace compressa (Tapeworm Plant)			
124.	573	Poa drummondiana (Knotted Poa)			
125.	577	Poa poiformis (Coastal Poa)			
126.	24166	Pseudocheirus occidentalis (Western Ringtail Possum, ngwayir)		Т	
127.	48677	Pterostylis ectypha			
128.	2578	Rhagodia baccata (Berry Saltbush)			
129.	11930	Rhagodia baccata subsp. dioica (Sea Berry Saltbush)			
130.	48096	Rhipidura albiscapa (Grey Fantail)			
131.	48891	Roepera fruticulosa			
132.	27238	Sargassum distichum			
133.	27249	Sargassum linearifolium			
134.	27254	Sargassum podacanthum			
135.	7595	Scaevola anchusifolia			
136.	7606	Scaevola crassifolia (Thick-leaved Fan-flower)			
137.	968	Schoenoplectus pungens (Sharpleaf Rush)			
138.	20161	Senecio pinnatifolius			
139.	25534	Sericornis frontalis (White-browed Scrubwren)			
140.	30948	Smicrornis brevirostris (Weebill)			
141.	8231	Sonchus oleraceus (Common Sowthistle)	Υ		
142.	1312	Sowerbaea laxiflora (Purple Tassels)			
143.	625	Spinifex longifolius (Beach Spinifex)			
144.	4828	Spyridium globulosum (Basket Bush)			
145.	19403	Stenopetalum gracile			
146.	25655	Stipiturus malachurus (Southern Emu-wren)			
147.	7798	Stylidium schoenoides (Cow Kicks)			
148.	2820	Tetragonia decumbens (Sea Spinach)	Υ		
149.	4535	Tetratheca hirsuta (Black Eyed Susan)			
150.	2644	Threlkeldia diffusa (Coast Bonefruit)			
151.	1319	Thysanotus arenarius			
152.	1343	Thysanotus patersonii			
153.	1351	Thysanotus sparteus			
154.	6280	Trachymene pilosa (Native Parsnip)			
155.	25521	Trichosurus vulpecula (Common Brushtail Possum)			
156.	24158	Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)			
157.	4298	Trifolium hirtum (Rose Clover)	Υ		
158.	33276	Triglochin isingiana			
159.	152	Triglochin trichophora			
160.	30954	Tursiops aduncus (Indo-Pacific Bottlenose Dolphin)			
161.	11137	Vulpia fasciculata	Υ		
162.	1256	Xanthorrhoea preissii (Grass tree, Palga)			
163.	6289	Xanthosia huegelii			
164.	2331	Xylomelum occidentale (Woody Pear, Djandin)			
165.	25765	Zosterops lateralis (Grey-breasted White-eye, Silvereye)			

Conservation Codes

T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 2
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.



Appendix G Basic Summary of Records



Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 05:25:43PM, 17/02/2021

Receipt No.	:		
ID No:	72150		

Search Results

This response relates to a search request received for:

Dalyellup, WA, 6230

That portion of Lot 9077 on Deposited Plan 60716 as shown as Subject A on Deposited Plan 412592 on certificate of title 2717/207, Dalyellup WA 6230

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address

Dalyellup, WA, 6230

That portion of Lot 9077 on Deposited Plan 60716 as shown as Subject A on Deposited Plan 412592 on certificate of title 2717/207, Dalyellup WA 6230

Parcel Status

Classification: 21/02/2018 - Remediated for restricted use

Nature and Extent of Contamination:

Treated solid residue is present beneath the site.

Metals (including chromium, hexavalent chromium, cobalt, manganese, molybdenum, nickel, tin and vanadium) are present in soil beneath the site.

Saline leachate and metals (including hexavalent chromium, chromium, copper, cobalt, lead, vanadium and zinc) are present in groundwater beneath the site.

Restrictions on Use:

The land use of the site is restricted to endemic bushland. The site should not be developed for irrigated recreational uses, such as parkland or playing fields, or more sensitive uses such as residential use or childcare centres without further contamination assessment and/or remediation.

Ongoing management of the site is required to be undertaken in accordance with the approved SMP.

Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site.

Other than for remediation purposes, ground disturbance is not permitted and a minimum of 2m of clean fill is to be maintained at all times across the site.

Reason for Classification:

This site was reported to the Department of Water and Environmental Regulation (DWER) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003' (the Act), which commenced on 1 December 2006.

The site was first classified under section 13 of the Act based on information submitted to DWER by

Disclaimer

This Summary of Records has been prepared by Department of Water and Environmental Regulation (DWER) as a requirement of the Contaminated Sites Act 2003. DWER makes every effort to ensure the accuracy, currency and reliability of this information at the time it was prepared, however advises that due to the ability of contamination to potentially change in nature and extent over time, circumstances may have changed since the information was originally provided. Users must exercise their own skill and care when interpreting the information contained within this Summary of Records and, where applicable, obtain independent professional advice appropriate to their circumstances. In no event will DWER, its agents or employees be held responsible for any loss or damage arising from any use of or reliance on this information. Additionally, the Summary of Records must not be reproduced or supplied to third parties except in full and unabridged form.



Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 05:25:43PM, 17/02/2021

September 2009. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by July 2015.

The former Dalyellup Waste Residue Disposal Facility (the site) operated under Part IV of the Environmental Protection Act 1986 (licence L6130/1989/12). The site operated as a licenced facility for the disposal of Treated Solid Residue (TSR) from the production of titanium dioxide pigment between March 1989 and March 2013. The site was issued a Closure Notice from DWER on 14 May 2013. This Closure Notice was revised on 1 August 2013.

Historically, the site comprised a number of waste disposal pond areas (two northern ponds, one central pond and two southern ponds), with the remainder of this lot being access roads and coastal dunes.

Monitoring of radiation, soil and groundwater has been undertaken at the site since the early 1990s as part of licence requirements. Other human health and environmental assessments have been undertaken at the site since 2001.

Groundwater investigations of the superficial aquifer have found that the TSR is generating saline leachate that is increasing total dissolved solid concentrations of groundwater down hydraulic gradient of the site, toward the marine environment. However, a risk assessment of the saline leachate has reported that there is no evidence of an adverse impact on the marine environment from the salt plume exiting the site.

Groundwater monitoring events have reported metals (such as hexavalent chromium, chromium, zinc, copper, lead, cobalt vanadium and zinc) at concentrations exceeding ecological assessment levels for marine waters as specified in 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014 [DER,2014]). It is noted that the concentrations of metals (such as lead, cobalt, copper and zinc) are likely to be natural background conditions. A risk assessment completed for the metals chromium and vanadium found that the potential for sustained discharge of these metals at concentrations above the adopted water quality ecosystem criteria is considered very low.

Remediation of the southern ponds was undertaken in 2001 and comprised the capping of the TSR with 2 metres (m) of coastal sand and revegetation. Remediation of the central and northern ponds was undertaken in 2013 and comprised the capping of the pond areas with at least 2 metres of clean fill material sourced from the site.

Validation sampling of the capping material reported concentrations of contaminants of potential concern below Health Investigation Levels for public open space as specified in the 'National Environment Protection (Assessment of Site Contamination) Measure 1999' (the NEPM).

Metals (such as hexavalent chromium, chromium, cobalt, manganese, molybdenum, nickel, tin and vanadium) were present in capping material at concentrations exceeding the relevant Ecological Investigation Levels for public open space as specified in the NEPM. A fate and transport assessment completed for chemicals of concern has found that the likelihood of these metals entering into the marine environment at elevated concentrations is low.

Post remediation gamma monitoring of the capping layer was conducted in February 2014. The monitoring results reported gamma radiation levels comparable with natural background radiation of the area. A risk assessment found concentrations of gamma radiation present are unlikely to pose a risk human health.

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 05:25:43PM, 17/02/2021

An accredited contaminated sites auditor (the auditor) reviewed the investigations and risk assessments completed for the site. A Mandatory Auditors Report (MAR) was submitted to DWER in October 2013 in relation to the Final Closure Plan which detailed the scope, timing, approvals process, validation and ongoing monitoring requirements associated with the rehabilitation of the site.

The Closure Plan was prepared in order to satisfy the conditions of Ministerial Statements (Condition 4 of Ministerial Statement 213; and Condition 4-1 of Ministerial Statement 332). These conditions were cleared by the Environmental Protection Authority in a letter dated 8 April 2015.

A subsequent MAR was prepared at the completion of the remediation and validation works in July 2015. The purpose of this MAR was to assess the suitability of the site for its proposed end use, which is currently proposed as endemic regional bushland.

The Department of Health, the Radiological Council and DWER accepted the Auditors conclusions and recommendations, on the understanding that the site would be subject to numerous restrictions on use and a site management plan would be required.

Based on the information provided, the site appears suitable for passive recreational use as endemic bushland, but may not be suitable for use as irrigated parkland or playing fields (due to the potential for on-going irrigation to generate leachate) or more sensitive land uses such as residential use or child care centres.

The site is contaminated and has been remediated such that it is suitable for the proposed land use, subject to implementation of the ongoing Site Management Plan (SMP) and other restrictions on use. Therefore, the site is classified as 'remediated for restricted use'.

A memorial stating the site's classification has been placed on the certificate of title, and will trigger the need for further investigations and risk assessment should the site be proposed for a more sensitive land use.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

An Ongoing Site Management Plan (including a radiation management plan) has been prepared, endorsed by the Auditor and submitted for review by Department of Health, the Radiological Council and DWER.

Certificate of Title Memorial

Under the Contaminated Sites Act 2003, this site has been classified as "remediated for restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Water and Environmental Regulation.

Current Regulatory Notice Issued

Date Issued: Nil

General

No other information relating to this parcel.

Type of Regulatory Notice: Nil

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Appendix H Dangerous Goods Licenses

Reference ID: 637463212530077142 Date/Time of query: 15/Jan/2021 3:27 PM

Dangerous goods site licence register report

This report is an excerpt of the register of dangerous goods site licences related to the area of interest you searched.



Search Details

Site address (if applicable)

MINNINUP RD BUNBURY 6230

Licence location (as recorded on the licence)

DGS016093 MINNINUP RD ([RESERVE 37116]) BUNBURY WA 6230

Dangerous goods licences held

Period of licence	Licence number	Products stored (see legend)	Licence holder
15/12/1999 - 01/03/2022	DGS016093	2.3, 8	WATER CORPORATION

This report is an excerpt of the register of dangerous goods site licence(s) related to the searched area of interest.

- It reports products currently stored at a site, or in the case of a closed licence, the products stored at the site at the time of its closure.
- The report is generated from data contained in the DMIRS dangerous goods licensing system.
- Pre-1995 electronic records do not exist. As such:
 - Sites recorded as starting in 1995 may have existed prior to 1995.
 - · Data for sites that closed prior to 1995 may not be available.
- Additional information may be available. If you wish to obtain additional material, please email cso@dmirs.wa.gov.au stating your requirements.
- To obtain copies of licences, or documents on file, a Freedom of Information (FOI) application is required. To submit an FOI application, go to the DMIRS FOI page.

Legend

- 2.1 Flammable gases
- 2.2 Non-Flammable gases non-toxic gases
- 2.3 Toxic gases
- 3 Flammable liquids
- 4.1 Flammable solids
- 4.2 Spontaneously combustible substances
- 4.3 Dangerous when wet
- 5.1 Oxidizing agents
- 5.2 Organic peroxides
- 6 Toxic substances
- 8 Corrosive substances
- 9 Miscellaneous dangerous goods
- C1 Combustible liquids
- * Incomplete data available. Please contact Dangerous Goods Licensing at cso@dmirs.wa.gov.au for more information.

Note 1. DMIRS does not regulate

- · Division 6.2 Infectious Substances
- Class 7 Radiactive Substances

These products are regulated by the Department of Health

Reference ID: 637463210686922473 Date/Time of query: 15/Jan/2021 3:24 PM

Dangerous goods site licence register report

This report is an excerpt of the register of dangerous goods site licences related to the area of interest you searched.



Search Details

Site address (if applicable)

MINNINUP SOUTH RD BUNBURY 6230

Licence location (as recorded on the licence)

DGS020688 MINNINUP SOUTH RD (RESERVE 37116) BUNBURY WA 6230

Dangerous goods licences held

Period of licence	Licence number	Products stored (see legend)	Licence holder
20/11/2006 - 20/02/2009	DGS020688	2.3	WATER CORPORATION / SOUTH WEST REGION

This report is an excerpt of the register of dangerous goods site licence(s) related to the searched area of interest.

- It reports products currently stored at a site, or in the case of a closed licence, the products stored at the site at the time of its closure.
- The report is generated from data contained in the DMIRS dangerous goods licensing system.
- Pre-1995 electronic records do not exist. As such:
 - Sites recorded as starting in 1995 may have existed prior to 1995.
 - · Data for sites that closed prior to 1995 may not be available.
- Additional information may be available. If you wish to obtain additional material, please email cso@dmirs.wa.gov.au stating your requirements.
- To obtain copies of licences, or documents on file, a Freedom of Information (FOI) application is required. To submit an FOI application, go to the DMIRS FOI page.

Legend

- 2.1 Flammable gases
- 2.2 Non-Flammable gases non-toxic gases
- 2.3 Toxic gases
- 3 Flammable liquids
- 4.1 Flammable solids
- 4.2 Spontaneously combustible substances
- 4.3 Dangerous when wet
- 5.1 Oxidizing agents
- 5.2 Organic peroxides
- 6 Toxic substances
- 8 Corrosive substances
- 9 Miscellaneous dangerous goods
- C1 Combustible liquids
- * Incomplete data available. Please contact Dangerous Goods Licensing at cso@dmirs.wa.gov.au for more information.

Note 1. DMIRS does not regulate

- · Division 6.2 Infectious Substances
- Class 7 Radiactive Substances

These products are regulated by the Department of Health

Appendix I Historical Aerials



Historical aerials 2008 to 2015

Appendix J Lab Procedures



Envirolab Services Pty Ltd

PERTH CHEMICAL TESTING LABORATORY MPL LABORATORIES (A DIVISION OF ENVIROLAB SERVICES PTY LTD)

| Accreditation Number: 2901 | Site Number: 2213 |

Address Details: 16-18 Hayden Court MYAREE, WA 6154 AUSTRALIA

Website: www.envirolab.com.au

Contact Details: Mr T Lee +61(08) 93172505

tlee@envirolab.com.au

Availability: Services available to external clients

Note: Not all of the columns of the scope of accreditation displayed include data.

The only data displayed is that deemed relevant and necessary for the clear description of the activities and services covered by the scope of accreditation. Grey text appearing in a SoA is additional freetext providing further refinement or information on the data in the preceding line entry.

ISO/IEC 17025 (2017) Agribusiness

PRODUCT	DETERMINANT	TECHNIQUE	PROCEDURE	LIMITATION/RANGE
Plant material	Aluminium; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lead; Lithium; Magnesium; Manganese; Molybdenum; Nickel; Phosphorus; Potassium; Sodium; Strontium; Sulfur; Titanium; Vanadium; Zinc;	ICP-AES	In-house AGRI-010 and METALS-020	
	Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Caesium; Cerium; Chromium; Cobalt; Copper; Dysprosium; Erbium; Europium; Gallium; Hafnium; Iron; Lanthanum; Lead; Lithium; Manganese; Mercury; Molybdenum; Neodymium; Nickel; Niobium; Praseodymium; Rhenium; Rubidium; Samarium; Scandium; Selenium; Silver; Strontium; Tantalum; Tellurium; Thallium; Thorium; Thulium; Tin; Titanium; Tungsten; Uranium; Vanadium; Ytterbium; Yttrium; Zinc; Zirconium;	ICP-MS	In-house AGRI-010 and Metals-022	
Soils	Phosphorus - Available (Bray)	Discrete analyser (DA)	Rayment and Lyons 9E and in-house AGRI-004	
	Micronutrients - Mehlich 3 extractable aluminium; Micronutrients - Mehlich 3 extractable boron; Micronutrients - Mehlich 3 extractable calcium; Micronutrients - Mehlich 3 extractable chromium; Micronutrients - Mehlich 3 extractable copper; Micronutrients - Mehlich 3 extractable iron; Micronutrients - Mehlich 3 extractable magnesium; Micronutrients - Mehlich 3 extractable manganese; Micronutrients - Mehlich 3 extractable phosphorus; Micronutrients - Mehlich 3 extractable potassium; Micronutrients - Mehlich 3 extractable sodium; Micronutrients - Mehlich 3 extractable sulfur; Micronutrients - Mehlich 3 extractable sulfur; Micronutrients - Mehlich 3 extractable zinc;	ICP-AES	Rayment and Lyons 18F and in-house AGRI-006	
	Micronutrients - Calcium chloride extractable boron; Micronutrients - Calcium chloride extractable molybdenum;	ICP-AES	Rayment and Lyons 12C2/12E1 and in- house AGRI-009	
	Sulfur - Inorganic KCI-40 extractable	ICP-AES	Rayment and Lyons 10 D1 and in-house AGRI- 001	
	Micronutrients - DTPA extractable copper; Micronutrients - DTPA extractable iron; Micronutrients - DTPA extractable manganese; Micronutrients - DTPA extractable zinc;	ICP-AES	Rayment and Lyons 12A1 and in-house AGRI-007	
	Phosphate buffering index (PBI)	Discrete analyser (DA)	Rayment and Lyons 9I2c, 9I3c, 9I4c and in- house AGRI-003	
	Plant material	Plant material Aluminium; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lead; Lithium; Magnesium; Manganese; Molybdenum; Nickel; Phosphorus; Potassium; Sodium; Strontium; Sulfur; Titanium; Vanadium; Zinc; Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Caesium; Cerium; Chromium; Cobalt; Copper; Dysprosium; Erbium; Europium; Gallium; Hafnium; Iron; Lanthanum; Lead; Lithium; Manganese; Mercury; Molybdenum; Neodymium; Nickel; Niobium; Praseodymium; Rhenium; Rubidium; Samarium; Scandium; Selenium; Silver; Strontium; Tantalum; Tellurium; Thallium; Thorium; Tundium; Tir, Titanium; Tungsten; Uranium; Vanadium; Ytterbium; Yttrium; Zinc; Zirconium; Soils Phosphorus - Available (Bray) Micronutrients - Mehlich 3 extractable aluminium; Micronutrients - Mehlich 3 extractable chromium; Micronutrients - Mehlich 3 extractable chromium; Micronutrients - Mehlich 3 extractable iron; Micronutrients - Mehlich 3 extractable magnesium; Micronutrients - Mehlich 3 extractable magnesium; Micronutrients - Mehlich 3 extractable phosphorus; Micronutrients - Mehlich 3 extractable sodium; Micronutrients - Mehlich 3 extractable sulfur; Micronutrients - Mehlich 3 extractable sodium; Micronutrients - Mehlich 3 extractable solium; Micronutrients - DTPA extractable solium; Micronutrient	Plant material Aluminium; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lead; Lithium; Magnesium; Manganese; Molybdenum; Nickel; Phosphorus; Potassium; Sodium; Strontium; Sulfur; Titanium; Vanadium; Zinc; Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Caesium; Cerium; Chromium; Cobalt; Copper; Dysprosium; Erbium; Europium; Gallium; Hafnium; Iron; Lanthanum; Lead; Lithium; Manganese; Mercury; Molybdenum; Neodymium; Nickel; Niobium; Praseodymium; Rhenium; Rubidium; Samarium; Scandium; Selenium; Silver; Strontium; Tantalum; Tellurium; Thalium; Thorium; Thulium; Tin; Titanium; Tungsten; Uranium; Vanadium; Ytterbium; Yttrium; Zinc; Zirconium; Soils Phosphorus - Available (Bray) Discrete analyser (DA) Micronutrients - Mehlich 3 extractable aluminium; Micronutrients - Mehlich 3 extractable calcium; Micronutrients - Mehlich 3 extractable copper; Micronutrients - Mehlich 3 extractable copper; Micronutrients - Mehlich 3 extractable iron; Micronutrients - Mehlich 3 extractable manganese; Micronutrients - Mehlich 3 extractable manganese; Micronutrients - Mehlich 3 extractable potassium; Micronutrients - Mehlich 3 extractable sulfur; Micronutrients - Mehlich 3 extractable sulfur; Micronutrients - Mehlich 3 extractable sulfur; Micronutrients - Mehlich 3 extractable cinc; Micronutrients - Calcium chloride extractable boron; Micronutrients - Calcium chloride extractable molybdenum; Sulfur - Inorganic KCI-40 extractable copper; Micronutrients - DTPA extractable manganese; Micronutrients -	Plant material Aluminium; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lead; Lithium; Magnesium; Mangaeser; Molybdenum; Nickel; Phosphorus; Polassium; Sodium; Strontium; Sulfur; Titanium; Vanadium; Zinc; Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Caesium; Cerium; Chromium; Cobalt; Copper; Dysprosium; Erbium; Europium; Gallium; Hafnium; Iron; Lanthanum; Lead; Lithium; Manganese; Mercury; Molybdenum; Neodymium; Nickel; Niobium; Praseodymium; Rhenium; Rubidium; Samarium; Scandium; Selenium; Silver; Strontium; Tantalum; Tellurium; Tanigum; Tungsten; Urranium; Vanadium; Ytterbium; Yttrium; Tingsten; Urranium; Vanadium; Ytterbium; Yttrium; Zinc; Zirconium; Soils Phosphorus - Available (Bray) Discrete analyser (DA) Micronutrients - Mehlich 3 extractable aluminium; Micronutrients - Mehlich 3 extractable boron; Micronutrients - Mehlich 3 extractable bron; Micronutrients - Mehlich 3 extractable copper; Micronutrients - Mehlich 3 extractable copper; Micronutrients - Mehlich 3 extractable manganese; Micronutrients - Mehlich 3 extractable mingensium; Micronutrients - Mehlich 3 extractable sulfur; Micronutrients - Mehlich 3 extractable mingensium; Mic



Exchangeable sodium percentage (ESP)	ICP-AES	In-house Metals-009, 020
Micronutrients - Ammonium bicarbonate/EDTA extractable copper; Micronutrients - Ammonium bicarbonate/EDTA extractable zinc;	ICP-AES	Rayment and Lyons 12B1; in-house AGRI- 008
Phosphorus - Available (Olsen)	Discrete analyser (DA)	Rayment and Lyons 9C and in-house AGRI-005
Aluminium - Exchangeable; Calcium - Exchangeable; Magnesium - Exchangeable; Potassium - Exchangeable; Sodium - Exchangeable;	ICP-AES	Rayment and Lyons 15A1, 15A2 and in- house METALS-009, METALS-020
Cation exchange capacity (CEC)	Calculation	in-house Metals-009 and Metals-020
Micronutrients - Ammonium bicarbonate/EDTA extractable copper	ICP-AES	Rayment and Lyons 12B1 and in-house AGRI-008
Phosphorus - Available (Colwell)	Discrete analyser (DA)	Rayment and Lyons 9B and in-house AGRI-002

ISO/IEC 17025 (2005) Environment

SERVICE	PRODUCT	DETERMINANT	TECHNIQUE	PROCEDURE	LIMITATION/RANGE
Analysis for asbestos, mineral fibres (including synthetic) and organic fibres	Air	Asbestos	Membrane filter	Membrane filter method described in the National Occupational Health and Safety Commission Guidance Note (2005) and supplementary work instruction in-house ASB-002	
		Volume measurement	Classical	Membrane filter method described in the National Occupational Health and Safety Commission Guidance Note: 3006 (1989) and supplementary work instruction in-house ASB-005 Membrane filter method described in the National Occupational Health and Safety Commission Guidance Note (2005) and supplementary work instruction in-house ASB-002	
		Synthetic mineral fibres (SMF)	Membrane filter	Membrane filter method described in the National Occupational Health and Safety Commission Guidance Note: 3006 (1989) and supplementary work instruction in-house ASB-005	
	Bulk samples; Soils;	Amosite; Chrysotile; Crocidolite; Organic fibres; Synthetic mineral fibres (SMF);	Polarised light microscopy (including dispersion staining)	AS4964 and supplementary work instruction in-house ASB-001	
Analysis for carbamate pesticides	Saline waters; Surface waters; Waste waters;	3-Hydroxycarbofuran (thiobencarb, S-[(4-chlorophenyl)methyl]-N,N-diethylcarbamothioate); Aldicarb; Carbaryl; Carbofuran; Chlorpropham; Fluometuron; Linuron; Methiocarb; Methomyl; Mexacarbate; Neburon; Oxamyl (thioxamyl); Propham; Propoxur; Siduron; Swep (methyl N-[3,4-dichlorophenyl] carbamate);	GC-MS	In-house Org-031 Other carbamate pesticides in accordance with ELN- P09	
	Ground	Carbaryl; Carbofuran; Accreditation Number: 2901 Site Number	GC-MS; GC-MS-	In-house Org-012, 017	



	waters; Impinger solutions; Industrial waters; Irrigation and stock waters; Sediments; Sludges; Soils; Sorbents; Steam- raising waters; Waste waters;		MS;	Other carbamate pesticides in accordance with ELN-P09	
Analysis for chlorinated dioxins and dibenzofurans	Ground waters; Saline waters; Trade wastes;	1,2,3,4,6,7,8-Heptachlorodibenzodioxin; 1,2,3,4,6,7,8-Heptachlorodibenzofuran; 1,2,3,4,7,8,9-Heptachlorodibenzofuran; 1,2,3,4,7,8-Hexachlorodibenzodioxin; 1,2,3,4,7,8-Hexachlorodibenzofuran; 1,2,3,6,7,8-Hexachlorodibenzofuran; 1,2,3,7,8,9-Hexachlorodibenzofuran; 1,2,3,7,8,9-Hexachlorodibenzofuran; 1,2,3,7,8-Pentachlorodibenzofuran; 1,2,3,7,8-Pentachlorodibenzofuran; 2,3,4,6,7,8-Hexachlorodibenzofuran; 2,3,4,7,8-Pentachlorodibenzofuran; 2,3,4,7,8-Pentachlorodibenzofuran; 2,3,7,8-Tetrachlorodibenzofuran; 2,3,7,8-Tetrachlorod	GC-MS-MS	In-house Org-038; Other Dibenzofurans and Dioxins in accordance with ELN- P09	
Analysis for cyanide	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Soils; Steam- raising waters; Trade wastes;	Cyanide - Free; Cyanide - Total; Cyanide - Weak acid dissociable (WAD);	Discrete analyser (DA); Segmented flow analyser (SFA);	In- house Inorg- 013 (DA) In- house Inorg- 014 (SFA)	
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Steam- raising waters; Trade wastes;	Cyanide - Free; Cyanide - Total; Cyanide - Weak acid dissociable (WAD);	Classical	APHA 4500 CN D; Inhouse Inorg-109	
	Soils	Cyanide - Total	Classical	APHA 4500 CN D; Inhouse Inorg-109	
Analysis for diesel particulates	Diesel particulates	Carbon - Elemental	Evolved gas analyser	NIOSH 5040; In-house Dust-0003	
Analysis for elements	Emissions - Industrial	Mercury	Atomic absorption spectroscopy (AAS) - Vapour generation	in-house METALS-006 and METALS-021	
	Ground waters;	Mercury	Atomic absorption spectroscopy (AAS)	APHA; In-house Metals-001, 003, 021	



	Saline waters; Sediments; Sewage; Soils; Steam- raising waters; Trade wastes;		- Vapour generation		
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Sewage; Soills; Steam- raising waters; Trade wastes;	Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Chromium; Cobalt; Copper; Gold; Iron; Lead; Lithium; Manganese; Molybdenum; Nickel; Selenium; Silicon; Silver; Strontium; Tellurium; Thallium; Thorium; Tin; Titanium; Tungsten; Uranium; Vanadium; Zinc;	ICP-MS	APHA; In-house Metals-001, 002, 022 Other elements in accordance with ELN- P09	
		Aluminium; Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lanthanum; Lithium; Magnesium; Manganese; Molybdenum; Nickel; Phosphorus; Potassium; Selenium; Silicon; Silver; Sodium; Strontium; Sulfur; Tantalum; Tellurium; Tin; Titanium; Tungsten; Uranium; Vanadium; Zinc; Zirconium;	ICP-AES	APHA; In-house Metals-001, 002, 020 Other elements in accordance with ELN- P09	
	Air - Ambient; Air - Confined spaces; Impinger solutions; Monitoring filters; Sorbents;	Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Chromium; Cobalt; Copper; Gold; Iron; Lead; Lithium; Manganese; Molybdenum; Nickel; Selenium; Silver; Strontium; Tellurium; Thallium; Thorium; Tin; Titanium; Tungsten; Uranium; Vanadium; Zinc;	ICP-MS	NIOSH/OSHA 7300, 7301, 7303; In-house Metals-006, 022, 025	
		Aluminium; Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lead; Lithium; Magnesium; Manganese; Mercury; Molybdenum; Nickel; Potassium; Selenium; Silver; Sodium; Strontium; Tin; Vanadium; Zinc;	Atomic absorption spectroscopy (AAS) - Vapour generation; ICP-AES;	NIOSH/OSHA 7300, 7301, 7303; In-house Metals-006, 020, 021, 025	
	Impinger solutions	Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Chromium; Cobalt; Copper; Gold; Iron; Lead; Lithium; Magnesium; Manganese; Molybdenum; Nickel; Potassium; Selenium; Silver; Sodium; Strontium; Sulfur; Tellurium; Thallium; Thorium; Tin; Titanium; Tungsten; Uranium; Vanadium; Zinc;	ICP-MS	NIOSH/OSHA 7300, 7301, 7303 and in- house METALS-006, 022	
Analysis for fungicides	Air - Ambient; Ground waters; Saline waters; Sediments; Sludges; Soils; Waste waters;	Propiconazole; Tebuconazole;	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other triazole fungicides in accordance with ELN- P09	
Analysis for herbicides	Saline waters; Surface waters; Trade wastes;	Diuron; Fenuron; Isoproturon; Monuron; Tebuthiuron; Accreditation Number: 2901 Site Number:	GC-MS 2213 Printed on :	In-house Org-031 Other herbicides in accordance with ELN- P09 31-May-2019	



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	Saline waters; Soils; Surface waters;	Aminomethylphosphonic acid (AMPA); Glyphosate (n-[phosphonomethyl]glycine);	HPLC	In-house AT-012
	Ground waters; Industrial waters; Irrigation and stock waters; Saline waters; Sediments; Sewage; Sludges; Soils; Steam-raising waters; Trade wastes;	(R)-2-(2,4-Dichlorophenoxy)propanoic acid (dichlorprop, 2,4-DP); 2,2-Dichloropropanoic acid (2,2-DPA, dalapon); 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T); 2,4-6-Trichlorophenoxyacetic acid (2,4,6-T); 2,4-Dichlorophenoxyacetic acid (2,4-D); 2,6-Dichlorophenoxyacetic acid (2,6-D); 2-(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP, fenoprop, silvex); 2-Chlorophenoxyacetic acid; 2-Methyl-4-chlorophenoxyacetic acid (MCPA); 2-sec-Butyl-4,6-dinitrophenol ([RS]-2,4-dinitro-6-sec-butylphenol, dinoseb); 3,5-Dichlorobenzoic acid; 3,6-Dichloro-2-methoxybenzoic acid (dicamba); 3-Amino-2,5-dichlorobenzoic acid; 4-(2,4-Dichlorophenoxy)butanoic acid (2,4-DB, [2,4-dichlorophenoxy]butyric acid); 4-(4-Chloro-2-methylphenoxy)butanoic acid (2,4-MCPB, MCPB, 4-[4-chloro-o-tolyloxyl]butyric acid); 4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid (picloram); 4-Chlorophenoxyacetic acid (4-CPA); Acifluorfen; Bentazone; Bromoxynil; Clopyralid; Dimethyl tetrachloroterephthalate (DCPA, dacthal); Fluroxypyr; Ioxynil; Methylchlorophenoxypropionic acid (RS-2-[4-chloro-2-methylphenoxy]propanoic acid, MCPP, mecoprop); Triclopyr;	GC-MS	In-house Org-004, 031 Other acid herbicides in accordance with ELN-P09
	Air - Ambient; Ground waters; Irrigation and stock waters; Saline waters; Sediments; Sludges; Soils; Waste waters;	2-sec-Butyl-4,6-dinitrophenol ([RS]-2,4-dinitro-6-sec-butylphenol, dinoseb); Ametryne (ametryn); Atrazine; Cyanazine; Hexazinone; Metribuzin; Prometryn; Propazine; Simazine; Terbuthylazine; Terbutryn;	GC-MS-MS	In-house Org-017 Other triazine herbicides in accordance with ELN- P09
		Alachlor; Azobenzene; Bromacil; Metalochlor; Trifluralin;	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other herbicides in accordance with ELN- P09
	Air - Ambient; Ground waters; Irrigation and stock waters; Saline waters; Sediments; Soils; Waste waters;	Molinate	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other carbamates in accordance with ELN-P09
	Surface waters	Diquat; Paraquat;	HPLC	In-house AT-018
Analysis for hydrocarbons	Ground waters	Chloral hydrate (trichloroacetaldehyde); Chloroacetic acid; Dichloroacetic acid; Trichloroacetic acid;	GC-ECD	In-house Org-031
	Ground waters; Irrigation and stock waters; Saline waters; Sediments; Sewage;	Halogenated hydrocarbons Accreditation Number: 2901 Site Number	Gas chromatography (GC) - Purge and trap; Gas chromatography (GC) - Static headspace; GC-MS - Headspace; GC-	In-house Org-012, 013, -014 in accordance with ELN-P09

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Sludges; Soils; Steam- raising waters; Trade wastes;		MS - Purge and trap;		
	Butanone (methyl ethyl ketone, MEK, 2-butanone); Cyclohexane; Methyl tert-butyl ether (MTBE);	Gas chromatography (GC); GC-MS - Purge and trap;	In-house Org-013, Org- 014	
	1,1,1,2-Tetrachloroethane; 1,1,1-Trichloroethane (1,1,1-TCA, methyl chloroform, chlorothene); 1,1,2,2-Tetrabromoethane (acetylene tetrabromide); 1,1,2,2-Tetrachloroethane (acetylene tetrachloride); 1,1,2-Trichloroethane (1,1,2-TCA, vinyl trichloride); 1,1-Dichloroethane (1,1,2-TCA, vinyl trichloride); 1,1-Dichloroethane (1,1-DCA); 1,1-Dichloropropene; 1,2 Dibromoethane (ethylene dibromide, EDB); 1,2,3-Trichlorobenzene; 1,2,3-Trichloropropane (allyl trichloride); 1,2,4-Trichlorobenzene (1,2,4-TCB); 1,2-Dibromo-3-chloropropane (DBCP); 1,2-Dibromoethene; 1,2-Dibromoethane; 1,2-Dibromoethane; 1,2-Dibromoethane; 1,2-Dibromoethane; 1,2-Dichlorobenzene (o-dichlorobenzene); 1,3-Dichlorobenzene (m-dichlorobenzene); 1,3-Dichloropropane (propylene dichloride); 1,3-Dichloropropane; 1,4-Dichlorobenzene (p-dichlorobenzene); 2,2-Dichloropropane; 2-Chlorotoluene (o-chlorotoluene); 4-Chlorotoluene (p-chlorotoluene); Bromobenzene (phenylbromide); Bromobenzene (chlorobromomethane); Bromodichloromethane (dichlorobromomethane); Bromodichloromethane (chlorobromomethane); Chlorobenzene (benzene chloride, monochlorobenzene); Chloroethane; Chloromethane; cis-1,2-Dibromoethene; cis-1,2-Dichloropropylene); Dibromomethane; Chloroethane; Chlorodifluoromethane (DCM, methylene chloride); Hexachloro-1,3-butadiene (hexachlorobrothylene, perchloroethene, tetrachloroethylene); trans-1,2-Dichloropropene (trans-1,3-dichloropropylene); Trichlorofuoromethane (trichloroethylene, TCE); Trichlorofuoromethane (trichloroethylene, TCE); Trichlorofuoromethane (trichloroethylene, TCE); Trichlorofuoromethane (trichloroethene (chloroform); Vinyl bromide (bromoethene); Vinyl chloride;	GC-MS; GC-MS - Purge and trap;	In-house Org-012, -013, -014	
Ground waters; Soils;	Total carcinogenic polycyclic aromatic hydrocarbons (PAHs)	Calculation	NEPM Schedule B1	
	as benzo(a)pyrene TEQ			
Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sorbent tubes; Steam- raising waters;	2,5-Dimethylbenzaldehyde; 2-Methylbenzaldehyde (o-tolualdehyde); 2-Methylpropanal (isobutyraldehyde); 3-Methylbenzaldehyde (m-tolualdehyde); 4-Methylbenzaldehyde (p-tolualdehyde); Acetaldehyde (ethanal); Benzaldehyde (phenylmethanal); Butyraldehyde (butanal); Crotonaldehyde; Decyl aldehyde (decanal); Formaldehyde (methanal); Heptanal; Hexanal (hexaldehyde); Isovaleraldehyde; Methacrolein; Nonanal; Octanal; Pentanal (valeraldehyde); Propionaldehyde (propanal);	HPLC - Diode array detection	in-house AT-010	
Ground waters; Industrial	Benzylalcohol; Dibenzofuran; Isophorone (isoforone, isoacetophorone); Isosafrole; Phenacetin; Safrole; Accreditation Number: 2901 Site Number:	GC-MS 2213 Printed on :	In-house Org-012 Other oxygenated hydrocarbons in 31-May-2019	



Ti Irri ai W Si W Si Si Si ra W Ti	vaters - freated; rrigation and stock vaters; saline vaters; seediments; seewage; sludges; steam- aising vaters; frade vastes;			accordance with ELN-P09	
w In W Tr Irri au Le Si W Si Si ra w	eround vaters; industrial vaters - freated; rrigation ind stock vaters; eachates; ealine vaters; seline vaters; stelam- aising vaters; rade vastes;	1,2,4,5-Tetrachlorobenzene; 1,2,4- Trimethylbenzene (1,2,4-TMB, pseudo-cumene); 1,3,5-Trimethylbenzene (1,3,5-TMB, mesitylene); Benzene; Ethylbenzene; Isopropylbenzene (cumene); Isopropyl toluene; n-Butylbenzene; n- Propylbenzene; Naphthalene; sec-Butylbenzene; Styrene (ethenyl benzene); Tert-butyl benzene; Toluene; Xylene;	GC-MS - Purge and trap	In-house Org-013, 014	
		Other monocyclic aromatic hydrocarbons in accordance with ELN-P09			
AI EI In G W In W TI S S S S S S S T r a W T T	wir - Ambient; Emissions - Industrial; Fround Vaters; Industrial Vaters - Freated; Saline Vaters; Sediments; Sediments; Sedimes; Siludges; Soils; Steam- Laising Vaters; Frade Vastes;	1-Chloronaphthalene; 1-Methylnaphthalene; 2-Chloronaphthalene; 2-Methylnaphthalene; 3-Methylcholanthrene; 7,12-Dimethylbenz(a)anthracene; Acenaphthene; Acenaphthylene (acenaphthalene); Anthracene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b,j)fluoranthene; Benzo(b,k)fluoranthene; Benzo(b)fluoranthene; Benzo(b)fluoranthene; Chrysene; Coronene; Dibenzo(a,h)anthracene; Fluoranthene (benzo[j,k]fluorene); Fluorene; Indeno(1,2,3-cd)pyrene; n-2-Fluorenylacetamide; Naphthalene; Perylene; Phenanthrene; Pyrene;	GC-MS; GC-MS- MS;	In-house Org-012, 017, 033 Other polycyclic aromatic hydrocarbons in accordance with ELN-P09	
AI EI In G W In W Ti Ir an W Si Si Si Si Si Ti	Saline vaters; Sediments;	1,2,3,4-Tetrachlorobenzene; 1,2,3,5- Tetrachlorobenzene; 1,2,3-Trichlorobenzene; 1,2,4,5-Tetrachlorobenzene; 1,2,4- Trichlorobenzene (1,2,4-TCB); 1,2,4- Trimethylbenzene (1,2,4-TMB, pseudo-cumene); 1,2-Dichlorobenzene (o-dichlorobenzene); 1,3,4- Trichlorobenzene; 1,3,5-Trinitrobenzene; 1,3- Dichlorobenzene (m-dichlorobenzene); 1,3- Dinitrobenzene (m-dichlorobenzene); 1,3- Dinitrobenzene; 1,4-Dichlorobenzene (p- dichlorobenzene); 1-Naphthylamine; 2,4- Dinitrotoluene; 2,6-Dinitrotoluene; 2- Naphthylamine; 2-Picoline (2-methylpyridine); 4- Aminobiphenyl; 5-Nitro-o-toluidine; Hexachloro- 1,3-butadiene (hexachlorobutadiene, HCBD); Hexachlorocyclopentadiene (HCCPD); Hexachlorocyclopentadiene (HCCPD); Hexachlorocyclopentadiene (HCCPD); Hexachlorocyclopentadiene; N-Nitrosodiethylamine (N- ethyl-N-nitroso-ethanamine); N- Nitrosomethylethylamine; N-Nitrosopyrrolidine; Nitrobenzene (mononitrotoluene, MNT, methylnitrobenzene); o-Toluidine; Pentachlorobenzene; Pentachloroethane	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033	

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		(ethanepentachloride); Pentachloronitrobenzene (quintozene);			
		Other anilines, nitroaromatics, nitrosoamines, oxygenated hydrocarbons and semi volatile chlorinated hydrocarbons in accordance with ELN-P09			
	Air - Ambient; Emissions - Industrial; Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Sewage; Sludges; Soils; Trade wastes;	2-Acetylaminofluorene; 3-Methylcholanthrene; 4-Bromophenylphenyl ether; 4-Chlorophenylphenyl ether (p-chlorodiphenyl ether);	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other aromatic hydrocarbons and haloethers in accordance with ELN-P09	
	Air - Ambient; Clays; Emissions - Industrial; Saline waters; Sediments; Sludges; Soils; Surface waters; Trade wastes;	Dibutyltin; Diphenyltin; Monobutyltin; Monophenyltin; Tributyltin (TBT); Triphenyltin;	GC-MS-MS	In-house Org-018 Other organometallic compounds in accordance with ELN- P09	
	Air - Ambient; Monitoring filters; Sorbent tubes;	BTEX (benzene, toluene, ethylbenzene and xylene)	Gas chromatography (GC)	In-house Org-023	
		Allyl chloride; Bromochloromethane (chlorobromomethane); cis-1,2-Dichloroethylene; Epichlorohydrin; Hexachloroethane; trans-1,2-Dichloroethene (trans-1,2-DCE, trans-1,2-dichloroethylene);	Gas chromatography (GC); GC-MS;	OSHA 007 (2000); Inhouse Org-023	
Analysis for industrial chemicals	Ground waters; Irrigation and stock waters; Saline waters; Sediments; Sewage; Sludges; Soils; Steam- raising waters; Trade wastes;	Acetophenone; Cyclohexanone; Ethylmethanesulfonate; Methyl methane sulfonate;	GC-MS	In-house Org-012 Other oxygenated hydrocarbons in accordance with ELN- P09	
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters;	2-Methylisoborneol (MIB); Geosmin; Accreditation Number: 2901 Site Number	GC-MS-MS	In-house Org-017 31-May-2019	



Sewage; Trade wastes;			
Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Trade wastes;	1,4-Dioxane	GC-MS	In-house Org-037
Air - Ambient; Emissions Industrial; Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments Sewage; Sludges; Soils; Steam- raising waters; Trade wastes;	Methapyrilene; p-Dimethylaminoazobenzene (4-dimethylaminoazobenzene, DAB, dimethylaminoazobenzene);	GC-MS; GC-MS- MS;	In-house Org-012, 017, 033 Other nitroaromatics and anilines in accordance with ELN-P09
Air - Ambient; Emissions Industrial; Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments Sewage; Sludges; Soils; Sorbents; Steam- raising waters; Trade wastes;		GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other haloethers in accordance with ELN-P09
	Carbazole; Irgarol (cybutryne); N-Nitroso-n-butylamine; N-Nitrosodi-n-propylamine; N-Nitrosomorpholine; N-Nitrosopiperidine; n-Phenylaniline (diphenylamine);	GC-MS; GC-MS- MS;	In-house Org-012, 017, 033 Other nitrosamines in accordance with ELN- P09
Air - Ambient; Monitoring filters; Sorbents;	1,1,2,2-Tetrachloroethane (acetylene tetrachloride); 1,4-Dichlorobenzene (p-dichlorobenzene); a'-Methylstyrene; Allyl alcohol; Cyclohexane; Cyclohexanol; Diacetone alcohol (2-pentanone, 4-hydroxy-4-methyl-2-pentanone); Ethoxyethane (ethyl ether); Heptane (n-heptane); Hexane (n-hexane); Isoamyl alcohol; Isophorone (isoforone, isoacetophorone); Isopropylbenzene (cumene); Methyl amyl ketone (MAK);	Gas chromatography (GC); GC-MS;	OSHA 007 (2000); In- house Org-023

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		Methylcyclohexane; Octane (n-octane); Pentane (n-pentane);			
	Air - Ambient; Impinger solutions; Monitoring filters; Sorbents;	Sulfate - Total	Classical; Ion chromatography (IC);	In-house Inorg 081, 094	
		Hydrofluoric acid	Classical; Ion chromatography (IC); Ion selective electrode (ISE);	NIOSH/OSHA 7903, 7906; In-house Inorg- 026,081, 094, 126	
		Fluoride - Gaseous	Classical; Ion chromatography (IC); Ion selective electrode (ISE);	NIOSH/OSHA 7903; Inhouse Inorg 026, 081, 094	
		Nicotine	GC-MS; GC-MS- MS;	In-house Org-012, 017, 033	
		Ammonia	Classical; Discrete analyser (DA);	APHA 4500-NH ₃ -F; Inhouse Inorg-093, Inorg-057	
		Hydrochloric acid	Classical; Ion chromatography (IC);	NIOSH/OSHA 7903, 7907; In-house Inorg 081, 094, 126	
	Impinger solutions	Hydrofluoric acid	Classical; Ion chromatography (IC); Ion selective electrode (ISE);	in-house INORG-026, INORG-081, INORG- 094	
		Hydrochloric acid	Classical; Ion chromatography (IC);	in-house INORG-081, INORG-094	
		Nitrogen - Oxides (NOx)	Classical; Ion chromatography (IC);	In-house INORG-081, 099	
		Sulfur dioxide; Sulfur trioxide (sulfuric anhydride);	Classical; Ion chromatography (IC);	In-house INORG-081, 095	
	Bore waters; Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Sludges; Soils; Steam- raising waters; Surface waters; Trade wastes;	1,4-Dioxane	GC-MS - Headspace	in-house ORG-013 and ORG-014	
nutrients	Ground waters; Saline waters; Sewage; Soils; Steam- raising waters; Trade wastes;	Nitrogen - Ammonia	Discrete analyser (DA)	In-house Inorg-057	
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	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Soils; Trade wastes;	Nitrogen - Total Kjeldahl (TKN)	Classical; Discrete analyser (DA);	APHA 4500 N _{org} C (Classical); In-house Inorg-062 (DA)
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Steam- raising waters; Trade wastes;	Nitrogen - Total	Discrete analyser (DA)	In-house Inorg-055, 061 (digestion)
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Soils; Steam- raising waters; Trade wastes;	Phosphorus - Soluble reactive; Phosphorus - Total;	Classical; Discrete analyser (DA);	APHA 4500-P E, J (Classical); Inorg-060 (DA), In-house Prep1
		Nitrogen - Nitrate; Nitrogen - Nitrite;	Classical; Discrete analyser (DA); Ion chromatography (IC);	APHA 4500 NO ₂ -B (Classical) APHA 4500 NO ₃ -F (Classical) In-house Inorg-055 (DA) In-house Inorg-081 (DA) In-house Prep1
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Sediments; Sewage; Sludges; Soils; Steam- raising waters; Trade wastes;	Nitrogen - Total	Chemiluminescence	In-house Inorg-110
	Soils	Nitrogen - Total	Calculation; Discrete analyser (DA);	In-house Inorg-062
Analysis for	Air -	bis-Phenol A (BPA)	GC-MS; GC-MS-	In-house Org-012, 017,



organic vapours	Ambient; Emissions; Filters;		MS;	033
	Air - Ambient; Filters; Sorbent tubes;	1,1,1,2-Tetrachloro-2,2-difluoroethane; 1,1,2,2-Tetrachloro-1,2-difluoroethane; 1,1-Dichloro-1-nitroethane; 1,1-Dichloroethane; 1,1-Dichloro-1-nitroethane; 1,1-Dichloroethane; 1,2-Dichloropropane (allyl trichloride); 1,2-Dichloropropane (propylene dichloride); 1,4-Dioxane; 2-Chloroethanol (ethylene chlorohydrin); 2-Hexanone (MBK); 2-Methylpropan-2-ol (tert-butylacetate); Benzylchloride (chloromethylbenzene); Bromoethane (ethylbromide); Bromoform (tribromomethane); Butylacetate; Camphor (1,7,7-trimethylbicyclo[2,2,1]haptan-2-one, 2-bornanone); Carbon tetrachloride (tetrachloromethane); Chlorobenzene (benzene chloride, monochlorobenzene); Cyclohexene; Diacetone alcohol (2-pentanone, 4-hydroxy-4-methyl-2-pentanone); Dibromodifluoromethane (freon-12B2); Dichloroethyl ether; Diisobutyl ketone (DIBK, 2,6-dimethyl-4-heptanone, isovalerone); Ethylacetate; Ethyl butyl ketone (3-heptanone); Ethylacetate; Ethyl sec-amyl ketone (5-methyl-3-heptanone); Glycidol (2,3-epoxy-1-propanol); Isoamyl acetate; Isobutyl acetate; Isobutyl alcohol (isobutanol, 2-methylpropan-1-ol); Isopropyl acetate (2-propyl acetate); Isopropyl glycidyl ether; Mesityl oxide (methyl isobutenyl ketone); Methyl acetate; Methylal (dimethoxymethane); Methyl isobutyl carbinol (4-methylpentan-2-ol, MIBC); n-Butanol; n-Butylglycidyl ether (BGE, 2-[butoxymethyloxirane); n-Propylnitrate; p-Tert-butyltoluene; Phenylglycidyl ether; Propylacetate; sec-Butanol (sec-butylalcohol, 2-butanol); sec-Hexylacetate; Tetrahydrofuran (THF); Tetramethylsuccinonitrile; Vinyl toluene; Volatile organic compounds (VOCs) as heptane equivalents;	Gas chromatography (GC); GC-MS;	OSHA 007 (2000); Inhouse Org-023 Other VOCs in accordance with ELN-P09
Analysis for organochlorine pesticides	Air - Ambient; Bore waters; Ground waters; Saline waters; Sediments; Sludges; Soils; Waste waters;	α-Hexachlorocyclohexane (α-HCH); β-Hexachlorocyclohexane (β-HCH); γ-Hexachlorocyclohexane (β-HCH); γ-Hexachlorocyclohexane (γ-HCH); 2,2,2-Trichloro-1,1-bis(4-chlorophenyl)ethanol (dicofol); Aldrin; cis-Chlordane (α-chlordane); Dieldrin; Endosulfan 1 (α-endosulfan); Endosulfan II (β-endosulfan); Endosulfan sulfate; Endrin; Endrin aldehyde; Endrin ketone; Heptachlor; Heptachlor epoxide; Hexachlorobenzene (HCB); Isodrin; Methoxychlor; Mirex; o,p'-Dichlorodiphenyldichloroethane (o,p'-DDD); o,p'-Dichlorodiphenyltrichloroethane (o,p'-DDT); oxychlordane; p,p'-Dichlorodiphenyltrichloroethane (p,p'-DDD); p,p'-Dichlorodiphenyldichloroethylene (p,p'-DDD); p,p'-Dichlorodiphenyltrichloroethane (p,p'-DDT); trans-Chlordane (γ-chlordane); trans-Nonachlor;	Gas chromatography (GC); GC-MS; GC- MS-MS;	In-house Org-005, 012, 017, 033 Other organochlorine pesticides in accordance with ELN-P09
	Bore waters; Ground waters; Saline waters; Sediments; Sludges; Soils; Waste waters;	Organochlorine pesticides	Gas chromatography (GC); GC-MS;	In-house Org-005, Org- 012 in accordance with ELN-P09
		2,2,2-Trichloro-1,1-bis(4-chlorophenyl)ethanol (dicofol); Endrin ketone; Isodrin; Mirex; o,p'-Dichlorodiphenyldichloroethane (o,p'-DDD); o,p'-Dichlorodiphenyldichloroethylene (o,p'-DDE); o,p'-Dichlorodiphenyltrichloroethane (o,p'-DDT); Oxychlordane; trans-Nonachlor;	Gas chromatography (GC); GC-MS;	In-house Org-012, Org- 015



Analysis for organometals	Clays; Saline waters; Surface	Methyl mercury; Trimethyllead;	GC-MS-MS	In-house Org-018 Other organometals in accordance with ELN-P09
	waters; Trade wastes;			
	Clays; Saline waters; Sediments; Soils; Sorbents; Surface waters; Trade wastes;	Dioctyltin; Methyl mercury; Monooctyltin; Tetrabutyltin; Tricyclohexyltin; Trimethyllead; Trioctyltin;	GC-MS-MS	In-house Org-018 Other organometals in accordance with ELN-P09
Analysis for organophosphate pesticides	Air - Ambient; Bore waters; Ground waters; Saline waters; Sediments; Sewage and trade wastes; Sludges; Soils; Surface waters;	2-Methoxycarbonyl-1-methylvinyl dimethyl phosphate (mevinphos); Azinphos-methyl (guthion); Bromophosethyl; Carbophenothion (trithion); Chlorpyrifos ethyl (chlorpyrifos); Chlorpyrifos methyl; cis-Chlorfenvinphos (chlorfenvinphos Z); Coumaphos - Co-Ral; Demeton-o; Demeton-s; Demeton-S-methyl; Diazinon; Dichlorvos; Diethyl-2- ([dimethoxyphosphorothioyl]sulfanyl)butanedioate (maldison, malathion, carbofos, mercaptothion); Dimethoate; Disulfoton; EPN (O-ethyl O-[4-nitrophexhenyl] phenylphosphonothioate); Ethion; Ethoprop (1-ethoxy-propylsulfanylphosphoryl sulfanylpropane); Fenamiphos; Fenchlorphos (ronnel); Fenitrothion; Fensulfothion; Fenthion; Methidathion; Monocrotophos; Naled; O,O-Diethyl O-(4-nitrophenyl) phosphorothioate (parathion, diethyl parathion, parathion-ethyl, folidol); O,O-Diethyl S-([ethylsulfanyl]methyl) phosphorodithioate (phorate, thimet); O-Ethyl O-(4-[methylthio]phenyl) S-propyl phosphorodithioate (bolstar, sulprofos); Parathionmethyl; Phosalone (zolone, fosalone); Phosmet; Pirimiphos ethyl; Pirimiphos methyl; Prothiofos; Temephos (temefos, abate); Tetrachlorvinphos (stirofos); Tetraethylpyrophosphate (TEPP); trans-Chlorfenvinphos (chlorfenvinphos E); Trichloronate;	Gas chromatography (GC); GC-MS; GC- MS-MS;	In-house Org-008, 012, 015, 033 Other organophosphorus pesticides in accordance with ELN-P09
Analysis for petroleum hydrocarbons	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Soils; Steam- raising waters; Trade wastes;	Total recoverable hydrocarbons (TRH): C ₆ -C ₁₀	GC-MS - Purge and trap	In-house Org-016
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Soils; Trade wastes;	Aliphatics - Variable fractions: C_{10} - C_{40} ; Aromatics - Variable fractions: C_{10} - C_{40} ; Total recoverable hydrocarbons (TRH) - Variable fractions, silica: $>C_{10}$ - C_{40} ; Total recoverable hydrocarbons (TRH): $>C_{10}$ - C_{16} ; Total recoverable hydrocarbons (TRH): $>C_{16}$ - C_{34} ; Total recoverable hydrocarbons (TRH): $>C_{34}$ - C_{40} ;	GC-FID	In-house Org-003
	Soils	Total recoverable hydrocarbons (TRH): >C ₁₆ -C ₃₄ ;	GC-FID	In-house Org-003



		$\label{eq:coverable} \begin{tabular}{ll} Total recoverable hydrocarbons (TRH): $$^2_{34}$-$$^2_{40}$; \\ Total recoverable hydrocarbons (TRH): $$^2_{10}$-$$^2_{16}$; \\ \end{tabular}$		Validated to NEPM B3 TRH
		Volatile total recoverable hydrocarbons (TRH): C_6 - C_{10}	GC-MS - Purge and trap	In-house Org-016 Validated to NEPM B3 TRH
Analysis for phenols	Ground waters; Irrigation and stock waters; Saline waters; Sediments; Sewage; Sludges; Soils; Steam- raising waters; Trade wastes;	Phenols	GC-MS	In-house Org-012 in accordance with ELN-P09
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Sewage; Sludges; Soils; Steamraising waters; Trade wastes;	2,3,4,6-Tetrachlorophenol; 2,4,5-Trichlorophenol; 2,4,6-Trichlorophenol; 2,4-Dinitrophenol; 2,6-Dichlorophenol; 2-Methyl-4,6-dinitrophenol (4,6-dinitro-o-cresol); 2-Nitrophenol; 4-Nitrophenol; Pentachlorophenol;	GC-MS	In-house Org-004, 031
		3-Methylphenol (3-cresol, m-cresol)	GC-MS	In-house Org-012
	Emissions - Stack; Ground waters; Irrigation and stock waters; Saline waters; Sediments; Sewage; Sludges; Soils; Steam- raising waters; Trade wastes;	2,3,4,5-Tetrachlorophenol; 2,3,4,6-Tetrachlorophenol; 2,3,5-Tichlorophenol; 2,3,5-Tichlorophenol; 2,4,5-Trichlorophenol; 2,4,6-Trichlorophenol; 2,4-Dichlorophenol; 2,4-Dinitrophenol; 2,4-Dinitrophenol; 2,6-Dichlorophenol; 2,4-Dinitrophenol (o-chlorophenol); 2-Cyclohexyl-4,6-dinitrophenol (dinex); 2-Methyl-3,5-dinitrophenol (3,5-dinitro-o-cresol); 2-Methyl-4,6-dinitrophenol (4,6-dinitro-o-cresol); 2-Methylphenol (2-cresol, o-cresol); 2-Nitrophenol; 2-sec-Butyl-4,6-dinitrophenol ([RS]-2,4-dinitro-6-sec-butylphenol, dinoseb); 3-Methylphenol (3-cresol, m-cresol); 4,6-Dinitro-2-methylphenol; 4-Chloro-3-methylphenol; 4-Methylphenol (4-cresol, p-cresol); 4-Nitrophenol; bis-Phenol A (BPA); Pentachlorophenol; Phenol;	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other phenols in accordance with ELN-P09
Analysis for phthalates	Air - Ambient; Emissions - Industrial; Ground waters; Irrigation and stock waters; Saline waters; Sediments; Sewage; Sludges; Soils; Steam- raising	Accreditation Number: 2901 Site Number	Gas chromatography (GC); GC-MS; GC-MS-MS;	In-house Org-012, 017 in accordance with ELN-P09



	waters; Trade wastes;				
		bis-(2-Ethylhexyl) adipate; bis-(2-Ethylhexyl) phthalate (diisooctyl phthalate, dioctyl phthalate, di-n-octyl phthalate); Butylbenzylphthalate; Dibutylphthalate (di-n-butyl phthalate, DBP); Diethylphthalate; Dimethylbenzene-1,2-dicarboxylate (dimethylphthalate);	Gas chromatography (GC); GC-MS; GC- MS-MS;	In-house Org-012, 017	
Analysis for obysical and chemical characteristics	Emissions - Industrial; Impinger solutions;	Fluoride	Classical; Ion chromatography (IC); Ion selective electrode (ISE);	in-house INORG-081, INORG-098	
		Chloride	Classical; Ion chromatography (IC);	in-house INORG-097, INORG-026 and INORG-081	
		Ammonia	Classical; Discrete analyser (DA);	APHA 4500 NH ₃ -F and in-house INORG-093 and INORG-057	
	Ground waters; Irrigation and stock waters; Saline waters; Sediments; Soils; Steamraising waters; Trade wastes;	Iron - Ferrous	Classical; Discrete analyser (DA);	APHA; In-house Inorg- 076	
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Steamraising waters; Trade wastes;	Carbon - Dissolved; Carbon - Total; Carbon - Total inorganic (TIC); Dissolved inorganic carbon;	Nondispersive infrared (NDIR)	In-house Inorg-110	
		Bromide; Chloride; Fluoride; Iodide; Sulfate;	Ion chromatography (IC)	APHA 4110B; In-house Inorg-081	
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Sewage; Soils; Trade wastes;	Chromium - Hexavalent	Classical; Discrete analyser (DA);	APHA; In-house Inorg- 024	
		Chromium - Hexavalent	Ion chromatography (IC)	In-house Inorg-118	
	Biosolids; Bore waters; Ground waters; Industrial	Phenois	Discrete analyser (DA)	In-house Inorg-030	
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waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Sewage; Soils; Steam- raising waters; Trade wastes;				
Biosolids; Sediments; Soils;	Organic matter	Classical	In-house Inorg-036	
Air - Ambient	Phosphoric acid mist as phosphate	Classical; Discrete analyser (DA);	Inorg-060, 094	
	Ash; Combustible matter; Solids - Insoluble; Solids - Soluble; Solids - Total;	Classical	AS3580.10.1, AS3580.10.2; In-house Inorg-050	
	Phosphoric acid mist as phosphate	Classical; Ion chromatography (IC);	NIOSH 7908; Inorg- 081, 126	
	Sulfuric acid mist	Classical; Ion chromatography (IC);	NIOSH/OSHA 7903; NIOSH 7908; In-house Inorg-081, 094, 126	
	Particulate matter - PM ₁₀	Gravimetric	AS 3580.9.6; In-house Dust-004	
	Suspended particular matter - Total	Gravimetric	AS 3580.9.3; In-house Dust-004	
Air - Ambient; Filters; Impinger solutions; Sorbents;	Chromium - Hexavalent	Discrete analyser (DA)	NIOSH/OSHA 7600; Inhouse Metals 006, Inorg-024	
	Hydrobromic acid; Nitric acid;	Classical; Ion chromatography (IC);	NIOSH 7907; In-house Inorg-081, 126	
	Chromium - Hexavalent	Ion chromatography (IC)	NIOSH/OSHA; In- house Inorg 118	
Emissions - Stack	Hydrogen sulfide	Ion chromatography (IC)	in-house INORG-081, INORG-096	
Soils	Bromide; Chloride; Fluoride; Iodide; Sulfate;	Ion chromatography (IC)	APHA 4110B; In-house Inorg-081, In-house Prep1	
	Moisture	Classical	In-house Inorg-008	
	Aluminium - Exchangeable; Calcium - Exchangeable; Magnesium - Exchangeable; Potassium - Exchangeable; Sodium - Exchangeable;	ICP-AES	In-house Metals-009, 020	
	Cation exchange capacity (CEC)	Calculation	In-house Metals-009, 020	
	Micronutrients - DTPA extractable copper; Micronutrients - DTPA extractable iron; Micronutrients - DTPA extractable manganese; Micronutrients - DTPA extractable zinc;	ICP-AES	Rayment and Lyons 12A1; in-house AGRI- 007	
	рН	Classical	In-house Prep1, Inorg- 001	
	Phosphorus buffer index (PBI)	Discrete analyser (DA)	Rayment and Lyons 9l2c, 9l3c, 9l4c; in- house AGRI-003	
	LAcoroditation Number: 2001 Site Number:	Classical	In-house Prep1, Inorg- 002	
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	Chromium reducible sulfur suite (CRS)	Classical	ASSMAC; In-house INORG-068
	Sodium absorption ratio (SAR)	ICP-AES	In-house Metals 009, 020
	Sulfur potassium chloride extractable (SKCI)	ICP-AES	Rayment and Lyons 10D1 and in-house AGRI-001
Bore waters; Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Steam- raising waters; Trade wastes;	Chromium - Hexavalent	Discrete analyser (DA)	In-house Inorg-024
	Chemical oxygen demand (COD)	Classical	APHA 5220 B; in-house Inorg-067
	Hardness	Calculation	APHA 2340 B; In-house Metals-008
	Oil and grease	Classical	APHA 5520B; In-house Inorg-003
	Conductivity	Classical	APHA 2510; In-house Inorg-002
	Solids - Settleable	Gravimetric	APHA 2540 F; In-house Inorg-084
	Solids - Total	Gravimetric	APHA 2540B; In-house Inorg-041
	Turbidity	Classical	APHA 2310B and Inhouse Inorg-022
	Solids - Total suspended	Classical	APHA 2540 D; In-house Inorg-019
	рН	Classical	APHA 4500 H ⁺ B; In- house Inorg-001
	Chemical oxygen demand (COD)	Discrete analyser (DA)	In-house Inorg-067
	Chromium - Hexavalent	lon chromatography (IC)	In-house Inorg-118
	Chlorine - Free; Chlorine - Total;	Classical	APHA 4500 CI G; In- house Inorg-042
	Solids - Total dissolved (TDS)	Classical	APHA 2540C; In-house Inorg-018
	Sugar	Classical	AS 1141,35; in-house Inorg-085
	Colour	Discrete analyser (DA)	In-house Inorg-028
	Sulfate	Discrete analyser (DA)	In-house Inorg-009
Bore waters; Ground waters; Industrial waters - Treated; Irrigation and stock	Chloride	Discrete analyser (DA)	In-house Inorg-087

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waters; Saline waters; Sewage; Soils; Steam- raising waters; Trade wastes;				
Bore waters; Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Seewage; Soils; Steam- raising waters; Trade wastes;	Fluoride	Ion selective electrode (ISE)	APHA 4500F ⁻ C; Inhouse Inorg-026	
	Carbon - Total organic (TOC); Dissolved organic carbon (DOC); Organic carbon - Dissolved non-purgeable;	Classical	APHA 5310B and In- house Inorg-079	
	Formaldehyde (methanal)	Discrete analyser (DA); UV-vis spectrophotometry;	In-house Inorg-113	
Bore waters; Trade wastes;	Sulfide	Discrete analyser (DA)	In-house Inorg-101	
Bore waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Steam- raising waters; Trade wastes;	Carbon dioxide - Total	Calculation	APHA 2320B, 4500 CO ₂ C, in-house Inorg-001, Inorg-005, Inorg-006	
	Alkalinity - Bicarbonate; Alkalinity - Carbonate; Alkalinity - Hydroxide;	Classical	APHA 2320 B, in-house Inorg-006	
	Acidity	Classical	APHA 2310 B, in-house Inorg-001	
	Carbon dioxide - Free	Calculation	APHA 2310B, 4500 CO ₂ C, in-house Inorg- 005	
	Loss on ignition	Classical	In-house Inorg-092	
	Biochemical oxygen demand (BOD)	Classical	APHA 5210D, in-house Inorg-091	
	Langelier saturation index	Calculation	In-house Inorg-086	
Bore waters; Industrial waters - Treated;	Methyl blue active substances (MBAS) Accreditation Number: 2901 Site Numbers	Classical 2213 Printed on :	APHA 5540 C; In-house Inorg-021 31-May-2019	



	Irrigation and stock waters; Saline waters; Steam- raising waters;			
	Sediments; Sludges; Soils; Solid wastes;	Sample preparation	Classical	AS 4439.2; USEPA TCLP 1311; (volatiles) in- house Inorg- 004 TCLP USEPA (inorganics; 1311; non- volatiles, house semi- volatiles) 004 In- Seawater elutriate preparation In- house Inorg- 004 USEPA 1313, 1314, 1315, 1316 Environment Assessment Framework (LEAF) procedures INORGE INORG
	Sediments; Soi l s;	Suspension peroxide oxidation combined acidty and sulfur (SPOCAS)	Classical; ICP-AES;	ASSMAC; In-house Inorg-064, Metals-020
		Acid buffering characteristic curve (ABCC); Acid neutralising capacity (ANC); Net acid generation (NAG); Net acid production potential (NAPP);	Classical	In-house AMD-001
Analysis for polybrominated diphenylethers	Liquid wastes	2,2',3,4,4',5',6-Heptabromodiphenyl ether; 2,2',4,4',5,5'-Hexabromodiphenyl ether; 2,2',4,4',5,6'-Hexabromodiphenyl ether; 2,2',4,4',5-Pentabromodiphenyl ether; 2,2',4,4',6- Pentabromodiphenyl ether; 2,2',4,4'- Tetrabromodiphenyl ether; 2,4,4'- Tribromodiphenyl ether; Decabromodiphenyl ether (polybrominated diphenyl ether);	GC-MS-MS	in-house ORG-017 Other polybrominated diphenylethers in accordance with ELN- P09
			GC-MSMS	
	Liquid wastes; Saline waters; Surface waters;	2,2',3,4,4',5',6-Heptabromodiphenyl ether; 2,2',4,4',5,5'-Hexabromodiphenyl ether; 2,2',4,4',5,6'-Hexabromodiphenyl ether; 2,2',4,4',5-Pentabromodiphenyl ether; 2,2',4,4',6- Pentabromodiphenyl ether; 2,2',4,4'- Tetrabromodiphenyl ether; 2,4,4'- Tribromodiphenyl ether; Decabromodiphenyl ether (polybrominated diphenyl ether);	GC-MS-MS	In-house Org-017 Other polybrominated diphenylethers in accordance with ELN- P09
Analysis for polyhalogenated biphenyls	Wipes	Aroclor 1016; Aroclor 1221; Aroclor 1232; Aroclor 1242; Aroclor 1248; Aroclor 1254; Aroclor 1260;	Gas chromatography (GC)	In-house Org-010, 011
	Air - Ambient; Emissions - Industrial; Ground waters; Irrigation and stock waters; Saline waters;	Polyhalogenated biphenyls (PCBs) congeners - 28, 52, 101, 118, 138, 153, 180 Accreditation Number: 2901 Site Number	GC-MS	In-house Org-012

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	Sediments; Sewage; Sludges; Soils; Trade wastes;				
	Aggregates; Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Sewage; Sludges; Soils; Steam- raising waters; Trade wastes;	Polychlorinated biphenyl (PCB) congener 8; Polychlorinated biphenyl (PCB) congener 18; Polychlorinated biphenyl (PCB) congener 44; Polychlorinated biphenyl (PCB) congener 66; Polychlorinated biphenyl (PCB) congener 77; Polychlorinated biphenyl (PCB) congener 81; Polychlorinated biphenyl (PCB) congener 105; Polychlorinated biphenyl (PCB) congener 114; Polychlorinated biphenyl (PCB) congener 118; Polychlorinated biphenyl (PCB) congener 123; Polychlorinated biphenyl (PCB) congener 123; Polychlorinated biphenyl (PCB) congener 126; Polychlorinated biphenyl (PCB) congener 157; Polychlorinated biphenyl (PCB) congener 157; Polychlorinated biphenyl (PCB) congener 169; Polychlorinated biphenyl (PCB) congener 170; Polychlorinated biphenyl (PCB) congener 187; Polychlorinated biphenyl (PCB) congener 189; Polychlorinated biphenyl (PCB) congener 195; Polychlorinated biphenyl (PCB) congener 206; Polychlorinated biphenyl (PCB) congener 209; Polychlorinated biphenyl (PCB) congener 209; Polychlorinated biphenyls (PCBs) congeners - 28, 52, 101, 118, 138, 153, 180;	GC-MS-MS	In-house Org-017 Other PCB congeners in accordance with ELN-P09	
		Aroclor 1016; Aroclor 1221; Aroclor 1232; Aroclor 1242; Aroclor 1248; Aroclor 1254; Aroclor 1260;	Gas chromatography (GC)	In-house Org-006	
Analysis for pyrethroid and pyrethrum pesticides	Air - Ambient; Bore waters; Ground waters; Saline waters; Sediments; Sludges; Soils; Surface waters; Trade wastes; Waste waters;	λ-Cyhalothrin; Bifenthrin; cis-Permethrin; Cyfluthrin ([(R)-cyano-[4-fluoro-3- (phenoxy)phenyl]methyl] (1R,3R)-3-(2,2- dichloroethenyl)-2,2-dimethylcyclopropane-1-carboxylate); Cypermethrin; Delta-methrin; Esfenvalerate; trans-Permethrin;	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other synthetic pyrethroids in accordance with ELN-P09	
Analysis for respirable quartz	Filters	α-Quartz; Cristobalite; Crystalline silica (mass) - Quartz;	Fourier transform infrared spectroscopy (FTIR); Gravimetric;	NIOSH 7603; In-house Dust-004	
Analysis of inhalable and respirable dust	Filters	Dust - Inhalable	Gravimetric	AS 3640; In-house Dust-004	
		Dust - Respirable	Gravimetric	AS 2985; In-house Dust-004	
Analysis of the workplace environment and hazards for inorganic gases	Gases	Sulfur dioxide	Classical; Ion chromatography (IC);	NIOSH/OSHA 6004; Inhouse Inorg-060, 094	
	Air - Confined spaces; Air - Mines; Gases;	Phosphoric acid mist	Classical; Discrete analyser (DA);	In-house Inorg-060, 094	
		Fluoride - Total	Ion chromatography (IC); Ion selective electrode (ISE);	NIOSH/OSHA 7906; Inhouse Inorg-026, 081, 094	
		Ammonia	Classical; Discrete analyser (DA);	NIOSH 6015; In-house Inorg-0057, 093	
		Sulfate - Total Accreditation Number: 2901 Site Number	Classical; Ion : 2213 Printed on :	In-house Inorg-081, 094 31-May-2019	



			chromatography (IC);		
		Sulfuric acid	Classical; Ion chromatography (IC);	NIOSH/OSHA 7903; NIOSH 7908; In-house Inorg-081, 094, 126	
		Hydrogen cyanide	Classical; Discrete analyser (DA);	NIOSH/OSHA 6010; Inhouse Inorg-013, 105	
		Hydrobromic acid mist; Nitric acid mist;	Classical; Ion chromatography (IC);	NIOSH 7907; In-house Inorg-081, 126	
		Hydrofluoric acid	Classical; Ion chromatography (IC); Ion selective electrode (ISE);	NIOSH/OSHA 7903, 7906; In-house Inorg- 026, 081, 094, 126	
		Hydrochloric acid	Classical; Ion chromatography (IC);	NIOSH 7903, 7907; Inhouse Inorg-081, 094, 126	
		Phosphoric acid mist	Classical; Ion chromatography (IC);	In-house Inorg-081, 126	
		Hydrogen su l fide	Classical; Ion chromatography (IC);	NIOSH/OSHA 7903; Inhouse Inorg-081, 096	
Analysis of the workplace environment and hazards for metals and metal compounds	Dust wipes; Filters; Swabs;	Iron - Ferrous	Classical; Discrete analyser (DA);	In-house Inorg-076	
		Chromium VI	Ion chromatography (IC)	NIOSH/OSHA; In- house Inorg-118	
		Chromium VI	Classical; Discrete analyser (DA);	NIOSH/OSHA 7600; Inhouse Inorg-024	
		Mercury	Atomic absorption spectroscopy (AAS) - Cold vapour	NIOSH/OSHA 6009; Inhouse Metals-021, 025	
	Dust wipes; Filters; Swabs; Welding fumes and gases;	Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Chromium; Cobalt; Copper; Gold; Iron; Lead; Lithium; Manganese; Molybdenum; Nickel; Selenium; Silver; Strontium; Tellurium; Thallium; Thorium; Tin; Titanium; Tungsten; Uranium; Vanadium; Zinc;	Atomic absorption spectroscopy (AAS) - Flame; ICP-MS;	NIOSH/OSHA 7300, 7301, 7303; In-house Metals-022, 025	
		Aluminium; Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lanthanum; Lead; Lithium; Magnesium; Manganese; Molybdenum; Nickel; Phosphorus; Potassium; Selenium; Silicon; Silver; Sodium; Strontium; Sulfur; Tantalum; Tellurium; Tin; Titanium; Tungsten; Vanadium; Zinc; Zirconium;	Atomic absorption spectroscopy (AAS) - Flame; ICP-AES;	NIOSH/OSHA 7300, 7301, 7303; In-house Metals-020, 024, 025	
Analysis of the workplace environment in confined spaces	Organic vapours	1-Propanol (n-Propanol); 4-Methyl-2-pentanone (methyl isobutyl ketone, MIBK); Acetone; Benzene; Butanone (methyl ethyl ketone, MEK, 2-butanone); Diethylketone; Diisobutyl ketone (DIBK, 2,6-dimethyl-4-heptanone, isovalerone); Ethanol; Ethoxyethane (ethyl ether); Ethylacetate; Ethylbenzene; Ethylformate; Formaldehyde (methanal); Hexane (n-hexane); Methanol; n-Propylacetate; Octane (n-octane); Styrene (ethenyl benzene); Tetrachloroethene (perchlororethylene, perchloroethene, tetrachloroethylene); Tetrahydrofuran (THF); Toluene; Trichloroethane; Xylene;	Gas chromatography (GC); GC-MS;	In-house Org-023	
	Air - Confined spaces; Air - Mines; Organic vapours;	a-Methastyrene; 1,1,1,2-Tetrachloro-2,2-difluoroethane; 1,1,2,2-Tetrachloro-1,2-difluoroethane; 1,1,2,2-Tetrachloroethane (acetylene tetrachloride); 1,1-Dichloro-1-nitroethane; 1,1-Dichloroethane (1,1-DCA); 1,2,3-Trichloropropane (allyl trichloride); 1,2-Dichlorobenzene (o-dichlorobenzene); 1,2-I Accreditation Number: 2901 Site Number	Gas chromatography (GC); GC-MS;	OSHA 007 (2000); Inhouse Org-023	



	Dichloroethylene; 1,2-Dichloropropane (propylene dichloride); 1,4-Dichlorobenzene (p-dichlorobenzene); 1-Propanol (n-Propanol); 2-Chloroethanol (ethylene chlorohydrin); 2-Heptanone (methyl n-amyl ketone); 2-Hexanone (MBK); 2-Methylpropan-2-ol (tert-butanol, tert-butyl alcohol); Allyl alcohol; Allyl chloride; Benzylchloride (chloromethylbenzene); Bromochloromethane (chlorobromomethane); Bromoethane (ethylbromide); Bromoform (tribromomethane); Butylacetate; Butylalcohol; Camphor (1,7,7-trimethylbicyclo[2,2,1]haptan-2-one, 2-bornanone); Carbon tetrachloride (tetrachloromethane); Chlorobenzene (benzene chloride, monochlorobenzene); Cyclohexane; Cyclohexanol; Cyclohexene; Diacetone alcohol (2-pentanone, 4-hydroxy-4-methyl-2-pentanone); Dichloroethyl ether; Difluorodibromomethane; Diisobutyl ketone (DIBK, 2,6-dimethyl-4-heptanone, isovalerone); Dioxane (diethylene dioxide); Epichlorohydrin; Ethoxyethane (ethyl ether); Ethylacetate; Ethyl butyl ketone (3-heptanone); Ethylformate; Ethyl sec-amyl ketone (5-methyl-3-heptanone); Glycidol (2,3-epoxy-1-propanol); Heptane (n-heptane); Hexane (n-hexane); Isoamyl acetate; Isoamyl alcohol; Isobutyl acetate; Isoamyl alcohol; Isobutyl acetate; Isopropyl acetate (2-propyl acetate); Isopropyl acetate (2-propyl acetate); Isopropyl acetate (2-propyl acetate; Isopropyl ether; Isopropyl glycidyl ether; Mesityl oxide (methyl isobutyl carbinol (4-methylpentan-2-ol, MIBC); n-Butylglycidyl ether (BGE, 2-[butoxymethy]oxirane); n-Propylacetate; n-Propylnitrate; Octane (n-octane); p-Tert-butyltoluene; Pentane (n-pentane); Phenylglycidyl ether; sec-Butanol (sec-butylalcohol, 2-butanol); sec-Butylacetate (butan-2-yl acetate, 2-butylacetate); sec-Hexylacetate; Tert-butyl acetate; Tetrahydrofuran (THF); Tetramethylsuccinonitrile; Vinyl toluene; Volatile organic compounds (VOCs) as heptane equivalents;			
	Benzene; Ethylbenzene; Toluene; Xylene;	Gas chromatography (GC); GC-MS;	In-house Org-023	
t	Ammonium chloride; Ammonium nitrate; Ammonium sulfate;	Classical; Discrete analyser (DA);	In-house Inorg-57, 093	

ISO/IEC 17025 (2005) Food and Beverage

Acid mist

SERVICE	PRODUCT	DETERMINANT	TECHNIQUE	PROCEDURE	LIMITATION/RANGE
Analysis for chlorinated dioxins and dibenzofurans	Waters for potable and domestic purposes	1,2,3,4,6,7,8-Heptachlorodibenzodioxin; 1,2,3,4,6,7,8-Heptachlorodibenzofuran; 1,2,3,4,7,8,9-Heptachlorodibenzofuran; 1,2,3,4,7,8-Hexachlorodibenzodioxin; 1,2,3,4,7,8-Hexachlorodibenzofuran; 1,2,3,7,8,9-Hexachlorodibenzodioxin; 1,2,3,7,8,9-Hexachlorodibenzodioxin; 1,2,3,7,8-Pentachlorodibenzofuran; 1,2,3,7,8-Pentachlorodibenzofuran; 2,3,4,6,7,8-Hexachlorodibenzofuran; 2,3,4,6,7,8-Hexachlorodibenzofuran; 2,3,7,8-Tetrachlorodibenzofuran; 2,3,7,8-Tetrachlorodib	GC-MS-MS	In-house Org-038 Other Dibenzofurans and Dioxins in accordance with ELN- P09	
Analysis for elements	Waters for potable and domestic purposes	Mercury	Atomic absorption spectroscopy (AAS) - Vapour generation	APHA; In-house Metals-001, 003, 021	
		Aluminium; Antimony; Arsenic; Barium; Beryllium; Accreditation Number: 2901 Site Number:		APHA; In-house 31-May-2019	



		Bismuth; Boron; Cadmium; Chromium; Cobalt; Copper; Gold; Iron; Lead; Lithium; Manganese; Molybdenum; Nickel; Selenium; Silicon; Silver; Strontium; Tellurium; Thallium; Thorium; Tin; Titanium; Tungsten; Uranium; Vanadium; Zinc;		Metals-001, 002, 022 Other elements in accordance with ELN- P09	
		Aluminium; Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lanthanum; Lithium; Magnesium; Manganese; Molybdenum; Nickel; Phosphorus; Potassium; Selenium; Silicon; Silver; Sodium; Strontium; Sulfur; Tantalum; Tellurium; Tin; Titanium; Tungsten; Uranium; Vanadium; Zinc; Zirconium;	ICP-AES	APHA; In-house Metals-001, 002, 020 Other elements in accordance with ELN- P09	
Analysis for herbicides	Potable waters	Molinate	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other carbamates in accordance with ELN- P09	
		(R)-2-(2,4-Dichlorophenoxy)propanoic acid (dichlorprop, 2,4-DP); 2,2-Dichloropropanoic acid (2,2-DPA, dalapon); 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T); 2,4-6-Trichlorophenoxyacetic acid (2,4,6-T); 2,4-Dichlorophenoxyacetic acid (2,4-D); 2,6-Dichlorophenoxyacetic acid (2,6-D); 2-(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP, fenoprop, silvex); 2-Chlorophenoxyacetic acid; 2-Methyl-4-chlorophenoxyacetic acid (MCPA); 2-sec-Butyl-4,6-dinitrophenol ([RS]-2,4-dinitro-6-sec-butylphenol, dinoseb); 3,5-Dichlorobenzoic acid; 3,6-Dichloro-2-methoxybenzoic acid (dicamba); 3-Amino-2,5-dichlorobenzoic acid; 4-(2,4-Dichlorophenoxy)butanoic acid (2,4-DB, [2,4-dichlorophenoxy]butyric acid); 4-(4-Chloro-2-methylphenoxy)butanoic acid (2,4-MCPB, MCPB, 4-[4-chloro-o-tolyloxyl]butyric acid); 4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid (picloram); 4-Chlorophenoxyacetic acid (4-CPA); Acifluorfen; Bentazone; Bromoxynil; Clopyralid; Dimethyl tetrachloroterephthalate (DCPA, dacthal); Fluroxypyr; loxynil; Methylchlorophenoxypropionic acid (RS-2-[4-chloro-2-methylphenoxy]propanoic acid, MCPP, mecoprop); Triclopyr;	GC-MS	In-house Org-004, 031 Other acid herbicides in accordance with ELN- P09	
		2-sec-Butyl-4,6-dinitrophenol ([RS]-2,4-dinitro-6-sec-butylphenol, dinoseb); Ametryne (ametryn); Atrazine; Cyanazine; Hexazinone; Metribuzin; Prometryn; Propazine; Simazine; Terbuthylazine; Terbutryn;	GC-MS-MS	In-house Org-017 Other triazine herbicides in accordance with ELN- P09	
		Diuron; Fenuron; Isoproturon; Monuron; Tebuthiuron;	GC-MS	In-house Org-031 Other herbicides in accordance with ELN- P09	
		Diquat; Paraquat;	HPLC	In-house AT-018	
		Alachlor; Azobenzene; Bromacil; Metalochlor; Trifluralin;	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other herbicides in accordance with ELN- P09	
		Aminomethylphosphonic acid (AMPA); Glyphosate (n-[phosphonomethyl]glycine);	HPLC	In-house AT-010	
Analysis for phenols	Waters for potable and domestic purposes	Phenois	GC-MS	In-house Org-012 in accordance with ELN- P09	
		2,3,4,6-Tetrachlorophenol; 2,4,5-Trichlorophenol; 2,4,6-Trichlorophenol; 2,4-Dichlorophenol; 2,4-Dinitrophenol; 2,6-Dichlorophenol; 2-Methyl-4,6-dinitrophenol (4,6-dinitro-o-cresol); 2-Nitrophenol; 4-Nitrophenol; Pentachlorophenol;	GC-MS	In-house Org-004, 031	
		2,3,4,5-Tetrachlorophenol; 2,3,4,6- Tetrachlorophenol; 2,3,5,6-Tetrachlorophenol; 2,3,5-Trichlorophenol; 2,3-Dichlorophenol; 2,4,5- Trichlorophenol; 2,4,6-Trichlorophenol; 2,4- Accreditation Number: 2901 Site Number	GC-MS; GC-MS- MS; : 2213 Printed on :	In-house Org-012, 017, 033 Other phenols in 31-May-2019	



		Dichlorophenol; 2,4-Dimethylphenol; 2,4-Dinitrophenol; 2,6-Dichlorophenol; 2-Chlorophenol (o-chlorophenol); 2-Cyclohexyl-4,6-dinitrophenol (dinex); 2-Methyl-3,5-dinitrophenol (3,5-dinitro-o-cresol); 2-Methyl-4,6-dinitrophenol (4,6-dinitro-o-cresol); 2-Methylphenol (2-cresol, o-cresol); 2-Nitrophenol; 2-sec-Butyl-4,6-dinitrophenol ([RS]-2,4-dinitro-6-sec-butylphenol, dinoseb); 3-Methylphenol (3-cresol, m-cresol); 4,6-Dinitro-2-methylphenol; 4-Chloro-3-methylphenol; 4-Methylphenol (4-cresol, p-cresol); 4-Nitrophenol; bis-Phenol A (BPA); Pentachlorophenol; Phenol;		accordance with ELN-P09
		3-Methylphenol (3-cresol, m-cresol)	GC-MS	In-house Org-012
Analysis for polyhalogenated biphenyls	Waters for potable and domestic purposes	Polychlorinated biphenyl (PCB) congener 77; Polychlorinated biphenyl (PCB) congener 81; Polychlorinated biphenyl (PCB) congener 105; Polychlorinated biphenyl (PCB) congener 114; Polychlorinated biphenyl (PCB) congener 118; Polychlorinated biphenyl (PCB) congener 123; Polychlorinated biphenyl (PCB) congener 126; Polychlorinated biphenyl (PCB) congener 156; Polychlorinated biphenyl (PCB) congener 157; Polychlorinated biphenyl (PCB) congener 167; Polychlorinated biphenyl (PCB) congener 169; Polychlorinated biphenyl (PCB) congener 189; Polychlorinated biphenyls (PCBs) congeners - 28, 52, 101, 118, 138, 153, 180;	GC-MS-MS	In-house Org-017 Other PCB congeners in accordance with ELN-P09
		Aroclor 1016; Aroclor 1221; Aroclor 1232; Aroclor 1242; Aroclor 1248; Aroclor 1254; Aroclor 1260;	Gas chromatography (GC)	In-house Org-006
		Polyhalogenated biphenyls (PCBs) congeners - 28, 52, 101, 118, 138, 153, 180	GC-MS	In-house Org-012
Analysis for pyrethroid and pyrethrum pesticides	Potable waters	λ-Cyhalothrin; Bifenthrin; cis-Permethrin; Cyfluthrin ([(R)-cyano-[4-fluoro-3-(phenoxy)phenyl]methyl] (1R,3R)-3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropane-1-carboxylate); Cypermethrin; Delta-methrin; Esfenvalerate; trans-Permethrin;	GC-MS; GC-MS- MS;	In-house Org-012, 017, 033 Other synthetic pyrethroids in accordance with ELN-P09
Analysis for residues and contaminants (hydrocarbons, phthalates, industrial chemicals)	Waters for potable and domestic purposes	1,2,3,4-Tetrachlorobenzene; 1,2,3,5-Tetrachlorobenzene; 1,2,3-Trichlorobenzene; 1,2,4-Trichlorobenzene (1,2,4-TCB); 1,2,4-Trimethylbenzene (1,2,4-TMB, pseudo-cumene); 1,2-Dichlorobenzene (o-dichlorobenzene); 1,3,5-Trichlorobenzene; 1,3,5-Trinitrobenzene; 1,3-Dichlorobenzene (m-dichlorobenzene); 1,3-Dinitrobenzene (m-dichlorobenzene); 1,3-Dinitrobenzene; 1,4-Dichlorobenzene (p-dichlorobenzene); 1-Naphthylamine; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Naphthylamine; 2-Picoline (2-methylpyridine); 4-Aminobiphenyl; 5-Nitro-o-toluidine; Hexachloro-1,3-butadiene (hexachlorobutadiene, HCBD); Hexachloroethane; Hexachloropropene; N-Nitroso-n-propylamine; N-Nitrosodiethylamine (Nethyl-N-nitroso-ethanamine); N-Nitrosomethylethylamine; N-Nitrosopyrrolidine; Nitrobenzene (mononitrotoluene, MNT, methylnitrobenzene); o-Toluidine; Pentachlorobenzene (ethanepentachloride); Pentachloronitrobenzene (quintozene);	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033
		Other anilines, nitroaromatics, nitrosoamines, oxygenated hydrocarbons and semi volatile chlorinated hydrocarbons in accordance with ELN-P09		
		1,4-Dioxane	GC-MS - Headspace	in-house ORG-013 and ORG-014
		Carbazole; Irgarol (cybutryne); N-Nitroso-n-butylamine; N-Nitrosodi-n-propylamine; N-Nitrosomorpholine; N-Nitrosopiperidine; n-Phenylaniline (diphenylamine);	GC-MS; GC-MS- MS;	In-house Org-012, 017, 033 Other nitrosamines in accordance with ELN-
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		P09	
2-Acetylaminofluorene; 3-Methylcholanthrene; 4-Bromophenylphenyl ether; 4-Chlorophenylphenyl ether (p-chlorodiphenyl ether);	GC-MS; GC-MS- MS;	In-house Org-012, 017, 033 Other aromatic hydrocarbons and haloethers in accordance with ELN- P09	
Butanone (methyl ethyl ketone, MEK, 2-butanone); Cyclohexane; Methyl tert-butyl ether (MTBE);	Gas chromatography (GC); GC-MS - Purge and trap;	In-house Org-013, Org- 014	
Dibutyltin; Diphenyltin; Monobutyltin; Monophenyltin; Tributyltin (TBT); Triphenyltin;	GC-MS-MS	In-house Org-018 Other organometallic compounds in accordance with ELN- P09	
Total recoverable hydrocarbons (TRH): C ₆ -C ₁₀	GC-MS - Purge and trap	In-house Org-016	
2-Nitroaniline; 3-Nitroaniline; 4-Chloroaniline; 4-Nitroaniline; 4-Nitroquinoline-1-oxide (4-nitroquinoline-n-oxide); Aniline; Caprolactam; Methapyrilene; p-Dimethylaminoazobenzene (4-dimethylaminoazobenzene, DAB, dimethylaminoazobenzene);	GC-MS; GC-MS- MS;	In-house Org-012, 017, 033 Other nitroaromatics and anilines in accordance with ELN-P09	
1,2,4,5-Tetrachlorobenzene; 1,2,4- Trimethylbenzene (1,2,4-TMB, pseudo-cumene); 1,3,5-Trimethylbenzene (1,3,5-TMB, mesitylene); Benzene; Ethylbenzene; Isopropylbenzene (cumene); Isopropyl toluene; n-Butylbenzene; n- Propylbenzene; Naphthalene; sec-Butylbenzene; Styrene (ethenyl benzene); Tert-butyl benzene; Toluene; Xylene;	GC-MS - Purge and trap	In-house Org-013, 014	
Other monocyclic aromatic hydrocarbons in accordance with ELN-P09			
2-Methylisoborneol (MIB); Geosmin;	GC-MS-MS	In-house Org-017	
1,1,1,2-Tetrachloroethane; 1,1,1-Trichloroethane (1,1,1-TCA, methyl chloroform, chlorothene); 1,1,2,2-Tetrabromoethane (acetylene tetrabromide); 1,1,2,2-Tetrachloroethane (acetylene tetrachloride); 1,1,2-Trichloroethane (1,1,2-TCA, vinyl trichloride); 1,1-Dichloroethane (1,1,2-TCA, vinyl trichloride); 1,1-Dichloroethane (1,1-DCA); 1,1-Dichloropthene (1,1-DCE, chloride); 1,1-Dichloroptopene; 1,2 Dibromoethane (ethylene dibromide, EDB); 1,2,3-Trichlorobenzene; 1,2,3-Trichloropropane (allyl trichloride); 1,2,4-Trichlorobenzene (1,2,4-TCB); 1,2-Dibromoethane; 1,2-Dibromoethene; 1,2-Dibromomethane; 1,2-Dichlorobenzene (o-dichlorobenzene); 1,2-Dichlorobenzene (o-dichlorobenzene); 1,3-Dichloroptopane (propylene dichloride); 1,3-Dichloroptopane; 1,4-Dichlorobenzene (p-dichlorobenzene); 2,2-Dichloroptopane; 2-Chlorotoluene (o-chlorotoluene); 4-Chlorotoluene (p-chlorotoluene); Bromobenzene (phenylbromide); Bromobenzene (chlorobromomethane); Bromoform (tribromomethane); Bromodichloromethane (dichlorobromomethane); Bromoform (tribromomethane); Chlorobenzene (benzene chloride, monochlorobenzene); Chloroethane; Chloromethane; cis-1,2-Dibromoethene; cis-1,2-Dichloropropylene); Dibromochloromethane (chlorodibromomethane); Dibromomethane (chlorodifluoromethane); Dibromomethane (chlorodifluoromethane); Dibromomethane (benzene chloride); Hexachloro-1,3-butadiene (hexachlorobutadiene, HCBD); Tetrachloroethene (perchloroethylene); perchloroethylene, perchloroethene, tetrachloroethylene); trans-1,2-	GC-MS; GC-MS - Purge and trap;	In-house Org-012, -013, -014	

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	Dichloroethene (trans-1,2-DCE, trans-1,2-dichloroethylene); trans-1,3-Dichloropropene (trans-1,3-dichloropropylene); Trichloroethene (trichloroethylene, TCE); Trichlorofluoromethane (freon-11, trichloromonofluoromethane); Trichloromethane (chloroform); Vinyl bromide (bromoethene); Vinyl chloride;			
	2,5-Dimethylbenzaldehyde; 2-Methylbenzaldehyde (o-tolualdehyde); 2-Methylpropanal (isobutyraldehyde); 3-Methylbenzaldehyde (m-tolualdehyde); 4-Methylbenzaldehyde (p-tolualdehyde); Acetaldehyde (ethanal); Benzaldehyde (phenylmethanal); Butyraldehyde (butanal); Crotonaldehyde; Decyl aldehyde (decanal); Formaldehyde (methanal); Heptanal; Hexanal (hexaldehyde); Isovaleraldehyde; Methacrolein; Nonanal; Octanal; Pentanal (valeraldehyde); Propionaldehyde (propanal);	HPLC - Diode array detection	in-house AT-010	
	Cyanide - Free; Cyanide - Total; Cyanide - Weak acid dissociable (WAD);	Discrete analyser (DA); Segmented flow analyser (SFA);	In- house Inorg- 013	
	1,4-Dioxane	GC-MS	In-house Org-037	
	1-Chloronaphthalene; 1-Methylnaphthalene; 2-Chloronaphthalene; 2-Methylnaphthalene; 3-Methylcholanthrene; 7,12-Dimethylbenz(a)anthracene; Acenaphthene; Acenaphthylene (acenaphthalene); Anthracene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b,j)fluoranthene; Benzo(b,j)fluoranthene; Benzo(b,j)fluoranthene; Benzo(b,j)fluoranthene; Benzo(k)fluoranthene; Chrysene; Coronene; Dibenzo(a,h)anthracene; Fluoranthene (benzo[j,k]fluorene); Fluorene; Indeno(1,2,3-cd)pyrene; n-2-Fluorenylacetamide; Naphthalene; Perylene; Phenanthrene; Polycyclic aromatic hydrocarbons (PAHs); Pyrene;	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other polycyclic aromatic hydrocarbons in accordance with ELN-P09	
	Chloral hydrate (trichloroacetaldehyde); Chloroacetic acid; Dichloroacetic acid; Trichloroacetic acid;	GC-ECD	In-house Org-031	
	Halogenated hydrocarbons	Gas chromatography (GC) - Purge and trap; Gas chromatography (GC) - Static headspace; GC-MS - Headspace; GC- MS - Purge and trap;	In-house Org-013, -014 in accordance with ELN-P09	
	Acetophenone; Cyclohexanone; Ethylmethanesulfonate; Methyl methane sulfonate;	GC-MS	In-house Org-012 Other oxygenated hydrocarbons in accordance with ELN- P09	
	Cyanide - Free; Cyanide - Total; Cyanide - Weak acid dissociable (WAD);	Classical	APHA 4500 CN D; Inhouse Inorg-109	
	Aliphatics – Variable fractions: C_{10} – C_{40} ; Aromatics – Variable fractions: C_{10} – C_{40} ; Total recoverable hydrocarbons (TRH) – Variable fractions, silica: $>C_{10}$ – C_{40} ; Total recoverable hydrocarbons (TRH): $>C_{10}$ – C_{16} ; Total recoverable hydrocarbons (TRH): $>C_{16}$ – C_{34} ; Total recoverable hydrocarbons (TRH): $>C_{34}$ – C_{40} ;	GC-FID	In-house Org-003	
	bis-(2-Ethylhexyl) adipate; bis-(2-Ethylhexyl) phthalate (diisooctyl phthalate, dioctyl phthalate, di-n-octyl phthalate); Butylbenzylphthalate; Dibutylphthalate (di-n-butyl phthalate, DBP); Diethylphthalate; Dimethylbenzene-1,2-dicarboxylate (dimethylphthalate); Accreditation Number: 2901 Site Number:	Gas chromatography (GC); GC-MS; GC-MS-MS;	In-house Org-012, 017 31-May-2019	



		bis-2-Chloro-ethoxy-methane; bis-2-Chloro-ethylether; bis-2-Chloro-isopropyl-ether;	GC-MS; GC-MS- MS;	In-house Org-012, 017, 033 Other haloethers in accordance with ELN- P09	
		Ethylenediaminetetraacetic acid (EDTA); Nitrilotriacetic acid (NTA);	GC-MS; GC-MS- MS;	In-house Org-034	
		Benzylalcohol; Dibenzofuran; Isophorone (isoforone, isoacetophorone); Isosafrole; Phenacetin; Safrole;	GC-MS	In-house Org-012 Other oxygenated hydrocarbons in accordance with ELN- P09	
		Phthalates	Gas chromatography (GC); GC-MS; GC- MS-MS;	In-house Org-012, 017 in accordance with ELN-P09	
Analysis of fungicide residues and contaminants	Potable waters	Propiconazole; Tebuconazole;	GC-MS; GC-MS-MS;	In-house Org-012, 017, 033 Other triazole fungicides in accordance with ELN- P09	
Analysis of pesticide residues and contaminants	Potable waters	3-Hydroxycarbofuran (thiobencarb, S-[(4-chlorophenyl)methyl]-N,N-diethylcarbamothioate); Aldicarb; Carbaryl; Carbofuran; Chlorpropham; Fluometuron; Linuron; Methiocarb; Methomyl; Mexacarbate; Neburon; Oxamyl (thioxamyl); Propham; Propoxur; Siduron; Swep (methyl N-[3,4-dichlorophenyl] carbamate);	GC-MS	In-house Org-031 Other carbamate pesticides in accordance with ELN- P09	
		Carbaryl; Carbofuran;	GC-MS; GC-MS-MS;	In-house Org-012, 017 Other carbamate pesticides in accordance with ELN- P09	
		α-Hexachlorocyclohexane (α-HCH); β-Hexachlorocyclohexane (β-HCH); δ-Hexachlorocyclohexane (β-HCH); γ-Hexachlorocyclohexane (γ-HCH); γ-Hexachlorocyclohexane (γ-HCH); γ-Hexachlorocyclohexane (γ-HCH); γ-Hexachlorocyclohexane (γ-HCH); γ-Hexachlorocyclohexane (γ-HCH); γ-Hexachlorophenyl)ethanol (dicofol); Aldrin; cis-Chlordane (α-chlordane); Dieldrin; Endosulfan 1 (α-endosulfan); Endosulfan II (β-endosulfan); Endosulfan sulfate; Endrin; Endrin aldehyde; Endrin ketone; Heptachlor; Heptachlor epoxide; Hexachlorobenzene (HCB); Isodrin; Methoxychlor; Mirex; ο,p'-Dichlorodiphenyldichloroethane (ο,p'-DDD); ο,p'-Dichlorodiphenyldichloroethylene (ο,p'-DDD); ο,p'-Dichlorodiphenyldichloroethane (p,p'-DDD); p,p'-Dichlorodiphenyldichloroethylene (p,p'-DDD); p,p'-Dichlorodiphenyltrichloroethane (p,p'-DDT); trans-Chlordane (γ-chlordane); trans-Nonachlor;	Gas chromatography (GC); GC-MS; GC- MS-MS;	In-house Org-005, 012, 017, 033 Other organochlorine pesticides in accordance with ELN-P09	
		2,2,2-Trichloro-1,1-bis(4-chlorophenyl)ethanol (dicofol); Endrin ketone; Isodrin; Mirex; o,p'-Dichlorodiphenyldichloroethane (o,p'-DDD); o,p'-Dichlorodiphenyldichloroethylene (o,p'-DDE); o,p'-Dichlorodiphenyltrichloroethane (o,p'-DDT); Oxychlordane; trans-Nonachlor;	Gas chromatography (GC); GC-MS;	In-house Org-012, Org- 015	
		Organochlorine pesticides	Gas chromatography (GC); GC-MS;	In-house Org-005, Org- 012 in accordance with ELN-P09	
		2-Methoxycarbonyl-1-methylvinyl dimethyl phosphate (mevinphos); Azinphos-methyl (guthion); Bromophosethyl; Carbophenothion (trithion); Chlorpyrifos ethyl (chlorpyrifos); Chlorpyrifos methyl; cis-Chlorfenvinphos (chlorfenvinphos Z); Coumaphos - Co-Ral; Demeton; Demeton-S-methyl; Diazinon; Dichlorvos; Diethyl-2- ([dimethoxyphosphorothioyl]sulfanyl)butanedioate (maldison, malathion, carbofos, mercaptothion); Dimethoate; Disulfoton; EPN (O-ethyl O-[4- Accreditation Number: 2901 Site Number	Gas chromatography (GC); GC-MS; GC-MS-MS;	In-house Org-008, 012, 015, 033 Other organophosphorus pesticides in accordance with ELN-P09	



		nitrophexhenyl] phenylphosphonothioate); Ethion; Ethoprop (1-ethoxy-propylsulfanylphosphoryl sulfanylpropane); Fenamiphos; Fenchlorphos (ronnel); Fenitrothion; Fensulfothion; Fenthion; Methidathion; Monocrotophos; Naled; O,O-Diethyl O-(4-nitrophenyl) phosphorothioate (parathion, diethyl parathion, parathion-ethyl, folidol); O,O-Diethyl S-([ethylsulfanyl]methyl) phosphorodithioate (phorate, thimet); O-Ethyl O-(4-[methylthio]phenyl) S-propyl phosphorodithioate (bolstar, sulprofos); Parathionmethyl; Phosalone (zolone, fosalone); Phosmet; Pirimiphos ethyl; Pirimiphos methyl; Prothiofos; Temephos (temefos, abate); Tetrachlorvinphos (stirofos); Tetraethylpyrophosphate (TEPP); trans-Chlorfenvinphos (chlorfenvinphos E); Trichloronate;			
Analysis of physical and nutritional characteristics	Waters for potable and domestic purposes	Colour	Discrete analyser (DA)	In-house Inorg-028	
		Chromium - Hexavalent	Discrete analyser (DA)	In-house Inorg-024	
		Nitrogen - Total	Discrete analyser (DA)	In-house Inorg-055, 061 (digestion)	
		Turbidity	Classical	APHA 2310B and Inhouse Inorg-022	
		Chromium - Hexavalent	Ion chromatography (IC)	In-house Inorg-118	
		Oil and grease	Classical	APHA 5520B; In-house Inorg-003	
		рН	Classical	APHA 4500 H ⁺ B; Inhouse Inorg-001	
		Phenols	Discrete analyser (DA)	In-house Inorg-030	
		Solids - Total suspended	Classical	APHA 2540 D; In-house Inorg-019	
		Solids - Total dissolved (TDS)	Classical	APHA 2540C; In-house Inorg-018	
		Biochemical oxygen demand (BOD)	Classical	APHA 5210D, in-house Inorg-091	
		Solids - Total	Gravimetric	APHA 2540B; In-house Inorg-041	
		Solids - Settleable	Gravimetric	APHA 2540 F; In-house Inorg-084	
		Sulfate	Discrete analyser (DA)	In-house Inorg-009	
		Chlorine - Free; Chlorine - Total;	Classical	APHA 4500 CI G; In- house Inorg-042	
		Chemical oxygen demand (COD)	Classical	APHA 5220 B; in-house Inorg-067	
		Chromium - Hexavalent	Classical; Discrete analyser (DA);	APHA; In-house Inorg- 024	
		Nitrogen - Ammonia	Discrete analyser (DA)	In-house Inorg-057	
		Methyl blue active substances (MBAS)	Classical	APHA 5540 C; In-house Inorg-021	
		Acidity	Classical	APHA 2310 B, in-house Inorg-001	
		Chromium - Hexavalent	Ion chromatography (IC)	In-house Inorg-118	
		Chloride	Discrete analyser (DA)	In-house Inorg-087	
		Accreditation Number: 2901 Site Number:	2213 Printed on :	31-May-2019	



		Chemical oxygen demand (COD)	Discrete analyser (DA)	In-house Inorg-067
		Carbon dioxide - Total	Calculation	APHA 2320B, 4500 CO ₂ C, in-house Inorg- 001, Inorg-005, Inorg- 006
		Fluoride	Ion selective electrode (ISE)	APHA 4500F ⁻ C; In- house Inorg-026
		Langelier saturation index	Calculation	In-house Inorg-086
		Carbon - Total organic (TOC); Dissolved organic carbon (DOC); Organic carbon - Dissolved non-purgeable;	Classical	APHA 5310B and In- house Inorg-079
		Conductivity	Classical	APHA 2510; In-house Inorg-002
		Hardness	Calculation	APHA 2340 B; In-house Metals-008
		Iron - Ferrous	Classical; Discrete analyser (DA);	APHA; In-house Inorg- 076
		Carbon - Dissolved; Carbon - Total; Carbon - Total inorganic (TIC); Dissolved inorganic carbon;	Nondispersive infrared (NDIR)	In-house Inorg-110
		Bromide; Chloride; Fluoride; Iodide; Sulfate;	Ion chromatography (IC)	APHA 4110B; In-house Inorg-081
		Sulfide	Discrete analyser (DA)	In-house Inorg-101
		Nitrogen - Total	Chemiluminescence	In-house Inorg-110
		Alkalinity - Bicarbonate; Alkalinity - Carbonate; Alkalinity - Hydroxide;	Classical	APHA 2320 B, in-house Inorg-006
		Phosphorus - Soluble reactive; Phosphorus - Total;	Classical; Discrete analyser (DA);	APHA 4500-P E, J (Classical); Inorg-060 (DA)
		Sugar	Classical	AS 1141.35; in-house Inorg-085
		Carbon dioxide - Free	Calculation	APHA 2310B, 4500 CO ₂ C, in-house Inorg- 005
		Nitrogen - Total Kjeldahl (TKN)	Classical; Discrete analyser (DA);	APHA 4500 N _{org} C (Classical); In-house Inorg-062 (DA)
		Formaldehyde (methanal)	Discrete analyser (DA); UV-vis spectrophotometry;	In-house Inorg-113
		Loss on ignition	Classical	In-house Inorg-092
		Nitrogen - Nitrate; Nitrogen - Nitrite;	Classical; Discrete analyser (DA); Ion chromatography (IC);	APHA 4500 NO ₂ ⁻ B (Classical) APHA 4500 NO ₃ - F (Classical) In-house Inorg-055 (DA) In-house Inorg-081 (DA)
Analysis of polybrominated diphenyl ether residues and contaminants	Potable waters	2,2',3,4,4',5',6-Heptabromodiphenyl ether; 2,2',4,4',5,5'-Hexabromodiphenyl ether; 2,2',4,4',5,6'-Hexabromodiphenyl ether; 2,2',4,4',5-Pentabromodiphenyl ether; 2,2',4,4',6- Pentabromodiphenyl ether; 2,2',4,4'- Tetrabromodiphenyl ether; 2,4,4'- Tribromodiphenyl ether; Decabromodiphenyl ether (polybrominated diphenyl ether);	GC-MS-MS	In-house Org-017 Other polybrominated diphenylethers in accordance with ELN- P09

ISO/IEC 17025 (2005)

Human Testing for Workplace and/or Community Screening

SERVICE PRODUCT DETERMINANT TECHNIQUE PROCEDURE LIMITATION/RANGE
Accreditation Number: 2901 | Site Number: 2213 | Printed on : 31-May-2019



Monitoring for biomarkers	Urine	Creatinine	Discrete analyser (DA)	In-house Inorg-090
Monitoring for heavy metals, organometals and trace elements	Urine	Cadmium; Chromium; Cobalt; Lead; Nickel; Vanadium;	Atomic absorption spectroscopy (AAS); Atomic absorption spectroscopy (AAS) - Graphite furnace; ICP-AES;	In-house Metals-020, 024, 025
		Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Chromium; Cobalt; Copper; Iron; Lead; Lithium; Manganese; Molybdenum; Nickel; Selenium; Silver; Strontium; Tellurium; Thallium; Thorium; Tin; Titanium; Tungsten; Uranium; Vanadium; Zinc;	ICP-MS	In-house Metals-022, -025
		Mercury	Atomic absorption spectroscopy (AAS) - Vapour generation	In-house Metals-021, -025
Monitoring for pesticides	Urine	(R)-2-(2,4-Dichlorophenoxy)propanoic acid (dichlorprop, 2,4-DP); 2,4-Dichlorophenoxyacetic acid (2,4-D); 2-(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP, fenoprop, silvex); 2-Methyl-4-chlorophenoxyacetic acid (MCPA); 3,6-Dichloro-2-methoxybenzoic acid (dicamba); 4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid (picloram); Acid herbicides; Bromoxynil; Clopyralid; Methylchlorophenoxypropionic acid (RS-2-[4-chloro-2-methylphenoxy]propanoic acid, MCPP, mecoprop); Triclopyr;	GC-MS; GC-MS-MS;	in house ORG-040
Monitoring for residues, hydrocarbons and other contaminants of the environment (excluding pesticides)	Urine	Thiocyanate	Discrete analyser (DA)	In-house Inorg-089
		1-Hydroxypyrene; 2,5-Hexanedione; 2-Methylhippuric acid; 2-Methylphenol (2-cresol, o-cresol); 3-Methylhippuric acid; 3-Methylphenol (3-cresol, m-cresol); 4-Methylhippuric acid; 4-Methylphenol (4-cresol, p-cresol); Catechol; Dichloroacetic acid; Hydroquinone; m-Toluic; Mandelic acid; o-Toluic acid; p-Toluic acid; Pentachlorophenol; Phenol; Phenylglyoxylic acid; s-Benzylmercapturic acid (SBMA); s-Phenyl mercapturic acid; Semi-volatile organic compounds (SVOCs) - Metabolites; trans-Muconic acid; Trichloroacetic acid;	GC-MS; GC-MS- MS;	in house ORG-040 Other SVOCs/SVOC metabolite compounds in accordance with ELN-P09

ISO/IEC 17025 (2005) Infrastructure and Asset Integrity

SERVICE	PRODUCT	DETERMINANT	TECHNIQUE	PROCEDURE	LIMITATION/RANGE
Evaluation of geotechnical and civil construction material - Soil classification	Soils	Sieve analysis	Not applicable	AS 1289.3.6.1 and inhouse Inorg-107	
Evaluation of geotechnical and civil construction material - Soil engineering properties	Soils	Fine particle analysis	Hydrometer	AS 12893.6.3 and inhouse Inorg-107	

ISO/IEC 17025 (2005) Materials

SERVICE	PRODUCT	DETERMINANT	TECHNIQUE	PROCEDURE	LIMITATION/RANGE
Analysis of lubricants, oils	Mineral oils	Aroclor 1016; Aroclor 1221; Aroclor 1232; Aroclor 1242; Aroclor 1248; Aroclor 1254; Aroclor 1260;	Gas chromatography (GC)	in-house ORG-10, ORG-011	
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and related products					
Chemical analysis of polymers and related materials	Paints and related coating materials	Lead	ICP-AES	in-house METALS-004, METALS-020	
		Lead	Atomic absorption spectroscopy (AAS)	in-house METALS-004, METALS-024	

Ac	creditation Number: 2901	Site Number: 2213	Printed on : 31-May-2019
		END OF SCOPE	



Australian Laboratory Services Pty Ltd

PERTH ENVIRONMENTAL LABORATORY ALS ENVIRONMENTAL LABORATORY

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Availability: Services available to external clients

Note: Not all of the columns of the scope of accreditation displayed include data.

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ISO/IEC 17025 (2005) Environment

SERVICE	PRODUCT	DETERMINANT	TECHNIQUE	PROCEDURE	LIMITATION/RANGE
Analysis for cyanide	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Soils; Trade wastes;	Cyanide - Free	Segmented flow analyser (SFA)	in-house method QWI- EN/EK025SF	
		Cyanide - Weak acid dissociable (WAD)	Segmented flow analyser (SFA)	in-house method QWI- EN/EK028SF	
		Cyanide - Total	Segmented flow analyser (SFA)	in-house method QWI- EN/EK026SF	
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Soils; Trade wastes;	Cyanide - Amenable to chlorination	Classical; Discrete analyser (DA); UV- vis spectrophotometry;	in-house method EK030	
		Cyanide - Total	Classical; Discrete analyser (DA); UV- vis spectrophotometry;	in-house method EK026	
		Cyanide - Free	Classical; Discrete analyser (DA); UV- vis spectrophotometry;	in-house method EK025	

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		Cyanide - Weak acid dissociable (WAD)	Classical; Discrete analyser (DA); UV- vis spectrophotometry;	in-house method EK028	
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Leachates; Saline waters; Sediments; Soils; Solid wastes; Trade wastes;	Cyanide - Amenable to chlorination	Classical; Discrete analyser (DA); Flow injection analyser (FIA); UV- vis spectrophotometry;	in-house method EK030	
Analysis for elements	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Steam- raising waters; Trade wastes;	Aluminium; Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lead; Magnesium; Manganese; Molybdenum; Nickel; Phosphorus; Potassium; Rubidium; Selenium; Silica; Silicon; Silver; Sodium; Strontium; Sulfur; Tin; Titanium; Vanadium; Zinc;	ICP-AES; ICP-MS;	USEPA 3005 and in-house methods EG005; EG020; ED040; ED093; EN025	
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Sewage; Soils; Steam- raising waters; Trade wastes;	Mercury	Flow injection mercury system (FIMS)	in-house method EG035	
	Fresh waters; Saline waters;	Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Chromium; Cobalt; Copper; Iron; Lead; Lithium; Manganese; Molybdenum; Nickel; Selenium; Silver; Strontium; Tellurium; Thallium; Thorium; Tin; Titanium; Uranium; Vanadium; Zinc;	ICP-MS	In-house EG093 and 094	
			OCTOPOLE REACTION CELL		
	Sediments; Soils;	Aluminium; Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lead; Lithium; Magnesium; Manganese; Molybdenum; Nickel; Potassium; Selenium; Silver; Sodium; Strontium; Sulfur; Thallium; Thorium; Tin; Uranium; Vanadium; Zinc;	ICP-AES; ICP-MS;	USEPA 200.2 and in-house methods EG005; EG020; ED040; ED093; EN069	
	Sediments; Soils; Solid wastes;	Aluminium; Antimony; Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Iron; Lead; Manganese; Nickel; Silver; Vanadium; Zinc; Accreditation Number: 825 Site Number: 158	ICP-AES	in-house method EN071	



		Selenium	ICP-MS	in-house method EN071	
		Mercury	Flow injection mercury system (FIMS)	in-house method EN071	
Analysis for explosives	Biosolids; Soils;	1,3,5-Trinitrobenzene	GC-MS	in-house methods ORG14; ORG16; ORG17; EP074; EP075	
Analysis for nerbicides	Saline waters; Sediments; Soils;	Diallate	GC-MS	in-house methods ORG14; ORG16; ORG17; ORG38; EP074; EP075; QWI- EN02	
		Propyzamide (pronamide, 3,5-dichloro-N-[1,1-dimethylpropynyl]benzamide, KERB)	GC-MS	in-house methods ORG14; ORG16; ORG17; EP074; EP075	
	Saline waters; Sediments; Soils; Solid wastes; Trade wastes;	Atrazine; Simazine;	GC-MS	in-house methods ORG14; ORG17; EP068; EP075; QWI- EN02	
Analysis for nydrocarbons	Saline waters; Sediments; Soils; Trade wastes;	2-Methylcholanthrene; 2-Methylnaphthalene; 7,12-Dimethylbenz(a)anthracene; Acenaphthene; Acenaphthylene (acenaphthalene); Anthracene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b,j)fluoranthene; Benzo(g,h,i)perylene; Benzo(k)fluoranthene; Chrysene; Dibenzo(a,h)anthracene; Fluoranthene (benzo[j,k]fluorene); Fluorene; Indeno(1,2,3-cd)pyrene; n-2-Fluorenylacetamide; Naphthalene; Phenanthrene; Pyrene;	GC-MS	in-house methods ORG14; ORG17; EP075; QWI-EN02	
		2-Hexanone (MBK); 4-Methyl-2-pentanone (methyl isobutyl ketone, MIBK); Acetone; Butanone (methyl ethyl ketone, MEK, 2-butanone); Dibenzofuran; Isosafrole; Safrole; Vinyl acetate;	GC-MS	in-house methods ORG14; ORG16; ORG17; ORG38; EP074; EP075; QWI- EN02	
		Benzo(a)pyrene; Total carcinogenic polycyclic aromatic hydrocarbons (PAHs);	Calculation	NEPM schedule B1	
		1,2,3-Trichlorobenzene; 1,2,4-Trichlorobenzene (1,2,4-TCB); 1,2,4-Trimethylbenzene (1,2,4-TMB, pseudo-cumene); 1,2-Dichlorobenzene (odichlorobenzene); 1,3,5-Trimethylbenzene (1,3,5-TMB, mesitylene); 1,3-Dichlorobenzene (mdichlorobenzene); 1,4-Dichlorobenzene (pdichlorobenzene); 1-Methyl-4-isopropylbenzene (4-isopropyltoluene, p-isopropyltoluene); 2-Chlorotoluene (o-chlorotoluene); 4-Chlorotoluene (p-chlorotoluene); Benzene; Bromobenzene (phenylbromide); Chlorobenzene (benzene chloride, monochlorobenzene); Ethylbenzene; Isopropylbenzene (cumene); m-Xylene; n-Butylbenzene; n-Propylbenzene; o-Xylene; p-Xylene; seo-Butylbenzene; Styrene (ethenylbenzene); Tert-butyl benzene; Toluene;	GC-MS; GC-MS - Purge and trap;	in-house methods ORG16; EP074; EP080; QWI- EN02	



1-Naphthylamine; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Picoline (2-methylpyridine); 4-Aminobiphenyl; 5-Nitro-o-toluidine; Nitrobenzene (mononitrotoluene, MNT, methylnitrobenzene); Pentachloronitrobenzene (quintozene); Pentachloronitrobenzene (quintozene); Phenacetin; 1,2,3,5-Tetrachlorobenzene; Hexachlorobenzene (HCB); Pentachlorobenzene;		1,1,1,2-Tetrachloroethane; 1,1,1-Trichloroethane (1,1,1-TCA, methyl chloroform, chlorothene); 1,1,2,2-Tetrabromoethane (acetylene tetrabromide); 1,1,2,2-Tetrachloroethane (acetylene tetrachloride); 1,1,2-Trichloroethane (1,1,2-TCA, vinyl trichloride); 1,1-Dichloroethane (1,1-DCA); 1,1-Dichloroethene (1,1-DCE, chloride); 1,1-Dichloropropene; 1,2 Dibromoethane (ethylene dibromide, EDB); 1,2,3-Trichloropropane (allyl trichloride); 1,2-Dibromo-3-chloropropane (DBCP); 1,2-Dibromoethene; 1,2-Dichloropropane (DBCP); 1,2-Dibromoethene; 1,2-Dichloropropane (propylene dichloride); 1,3-Dichloropropane (propylene dichloride); 1,3-Dichloropropane; 2,2-Dichloropropane; 4-Bromophenylphenyl ether; 4-Chlorophenylphenyl ether (p-chlorodiphenyl ether); bis-(2-Chloroethoxy) methane; bis-(2-Chloroethyl) ether; Bromodichloromethane (dichlorobromomethane); Bromoform (tribromomethane); Bromomethane (methylbromide); Carbon tetrachloride (tetrachloromethane); Chloroethane; cis-1,2-Dibromoethene; cis-1,3-dichloropropylene); cis-1,4-Dichloro-2-butene; Dibromochloromethane (chlorodibromomethane); Dibromomethane; Dichlorodifluoromethane (freon-12); Dichloromethane (DCM, methylene chloride); Hexachloro-1,3-butadiene (HCCPD); Hexachlorobutadiene, HCBD); Hexachlorobutadiene, HCBD); Hexachloroethane; Hexachloropropene; lodomethane (methyl iodine); Pentachloroethane (ethanepentachloride); Tetrachloroethane; Tetrachloroethene (trans-1,2-DCE, trans-1,2-dichloroethene (trans-1,3-Dichloropropene (trans-1,3-dichloropropylene); trans-1,4-Dichloro-2-butene; Tribromoethene; Trichloroethene (trans-1,3-dichloropropylene); trans-1,4-Dichloro-2-butene; Tribromoethene; Trichloroethene (freon-11, trichloromonofluoromethane); Trichloromethane (chloroform); Vinyl bromide (bromoethene); Vinyl chloride;	GC-MS; GC-MS - Purge and trap;	in-house methods ORG16; EP074; EP093; QWI- EN02	
(HCB); Pentachlorobenzene; (H		Dinitrotoluene; 2-Picoline (2-methylpyridine); 4- Aminobiphenyl; 5-Nitro-o-toluidine; Nitrobenzene (mononitrotoluene, MNT, methylnitrobenzene); Pentachloronitrobenzene (quintozene);	GC-MS	methods ORG14; ORG16; ORG17; EP074;	
waters; Xylene; Toluene; Headspace methods QWI-ORG/EP080HS 2-Methylnaphthalene; 3-Methylcholanthrene; 7,12-Dimethylbenz(a)anthracene; Acenaphthene; Acenaphthylene (acenaphthalene); Anthracene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b,j)fluoranthene; Benzo(b,j)fluoranthene; Benzo(b,j)fluoranthene; Benzo(b,j)fluoranthene; Chrysene; Coronene; Dibenzo(a,h)anthracene;			GC-MS	methods ORG14; ORG17; ORG38; EP075;	
7,12-Dimethylbenz(a)anthracene; Acenaphthene; method Acenaphthylene (acenaphthalene); Anthracene; ORG/EP132-LL Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b,j)fluoranthene; Benzo(e)pyrene; Benzo(g,h,i)perylene; Benzo(k)fluoranthene; Chrysene; Coronene; Dibenzo(a,h)anthracene;	waters; Saline			methods QWI-	
Fluoranthene (benzo[j,k]fluorene); Fluorene; Indeno(1,2,3-cd)pyrene; Naphthalene; Perylene; Phenanthrene; Pyrene;		7,12-Dimethylbenz(a)anthracene; Acenaphthene; Acenaphthylene (acenaphthalene); Anthracene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b,j)fluoranthene; Benzo(e)pyrene; Benzo(g,h,i)perylene; Benzo(k)fluoranthene; Chrysene; Coronene; Dibenzo(a,h)anthracene; Fluoranthene (benzo[j,k]fluorene); Fluorene; Indeno(1,2,3-cd)pyrene; Naphthalene; Perylene;	GC-MS	method	
Naphthalene GC-MS - in-house Headspace method QWI- Accreditation Number: 825 Site Number: 15847 Printed on : 31-May-2019			Headspace	method QWI-	



		1		ORG/EP080HS	
	Sediments	2-Methylnaphthalene; 3-Methylcholanthrene; 7,12-Dimethylbenz(a)anthracene; Acenaphthene; Acenaphthylene (acenaphthalene); Anthracene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b,j)fluoranthene; Benzo(e)pyrene; Benzo(g,h,i)perylene; Benzo(k)fluoranthene; Chrysene; Coronene; Dibenzo(a,h)anthracene; Fluoranthene (benzo[j,k]fluorene); Fluorene; Indeno(1,2,3-cd)pyrene; Naphthalene; Perylene; Phenanthrene; Pyrene;	GC-MS	in-house method ORG/EP132-SD	
Analysis for ndustrial chemicals	Saline waters; Sediments; Soils; Trade wastes;	3,3'-Dichlorobenzidine; 3-Nitroaniline; 4-Chloroaniline; 4-Nitroaniline; 4-Nitroquinoline-1-oxide (4-nitroquinoline-n-oxide); Acetophenone; Aniline; Carbazole; Chlorobenzilate; Isophorone (isoforone, isoacetophorone); Methyl tert-butyl ether (MTBE); p-Dimethylaminoazobenzene (4-dimethylaminoazobenzene, DAB, dimethylaminoazobenzene);	GC-MS	in-house methods ORG14; ORG16; ORG17; EP074; EP075	
		Ethylmethanesulfonate; Methyl methane sulfonate;	GC-MS	in-house methods ORG14; ORG16; ORG17; ORG38; EP074; EP075; QWI- EN02	
		Methapyrilene; N-Nitroso-n-butylamine; N-Nitrosodi-n-propylamine; N-Nitrosodiethylamine (N-ethyl-N-nitroso-ethanamine); N-Nitrosodimethylamine; N-Nitrosodiphenylamine (NDPhenylA); N-Nitrosomethylethylamine; N-Nitrosomorpholine; N-Nitrosopiperidine; N-Nitrosopyrrolidine; n-Phenylaniline (diphenylamine);	GC-MS	in-house methods ORG14; ORG17; ORG38; EP075	
		Carbon disulfide	GC-MS	in-house methods ORG14; ORG16; ORG17; EP074; EP075	
Analysis for nutrients	Saline waters; Surface waters; Trade wastes;	Nitrogen - Nitrate	Calculation	in-house EK258A	
		Nitrogen - Ammonia	Classical; Flow injection analyser (FIA);	in-house EK255A	
		Phosphorus - Total	Classical; Flow injection analyser (FIA);	in-house EK267A	
		Nitrogen - Nitrite	Classical; Flow injection analyser (FIA);	in-house EK257A	
		Phosphorus - Ortho	Classical; Flow injection analyser (FIA);	in-house EK271A	
		Nitrogen - Inorganic	Calculation	in-house EK263A	
		Nitrogen - Oxidised (NOx)	Classical; Flow injection analyser (FIA);	in-house EK259A	
		Nitrogen - Total	Classical; Flow injection analyser	in-house EK262A	



		(FIA);		
	Nitrogen - Total Kjeldahl (TKN)	Calculation	in-house EK261A	
	Nitrogen - Organic	Calculation	in-house EK260A	
Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Steam- raising waters; Trade wastes;	Nitrogen - Nitrate	Discrete analyser (DA)	in-house method EK058G	
	Nitrogen - Total oxidised	Discrete analyser (DA)	in-house method EK059G	
Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sediments; Sewage; Soils; Steam- raising waters; Trade wastes;	Nitrogen - Total	Calculation	in-house methods EK062; EK062G	
	Nitrogen - Organic	Calculation	in-house methods EK060; EK060G	
	Phosphorus - Total	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK067; EK067G	
	Phosphorus - Reactive	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK071; EK071G	
	Nitrogen - Inorganic	Calculation	in-house methods EK063; EK063G	
	Phosphorus - Organic	Calculation	in-house methods EK066; EK066G	
	Nitrogen - Ammonia	Classical; Discrete analyser (DA);	in-house methods EK055(B); EK055G	
I A	Nitrogen - Persulfate; Phosphorus - Total; Accreditation Number: 825 Site Number: 158	47 Printed on : 31	in-house -May-2019	



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				methods EK062; EK067PG	
		Nitrogen - Nitrite	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK057; EK057G	
		Nitrogen - Total Kjeldahl (TKN)	Classical; Discrete analyser (DA);	in-house methods EK061; EK061B; EK061G	
		Phosphorus - Acid hydrolysable	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK069; EK069G	
		Nitrogen - Total	Classical; Discrete analyser (DA);	in-house methods EK062P; EK062PG	
		Nitrogen - Nitrate	Calculation	in-house methods EK058; EK058G	
		Nitrogen - Total oxidised	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK059; EK059G	
Analysis for organochlorine pesticides	Saline waters; Sediments; Soils; Solid wastes; Trade wastes;	α-Hexachlorocyclohexane (α-HCH); β-Hexachlorocyclohexane (β-HCH); δ-Hexachlorocyclohexane (δ-HCH); γ-Hexachlorobenzene (γ-benzene hexachloride, γ-BHC, γ-HCB, lindane); γ-Hexachlorocyclohexane (γ-HCH); Aldrin; cis-Chlordane (α-chlordane); Dichlorodiphenyldichloroethane (DDD); Dichlorodiphenyldichloroethylene (DDE); Dichlorodiphenyltrichloroethane (DDT); Dieldrin; Endosulfan 1 (α-endosulfan); Endosulfan II (β-endosulfan); Endosulfan sulfate; Endrin; Endrin aldehyde; Endrin ketone; Heptachlor; Heptachlor epoxide; Hexachlorobenzene (HCB); Methoxychlor; trans-Chlordane (γ-chlordane);	GC-MS	in-house methods ORG14; ORG17; EP068; EP075; QWI- EN02	
Analysis for organophosphate pesticides	Saline waters; Sediments; Soils; Solid wastes; Trade wastes;	Azinphos-methyl (guthion); Bromophosethyl; Carbophenothion (trithion); Chlorpyrifos ethyl (chlorpyrifos); Chlorpyrifos methyl; cis-Chlorfenvinphos (chlorfenvinphos Z); Demeton-S-methyl; Diazinon; Dichlorvos; Diethyl-2-([dimethoxyphosphorothioyl]sulfanyl)butanedioate (maldison, malathion, carbofos, mercaptothion); Dimethoate; Ethion; Fenamiphos; Fenthion; Monocrotophos; O,O-Diethyl O-(4-nitrophenyl) phosphorothioate (parathion, diethyl parathion, parathion-ethyl, folidol); Parathionmethyl; Pirimiphos ethyl; Prothiofos; trans-Chlorfenvinphos (chlorfenvinphos E);	GC-MS	in-house methods ORG14; ORG17; EP068; EP075; QWI- EN02	
Analysis for petroleum hydrocarbons	Saline waters; Sediments; Soils; Trade wastes;	Aliphatic hydrocarbons - Variable fractions: C_6 - C_{44} ; Aromatic hydrocarbons - Variable fractions: C_6 - C_{44} ;	GC-FID - Purge and trap; GC-MS - Purge and trap;	in-house methods QWI- ORG14; ORG16; ORG17; ORG21; EP070; EP071; EP080	
		Total recoverable hydrocarbons (TRH) - Variable fractions: C ₆ -C ₄₀ Accreditation Number: 825 Site Number: 158	GC-FID - Purge and trap; GC-MS - Purge and trap;	in-house methods QWI- ORG14; ORG16; ORG17; EP071; EP080	



		Aliphatic hydrocarbons - Variable fractions: C_5 - C_{10} ; Aromatic hydrocarbons - Variable fractions: C_5 - C_{10} ;		in-house method QWI- ORG/EP079	
		Total petroleum hydrocarbons (TPH): C ₆ -C ₄₀	GC-FID; GC-FID - Purge and trap; GC-MS; GC-MS - Purge and trap;	in-house methods QWI- ORG14; ORG16; ORG17; ORG21; EP071; EP080	
	Ground waters	Total petroleum hydrocarbons (TPH): C_6 - C_9 ; Total recoverable hydrocarbons (TRH): C_6 - C_9 ; Total recoverable hydrocarbons (TRH): C_6 - C_{10} ;	GC-MS - Headspace	in-house methods QWI- ORG/EP080HS	
Analysis for phenols	Saline waters; Sediments; Soils; Trade wastes;	2,4,5-Trichlorophenol; 2,4,6-Trichlorophenol; 2,4-Dichlorophenol; 2,4-Dimethylphenol; 2,6-Dichlorophenol; 2-Chlorophenol (o-chlorophenol); 2-Methylphenol (2-cresol, o-cresol); 2-Nitrophenol; 3-Methylphenol (3-cresol, m-cresol); 4-Chloro-3-methylphenol; 4-Methylphenol (4-cresol, p-cresol); Pentachlorophenol; Phenol;	GC-MS	in-house methods ORG14; ORG17; EP075; QWI-EN02	
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters; Sewage; Steamraising waters; Trade wastes;	PhenoIs	Discrete analyser (DA)	in-house methods EP035; EP035G	
	Sediments; Soils; Solid wastes;	PhenoIs	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EP035; EP035G	
Analysis for phthalates	Saline waters; Sediments; Soils; Trade wastes;	bis-(2-Ethylhexyl) adipate; bis-(2-Ethylhexyl) phthalate (diisooctyl phthalate, dioctyl phthalate, di-n-octyl phthalate); Butylbenzylphthalate; Dibutylphthalate (di-n-butyl phthalate, DBP); Diethylphthalate;	GC-MS	in-house methods ORG14; ORG17; EP075; QWI-EN02	
Analysis for physical and chemical characteristics	Saline waters; Surface waters; Trade wastes;	Silica	Flow injection analyser (FIA)		
	Ground waters; Saline waters; Surface waters;	Chlorophyll a; Chlorophyll b; Chlorophyll c; Phaeophytin;	Calculation; UV-vis spectrophotometry;	APHA 10200 H and in-house method EP008	
	Ground waters; Industrial waters - Treated; Irrigation and stock waters; Saline waters;	Solids - Suspended; Solids - Total;	Classical	in-house method EA025	



Sewage; Steam- raising waters; Trade wastes;				
	Sulfate - Dissolved; Sulfate - Total;	Calculation; ICP- AES;	in-house method ED040	
	Hardness - Non-carbonate	Calculation	in-house method EA068	
	Solids - Fixed; Solids - Suspended;	Classical	in-house method EA036	
	Carbon dioxide	Calculation	in-house methods EA162; EA165	
	Solids - Total; Solids - Volatile;	Classical	in-house method EA035	
	Alkalinity	Classical	in-house methods ED025; ED030; ED035; ED037	
	Biochemical oxygen demand (BOD)	Classical	in-house method ED030	
	Colour - Apparent	Classical	in-house method EA040	
	Acidity	Classical	in-house method ED038	
	Sulfide	UV-vis spectrophotometry	in-house method EK085	
	Hardness - Calcium	Calculation	in-house method EA066	
	Chloride	Classical; Discrete analyser (DA);	in-house methods ED045; ED045G	
	Carbon - Total organic (TOC)	Nondispersive infrared (NDIR)	in-house method EP005	
	Iron - Ferric	Calculation	in-house methods EG053; EG053G	
	Solids - Dissolved; Solids - Fixed;	Classical	in-house method EA015A	
	Langelier saturation index	Classical	in-house method EA071	
	Chromium - Hexavalent	UV-vis spectrophotometry	in-house method EG050	
	Chromium - Hexavalent	Discrete analyser (DA)	in-house method EG050G	
	Dissolved organic carbon (DOC)	Nondispersive infrared (NDIR)	in-house method EP002	
	Resistivity	Calculation	in-house methods EA080; EA084	
	Carbon - Total inorganic (TIC)	Nondispersive infrared (NDIR)	in-house method EP006	
	Bicarbonate	Classical	in-house methods	



*			ED035; ED037
	Silica reactive	Discrete analyser (DA)	in-house method EG052G
	Solids - Volatile suspended	Classical	in-house method EA036
	Solids - Total dissolved (TDS)	Classical	in-house method EA015
	Chromium - Trivalent	Calculation	in-house methods EG049; EG049G
	Solids - Volatile dissolved	Classical	in-house method EA015B
	Solids - Fixed; Solids - Total;	Classical	in-house method EA035
	Salinity	Classical	in-house method EA020
	Hydroxide	Classical	in-house methods ED025; ED038
	Hardness - Total	Calculation	in-house method EA065
	Alkalinity - Residual	Calculation	in-house method EA161
	Colour - True	Classical	in-house method EA041
	Hardness - Carbonate	Calculation	in-house method EA067
	Cyanate	Classical; Discrete analyser (DA);	in-house methods EK020; EK020G
	pH - Saturation value	Calculation; Classical;	in-house methods EA005; EA070
	Solids - Total	Classical	in-house method EA030
	Iron - Ferrous	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EG051; EG051G
	Carbonate	Classical	in-house methods ED030; ED037
	Hardness - Magnesium	Calculation	in-house method EA067
	Carbon - Total	Nondispersive infrared (NDIR)	in-house method EP007
	Dissolved oxygen (DO)	Classical	in-house method EP025
	Solids - Non-settleable; Solids - Settleable;	Calculation	in-house method EA034
	Chlorine - Free	UV-vis spectrophotometry	in-house method EK010
	Sulfate Accreditation Number: 825 Site Number: 158	Discrete analyser (DA)	in-house methods ED041; ED041G



	Solids - Total dissolved (TDS)	Calculation	in-house method EA016	
	Turbidity	Classical	in-house method EA045	
	Conductivity	Classical	in-house method EA010	
Air - Ambient	Ash; Combustible matter; Deposited matter; Solids - Insoluble; Solids - Total; Solids - Total dissolved (TDS);	Gravimetric	AS 3580.10.1 and in-house methods EA120 to EA 142	
Leachates	Sulfate - Calcium phosphate extractable	Classical	In-house ED040N	
Sediments; Soils;	Sample preparation - Non-volatile components; Sample preparation - Semi-volatile components;	Toxicity characteristic leaching procedure (TCLP)	USEPA 1311 and in-house EN033	
	Sample preparation - Non-volatile components; Sample preparation - Semi-volatile components;	Leachate procedures	AS 4439.3 and in-house method EN2060	
		Bottle		
	Sample preparation	Leachate procedures	ASTM D3987 and in-house EN036	
		Shake extraction of solid waste with water		
	Sample preparation - Non-volatile components; Sample preparation - Semi-volatile components;	Leachate procedures	1:5 soil water leach and in- house EN034	
		Water		
Sediments; Soils; Solid wastes;	Chromium - Hexavalent	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EG048; EG048G	
	pH - Saturation value	Classical	in-house methods EA002 and EA070	
	Acidity	Classical	in-house methods EA009; EA011; EA019; EA021	
	Fluoride	Classical	in-house method EK040	
	Conductivity	Classical	in-house method EA010	
	Chloride	Classical; Discrete analyser (DA);	in-house methods ED045; ED045G	
	Loss on ignition	Classical	in-house method EA101	
	Organic matter	Classical	in-house method EP004	
	Iron - Ferrous	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EG051; EG051G	
	Exchangeable cations	ICP-AES	in-house methods ED007; ED008	
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		Acid neutralising capacity (ANC)	Classical	in-house method EA013
		Moisture	Classical	in-house method EA055
		Cyanate	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK020; EK020G
		Suspension peroxide oxidation combined acidty and sulfur (SPOCAS)		in-house methods EA002 to EA004; EA009; EA011; EA013; EA021; EA023SHCL; EA023TOS- ASS; EA026; EA029; EA033; EA033A; EA037
		Iron - Ferric	Calculation	in-house methods EG053; EG053G
		Salts - Total soluble	Classical	in-house method EA014
		Sulfate; Sulfate - Water soluble;	Calculation; ICP- AES;	in-house method ED040
		Acidity - Titratable peroxide (TPA)	Classical	in-house method EA012
		Sulfur - Chromium reducible	Classical	in-house method EA026
		Acidity - Titratable actual (TAA)	Classical	in-house method EA018
		Sulfur - Total oxidised	ICP-AES	in-house method ED043
		Chromium - Trivalent	Calculation	in-house methods EG049; EG049G
Analysis for polyhalogenated biphenyls	Saline waters; Sediments; Sewage; Soils; Solid wastes; Trade wastes;	Polychlorinated biphenyls (PCBs) - Total	GC-MS	in-house methods ORG14; ORG17; EP066
Analysis for pyrethroid and pyrethrum pesticides	Saline waters; Sediments; Soils; Solid wastes; Trade wastes;	Cypermethrin	GC-MS	in-house methods ORG14; ORG17; EP068; EP075; QWI- EN02

ISO/IEC 17025 (2005) Food and Beverage

SERVICE	PRODUCT	DETERMINANT	TECHNIQUE	PROCEDURE	LIMITATION/RANGE
Analysis for elements	Waters for potable and domestic purposes	Aluminium; Antimony; Arsenic; Barium; Beryllium; Bismuth; Boron; Cadmium; Chromium; Cobalt; Copper; Iron; Lead; Lithium; Magnesium; Molybdenum; Nickel; Selenium; Silver; Strontium; Tellurium; Thallium; Thorium; Tin; Titanium; Uranium; Vanadium; Zinc;	ICP-MS	In-house EG093 and 094	



			OCTOPOLE REACTION CELL		
		Mercury	Flow injection mercury system (FIMS)	in-house method EG035	
		Aluminium; Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Calcium; Chromium; Cobalt; Copper; Iron; Lead; Magnesium; Manganese; Molybdenum; Nickel; Phosphorus; Potassium; Rubidium; Selenium; Silica; Silicon; Silver; Sodium; Strontium; Sulfur; Tin; Titanium; Vanadium; Zinc;	ICP-AES; ICP-MS;	USEPA 3005 and in-house methods EG005; EG020; ED040; ED093; EN025	
Analysis for nerbicides	Potable waters	Propyzamide (pronamide, 3,5-dichloro-N-[1,1-dimethylpropynyl]benzamide, KERB)	GC-MS	in-house methods ORG14; ORG16; ORG17; EP074; EP075	
		Diallate	GC-MS	in-house methods ORG14; ORG16; ORG17; ORG38; EP074; EP075; QWI- EN02	
		Atrazine; Simazine;	GC-MS	in-house methods ORG14; ORG17; EP068; EP075; QWI- EN02	
Analysis for ohenols	Waters for potable and domestic purposes	2,4,5-Trichlorophenol; 2,4,6-Trichlorophenol; 2,4-Dichlorophenol; 2,4-Dimethylphenol; 2,6-Dichlorophenol; 2-Chlorophenol (o-chlorophenol); 2-Methylphenol (2-cresol, o-cresol); 2-Nitrophenol; 3-Methylphenol (3-cresol, m-cresol); 4-Chloro-3-methylphenol; 4-Methylphenol (4-cresol, p-cresol); Pentachlorophenol; Phenol;	GC-MS	in-house methods ORG14; ORG17; EP075; QWI-EN02	
		PhenoIs	Discrete analyser (DA)	in-house methods EP035; EP035G	
Analysis for polyhalogenated piphenyls	Waters for potable and domestic purposes	Polychlorinated biphenyls (PCBs) - Total	GC-MS	in-house methods ORG14; ORG17; EP066	
Analysis for byrethroid and byrethrum besticides	Potable waters	Cypermethrin	GC-MS	in-house methods ORG14; ORG17; EP068; EP075; QWI- EN02	
Analysis for residues and contaminants hydrocarbons, obthalates, ndustrial chemicals)	Waters for potable and domestic purposes	Cyanide - Amenable to chlorination	Classical; Discrete analyser (DA); UV- vis spectrophotometry;	in-house method EK030	
		Cyanide - Total	Segmented flow analyser (SFA)	in-house method QWI- EN/EK026SF	
		Total petroleum hydrocarbons (TPH): C ₆ -C ₉ ; Total recoverable hydrocarbons (TRH): C ₆ -C ₉ ; Total recoverable hydrocarbons (TRH): C ₆ -C ₁₀ ;	GC-MS - Headspace	in-house methods QWI- ORG/EP080HS	



Aliphatic hydrocarbons - Variable fractions: C_6 - C_{44} ; Aromatic hydrocarbons - Variable fractions: C_6 - C_{44} ;	GC-FID - Purge and trap; GC-MS - Purge and trap;	in-house methods QWI- ORG14; ORG16; ORG17; ORG21; EP070; EP071; EP080	
1,2,3,5-Tetrachlorobenzene; Hexachlorobenzene (HCB); Pentachlorobenzene;	GC-MS	in-house methods ORG14; ORG17; ORG38; EP075; QWI-EN02	
2-Hexanone (MBK); 4-Methyl-2-pentanone (methyl isobutyl ketone, MIBK); Acetone; Butanone (methyl ethyl ketone, MEK, 2-butanone); Dibenzofuran; Isosafrole; Safrole; Vinyl acetate;	GC-MS	in-house methods ORG14; ORG16; ORG17; ORG38; EP074; EP075; QWI- EN02	
3,3'-Dichlorobenzidine; 3-Nitroaniline; 4-Chloroaniline; 4-Nitroaniline; 4-Nitroquinoline-1-oxide (4-nitroquinoline-n-oxide); Acetophenone; Aniline; Carbazole; Chlorobenzilate; Isophorone (isoforone, isoacetophorone); Methyl tert-butyl ether (MTBE); p-Dimethylaminoazobenzene (4-dimethylaminoazobenzene, DAB, dimethylaminoazobenzene);	GC-MS	in-house methods ORG14; ORG16; ORG17; EP074; EP075	
Cyanide - Weak acid dissociable (WAD)	Segmented flow analyser (SFA)	in-house method QWI- EN/EK028SF	
1,1,1,2-Tetrachloroethane; 1,1,1-Trichloroethane (1,1,1-TCA, methyl chloroform, chlorothene); 1,1,2,2-Tetrabromoethane (acetylene tetrabromide); 1,1,2,2-Tetrachloroethane (acetylene tetrachloride); 1,1,2-Trichloroethane (1,1,2-TCA, vinyl trichloride); 1,1-Dichloroethane (1,1-DCA); 1,1-Dichloropropene; 1,2 Dibromoethane (ethylene dibromide, EDB); 1,2,3-Trichloropropane (allyl trichloride); 1,2-Dibromo-3-chloropropane (DBCP); 1,2-Dibromoethene; 1,2-Dichloroethane (1,2-DCA, ethylene dichloride); 1,2-Dichloropropane (propylene dichloride); 1,3-Dichloropropane (propylene dichloride); 1,3-Dichloropropane; 2,2-Dichloropropane; 4-Bromophenylphenyl ether; 4-Chlorophenylphenyl ether (p-chlorodiphenyl ether); bis-(2-Chloroethoxy) methane; bis-(2-Chloroethyl) ether; Bromodichloromethane (dichlorobromomethane); Bromoform (tribromomethane); Bromomethane (methylbromide); Carbon tetrachloride (tetrachloromethane); Chloroethane; cis-1,2-Dibromoethene; cis-1,3-dichloropropylene); cis-1,4-Dichloro-2-butene; Dibromochloromethane (chlorodibromomethane); Dibromomethane (pod, methylene chloride); Hexachloro-1,3-butadiene (hexachlorobutadiene, HCBD); Hexachlorobutadiene, HCBD); Hexachlorocyclopentadiene (HCCPD); Hexachloroethane; Hexachloropropene; lodomethane (methyl iodine); Pentachloroethane (ethanepentachloride); Tetrachloroethane; Tetrachloroethene (perchlororethylene, perchloroethene (trans-1,2-DCE, trans-1,2-Dichloropropene (trans-1,3-dichloropropylene); trans-1,4-Dichloro-2-butene; Tribromoethene; Trichloroethene (trans-1,4-Dichloro-2-butene; Tribromoethene; Trichloroethene	GC-MS; GC-MS - Purge and trap;	in-house methods ORG16; EP074; EP093; QWI- EN02	



(trichloroethylene, TCE); Trichlorofluoromethane (freon-11, trichloromonofluoromethane); Trichloromethane (chloroform); Vinyl bromide (bromoethene); Vinyl chloride;			
Total recoverable hydrocarbons (TRH) - Variable fractions: $C_6\text{-}C_{40}$	GC-FID - Purge and trap; GC-MS - Purge and trap;	in-house methods QWI- ORG14; ORG16; ORG17; EP071; EP080	
Ethylmethanesulfonate; Methyl methane sulfonate;	GC-MS	in-house methods ORG14; ORG16; ORG17; ORG38; EP074; EP075; QWI- EN02	
Benzene; Ethylbenzene; m-Xylene; o-Xylene; p-Xylene; Toluene;	GC-MS - Headspace	in-house methods QWI- ORG/EP080HS	
Carbon disulfide	GC-MS	in-house methods ORG14; ORG16; ORG17; EP074; EP075	
bis-(2-Ethylhexyl) adipate; bis-(2-Ethylhexyl) phthalate (diisooctyl phthalate, dioctyl phthalate, di-n-octyl phthalate); Butylbenzylphthalate; Dibutylphthalate (di-n-butyl phthalate, DBP); Diethylphthalate;	GC-MS	in-house methods ORG14; ORG17; ORG38; EP075; QWI-EN02	
Cyanide - Free	Classical; Discrete analyser (DA); UV- vis spectrophotometry;	in-house method EK025	
Cyanide - Amenable to chlorination	Classical; Discrete analyser (DA); Flow injection analyser (FIA); UV- vis spectrophotometry;	in-house method EK030	
Cyanide - Total	Classical; Discrete analyser (DA); UV- vis spectrophotometry;	in-house method EK026	
Cyanide - Weak acid dissociable (WAD)	Classical; Discrete analyser (DA); UV- vis spectrophotometry;	in-house method EK028	
1-Naphthylamine; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Picoline (2-methylpyridine); 4-Aminobiphenyl; 5-Nitro-o-toluidine; Nitrobenzene (mononitrotoluene, MNT, methylnitrobenzene); Pentachloronitrobenzene (quintozene); Phenacetin;	GC-MS	in-house methods ORG14; ORG16; ORG17; EP074; EP075	
Benzo(a)pyrene; Total carcinogenic polycyclic aromatic hydrocarbons (PAHs);	Calculation	NEPM schedu l e B1	
2-Methylnaphthalene; 3-Methylcholanthrene; 7,12-Dimethylbenz(a)anthracene; Acenaphthene; Acenaphthylene (acenaphthalene); Anthracene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b,j)fluoranthene; Benzo(e)pyrene; Benzo(g,h,i)perylene; Benzo(k)fluoranthene; Chrysene; Coronene; Dibenzo(a,h)anthracene; Fluoranthene (benzo[j,k]fluorene); Fluorene;	GC-MS	in-house method ORG/EP132-LL	



		Indeno(1,2,3-cd)pyrene; Naphthalene; Perylene; Phenanthrene; Pyrene;			
		Cyanide - Free	Segmented flow analyser (SFA)	in-house method QWI- EN/EK025SF	
		Aliphatic hydrocarbons - Variable fractions: C_5 - C_{10} ; Aromatic hydrocarbons - Variable fractions: C_5 - C_{10} ;		in-house method QWI- ORG/EP079	
		Total petroleum hydrocarbons (TPH): C ₆ -C ₄₀	GC-FID; GC-FID - Purge and trap; GC-MS; GC-MS - Purge and trap;	in-house methods QWI- ORG14; ORG16; ORG17; ORG21; EP071; EP080	
		Methapyrilene; N-Nitroso-n-butylamine; N-Nitrosodi-n-propylamine; N-Nitrosodiethylamine (N-ethyl-N-nitroso-ethanamine); N-Nitrosodimethylamine; N-Nitrosodiphenylamine (NDPhenylA); N-Nitrosomethylethylamine; N-Nitrosomorpholine; N-Nitrosopiperidine; N-Nitrosopyrrolidine; n-Phenylaniline (diphenylamine);	GC-MS	in-house methods ORG14; ORG17; ORG38; EP075	
		Naphthalene	GC-MS - Headspace	in-house method QWI- ORG/EP080HS	
		2-Methylcholanthrene; 2-Methylnaphthalene; 7,12-Dimethylbenz(a)anthracene; Acenaphthene; Acenaphthylene (acenaphthalene); Anthracene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b,j)fluoranthene; Benzo(g,h,i)perylene; Benzo(k)fluoranthene; Chrysene; Dibenzo(a,h)anthracene; Fluoranthene (benzo[j,k]fluorene); Fluorene; Indeno(1,2,3-cd)pyrene; n-2-Fluorenylacetamide; Naphthalene; Phenanthrene; Pyrene;	GC-MS	in-house methods ORG14; ORG17; EP075; QWI-EN02	
		1,2,3-Trichlorobenzene; 1,2,4-Trichlorobenzene (1,2,4-TCB); 1,2,4-Trimethylbenzene (1,2,4-TMB, pseudo-cumene); 1,2-Dichlorobenzene (odichlorobenzene); 1,3,5-Trimethylbenzene (1,3,5-TMB, mesitylene); 1,3-Dichlorobenzene (mdichlorobenzene); 1,4-Dichlorobenzene (pdichlorobenzene); 1-Methyl-4-isopropylbenzene (4-isopropyltoluene, p-isopropyltoluene); 2-Chlorotoluene (o-chlorotoluene); 4-Chlorotoluene (p-chlorotoluene); Benzene; Bromobenzene (phenylbromide); Chlorobenzene (benzene chloride, monochlorobenzene); Ethylbenzene; Isopropylbenzene (cumene); m-Xylene; n-Butylbenzene; n-Propylbenzene; o-Xylene; p-Xylene; sec-Butylbenzene; Styrene (ethenylbenzene); Tert-butyl benzene; Toluene;	GC-MS; GC-MS - Purge and trap;	in-house methods ORG16; EP074; EP080; QWI- EN02	
Analysis of pesticide residues and contaminants	Potable waters	Azinphos-methyl (guthion); Bromophosethyl; Carbophenothion (trithion); Chlorpyrifos ethyl (chlorpyrifos); Chlorpyrifos methyl; cis-Chlorfenvinphos (chlorfenvinphos Z); Demeton-S-methyl; Diazinon; Dichlorvos; Diethyl-2-([dimethoxyphosphorothioyl]sulfanyl)butanedioate (maldison, malathion, carbofos, mercaptothion); Dimethoate; Ethion; Fenamiphos; Fenthion; Monocrotophos; O,O-Diethyl O-(4-nitrophenyl) phosphorothioate (parathion, diethyl parathion, parathion-ethyl, folidol); Parathionmethyl; Pirimiphos ethyl; Prothiofos; trans-Chlorfenvinphos (chlorfenvinphos E);	GC-MS	in-house methods ORG14; ORG17; EP068; EP075; QWI- EN02	
	14	α-Hexachlorocyclohexane (α-HCH); β- Hexachlorocyclohexane (β-HCH); δ- Hexachlorocyclohexane (δ-HCH); γ- Hexachlorobenzene (γ-benzene hexachloride, γ- Accreditation Number: 825 Site Number: 158	GC-MS 47 Printed on : 31	in-house methods ORG14; ORG17; EP068; I-May-2019	



		BHC, γ-HCB, lindane); γ-Hexachlorocyclohexane (γ-HCH); Aldrin; cis-Chlordane (α-chlordane); Dichlorodiphenyldichloroethane (DDD); Dichlorodiphenyldichloroethylene (DDE); Dichlorodiphenyltrichloroethane (DDT); Dieldrin; Endosulfan 1 (α-endosulfan); Endosulfan II (β-endosulfan); Endosulfan sulfate; Endrin; Endrin aldehyde; Endrin ketone; Heptachlor; Heptachlor epoxide; Hexachlorobenzene (HCB); Methoxychlor; trans-Chlordane (γ-chlordane);		EP075; QWI- EN02	
Analysis of ohysical and nutritional characteristics	Waters for potable and domestic purposes	Hydroxide	Classical	in-house methods ED025; ED038	
		Phosphorus - Acid hydrolysable	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK069; EK069G	
		Nitrogen - Persulfate; Phosphorus - Total;		in-house methods EK062; EK067PG	
		Solids - Total dissolved (TDS)	Classical	in-house method EA015	
		Iron - Ferric	Calculation	in-house methods EG053; EG053G	
		Dissolved oxygen (DO)	Classical	in-house method EP025	
		Nitrogen - Nitrate	Discrete analyser (DA)	in-house method EK058G	
		Nitrogen - Nitrite	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK057; EK057G	
		Bicarbonate	Classical	in-house methods ED035; ED037	
		Alkalinity	Classical	in-house methods ED025; ED030; ED035; ED037	
		Langelier saturation index	Classical	in-house method EA071	
		Conductivity	Classical	in-house method EA010	
		Carbon - Total organic (TOC)	Nondispersive infrared (NDIR)	in-house method EP005	
		Sulfate - Dissolved; Sulfate - Total;	Calculation; ICP- AES;	in-house method ED040	
		Silica reactive	Discrete analyser (DA)	in-house method EG052G	
		Nitrogen - Total	Classical; Flow injection analyser (FIA);	in-house EK262A	
		Colour - Apparent	Classical	in-house method EA040	
		Chloride	Classical; Discrete analyser (DA);	in-house methods	



		ED045; ED045G	
Carbonate	Classical	in-house methods ED030; ED037	
Nitrogen - Inorganic	Calculation	in-house methods EK063; EK063G	
Carbon - Total	Nondispersive infrared (NDIR)	in-house method EP007	
Chlorophyll a; Chlorophyll b; Chlorophyll c; Phaeophytin;	Calculation; UV-vis spectrophotometry;	APHA 10200 H and in-house method EP008	
Solids - Non-settleable; Solids - Settleable;	Calculation	in-house method EA034	
Resistivity	Calculation	in-house methods EA080; EA084	
Nitrogen - Total	Classical; Discrete analyser (DA);	in-house methods EK062P; EK062PG	
Nitrogen - Total	Calculation	in-house methods EK062; EK062G	
Sulfate	Discrete analyser (DA)	in-house methods ED041; ED041G	
Turbidity	Classical	in-house method EA045	
Solids - Suspended; Solids - Total;	Classical	in-house method EA025	
Nitrogen - Nitrate	Calculation	in-house methods EK058; EK058G	
Silica	Flow injection analyser (FIA)		
Chlorine - Free	UV-vis spectrophotometry	in-house method EK010	
Nitrogen - Organic	Calculation	in-house methods EK060; EK060G	
Phosphorus - Ortho	Classical; Flow injection analyser (FIA);	in-house EK271A	
Colour - True	Classical	in-house method EA041	
Carbon dioxide	Calculation	in-house methods EA162; EA165	
pH - Saturation value	Calculation; Classical;	in-house methods EA005; EA070	
Nitrogen - Total Kjeldahl (TKN)	Classical; Discrete analyser (DA);	in-house methods EK061;	



		EK061B; EK061G	
Nitrogen - Total oxidised	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK059; EK059G	
Salinity	Classical	in-house method EA020	
Nitrogen - Oxidised (NOx)	Classical; Flow injection analyser (FIA);	in-house EK259A	
Carbon - Total inorganic (TIC)	Nondispersive infrared (NDIR)	in-house method EP006	
Solids - Total	Classical	in-house method EA030	
Phosphorus - Total	Classical; Flow injection analyser (FIA);	in-house EK267A	
Cyanate	Classical; Discrete analyser (DA);	in-house methods EK020; EK020G	
Dissolved organic carbon (DOC)	Nondispersive infrared (NDIR)	in-house method EP002	
Acidity	Classical	in-house method ED038	
Chromium - Trivalent	Calculation	in-house methods EG049; EG049G	
Iron - Ferrous	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EG051; EG051G	
Chromium - Hexavalent	Discrete analyser (DA)	in-house method EG050G	
Solids - Fixed; Solids - Total;	Classical	in-house method EA035	
Phosphorus - Reactive	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK071; EK071G	
Nitrogen - Ammonia	Classical; Discrete analyser (DA);	in-house methods EK055(B); EK055G	
Hardness - Carbonate	Calculation	in-house method EA067	
Hardness - Magnesium	Calculation	in-house method EA067	
Phosphorus - Organic	Calculation	in-house methods EK066; EK066G	
Solids - Total dissolved (TDS)	Calculation	in-house method EA016	
Hardness - Total	Calculation	in-house method EA065	
Nitrogen - Total Kjeldahl (TKN)	Calculation	in-house	



		EK261A	
Biochemical oxygen demand (BOD)	Classical	in-house method ED030	
Phosphorus - Total	Discrete analyser (DA); UV-vis spectrophotometry;	in-house methods EK067; EK067G	
Solids - Volatile dissolved	Classical	in-house method EA015B	
Hardness - Calcium	Calculation	in-house method EA066	
Nitrogen - Nitrite	Classical; Flow injection analyser (FIA);	in-house EK257A	
Solids - Total; Solids - Volatile;	Classical	in-house method EA035	
Solids - Volatile suspended	Classical	in-house method EA036	
Nitrogen - Total oxidised	Discrete analyser (DA)	in-house method EK059G	
Nitrogen - Nitrate	Calculation	in-house EK258A	
Solids - Dissolved; Solids - Fixed;	Classical	in-house method EA015A	
Nitrogen - Inorganic	Calculation	in-house EK263A	
Sulfide	UV-vis spectrophotometry	in-house method EK085	
Solids - Fixed; Solids - Suspended;	Classical	in-house method EA036	
Nitrogen - Organic	Calculation	in-house EK260A	
Nitrogen - Ammonia	Classical; Flow injection analyser (FIA);	in-house EK255A	
Chromium - Hexavalent	UV-vis spectrophotometry	in-house method EG050	
Hardness - Non-carbonate	Calculation	in-house method EA068	
Alkalinity - Residual	Calculation	in-house method EA161	

Accreditation Number: 825	Site Number: 158	347 Printed on : 3	31-May-2019
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----- END OF SCOPE -----

Appendix K Soil Sampling Logs

SOIL/SEDIMENT PROFILE LOG



Project number:	EEC14081,004	Weather:	Sunny	Time:	9:15:00 AM
Site name:	Greenpatch	Sampling method:	Excavator	QAQC samples:	NEPM & TPZ1 / TPZZ1 @ TP018
Sampling area:	Eastern Turning Circle	Total depth (mbgl):	3	Depth to water (mbgl):	_
Sampling location:	TP01	Refusal (Y/N):	N	Easting / northing:	370786 / 6304368
Scientist(s)	ZL and SMW	Fill present (Y/N):	Υ		
Date	15/12/2020	Fill thickness (mbgl):	2		

Soil depth (mbgl)	Soil description								Sample I.D.	Interval (mbgl)
	Туре	Colour	Texture	Moisture	Organics	Consistency	Origin	Other		
0.00 0.50	SAND	Pomiroo	Mod III IIII III	Dr□	0000		Dillir	Rd @r	P01 01	0.00 10.25
0.0010	SAND		I WI CO III III III III III III III III III				Dumited		□P01 □02	0.25 10.50
0.50 1.10	SAND	Pommroo	Med and anomarical	Dr□	oroso	000	Dillirad		□P01 □03	0.500
0.50	SAND		I WI CO						□P01 □04	001.10
1.10 2.00	SAND	0r00	Med and anomarical	Dr□	0000	000		outroormor.	□P01 □:05	1.10 1.60
1.10 2.00	SAND		I WI CO	DI DI DI DI DI DI DI DI DI DI DI DI DI D					P01 06	1.60 2.00
2,00 3,00	CAND		Med and anomarical	Dr□		000	0000-00	0.000r000Q	□P01 □07	2.00 12.50
2.00	SAND		I WI CO	DI DI DI DI DI DI DI DI DI DI DI DI DI D					P01 00	2.50 3.00

Additional details / comments:





CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 9:55:00 AM Weather: Sunny Project number: Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP02 Refusal (Y/N): N Easting / northing: 370805 / 6304348 ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin 0.00 10.25 0.00 0.25 SAND Pomroo Mod III III III III I Dr□ Dillrod 0.25 10.40 Mod III III III r Dr□ □r□□□ Dillrid cormon poster. SAND □r□□ 0.40 10.70 0.70 1.00 P02 04 1.00 1.50 Modello III III II 000000 0.40 3.00 SAND Dr□ P02 106 1.50 2.00 2.00 2.50 P02 0 0 2.50 3.00 Additional details / comments: Pillriiii P02 IIII od IIII od III Pr P02 Ⅲ01 0.00 10.25 Pollurooo No

CPS SOIL/SEDIMENT PROFILE LOG EEC14081,004 1:09:00 PM Project number: Weather: Sunny Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): 370746 / 6304253 Sampling location: TP03 Refusal (Y/N): Easting / northing: ZL and SMW Fill present (Y/N): Scientist(s) 15/02/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin 0.00 0.15 0.15 10.40 0.40 10.70 P03 □04 0.70 1.00 0.00 3.00 SAND Mod III III III III $Dr \square$ □r□□□ 1.00 1.50 P03 1106 1.50 2.00 2.00 2.50 □P03 □ 0 □ 2.50 3.00 Additional details / comments: PuirimeP03 Prom P03 Ⅲ01 0.00 10.15 No

SOIL/SEDIMENT PROFILE LOG EEC14081_004 10:53:00 AM Weather: Sunny Project number: Time: NEPM at TP04S01 Site name: Greenpatch Sampling method: Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): 370796 / 6304312 Sampling location: TP04 Refusal (Y/N): Easting / northing: ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin 0.00 0.15 0.15 10.40 0.40 10.70 0.70 1.00 0.00 3.00 SAND Mod no macaron $Dr \square$ □r□□□ 1.00 1.50 P04 1106 1.50 2.00 2.00 2.50 □P04 □ 0 □ 2.50 3.00 Additional details / comments: Puirim P04 Prom P04 Ⅲ01 0.00 10.15 No

SOIL/SEDIMENT PROFILE LOG EEC14081,004 12:10:00 PM Project number: Weather: Sunny Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): 370767 / 6304295 Sampling location: TP05 Refusal (Y/N): Easting / northing: ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin 0.00 0.15 0.40 10.70 P05 □04 0.70 1.00 0.00 3.00 SAND Mod III III III III $Dr \square$ □r□□□ 1.00 1.50 P05 106 1.50 2.00 2.00 2.50 _P05__0 2.50 3.00 Additional details / comments: Puirina P05 Prom P05 Ⅲ01 0.00 10.15 No

SOIL/SEDIMENT PROFILE LOG EEC14081_004 12:30:00 PM Weather: Sunny Project number: Time: NEPM at TP06S01 Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): 370754 / 6304281 Sampling location: TP06 Refusal (Y/N): Easting / northing: ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin 0.00 0.15 0.40 10.70 0.70 1.00 0.00 3.00 SAND Mod III III III III $Dr \square$ □r□□□ 1.00 1.50 1.50 2.00 2.00 2.50 _P06 ...0 □ 2.50 3.00 Additional details / comments: PuirumP06 Prom P06 Ⅲ01 0.00 10.15 No

SOIL/SEDIMENT PROFILE LOG EEC14081,004 Project number: Weather: Sunny 11:30:00 AM Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP07 Refusal (Y/N): Easting / northing: 370779 / 6304268 ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin 0.00 0.15 0.40 10.70 0.70 1.00 0.40 0.60 0.00 3.00 SAND Mod III III III III $Dr \square$ □r□□□ 1.00 1.50 P07 106 1.50 2.00 2.00 2.50 □P07Ⅲ0□ 2.50 3.00 Additional details / comments: PuirimeP07 Prom P07Ⅲ01 0.00 10.15 No

SOIL/SEDIMENT PROFILE LOG EEC14081_004 1:30:00 PM Weather: Sunny Project number: Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP08 Refusal (Y/N): Easting / northing: 370761 / 6304243 ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): Date Soil description Soil depth (mbgl) Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin 0.00 0.15 Polliroo □P0 □□□01 0.00 0.15 SAND Mod III III III III I Dr□ 0r110011r00010.00011r0000 □P0 □□□02 0.15 10.40 □P0 □□□03 0.40 10.70 0.70 1.00 P0041.20....1.30... Modello illinoillo rom 0000 0.15 3.00 SAND $\text{Dr} \, \square$ □P0 □□□05 1.00 1.50 P006 1.50 2.00 P007 2.00 2.50 P00 2.50 3.00 Additional details / comments: PurunP0 00r0000 000 Prom P001 0.00 10.15 Pomrooo No P005 1.00 1.50 Pollurooo

SOIL/SEDIMENT PROFILE LOG EEC14081,004 2:00:00 PM Project number: Weather: Sunny Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): 370733 / 6304228 Sampling location: TP09 Refusal (Y/N): Easting / northing: ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin 0.00 0.15 □P09□Ⅲ01 P09 02 □P09□□03 0.40 10.70 0.70 1.00 P09 04 0.00 0.15 0.00 3.00 SAND Mod III III III III $Dr \square$ □P09□Ⅲ05 1.00 1.50 P09 ___06 1.50 2.00 □P09□□07 2.00 2.50 P090 2.50 3.00 Additional details / comments: Puirump09 Prom P09 Ⅲ01 0.00 10.15 No

CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 3:30:00 PM Weather: Sunny Project number: Time: NEPM at TP10_S01 Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): 370776 / 6304219 Sampling location: TP10 Refusal (Y/N): Easting / northing: ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin 0.00 0.15 0.00 0.40 SILTY SAND 0r000 Mcd III III III III roo Dr□ 0.15 10.40 0.40 10.70 P10 □04 0.70 1.00 1.00 1.50 orom. Modeo manara 000000 0.40 3.00 SAND Dr□ □P10 □ 06 1.50 2.00 2.00 2.50 _P10 ...0 □ 2.50 3.00 Additional details / comments: PuirimP10 Prom P10 Ⅲ01 0.00 10.15 oroso No

SOIL/SEDIMENT PROFILE LOG EEC14081_004 2:50:00 PM Weather: Sunny Project number: Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP11 Refusal (Y/N): N Easting / northing: 370751 / 6304204 ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): 1.5 Date Soil description Soil depth (mbgl) Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin 0.00 10.15 0.00 0.15 SILTY SAND 0r000 Mod III III III III II Dr□ Dillrod прппп Power and the contract of the 0.15 10.40 Mcd ... Dr□ Dillrid SAND Pomeron or oo 0.40 10.70 P11 □04 0.70 1.00 1.00 1.50 Duriod 000 pumpun 1.00 m1.50 m ... 0.40 3.00 SAND Modello III III III Dr□ 1.50 2.00 2.00 2.50 _P11 ...0 □ 2.50 3.00 Additional details / comments: Prom P11 Ⅲ01 0.00 10.15 r No P11 Ⅲ05 1.00 1.50 Pollurooo

SOIL/SEDIMENT PROFILE LOG EEC14081,004 8:10:00 AM Project number: Weather: Sunny Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP12 Refusal (Y/N): Easting / northing: 370716 / 6304181 ZL and SMW Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): Date Soil description Soil depth (mbgl) Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin □P12 □ 01 0.00 0.20 0.00 10.20 Polliroo SAND Mod III III III III I Dr□ Dillrod □P12 □ 03 0.40 10.70 □P12 □ 04 0.70 1.00 0.20 3.00 Pomoroso Modes massirem 0000 Dillrod Pomromod md.o SAND $\text{Dr} \, \square$ □P12 Ⅲ05 1.00 1.50 □P12 □ 06 1.50 2.00 2.00 2.50 □P12 □ 0 □ 2.50 3.00 Additional details / comments: Puir P12 Prom P12 Ⅲ01 0.00 10.20 Pollurooo No

CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 4:10:00 PM Weather: Project number: Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 2.7 Depth to water (mbgl): Sampling location: TP13 Refusal (Y/N): Easting / northing: 370740 / 6304183 ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): 2.7 Date Soil description Soil depth (mbgl) Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin 0.00 0.15 0.00 0.30 SILTY SAND 0r000 Mcd III III III III r Dr□ Dillrod Roomodooraaaaraaaa 0.15 10.30 □P13 □ 03 0.30 10.65 □P13 □ 04 0.65 1.00 1.00 1.50 Dillrod Drairon Madan manaran Pommoomod modem coccess 0.30 2.70 SAND Dr□ □P13 □ 06 1.50 2.00 2.00 2.50 □P13 Ⅲ0 □ 2.50 2.70 Additional details / comments: PuirumP13 Pr P13 103 0.30 10.65 Dorumruna No

CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 4:15:00 PM Weather: Project number: Time: NEPM at TP14S01 Site name: Greenpatch Sampling method: Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 2.5 Depth to water (mbgl): Sampling location: TP14 Refusal (Y/N): Easting / northing: 370759 / 6304169 ZL and SMW Fill present (Y/N): Scientist(s) 15/12/2020 Fill thickness (mbgl): 2.5 Date Soil description Soil depth (mbgl) Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin 0.15 10.20 0.00 0.40 Pommrooo Mcdrc... Dr□ Dillrod SAND 0.15 0.20 0.40 10.70 □P14 □ 04 0.70 1.00 0000 Dillrod 0.40 12.50 SAND Pommron Modern montron 1.00 1.50 P14 1106 1.50 2.00 2.00 2.50 Additional details / comments: 00r0000 000 Prom P14 ⊞01 0.15 10.20 Dorumrano Yes P14 02 0.20 0.40 Pollurooo P14 Ⅲ03 0.40 10.70 Pomeron

CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 9:00:00 AM Weather: Sunny Project number: Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Eastern Turning Circle Sampling area: Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP15 Refusal (Y/N): Easting / northing: 370730 / 6304150 ZL and SMW Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): Date Soil description Soil depth (mbgl) Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin □P15 □ 01 0.00 0.15 op.....Roundaran 0.00 0.50 SAND Pomiroo Modino mininto Dr□ Dillrod □P15 Ⅲ02 0.50 0.70 P15 □04 0.70 1.00 1.00 1.50 Pommroo Modeon maran Dillrad 0.50 3.00 SAND Dr□ □P15 □ 06 1.50 2.00 2.00 2.50 □P15 □ 0 □ 2.50 3.00 Additional details / comments: PuirimP15 Pr P15 ⊞05 1.00 1.50 Pommroo No

SOIL/SEDIMENT PROFILE LOG EEC14081_004 4:45:00 PM Weather: Sunny Project number: Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Sampling area: Area 8 Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP16 Refusal (Y/N): N Easting / northing: 370701 / 6304155 ZL and SMW Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin 0.00 10.15 0.00 0.15 op....R....R SAND Pommron Mod III III III III I Dr□ Dillrod 0.15 10.40 0.40 10.70 0.15 1.20 SAND Mcd III III III II Dr□ Dillrod 0.70 1.00 1.00 1.20 □P16 □ 06 1.20 1.0 Dillrod Posterio mod. 1.20 3.00 SAND Pommrooo | Mod mo macan ram Dr□ 1. 0 2.40 _P16 __0 _ 2.40 3.00 Additional details / comments: Puir P16 dur Prom P16 ±05 1.00 1.20 Diriiiriii No

CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 4:10:00 PM Weather: Sunny Project number: Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Sampling area: Area 8 Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP17 Refusal (Y/N): N Easting / northing: 370695 / 6304138 ZL and SMW Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): 0.7 Date Soil description Soil depth (mbgl) Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin □P17 □ 01 0.00 0.15 0.00 -0.70 SAND Para Madao macara Dr□ □P17Ⅲ02 □P17 □ 03 0.40 10.70 □P17 □ 04 0.70 1.00 □P17Ⅲ05 1.00 1.50 0.70 3.00 SAND Mod III III III roll Dr□ orom rannara. □P17 □ 06 1.50 2.00 2.00 2.50 _P17...0. 2.50 3.00 Additional details / comments: PuirumP17 Prom P17Ⅲ03 0.40 10.70 Diriiiriii P17 □ 04 0.70 1.00

CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 Weather: Sunny 9:40:00 AM Project number: Time: NEPM at TP18S08 Site name: Greenpatch Sampling method: Excavator QAQC samples: Sampling area: Area 8 Total depth (mbgl): 3.1 Depth to water (mbgl): Sampling location: TP18 Refusal (Y/N): 370713 / 6304138 Easting / northing: ZL and SMW Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): 2.8 Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin □P1 □□□01 0.00 0.20 0.00 0.20 SAND Pomroo Mod III III III III II Dr□ Dillrod □P1 □Ⅲ02 □P1 □□□03 0.40 10.70 Pamaraa Madaa maaaraa 0.20 2.00 SAND Dr□ orom Dillirood □P1 □□□04 0.70 1.00 □P1 □□□05 1.00 1.50 □P1 □□□06 1.50 2.00 □P1 □□□07 2.00 2.50 2.00 12.0 CLAYEY SILT Dorumruuu Mod III III III r Dr□ □□rd P10 2.50 2.0 2.003.10 SAND Pommroo Mcd III III III III III Dr□ 000 00**0**r00 2.003.10 Additional details / comments: P....r.....P1......d.....r....... □ □ p □ □ □ □ d □ Pr 2.00 2.50 P107 D r mr m Dirillirillio Yes P1 ___09 2.03.10

CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 3:20:00 PM Weather: Sunny Project number: Time: NEPM at TP19S03 Sampling method: Site name: Greenpatch Excavator QAQC samples: Sampling area: Area 8 Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP19 Refusal (Y/N): N Easting / northing: 370688 / 6304122 Fill present (Y/N): Scientist(s) 16-Dec Fill thickness (mbgl): 0.9 Date Soil description Soil depth (mbgl) Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin □P19 □ 01 0.00 0.15 □P19 □ 02 0.00 0.90 SAND Pomorco Modeo monorco Dr□ ____d 000 0.40 0.60 □P19 □ 04 0.60 0.90 0.90 1.30 o com co 0.90 1.30 SAND 0r00 Modello illinoitroit Dr□ orom 000 □P19 □ 06 1.30 1.90 1.30 3.00 SAND Md III III III r Dr□ 0.000-0000 1.90 2.50 _P19 __0 _ 2.50 3.00 Additional details / comments: P....r.......P19......d....r...... Prom P19 Ⅲ03 0.40 10.60 Dorumrano P19 04 0.60 0.90 Pommroo

SOIL/SEDIMENT PROFILE LOG EEC14081_004 1:45:00 PM Weather: Sunny Project number: Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Sampling area: Area 8 Total depth (mbgl): 2.8 Depth to water (mbgl): Sampling location: TP20 Refusal (Y/N): Easting / northing: 370712 / 6304122 ZL and SMW Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): 2.8 Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin 0.00 0.20 0.00 0.50 SAND 0r00 Mcd III III III III roo Dr□ Dillrod 0.40 10.70 P20 □04 0.70 1.00 1.00 1.50 orom. 0.50 2.0 Modeo manara Dillrod SAND Dr□ □P20 □06 1.50 2.00 2.00 2.50 □P20 □ 0 □ 2.50 2.0 Additional details / comments: Pullrum P20 Prom P20 Ⅲ01 0.00 10.20 r No

SOIL/SEDIMENT PROFILE LOG EEC14081_004 Weather: Sunny 10:30:00 AM Project number: Time: TPZ2 and TPZZ2 at TP21S06 Site name: Greenpatch Sampling method: Excavator QAQC samples: Sampling area: Area 8 Total depth (mbgl): 2.8 Depth to water (mbgl): Sampling location: TP21 Refusal (Y/N): 370727 / 6304128 Easting / northing: Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin 0.00 0.15 Pommrooo 0.00 0.15 SAND Mod III III III III II Dr□ Dillrod 0.15 10.40 0.40 10.70 0.15 1.60 SAND Pommroo Mcdan and roa Dr□ orom Dillrod 0000r000000r000000r0000000 □P21 □ 04 0.70 1.00 1.00 1.60 Portuguid de miportur de de la composition de de la composition della composition de CLAYEY SILT Dirillirilli Modello III III roll Dr□ □□rd □P21 □ 06 1.60 2.00 P21 □07 2.00 2.50 2.00 2.0 SAND Pommroo Mcd == ====r== Dr□ 2.50 3.00 P21 00 Additional details / comments: Puir P21 Prom P21 Ⅲ06 1.60 1.00 Dorumrano P21 10 2.50 3.00 Pommroo

CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 4:00:00 PM Weather: Sunny Project number: Time: NEPM at TP22S05 Sampling method: Site name: Greenpatch Excavator QAQC samples: Sampling area: Area 8 Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP22 Refusal (Y/N): Easting / northing: 370732 / 6304111 ZL and SMW Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin 0.00 0.15 0.00 0.15 SAND Pomroo Mod III III III III II Dr□ Dillrod P22 02 0.15 10.40 0.15 1.00 SAND Pommron Mcdr... Dr□ 0r000 $\mathsf{D} \underline{\quad} \mathsf{r} \underline{\quad} \mathsf{d}$ 0.40 10.70 P22 04 0.70 1.00 1.00 1.50 Doramo Madas and res 1.00 2.00 SAND Dr□ □P22 □ 06 1.50 2.00 2.00 2.50 2.00 3.00 SAND Pommroo Mcd == ====r== Dr□ 00000000 P22 0 0 2.50 3.00 Additional details / comments: Puir P22 dur Prom P22 □06 1.50 1.00 Dorumruu No

CPS SOIL/SEDIMENT PROFILE LOG EEC14081_004 Weather: Sunny 12:40:00 PM Project number: Time: Sampling method: Site name: Greenpatch Excavator QAQC samples: Sampling area: Area 8 Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP23 Refusal (Y/N): Easting / northing: 370702 / 6304104 ZL and SMW Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): 0.7 Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Texture Moisture Organics Consistency Origin 0.00 0.15 0.00 -0.70 SAND Para Madao macara Dr□ DIIIriid 0.15 10.40 0.40 10.70 P23 04 0.70 1.00 0.70 11.00 Dorall roo Modello manufactura 000 Dillrod SAND $\text{Dr} \, \square$ Or O 1.00 1.50 P23 1106 1.50 1.00 1. 0 2.40 1.003.00 SAND Pommroo Mcd == ====r== Dr□ P23 0 0 2.40 3.00 Additional details / comments: Puir P23 durant Prom P23 Ⅲ04 0.70 1.00 Dorumruu No

SOIL/SEDIMENT PROFILE LOG EEC14081_004 Weather: Sunny 2:40:00 PM Project number: Time: Site name: Greenpatch Sampling method: Excavator QAQC samples: Sampling area: Area 8 Total depth (mbgl): 3 Depth to water (mbgl): Sampling location: TP24 Refusal (Y/N): N 370682 / 6304105 Easting / northing: ZL and SMW Fill present (Y/N): Scientist(s) 16/12/2020 Fill thickness (mbgl): Date Soil depth (mbgl) Soil description Sample I.D. Interval (mbgl) Туре Colour Moisture Organics Consistency Origin 0.00 0.15 0.00 -0.70 SAND Pomeron Mod III III III III Dr□ DIIIriid 0.15 10.40 0.40 10.70 □P24 □ 04 0.70 1.00 Modello illinoitroit Dillrod 0.70 2.00 SAND 0r00 Dr□ Or O 1.00 1.50 □P24 □ 06 1.50 2.00 2.00 2.50 SAND Dirillir Modello illustrati Dr□ 2.00 2.50 □P24 □ 0 □ 2.50 3.00 2.50 3.00 SAND Mcd Dr□ 0000r0000. Additional details / comments: Puir P24 durant Prom P24 Ⅲ07 2.00 2.50 Dorumruu No

Appendix L Bore Construction Logs



LITHOLOGICAL LOG

Client: Satterley Property Group
Project: Dalyellup Beach
Bore location: Adjacent to Abstraction Bore PB8
Datum: GDA '94 MGA Zone 50 E 371184
Bore Name: PB8 (obs) 14747 June 2010 June 2010 Job No: Hole commenced: Hole completed:

Logged by: Total Depth: N 6304106 CB

7.50 m

ler and drill type: Hand Auger e diameter: 75mm			R.L. TOC: 6,98 Casing Diam: 50mm Natural Surface: 6,40 LITHOLOGICAL LOG						
cc	BORE INSTRUCTION	GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	MOISTURE	COMMENTS
								2877	
-								Dry	
7									
1									
1					Fine - Medium			Moist	
-	☑								
7									
1									
1				NORTH CO.					
+			Sand	Yellow					
7						Moderately	Sub R		
1									
1									
-								Saturated	
7									
1									
+					Medium - Coarse				
7			Limestone	Cream	-				
1			1	Cream	1				
1			Limestone / Sand	Cream					
7									
7									
1									
-									
7									
1									
+									
7									
1									
	Gravel		Grain Size	Sorting	Grain Shape	Moisture	c c		
-	Sand		Very Fine Fine	Poor Moderate	Angular Subangular	Dry Moist		Date	
7	Clayey Sa	and .	Medium	Well	Subrounded Rounded	Saturated		Stick Up	0.58 m
=			Very course	Very well	Well rounded			Total Depth	8.1 mB3
	Sandy Cla	ıy	Gravel					Water Level	2.75 mB
	Clay		NOTES:						
7	Coffee Re	xck	_						
4:	Bentonite								



LITHOLOGICAL LOG

 Client:
 Satterley Property Group
 Job No:
 14747

 Project:
 Dalyellup Beach
 Hole commenced:
 June 2010

 Bore location:
 Adjacent to Abstraction Bore PB10
 Hole completed:
 June 010

 Datum:
 GDA '94 MGA Zone 50
 E 371267
 N 6304274
 Logged by:
 CB

ole dia	and drill type: Han ameter: 75mm	u Auger	Casing Diam:	50mm	R.L. TOC: Natural Surface: LITHOLOGICAL LOG				7,90 mAH 7,33 mAH
pth m)	BORE CONSTRUCTION	GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	MOISTURE	COMMENTS
n				Yellow				Dry	
- - - -	<u>V</u>			11/5/11/14/5/5/5	Fine - Medium		[1]	Moist	
- - -			Sand	Grey	_	Moderately	Sub R		
- - - - -				Yellow	Medium			Saturated	
			Limestone / Sand	Cream					
- n -									
n									
-	Gravel	-1	Grain Size Very Fine Fine Medium Cearse	Sorting Poor Moderate Well	Grain Shape Angular Subangular Subrounded Rounded	Moisture Dry Moist Saturated		Date Stick Up	0.57 m
_	Clayey Sa		Very course	Very well	Well rounded			Total Depth	9.6 mBTC
			NOTES:					Water Level	3.82 mBT0



GROUNDWATER MONITORING BORE: MW01

Sheet 1 OF 1

19/01/2016 Contractor: SFB Drilling Job Number: J1601005 Date: Client: Satterley Group Drill Rig: Eziprobe Logged: JΗ Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Project: Checked By: Dalyellup Beach Estate - Lots 9090 & 9076 RP Location: **WELL INSTALLATION DETAILS** Graphic Log Depth (m) Elevation (m AHD) Soil / Rock Description ID: MW01 Stick Up & RL: Type: Standpipe Tip Depth & RL: 6.00 m Installation Date: 21/01/2016 Static Water Level: 4.23m Steel Monument -SAND: fine to medium grained, sub-angular to sub-rounded, grey brown, with some non-plastic fines, trace organics Becoming pale grey, trace fines Sand 2 °0 0 000 ¥ 3 3.00 m °0° 0 000 Screen 0 °0 -00 0 000 0 000 Hole terminated at 6.00 m Target depth Groundwater encountered at 4.23 m on 19/01/16 during installation Groundwater encountered at 4.51 m on 03/02/16 during monitoring Comments: See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions



GROUNDWATER MONITORING BORE: MW02

Sheet 1 OF 1

19/01/2016 Contractor: SFB Drilling Job Number: J1601005 Date: Client: Satterley Group Drill Rig: Eziprobe Logged: JΗ Proposed Residential Subdivision Inclination: -90° Checked Date: 29/01/2016 Project: Checked By: Dalyellup Beach Estate - Lots 9090 & 9076 RP Location:

WELL INSTALLATION DETAILS Graphic Log Depth (m) Elevation (m AHD) Soil / Rock Description ID: MW02 Stick Up & RL: Type: Standpipe Tip Depth & RL: 4.40 m Installation Date: 20/01/2016 Static Water Level: 1.70m Steel Monument -SAND: fine to coarse grained, sub-angular to sub-rounded, dark grey / grey, trace organic fines, with some non plastic fines °0 0 Becoming yellow brown 1.40 m 000 \subseteq 0 000 2 0 00000 0 0 000 000 3 000 0 000 Hole terminated at 4.50 m Target depth Groundwater encountered at 1.7 m on 19/01/16 during installation Groundwater encountered at 0.58 m on 03/02/16 during monitoring 9 Comments: See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions



ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM9

Page: 1 of 5

Client: Cristal Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 27/07/1996

Drill Co: Bunb Boring Driller:

Rig Type: Total Depth (m): 48.2 Diameter (mm): 171

Easting: 370766

Northing: 6304210 Grid Ref: GDA94_MGA_zone_50 Collar RL: 34.35 Elevation: 34

to: 27/07/1996 Logged by: Bunb Boring Checked by: Georgia B.C.L. No.: Casing: PVC Screen: PVC **Surface Completion:** DRILLING COMMENTS/ CONTAMINANT INDICATORS **Drilling Method** LITHOLOGICAL DESCRIPTION _Fog Consistency Odours, staining, waste materials, Soil Type (Classification Group Symbol); Particle Size; Well Details Elevation / Depth (m) $\widehat{\mathbb{E}}$ (mdd) Sample ID Moisture Graphic L Colour; Secondary / Minor Components. separate phase liquids, imported Depth (fill, ash. <u></u>음 Ground Surface 34.00 0,00 0.0 SAND Yellow Shell Fine 1.0 2.0 -3.0 30.00 4.00 4.0 SAND Yellow Shell & Limestone Fine 5.0 28.00 6.00 6.0 LIMESTONE Brown Shells 7.0 8.0 9,0 10.0

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, AR - Air Rotary, BE - Bucket Excavation, DC - Diamond	D - Dry, SM - Slightly Moist, M - Moist, VM	Granular Soils	Cohesive Soils
Core, FH - Foam Hammer, HA - Hand Auger, HE - Hand Excavation (shovel),	- Very Moist, W - Wet, S - Saturated	VL - Very Loose, L - Loose, MD	VS - Very Soft, S - Soft, F -
HFA - Hollow Flight Auger, NDD - Non Destructive Drilling, PT - Pushtube, SD -		- Medium Dense, D - Dense, VD	Firm, ST - Stiff, VST - Very Stiff,
Sonic Drilling, SFA - Solid Flight Auger, SS - Split Spoon, WB - Wash Bore, WS		- Very Dense	H - Hard
- Window Sampler			



ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM9

Page: 2 of 5

Client: Cristal Project: Dalyellup Monitoring Project No.: Dalyellup Monitoring Location: Dalyellup

Date Drilled: 27/07/1996

Drill Co: Bunb Boring Driller:

Rig Type: Total Depth (m): 48.2 Diameter (mm): 171

Easting: 370766

Northing: 6304210 Grid Ref: GDA94_MGA_zone_50 Collar RL: 34.35 Elevation: 34 Logged by: Bunb Boring Checked by: Georgia

to: 27/07/1996 B.C.L. No.: Casing: PVC Screen: PVC **Surface Completion:** DRILLING COMMENTS/ CONTAMINANT INDICATORS **Drilling Method** LITHOLOGICAL DESCRIPTION _Fog Consistency Odours, staining, waste materials, Soil Type (Classification Group Symbol); Particle Size; Well Details $\widehat{\mathbb{E}}$ (mdd) Elevation / Depth (m) Sample ID Moisture Graphic Colour; Secondary / Minor Components. separate phase liquids, imported Depth (fill, ash. 음 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes. Moisture Abbreviations: Consistency Abbreviations:

Drining Abbreviations.	ľ
AH - Air Hammer, AR - Air Rotary, BE - Bucket Excavation, DC - Diamond	D
Core, FH - Foam Hammer, HA - Hand Auger, HE - Hand Excavation (shovel),	ŀ
HFA - Hollow Flight Auger, NDD - Non Destructive Drilling, PT - Pushtube, SD -	ı
Sonic Drilling, SFA - Solid Flight Auger, SS - Split Spoon, WB - Wash Bore, WS	
- Window Sampler	ı



ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM9

Page: 3 of 5

Client: Cristal Project: Dalyellup Monitoring Project No.: Dalyellup Monitoring Location: Dalyellup

Date Drilled: 27/07/1996

Drill Co: Bunb Boring

Driller:

Rig Type: Total Depth (m): 48.2 Diameter (mm): 171

Easting: 370766

Northing: 6304210 Grid Ref: GDA94_MGA_zone_50

Collar RL: 34.35 Elevation: 34 Logged by: Bunb Boring Checked by: Georgia

to: 27/07/1996 B.C.L. No.: Casing: PVC Screen: PVC **Surface Completion:** DRILLING COMMENTS/ CONTAMINANT INDICATORS **Drilling Method** LITHOLOGICAL DESCRIPTION Graphic Log Consistency Odours, staining, waste materials, Soil Type (Classification Group Symbol); Particle Size; Well Details (mdd) Elevation / Depth (m) Ξ Sample ID Moisture Colour; Secondary / Minor Components. separate phase liquids, imported Depth (fill, ash. 음 Backfill 22.0 23.0 24.0 9.60 24.40 LIMESTONE Brown Sand & broken Limestone 25.0 26.0 27.0 28.0 29.0

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:			
	D - Dry, SM - Slightly Moist, M - Moist, VM	Granular Soils	Cohesive Soils		
Core, FH - Foam Hammer, HA - Hand Auger, HE - Hand Excavation (shovel),	- Very Moist, W - Wet, S - Saturated	VL - Very Loose, L - Loose, MD	VS - Very Soft, S - Soft, F -		
HFA - Hollow Flight Auger, NDD - Non Destructive Drilling, PT - Pushtube, SD -		 Medium Dense, D - Dense, VD 	Firm, ST - Stiff, VST - Very Stiff,		
Sonic Drilling, SFA - Solid Flight Auger, SS - Split Spoon, WB - Wash Bore, WS		- Very Dense	H - Hard		
- Window Sampler					



ENVIRONMENTAL - GROUNDWATER

Bore ID,: DM9

Page: 4 of 5

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring

Location: Dalyellup Date Drilled: 27/07/1996

to: 27/07/1996

Drill Co: Bunb Boring **Driller**:

Rig Type: Total Depth (m): 48.2 Diameter (mm): 171 Easting: 370766

Northing: 6304210 Grid Ref: GDA94_MGA_zone_50

Collar RL: 34.35 Elevation: 34
Logged by: Bunb Boring Checked by: Georgia

B.C.L. No.: Casing: PVC Screen: PVC **Surface Completion:** DRILLING COMMENTS/ CONTAMINANT INDICATORS **Drilling Method** LITHOLOGICAL DESCRIPTION _Fog Soil Type (Classification Group Symbol); Particle Size; Consistency Well Details Odours, staining, waste materials, \mathbb{E} (mdd) Elevation / Depth (m) Sample ID Graphic Colour; Secondary / Minor Components. Moisture separate phase liquids, imported fill, ash. 음 32.0 1.60 32.40 CLAY Grey Sand 33.0 0.00 34.00 34.0 SAND Brown Orange Fine/Medium Limestone -1.00 35.00 35.0 LIMESTONE 36.0 37.0 38.0 39.0

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes, Drilling Abbreviations:

Moisture Abbreviations:

Consistency Abbreviations:

Drining Abbreviations.	
AH - Air Hammer, AR - Air Rotary, BE - Bucket Excavation, DC - Diamond	D
Core, FH - Foam Hammer, HA - Hand Auger, HE - Hand Excavation (shovel),	۱-۱
HFA - Hollow Flight Auger, NDD - Non Destructive Drilling, PT - Pushtube, SD -	-
Sonic Drilling, SFA - Solid Flight Auger, SS - Split Spoon, WB - Wash Bore, WS	3
- Window Sampler	1



ENVIRONMENTAL - GROUNDWATER

to: 27/07/1996

Bore ID.: DM9

Page: 5 of 5

Client: Cristal Project: Dalyellup Monitoring Project No.: Dalyellup Monitoring

Location: Dalyellup **Date Drilled:** 27/07/1996

Drilling Abbreviations:

AH - Air Hammer, AR - Air Rotary, BE - Bucket Excavation, DC - Diamond Core, FH - Foam Hammer, HA - Hand Auger, HE - Hand Excavation (shovel), HFA - Hollow Flight Auger, NDD - Non Destructive Drilling, PT - Pushtube, SD - Sonic Drilling, SFA - Solid Flight Auger, SS - Split Spoon, WB - Wash Bore, WS - Window Sampler

Drill Co: Bunb Boring Driller:

Rig Type: Total Depth (m): 48.2 Diameter (mm): 171

Easting: 370766

Northing: 6304210 Grid Ref: GDA94_MGA_zone_50

Collar RL: 34.35 Elevation: 34 Logged by: Bunb Boring Checked by: Georgia

B.C.L. No.: Casing: PVC Screen: PVC **Surface Completion:** DRILLING COMMENTS/ CONTAMINANT INDICATORS **Drilling Method** LITHOLOGICAL DESCRIPTION g Consistency Well Details Soil Type (Classification Group Symbol); Particle Size; Odours, staining, waste materials, \mathbb{E} (mdd) Elevation / Depth (m) Sample ID Graphic L Colour; Secondary / Minor Components. Moisture separate phase liquids, imported fill, ash. 음 Grout 42.0 43.0 44.0 Filter Pack 45.0 46.0 47.0 48.0 End of Log 49.0 NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Moisture Abbreviations:

D - Dry, SM - Slightly Moist, M - Moist, - Very Moist, W - Wet, S - Saturated

Consistency Abbreviations:

Cohesive Soils

H - Hard

VL - Very Loose, L - Loose, MD VS - Very Soft, S - Soft, F - Medium Dense, D - Dense, VD Firm, ST - Stiff, VST - Very Stiff,

Granular Soils

Very Dense

Well id	Targeted aquifer	Date drilled	Depth of well (m bol)	Screened interval (m ball)	Elevation (m AHD)	Top of Casing (m AHD)	Easting	Northing
Up-gradie	nt wells					0.0000		
DMIRS	Superficial	15,12.92	43	39 - 42	40.05	39.56	370837	6304504
DMIRD	Superficial	15.12.92	50	45 - 48	40.05	39.54	370837	6304504
DM9S	Superficial	23.7.96	36	32 - 35	33.8	34.35	370765.78	6304209.08
DM9D	Superficial	23.7.96	46	42 – 46	33.8	34.28	370765.78	6304209.08
Down-gra	dient wells							
DM2RS	Superficial	27.02.89	26.5	23.5 - 25.5	24.489	26.4	370525	6304503
DM2RD	Superficial	27.02.89	35.3	27 - 30	24.489	26.25	370525	6304503
DM4R3	Superficial	4.04.90	7.8	4.8 - 7.8	3.043	4.78	370364.96	6304388.68
DM4RD	Superficial	13.02.89	12.5	9.5 - 12.5	4.444	4.77	370364.96	6304368.66
DM7RS	Superficial	27.5.92	23	19 - 22	20.497	24.52	370479.84	6304180.9
DM7RD	Superficial	29.5.09	30.8	26-29	20.497	24.66	370479.84	6304180.9
DMBRS	Superficial	23.7.96	28	24 - 28	26.19	26.47	370506.9	6304410.2
DMSRD	Superficial	23.7.96	36	32 - 36	26.19	26.39	370506.9	6304410.2
Backgrou	nd wells							
MBR3D	Superficial	22.11.00	34.5	28 - 34	25.9	27.93	370416.8	6304040.34
MB4D	Superficial	10.11.88	16.2	2.2 - 16.2	5.13	3.35	370245	6303905
Yarragade	ee well							
YBd	Yarragadee	24.03.05	72	66 - 72	26	27.2	370516	6304473

Appendix M Surface and Groundwater Logs



MULTI-PARAMETER METER CALIBRATION RECORD

EEC14081,004

Project number:

Scientist Measurement 194.6 Temp. °C 25 Redox Calibration notes: 5 Air 2.10 D.O. ppm Zero Batch date Zobell B solution, for Ag/AgCl saturated KCl electrode ۳ ک 240 229 218 25 Post-cal o، L 20 25 30 B Temp. °C Pre-cal м > 273 262 251 1413 Post-cal 11112020 T °C 1.0000 15 1000 EC buffer µs/cm 1519 Pre-cal 345197.00 342069.00 341094.00 Batch / lot 4 Post-cal pH 4 buffer pH 7 buffer EC buffer 4.07 Solution Zobell B pH 4 Pre-cal Green Patch Post-cal 6.99 Multi-parameter meter details pH 7 Pre-cal Model number: 1412.2020 Serial number: Manufacturer: Site location: Date



Project number	:	140_1.004		Weather:			
Site name:		orccoPccc		Sampling method		□ □dd □r □P □□ p	
Sampling area:				Collar elevation (, ,	39.56	
Sampling locati	ion:	DM1R 🗆		Depth to water (mbtoc):		37.234	
Scientist:				Groundwater ele	. ,		
Date:		14 12 12 02 0		Recovery depth (•	40	
Time:		4115100 PM		Depth to base (m	*	42	
QAQC samples				Easting / northin		370□37	6304504
Purge rate (L/m		0.4		0.45 micron filter			
Sampling rate (L/min):	0.2		Sample preserva	tion (ice/esky):		
Mins	Appearance	Colour	Temp. (°C)	pH	E.C. (µS/cm)	Redox. (mV)	D.O. (ppm)
1	omounted	P	22.7	7.19	296□	□5.3	2.52
2	- IIII rod	P	22.5	7.13	2963	69.3	2.3 🗆
3	rod	P	22.3	7.12	2962	67.2	2.21
4	omountrad	P	21.9	7.09	2957	73.2	1.□0
5	nmonnord	P	21.□	7.07	295□	75.4	1.63
6	amamarad	Pumruu	21.6	7.05	2954	79.2	1.46
9	omomorad	P	21.4	7.03	2950	□1.2	1.41
12	- IIIIII rud	P	21.3	7.01	2947	□3.2	1.40
15	- III r d	P	20.9	6.93	2943	□□.7	1.4□
1□	rd	P	20.9	6.92	2943	□9.4	1.5□
21	rd	P	20.□	6. 🗆 9	2942.0	91.4	1.5□
Final stability o	f physical param	neters:	20.8	6.89	2942.0	91.4	1.58
Additional deta	ils / comments:						
Odour (Y/N):				Other:			
Staining (Y/N):							
Sheen (Y/N):							
Total titratable ac	idity (mg/L CaCO ₃	equivalents):					
T - 4 - 1 - 11 - 12 - 26 - 7 -		In order).					



Project number:		00140 01.004		Weather:				
Site name:		or codP		Sampling method	ing method:			
Sampling area:				Collar elevation ((m AHD):	39.54		
Sampling location	on:	DM1RD		Depth to water (n	nbtoc):	37.26		
Scientist:				Groundwater ele	vation (m AHD):	AHD): 2.2□		
Date:		1411212020		Recovery depth ((mbtoc):	46.2		
Time:		41000PM		Depth to base (m	ibtoc):	4□.2		
QAQC samples:				Easting / northin	g:	370□37	6304504	
Purge rate (L/mi	n):	0.4		0.45 micron filter	used (Y/N):			
Sampling rate (L	_/min):	0.2		Sample preserva	tion (ice/esky):			
Mins	Appearance	Colour	Temp. (°C)	рН	E.C. (µS/cm)	Redox. (mV)	D.O. (ppm)	
1	r		23.5	7.3□	1329	16 1. 5	1.29	
2	r		23.3	7.33	1337	. 6□.7	11.94	
3	0r		23.0	7.22	1326	73.9	3.31	
4			23.1	7.0□	1315	□75.1	4.07	
5			23.1	7.03	1303	⊞5.1	5.97	
6			23.5	7.00	1310	79.3	7.□3	
9			22.9	6.93	1305	□1	15.5□	
12	r		22.4	6. 🗆	1303	75.7	5.91	
15	r		22.2	6. 🗆	1302	⊞9.1	2.75	
1 🗆	r		22.1	6. 🗆	1300	<u>1</u> 95.5	2.05	
21	r		22.0	6. 🗆	1299	99.4	1.71	
Final stability of	physical param	eters:	22	6.88	1299.0	-99.4	1.71	
Additional detail	s / comments:							
Odour (Y/N):				Other:				
Sheen (Y/N):								
Total titratable aci	dity (mg/L CaCO ₃	equivalents):						

Total alkalinity (mg/L CaCO₃ equivalents):



Project number	:	140_1.004		Weather:	at.		
Site name:		orcoop		Sampling method		□ □ dd □ r IP □ □ p	
Sampling area:		DMO		Collar elevation (· '	34.35	
Sampling locati	on:	DM9		• •	· · · · · · · · · · · · · · · · · · ·	32.6	
Scientist:		_M_		Groundwater ele	. ,		
Date:		14 12 12 02 0		Recovery depth (•	34	
Time:	_	100000PM		Depth to base (m	•	36	
QAQC samples		0.4		Easting / northin		370765.7	6304209.09
Purge rate (L/m		0.4		0.45 micron filter			
Sampling rate (Sample preserva			
Mins	Appearance	Colour	Temp. (°C)	pH	E.C. (µS/cm)	Redox. (mV)	D.O. (ppm)
1		Pomroo	22.6	7.13	1311	56.1	5.25
2	r	Pomroo	22.0	7.12	1300	5 🗆 4	5.67
3		Pomroo	21.2	7.09	1296	65.2	5.37
4		Pomerco o	20.	7.05	1291	76.5	5.02
5		Pr	21.2	7.01	1293	□4.0	4.72
6		Pullir	21.7	6.9	1292	90.7	4.6
9			21.4	6.95	1291	100.□	4.99
12			22,1	6.□4	12⊡4	10 🗆 9	4.□9
15			22.1	6. □4	12 □4	109. 🗆	4.□9
1 🗆			22.2	6. 🗆 2	12 6	110.6	4.97
Final stability of	fh			0.00	4000.0	440.0	4.07
Final Stability of	f physical param	leters:	22.2	6.82	1286.0	110.6	4.97
Additional detai	ils / comments:						
Odour (Y/N):				Other:			
Staining (Y/N):							
Sheen (Y/N):							
Total titratable ac	idity (mg/L CaCO ₃	equivalents):					



Project number	:	001.004		Weather:				
Site name:		or on Pour		Sampling meth	od:	□ □dd □r iP □□ p		
Sampling area:				Collar elevation	ı (m AHD):	34.2□		
Sampling locati	ion:	DM9D		Depth to water	(mbtoc):	32.146		
Scientist:		□M□		Groundwater el	levation (m AHD):	2.134		
Date:		14 12 12 02 0		Recovery depth	ı (mbtoc):	42		
Time:		21301001PM		Depth to base (mbtoc):	42.4	4	
QAQC samples	:			Easting / northi	ng:	370765.7□	6304209.0□	
Purge rate (L/m	in):	0.4		0.45 micron filte	er used (Y/N):			
Sampling rate (L/min):	0.2		Sample preserv	ration (ice/esky):			
Mins	Appearance	Colour	Temp. (°C)	рН	E.C. (µS/cm)	Redox. (mV)	D.O. (ppm)	
1	rd		23.0	7.06	1106	32.6	6.65	
2			22.2	6. □6	1166	4	4.21	
3	umumurud		22.0	6.74	11□1	56.2	2.99	
4	omonuorod		22.1	6.61	119□	71.0	1.00	
5	omonuorod		21.6	6.55	1197	73.2	0.6□	
6	amamarad		21.3	6.51	119□	72.5	0.59	
9	omounorod		21. 🗆	6.44	119□	[6 □ 2	0.46	
12	rd		21.2	6.42	1201	60.2	0.53	
15	rd		21. 🗆	6.39	1202	62.4	0.47	
1 🗆	omounorod		21. 🗆	6.3□	1202	62.3	0.42	
Final stability of	 f physical param	leters:	21.8	6.38	1202.0	-62.3	0.42	
- mai stability 0	. Piryoicai paidiii		21.0	0.30	1202.0	-02.0	0.42	
Additional detai	ils / comments:							
Odour (Y/N):				Other:				
Staining (Y/N):								
Sheen (Y/N):								

Total alkalinity (mg/L CaCO₃ equivalents):

Total titratable acidity (mg/L $CaCO_3$ equivalents):



Project number	er:	140 1.004		Weather:				
Site name:		or on Pour		Sampling metho	d:	□□Ⅲr		
Sampling area	a:	P:::::D:::01::		Collar elevation	(m AHD):	6.9□		
Sampling loca	ation:			Depth to water (mbtoc):	3.09		
Scientist:	Scientist:			Groundwater ele	evation (m AHD):	3. □9	9	
Date:		1411212020	Recovery depth (mbtoc): 7			7.05		
Time:		121500₽M		Depth to base (n	nbtoc):	□.05		
QAQC sample	es:			Easting / northin	ng:	3711□4	6304106	
Purge rate (L/	min):	0.4		0.45 micron filte	r used (Y/N):			
Sampling rate	(L/min):	0.2		Sample preserva	ation (ice/esky):			
Litres	Appearance	Colour	Temp. (°C)	рН	E.C. (µS/cm)	Redox. (mV)	D.O. (ppm)	
1		Pr	20.	7.61	6□7	147.2	0.74	
2	- III - III	Pomroo	20.1	7.29	656	106.3	2. 🗆 1	
3	- IIIIIIII rod	Puller	20.0	7.25	64□	104.6	3.44	
4	omonnorad	P	20.0	7.26	660	106.0	5.29	
5		Pollogo	19.9	7.20	669	102.□	4.7□	
6	omomorad	Pollogo	19.□	7.21	670	103.5	4.91	
7		Pommomo	19.7	7.19	667	103.7	3.91	
		Pommomo	19.7	7.19	662	101.□	3.21	
9		Pommonio	19.7	7.1□	661	104.9	4.44	
10		Pommomo	19.7	7.1□	659	10.4.4	4.□9	
				1				
				1				
				1				
Final stability	of physical param	neters:	19.7	7.18	659.0	10.4.4	4.89	

Additional deta	ails / comments:		
Odour (Y/N):		Other:	
Staining (Y/N):			
Sheen (Y/N):			
Total titratable a	cidity (mg/L CaCO ₃ equivalents):		
Total alkalinity (ng/L CaCO₃ equivalents):		



Project number	er:	0001.004		Weather:			
Site name:		or coop coop		Sampling metho	od:		
Sampling area	:			Collar elevation (m AHD): 7.9			
Sampling loca	tion:	P_10D_02_		Depth to water (mbtoc): 4.14			
Scientist:				Groundwater el	evation (m AHD):	3.76	
Date:		14 12 2020		Recovery depth	(mbtoc):	□36	
Time:		11000 PM		Depth to base (r	pth to base (mbtoc): 9.36		
QAQC sample	s:			Easting / northin	ng:	371267 6304274	
Purge rate (L/r	nin):	0.4		0.45 micron filte	er used (Y/N):		
Sampling rate	(L/min):	0.2		Sample preservation (ice/esky):			
Litres	Appearance	Colour	Temp. (°C)	pH Ε.C. (μS/cm)		Redox. (mV)	D.O. (ppm)
1			20.4	7.51	96□	105.3	5□.11
2			19.6	7.45	955	105.1	4.21
3	- IIIIII r d	Pomroo	19.7	7.47	96□	107.6	3.24
4	nmornd	P	19.6	7.36	969	115.1	4.72
5	rod	P	19.6	7.34	972	11□3	3.4□
6	rod	P	19.6	7.36	971	11□6	3.43
7	rd	P	19.6	7.36	965	115.3	3.61
	rd	P	19.6	7.35	969	114.0	4.51
9	rd	P	19.6	7.35	970	113.0	3.74
10	rd	P	19.6	7.36	965	112.5	5.54

Additional deta	ils / comments:		
Odour (Y/N):		Other:	
Staining (Y/N):			
Sheen (Y/N):			
Total titratable ac	cidity (mg/L CaCO ₃ equivalents):		
• •	ng/L CaCO ₃ equivalents):		

7.36

965.0

112.5

5.54

19.6

Final stability of physical parameters:



Project number:	0 014001.004	Weather:			
Site name:	orcoo P ou	Sampling method:			
Sampling area:		Collar elevation (m AHD):			
Sampling location:	M□ 02	Depth to water (mbtoc):	1.7		
Scientist:		Groundwater elevation (m AHD)	: 💷		
Date:	1411212020	Recovery depth (mbtoc):	2.4□		
Time:	20000PM	Depth to base (mbtoc):	4.4□		
QAQC samples:		Easting / northing:	37120□	6304347	
Purge rate (L/min):	0.4	0.45 micron filter used (Y/N):			
Sampling rate (L/min):	0.2	Sample preservation (ice/esky):			

Litres	Appearance	Colour	Temp. (°C)	рН	E.C. (µS/cm)	Redox. (mV)	D.O. (ppm)
1	прппппппппппппппппппппппппппппппппппппп		19.3	7.34	100□	119.5	2.37
2	прппппппппппппппппппппппппппппппппппппп		19.0	7.21	1004	119.□	3.95
3	прпппп		1□0	7.32	1015	114.4	4.33
4	прпппп		1□6	7.25	1113	113.4	4.14
5	прпппп		1□5	7.20	1041	110.9	5.02
6	припп		1□5	7.21	1025	109.5	4.22
7	р		1□6	7.22	104□	105.4	3.75
	приши		1□6	7.22	1056	105.4	4.01
9	приши		1□6	7.23	1059	107.4	3.□2
10	- p		1□6	7.23	1063	106.0	4.0□
	+	+					
Final stability	of physical paran	neters:	18.6	7.23	1063.0	106.0	4.08

Additional deta	Additional details / comments:							
Odour (Y/N):		Other:	occurram commerco mranomidd crip oc p. o					
Staining (Y/N):			occusionistica crossociper minimped.					
Sheen (Y/N):								
Total titratable a	ncidity (mg/L CaCO ₃ equivalents):							
• ,	mg/L CaCO ₃ equivalents):							

SURFACE WATER SAMPLING LOG



Project number	:	0 014001.004		Weather:				
Site name:		orP		Sampling metho	d:			
Sampling area:				Easting / northin	g:			
Sampling locati	on:	01 d 02		0.45 micron filter	r used (Y/N):			
Scientist:				Sample preserva	ntion (ice/esky):			
Date:		17 12 12 02 0		QAQC samples:		111	1 1 02	
Time:		9.000M						
Sample I.D.	Appearance	Colour	Temp. (°C)	рН	E.C. (µS/cm)	Redox. (mV)	D.O. (ppm)	
□□ 02			21.2	7.55	121 🗆	4	6.□6	
□□ 01		Pommrooo	19.7	7.45	325.4	5□.□	3,23	
Additional deta	ils / comments:							
Odour (Y/N):				Other:			Irdr II.	
Staining (Y/N):								
Sheen (Y/N):								
	ng/L CaCO₃ equival	ents):		1				
	idity (mg/L CaCO ₃							

Appendix N HSL Checklist



Step 1 - Limitations to HSLs		Comments
Assessing contamination in soil and groundwater should only be carried out by a qualified professional.		OF VERNING ON CERTIFICATION
Fire galactimes retevant to site; critical trie following initiations. Is the site less than 400m²?	No - Proceed	
Have chemicals other than petroleum hydrocarbons been identified at the site?	May consider site-specific risk asessment refer to Section 5.2 of the Application Document)	TSR - heavy metals and radionuclides
Is the groundwater to be used for irrigation purposes?	May consider site-specific risk asessment (refer to Section 2.4.5 of the Application Document)	Shallow aquifer no
Is the site conservation land?	May be required to also assess ecological values refer to Section 2.4.5 of the Ambication Document)	
Is the depth to groundwater impact less than 2m bgs ?	May consider site-resolution periodical months of refer to contact may consider soil vapour sampling for vapour intrusion forfer to Section 3.4.3.6 the Analysis Document	In eastern portion of site.
Has significant odour been observed at the site?	Television 2-section 2-4.2 or the application of continents The particular of the above assess odour for sensitive land uses Trefer to Section 5.4 of the Apolication Document)	
Is the identified chemical a result of a solvent spill rather than perroleum spill/leak?	THSLs may be used where saturation point is not considered refer to Section 5.3 of the Apolication Document)	
Is the identified contamination an atypical petroleum mixture?	May consider site-specific risk asessment to consider cumulative effects between chemicals (refer to Section 3.6	
Is the soil source thickness significantly different than 2 m?	of the Application Document) For small source thicknesses, HSLs may be overly conservative if source fully depletes. For larger thicknesses HSLs may not adequately characterise risk however lateral extent of contamination	
	should also be considered. A site-specific HRA may be considered. (refer to Section 2.4.7 of the Application Document)	
Does the building have a crawl space rather than slab-on-ground construction?	HSLs may be used as likely to be conservative. However, for situations where habitants may be exposed in crawl space area	None proposed
	Such as spaces under owenings which incolorate garages workshop then consideration may be given to ambient air sampling. (refer to Section 2.3.4 of the Application Document)	
Does the building have or is likely to have a habitable basement?	■ May consider site-specific risk asessment (refer to Section 2.3.3 of the Application Document)	None proposed
Note that the HSLs may be used for assessing health risk. In addition to this assessment, legislation requirements still need to be fulfilled which may include other considerations and scological impacts - Assessment of environmental values and ecological impacts - Consideration of sustainability issues - Risks for extraction and use of groundwater - Soil source ongoing source to groundwater contamination - Local planning requirements, such as sensitive uses under commercial zones, or future land use zones - Social impacts and consultation with stakeholders	still need to be fulfilled which may include other considerations	



Step 2 - Identify receptors and scenarios to be considered	\Box	Comments
Step 2 - Identify receptors and scenarios to be considered Check the receptors and scenarios to be assessed. Note that receptors and scenarios may require consideration of future land use planning and local regulations pertaining to site redevelopment. Residential use (refer to Sections 2.1.1 and 2.3.1 of the Application Document) HSL-A Low-Density Residential — assumes access to sols with no management controls on site. Assessment may consider surface soils with direct contact, intrustive maintenance worker protection, and consider using surface soils HSL for all soils down to 3 m depth to protect uncontrolled excavation of contamination. HSL-B High-Density Residential — assumes limited access to surface soils with management controls on site. Assessment may consider surface soils with management controls on site and some contamination.		Comments Most conservative receptor (residential adopted to cover all scenarios.
HSL-A Medium-Density Residential with grassed open space – assumes access to sols with management controls on site. Assessment may consider surface sols with direct cortect and substrated sols through proper intrusion. Intrusive maintenance was may be protected under suitable site management plan. HSL-B Medium-Density Residential with permanent paving open space – assumes limited access to soils with management controls on site. Assessment may consider surface solf-stoats with limited direct contact. Intrusive maintenance workers may be protected under suitable site management plan. Intrusive maintenance workers may be protected under suitable site management plan (see the management plan (see the management plan). Interest presidential with single besented as a position of the protect of the protect of the protect of the protect of the protect of the protect of the protect suitable site management plan (refer to Section 2.3.) of the Application Document). HSL-B (for DC outside footprin) Medium- or High-Density Residential with communal basement car park – assumes no access to sols with management controls on site. HSL depth is displaced by depth of basement name overviews may be protected under suitable site management plan (refer to Section 2.3.) of the Application Document). HSL-B (for DC outside footprin) Medium- or High-Density Residential with communal basement car park – assumes no access to sols with management controls on site. HSL depth is displaced by depth of basement, increase and set of the basement outpern Ham. Note that areas outside of the basement foot protect out unders validate site management plan. Note that areas outside of the basement footprint may be required to be assessed as a building without basement and with limited direct contact with sold indirect contact with sold forect contact with sold forect contact with sold care contact with sold contact contact with sold care contact with sold care contact with sold care contact with sold contact contact with sold care contact with s		
HSL-C Recreational / Public Open Space (refer to Section 2.1.2 of the Application Document) Parks, ovals, peddestrian areas National parks, conservation areas – may be required to also assess ecological values (refer to Section 2.4.6 of the Application Document)		
HSL-D Commercial /Industrial Workers (refer to Section 2.1.3 of the Application Document) – considers only healthy adults under normal working conditions. Does not consider sensitive commercial uses such as schools, day care centres and medical practices. Commercial sensitive users — may consider using residential HSLs or a site-specific HRA (refer to Section 2.4.1 of the Application Document) Agricultural land — may consider using the specific HRA (refer to Section 2.4.5 of the Application Document)		
Shallow intrusive workers down to 1 m deep. May require assessment of direct contact for soils surface to <2 m (refer to Sections 2,1,4 and 2,4,3 of the Application document)		
Deep intrusive workers down to >1 m deep, such as sever. Should be managed with appropriate procedures and work practices for confined spaces (refer to Section 2.4.4 of the Application Document)		
Is a site management plan (that includes specific occupational hazard management for works on the site) to be implemented on the site (controlled site)?		



Step 3 - Identify soil type relevant to site (soils above impacts in soil and/or groundwater)	Comments
Note the following before selecting soil type for use in assessment: 1. The prime parameter that influences the value of the HSL is the air filled porosity and volatility of the specific chemical. The higher the air filled porosity the greater the potential for volatile chemicals to migrate vertically through the soil profile across the site. 2. The selection of a generic soil type requires knowledge of the soil profile across the site. 3. The selection of generic soil types should take into account the predominant characteristics of the soil profile and depth of contamination. The generic soil types assume a uniform profile, which at many, if not all, sites will not be the case. Where the overlying profile is predominantly fine materials (clays) (i.e. > 50% for soil column), these may be considered as the generic soil type. 4. Air filled porosity is affected by moisture content, The wetter the soil, the lower the air filled porosity. Generic soil types have assumed a typical moisture content for the profile typical of average soil conditions occurring at depth. Moisture content will vary greatly by location and season. Moisture content will also vary between sub-categories of soil, e.g. between sand and dayey and. HSLs may be adjusted based on moisture content. This is done in Step 7. 5. The selection of appropriate soil type is discussed in Section 3.2 of the Application Document.	
Is there one dominant soil type on the site (> 50% of soil cclumn)? Or can a geological setting be conservatively identified (i.e. allowing greater vapour transport)? Y - Proceed N - Consideration may be given to assuming the more conservative soil type, or may be given to a site-specific HRA (refer to Section 4.6 of the Application Document)	Yes, Sand
Has excavated area(s) been backfilled with more porous materials? Y - Consideration should be given to adopting a more porous soil type (refer to Section 3.2 of the Application Document) N - Proceed	No, backfilled with sand/silty clayey sand.
Does the site lithology contain rock formations or soil with large cracks that can form preferential pathways? Y - The derived HSLs do not include lithogies with rock formations. Consideration may be given to using soil-vapour sampling or carrying out a site-specific HRA (refer to Section 4,6 of the Application Document) N - Proceed	Not noted within top 3 m of profile.
Identify HSL soil type relevant to site and assessment (above impacts) The soil profile properties have been based on a predominant soil texture grouping developed by the US Department of Agriculture. The 12 texture classes have been grouped into 3 groups: sand, silt and clay. The groupings of the classes are based on mean particle size and saturation porosities. Refer to Section 3.2 for further discussion on the soil properties.	
HSL soil type selected: Sand – Properties selected to be representative of a coarse textured undisturbed soil profile, Consists of texture classes sand, sandy clay. Silt – Properties selected to be representative of a coarse textured undisturbed soil profile, Consists of texture classes salt, salty clay. Clay – Properties selected to be representative of a fine textured undisturbed soil profile. Consists of texture classes salt, salty clay. Other – Including soil with large cracks (preferential pathways) and fractured rock (basalt, sandstone, siltstone, limestone) - refer to Section 4.6 of the Application Document, Soil vapour measurement is preferred to soil or groundwater, Due to fractures and preferential vapour pathways in rock, consideration should be given to overlying weathered soil, or to using HSLs for surface soil in sand.	Sand was most prevalent during test pitting NEPM characterisation have Clay as <10%
For soil assessment (texture classification) undertaken in accord with AS 1726 the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit less than 50%, and fine with liquid limit greater than 50% respectively. Where there is uncertainty, laboratory analysis should be carried out. This may include parameters for detailed particle analysis and exact soil texture sub-class, and saturation porosity.	



Step 4 – Impact media	Comments
Are there impacts to media other than soil and groundwater? (e.g. surface water, bicia, colours etc) Note: aesthetic issues (odours/staining/ecological impacts etc.) to be addressed separately	
Soils Are there soil impacts remaining on the site? Depth to soil impacts, Note if considering basements, depths need to be displaced e.g. a 3 m deep basement means surface to <1 m represents 3 m to <4 m. (refer to Section 2.3.3 of the Application Document) Surface to <1 m	No hydrocarbon impacts noted in soils,
Is the site of interest an uncontrolled site where excavation activities such as construction may result in subsurface soil contaminantion brought to surface in the future? Consideration may be given to use of HSLs for direct contact and surface HSLs for vapour intrusion. for deeper soils. A site management plan may be used to address uncontrolled exeavation at a site. (refer to Sections 2.3.1, 3.4.1, and 4.7 of the Application Document)	
Groundwater Are there groundwater impacts beneath the site? Y - Proceed N - Go to soil vapour section	No / low concentrations observed.
Is the depth to groundwater less than 2 m? Y - The HSL values may not adequately address this scenario, A site-specific HRA may be considered. Soll vapour sampling may be used to assess vapour intrusion, (refer to Section 2.3.3 of the Application Document)	
Depth to groundwater impacts. Note if considering basements, depths should be displaced e.g. a 3 m deep basement means surface to 2 m represents 5 m (refer to Sections 2.3.3 of the Application Document). With basements, groundwater HSLs may not adequately characterise risks where the groundwater level is within 2 m of basement foundation. 2 m to < 4 m 3 to < 8 m 4 m to < 8 m 4 m to < 8 m 5 bistance of displacement (m) 2 m to < 4 m 5 bistance of displacement (m)	Groundwater is shallow in eastern portion of site.



Step 4 - Impact media (cont.)	Comments
Soil vapour	
Has soil vapour sampling been used to characterise	
vapour intrusion at the site? N - Proceed to Step 5	No
Depth to soil impacts. Note if considering basements, depths need to be displaced e.g. a 3 m deep basement means surface to <1 m represents 3 m to <4 m.	
(Refer to Section 2.3.3 of the Application Document.)	
surface to <1 m Displacement due to basement	
1 m to <2 m Distance of displacement (m)	
2 m to <4 m	
4 m to <8 m	
8 m and deeper	
In using soil vapour sampling, please note the following:	
1) It is recommended that soil vapour samples be taken as laterally close to a vapour source as possible (within or above).	
2) Any sample taken within 1 m of the open air is subject to high levels of uncertainty due to atmospherical and meteorological effects. This includes the base and wall of excavation pits.	
3) For sites subject to redevelopment with residential or commercial buildings, the soil vapour profiles are subject to change due to presence of concrete slabs. Caution is required on the use	
of soil vapour samples that are not within a soil source and in locations where buildings currently do not exist (refer to Section 1.6 of the Application Document).	
	I



Step 5 - Selection of relevant source concentrations	Comments
Soil concentrations	
1. Is the investigation site likely Ty - Statistical analysis using entire data set may not be applicable. Consideration may be given to using the maximums or using a sub-set for statistical analysis (refer to Section 3.4.1 of the Application Document) N - Statistical analysis using entire data set may be applicable.	
2. Is the site public open space / recreational land where users are unlikely to be in the same location for extended period? Y - Statistical analysis using entire data set may not be applicable. Consideration may be given to using the maximums or using a sub-set for statistical analysis (refer to Section 3.4.1 of the Application Document) N - Statistical analysis using entire data set may be applicable	
Statistical analysis is appropriate consideration should be given to the following methodology (refer to Section 3.4.1 of the Application Document): 1. Samples should be sub-divided into appropriate depth ranges as defined by HSLs (i.e. surface to < 1 m. 1 m to < 2 m. 2 m. 2 m to < 4 m. 4 m. 1 m. 1 m. 2 m. 2 m. 2 m. 4 m. 4 m. 4 m. 2 m. 4 m. 4	
Groundwater concentrations	
Has floating product been identified in any well?	No floating product identified
(a) If PSH is identified, dissolved phase is likely to contain chemicals at solubility limits. Proceed with HSL comparison, noting that if there is at least one chemical for which HSLs in groundwater is limiting (i.e. not all chemical HSLs are NL) then presence of PSH may be a potential vapour risk to site users (refer to Section 3.4.2 of the Application Document). Also note that the presence of PSH may trigger other keyslative requirements for remediation/monitoring. Is the area of interest represented by a single groundwater processing the dwelling processing the substance of the work of the wor	
of interest may be used. Multiple - where exposure may occur over larger areas such as recreational parkland, consideration may be given to averaging the concentrations across the area of interest.	
In deciding which set of monitoring data is most useful for analysis consideration may also be given to: - Historical results to determine trends in groundwater concentrations (i.e. the likelihood that concentrations may increase) - Upgradient wells and background concentrations - Groundwater flow direction (Page to New High & A 2 of the Application Document)	



Step 5 - Selection of Relevant Source Concentrations (cont)	Comments
Soil vapour concentrations	
Is the area of interest represented by a single or multiple vapour location? Single - small area of interest such as residential dwelling may be represented by the maximum soil vapour concentration if the dwelling location is unknown, otherwise if the building footprint is known, the groundwater well nearest to the point of interest may be used. Multiple - where exposure may occur over larger areas such as recreational parkland, consideration may be given to averaging the concentrations across the area of interest.	Not applicable.
Are soil vapour samples measured in shallow soil Y - Measurements are subject to influence from weather and atmospheric conditions and may not be considered reliable. less than 0.5 m from the surface where there is no existing slab or concrete paving?	
Are soil vapour samples measured in areas where there is no existing slab or concrete paving, and the site is planned to be redeveloped where a building of soil vapour within soil and groundwater source, may not be representative of the soil vapour in the future when a building is located on site. The placement of an impermeable barrier such as a concrete slab can cause building of soil vapour weithin soil and sub-slab, above levels measured where there is no slab present. Note soil vapour measurements from within soil and groundwater sources are not subject to vapour build-up as the soil vapour is likely to be at its maximum concentration when located within the source.	
Soil vapour measurements may be taken at multiple depths, including within the source zone, above the source zone, and directly under a building foundation. Each of the measurement depths should be considered individually.	
Refer to Sections 3.4.3 and 1.6 of the Application Document.	



Step 6 - HSL determination and combined vapour intrusion and direct contact	Comments
HSL determination	
HSLs and satuaration/solubility limits are presented in the Appendix B HSL tables. Select the appropriate HSLs for vapour intrusion from tables for:	
1) Each selected receptor listed in Step 2	
2) Dominant soil texture classification listed in Step 3	
3) Source depth listed in Step 4	
HSLs may be compared to soil/groundwater/soil vapour source concentrations determined in Step 5.	
Note for TPH C6 to C10, BTEX should be subtracted from analytical result prior to comparing with HSL	
1. Is the HSL value Not Limiting 'NL'? Y - Indicates that vapour reaches saturation point and cannot increase to a point which would result in an unacceptable health risk	
N - Continue with Question 2 for groundwater, or proceed to Question 3	
2. Is groundwater HSL not 'NL' and Y - May indicate potential vapour risk (refer to Section 3.4.2 of Application Document)	
PSH identified in water? N - Proceed to Question 3	No PSH in water observed
3. Are comparisons being made against soil HSLs? Y - Proceed to Question 4	
N - Proceed to Step 5	No
4. Does direct contact need to be considered HSL-A Low-Density Residential - surface soils, and possibly subsurface soils if determined to be relevant (refer to Section 4.7	No. soil contact not considered.
4. Dees uffect or intact freed to be considered as well as vapour influsion? as well as vapour influsion? of Application Document), Process do Combined pathways exposure'	No, soil contact not considered.
dis well as vapour intusion: Graphication Density Residential – surface soils, Proceed to 'Combined pathways exposure' HSL-B High-Density Residential – surface soils, Proceed to 'Combined pathways exposure'	
TISE O pig Poensity Residential - surface sols, Proceed to Combined pathways exposure ** INSEC Open Space Recreational – surface sols, Proceed to Combined pathways exposure'	
HSL-D Commarcial / Industrial – surface soils, Proceed to 'Combined pathways exposure'	
Intrusive Maintenance Worker – down to 2 m, Proceed to "Combined patimarys exposure"	
N - Proceed to Step 5	
5. Do cross-scenario exposure need to be considered? Y - Proceed to 'Combined pathways exposure'	
(eg. adjacent residential and open space) N - Proceed to Step 7	
Combined pathways exposure	
Refer to Section 3.3 of the Application Document.	No hydrocarbons identified
Combined exposures may occur on the same property where indoor vapour intrusion occurs concurrently with outdoor direct contact.	
Combined exposure may also occur on adjacent properties, e.g. vapour intrusion on residential property and direct contact on adjacent open space (park).	
For the given scenarios/chemicals, list the HSLs.	
Where a vapour intrusion HSL is Not Limiting (NL) the chemical / scenario does not need to be considered in the combined pathway exposure.	
The combined exposure is assessed as follows:	
Multiple exposure pathways: Cumulative Fraction = Cunder Building + Coutside Building where vapour intrusion can refer to soil, groundwater or soil vapour source	1
HSL vapour Intrusion + HSL vapour + HSL va	
The state of the s	
Multiple exposure scenarios: Cumulative Fraction = C_Land use 1 + C_Land use 2 where the HSLs may refer to HSLs for vapour intrusion or direct contact	
Multiple exposure scenarios: HSL Land use 1 HSL Land use 2 HSL Land use 2	
If a given C/HSL fraction is less than 0.1, the contribution of risk may be considered insignificant and the cumulative exposure need not be assessed for this scenario.	
Where a cumulative fraction is less than 1 risk is normally acceptable. Where the value exceeds 1 a site-specific assessment should be undertaken, or proceed to Step 7.	



	Comments
adjustments (vapour intrusion only)	
aach adjustment, careful consideration and justification is required.	
apour biodegradation (refer to Section 4.2 of Application Document)	
to applying attenuation factor for vapour degradation it is recommended to read the source documentation (Davis et al. 2009).	
minimum requirements for allowing attenuation factors for vapour degradation are as follows:	
there evidence of oxygen penetration? Y - Requires measurement of oxygen in soil gas with at least 5% at 1 m depth	
efer to Section 4.2.1 of Application Document) N - Attenuation factor may not be applicable	
the source depth 2 m or deeper? Y - Continue to Point 3 Y - Continue to Point 3 N - Attenuation factor may not be applicable	No hydrocarbons observed.
IN ALEIBBOOT ECO. THEY THE BE Approved	
pes the slab have one side less than 15m length? Y - Degradation factor may apply. Less than 4 m depth, a factor of 10 may apply. 4 m and deeper, a factor of 100 may apply.	
efer to Section 4.2.3 of Application Document) N - Attenuation factor may not be applicable	Conservative assumption
pil organic carbon content (refer to Section 4.3 of Application Document)	
be used to adjust soil HSLs only. Soil HSLs were based on fraction organic carbon content of 0.003.	
	No adjustment applied,
ocarbons. If surface soil, background sample in open space may not be appropriate to use if comparing for soil under stab.	
stment is linear, i.e. doubling the organic carbon will double the HSL. Applies only to soil HSL for vapour intrusion,	
	ŀ
ir exchange rate (refer to Section 4.4 of Application Document) s are based on air exchange rate (AER) of 0.6 h ⁻¹ for residential and 0.83 h ⁻¹ for commercial, No	No adjustment applied,
aful justification may be required prior to changing AER. Consideration should be given to weather conditions, practice of leaving doors/windows open, or closed in climate controlled	vo adjustment applied,
ling. New buildings tend to be more air tight to comply with energy saving regulations.	
11	
soil and groundwater, adjustment is linear with respect to AER. soil vapour, adjustment is variable depending on soil type and depth.	
Son vapour, adjustinent is variated experiating in Sour type and seption. To the charts in Appendix D to determine the adjustment factor,	
oisture content (refer to Section 4.5 of Application Document) s may be adjusted if moisture content in soil is significantly different from baseline HSLs. The baseline moisture contents used were (dry wt) for sand 8%, silt 22% and day 20%. No	No adjustment applied.
s may be adjusted in moisure content in so in significantly directs. From basenine HSLS. The basenine moisure contents used were (or wi) no sand 8%, six 22% and day 20%. Inviture content should be representative of long-term moisture content and not short-term result from result from exit so note that for a development.	чо абразинени арршесь.
future building where no building currently exists, moisture contents on site may not be representative for the future state of the site.	
scaling factors for different land use/chemicals/soils are presented in Appendix C of the Application Document and may be applied as described in Section 4.5.	



Step 7 – HSLs and adjustments (vapour intrusion) (cont.)	Comments
Saturation/solubility limits (soil and groundwater HSLs only)	
Apply the adjustments to the HSLs for vapour intrusion by multiplying by the determined factors.	
After applying the adjustments to the HSLs, is the revised HSL greater than the solubility / saturation limit? Y - Indicates that the predicted source concentration to produce an unacceptable vapour risk is higher than the saturation point. The revised HSL is not limiting to vapour (NL). Note this does not apply to soils with direct contact. N - Revised HSL may be compared with measured source concentrations.	Not applicable. No hydrocarbons observed.
Multi-Pathway Exposure	
1. Is inclusion of direct contact with soils Y - Repeat Step 6 with Adjusted Vapour Intrusion HSLs and Direct Contact HSLs required?	
2. Is cross-scenario exposure required to be assessed? Y - Repeat Step 6 with Adjusted Vapour Intrusion HSLs and Direct Contact HSLs N - Proceed to 'Screening assessment'	
Screening assessment	
Is the adjusted HSL less than Source concentration? Y - Indicates potential health risk N - Considered within acceptable health risks, If cancer endpoint (benzene) may also need to assess cancer risk level and cumulative cancer risk in Step 8	
Is the maximum soil, groundwater or soil-vapour concentration greater than the HSL by more than one or two orders of magnitude? Y - Indicates potential acute risk around hotspot N - Considered within acceptable health risks	
If the screening assessment indicates the potential for unacceptable health risk, consideration may be given to further investigations such as further contaminantion definiation, site-specific health risk assessment or site management. Before deciding the appropriate form of action considerations should include: - The magnitude of HSL exceedence - The nature of the source - The time frame required for managing health risks - Other statutory requirements	Not applicable



Step 8 – Cancer risk assessment	Comments
Acceptable cancer risk (Refer to Section 5.1 of Application Document) HSLs for benzene have been based on 1 x 10° cancer risk. In some jurisdictions it may be required to assess carcinogenic risks based on 1 x 10° cancer risk. The HSLs are linearly related to acceptable risk. HSLs based on a cancer risk of 1 x 10° may be calculated by dividing the HSLs in Appendix B by a factor of 10. The HSLs are linearly related to acceptable risk. HSLs based on a cancer risk of 1 x 10° may be calculated by dividing the HSLs in Appendix B by a factor of 10. The HSLs are linearly related to acceptable risk. HSLs based on a cancer risk of 1 x 10° may be calculated by dividing the HSLs in Appendix B by 10 would result in an acceptable risk. Hence there is no need to proceed further. The HSLs are linearly related to calculate the revised HSL from the non-limiting HSL. This process is outlined as follows:	No cumulative exposure assessment conducted as none of the applicable compounds were detected above LOR. Therefore no adjustment factor applied.
Calculating revised HSL for 10 ⁶ cancer risk from non-limiting HSL. 1) The non-limiting HSLs are presented in Friebel & Nadebaum 2011 (Part 1). 2) The derived HSLs are presented in Appendix F. 3) Find the pages that correspond to the source type (soil, groundwater, soil vapour) for the given scenario (residential / commercial / recreational / intrusive maintenance). Note indicator chemicals and TPH have been separated. 4) For the corresponding soil category, depth and chemical, the Vapour Intrusion HSL and saturation/solubility concentration is presented in the columns on the right. 5) If this HSL is divided by 10 and the result is greater than Csat (for soil) or saturation limit (for groundwater), then the revised HSL is still NL. Otherwise the result is the revised Vapour HSL.	HSL applied with no division conducted
Cumulative cancer risk (Refer to Section 3.6.1 of Application Document) HSLs for benzene have been based on 1 x 10 ⁻⁵ cancer risk. In most jurisdictions it is required to assess total carcinogenic risks based on 1 x 10 ⁻⁵ cancer risk. If HSLs are not NL for benzene and another carcinogenic chemical is identified, such as PAHs, follow the proedure outlined in Section 3.6.1. The-cumulative fraction may also be applied to more than two chemicals.	HSL for benzene has been applied with no adjustment factor applied. Not applicable. Not applicable.
Note that multiple sources should be considered. For example, a resident may be exposed through direct contact with PAHs in surface soil, but also benzene vapours from soil and groundwater. For vapour risk (benzene), the risk contribution should consider the greatest risk for the receptor from all vapour sources. Because multiple sources/depths the source concentration should be divided by their respective HSLs to calculate the benzene contribution to cumulative risk. The highest fraction determines which source poses the greatest risk to receptors. The same may be carried out for carcinogenic PAHs. The sum of the highest benzene fraction and the highest PAH fraction results in the highest possible cumulative fraction.	No petrogenic hydrocarbons identified therefore risk not further considered

Appendix O Quality Assurance and Quality Control Assessment

APPENDIX O: QUALITY CONTROL AND QUALITY ASSURANCE EVALUATION

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1 OVERVIEW

1.1 Guidelines

Sampling and analysis was undertaken in general accordance with the following guidance documentation:

- Assessment and Management of Contaminated Sites. Contaminated Sites Guidelines (DER, 2014)
- National Environment Protection (Assessment of Site Contamination) Measure. Schedule B (2) Guideline on Data Collection, Sample Design and Reporting (NEPC, 2013)
- Water Quality Sampling Part 1: Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples (Standards Australia, 1998, AS/NZS 5667.1:1998).

Strict hygiene procedures were applied throughout to assure sample integrity and quality, including the decontamination of all sampling equipment between sampling locations to prevent possible cross-contamination.

Consistent with aforementioned guidance documentation, quality control procedures included the collection and analysis of field duplicate and triplicate samples for every 20 samples (minimum) collected (per matrix) submitted for analysis. The primary laboratory used during this investigation was MPL, with ALS assuming the role of the secondary laboratory for analysis of the field triplicate samples.

Field blanks, rinsates and trip blanks were also collected to assess the presence of contamination during sampling, laboratory preparation / analysis, or transport. Such samples were collected on each day of sampling.

1.1.1 Soils

In addition to the guidelines in Section 1.1, soil sampling was conducted in accordance with the following guidance:

• Standards Australia. 2005. AS 4482.1. Guide to the Sampling and Investigation of Potentially Contaminated Soil. Part 1: Non-volatile and Semi-volatile Compounds. www.standards.com.au.

For the sampling of duplicate and triplicates, the soil in the relevant sampling interval was homogenised onsite and then spilt between the relevant sampling containers.

1.1.2 Groundwater

In addition to the guidelines in Section 1.1, groundwater sampling was conducted in accordance with the following guidance:

- Standards Australia. 1998. Water Quality—Sampling. Part 11: Guidance on Sampling of Groundwaters (AS/NZS 5667.11:1998)
- Standards Australia. 1998. Water Quality—Sampling. Part 1: Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples (AS/NZS 5667.1:1998)
- Victorian Environmental Protection Agency (VEPA). 2000. *Groundwater Sampling Guidelines* (VEPA, 2000).

For the sampling of duplicate and triplicates, sample was pumped directly into the sampling containers from the sampling tubing, filling the bottles in turn by a quarter until the bottles were filled with no headspace. This ensured a representative sample was collected in each bottle.

1.1.3 Surface Water

In addition to the guidelines in Section 1.1, surface water sampling was conducted in accordance with the following guidance:

• Standards Australia. 1998. Water Quality—Sampling. Part 4: Guidance on sampling from lakes, natural and man-made (AS/NZS 5667.4:1998) or

For the sampling of duplicate and triplicates, sample was collected directly into the sampling containers from the same location or spilt from a single sampling container. This ensured a representative sample was collected and submitted to both laboratories.

1.2 Quality Control Criteria

RPS requires that laboratories have a quality control and quality assurance (QAQC) program that is endorsed by National Association of Testing Authorities (NATA) and meets the following criteria:

• Relative percentage differences (RPDs) between original and duplicate samples to range between +/- 30%. If the RPD is greater than +/-30%, the higher value is used for evaluation purposes.

Calculation of the RPD value is provided in the following equation:

$$\% RPD = \left[\frac{C_O - C_S}{\left(\frac{C_O - C_S}{2} \right)} \right] \times 100$$

where: C₀ denotes concentration of the original sample

Cs denotes the concentration of the duplicate sample

The RPD calculation was used to normalise each pair of results to allow for QAQC data interpretation. For those RPD values which exceed a generally acceptable 30–50% (Standards Australia, 2005) data correlation is considered poor, however, consideration needs to be given to sample homogeneity and the concentrations detected.

• Concentrations of target analytes within the field blanks, rinsates and trip blanks to be below the respective Limit of Reporting (LOR).

1.3 Sample Preservation

Samples were stored in the applicable sterilised and preserved, as required, sample containers provided by the laboratory prior to sample collection with zero head space.

1.3.1 Sample Transportation and Storage

Following collection, samples were sealed in the appropriate container and immediately stored in a clean cooler (esky) containing ice until delivery to the laboratory.

A chain of custody (CoC) form accompanied the samples during transport and delivery. This form was signed by each individual responsible for the samples including RPS and laboratory personnel. Sample receipt advice was obtained from the laboratory noting temperature and condition of samples on delivery.

1.4 Decontamination Procedures

Strict hygiene procedures were applied throughout to assure sample integrity and quality, including the decontamination of all sampling equipment between sampling locations to prevent possible cross-contamination. Disposable nitrile gloves will be worn when handling and collecting the samples. Clean, new gloves will be worn for the collection of each soil sample and for the undertaking of surface water and or groundwater collection at each sample location.

All sample collection equipment utilised in soil, surface and groundwater collection was subjected to rigorous decontamination procedures to prevent cross-contamination of samples, comprising the following sequence:

- a. Remove adhered soils/sediment using scrapers, brushes and sponges.
- b. Wash thoroughly utilising deionised water with decon90
- c. Inspect equipment for any residues.
- d. Repeat (b) and (c) until no evidence of residues.
- e. Rinse thoroughly with de-ionised water.

All sample collection equipment utilised in groundwater or surface water collection was subjected to decontamination procedures described above, in addition to the following (where applicable):

- Tubing was replaced at each sampling location.
- Collection of samples was undertaken directly into laboratory supplied sampling containers.

1.5 Sample Quality Control

Quality assurance and quality control procedures was generally implemented as advocated in the abovementioned guideline documents. Quality control samples will be collected during the program as follows:

- Field duplicate samples will be collected at a minimum rate of one per 20 primary samples submitted for analysis per sample matrix, and issued to the primary laboratory for analysis.
- Field triplicate samples will be collected at a minimum rate of one per 20 primary samples submitted for analysis per sample matrix, and issued to the secondary laboratory for analysis.
- Field rinsate samples collected daily following the decontamination of sampling equipment after sampling, to determine whether any cross-contamination from the sampling equipment may have occurred and assess whether decontamination procedures are adequate.
- Field/Trip blanks (samples of de-ionised water used for rinsing which are placed in the esky during field work and transport to the laboratory) to check for any atmospheric cross-contamination during sampling or in transit.

1.6 Calibration Records

All field equipment was calibrated at the beginning of each sampling day in accordance with the instrument's manual. A record of calibration was maintained for each piece of field equipment, detailing the type of equipment, the serial number and success of calibration.

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2 FIELD QAQC EVALUATION

2.1 Sampling Frequencies

RPS proposed to collect field duplicate and triplicate samples at a minimum frequency of 1 per 20 primary samples analysed per sample matrix.

The following table (Table O.1) provides a summary of the numbers of primary and duplicate/triplicate samples collected, and the respective frequencies have been normalised to represent the number of QAQC samples per 20 primary samples for each matrix. As such, where the normalised number is <1, field QAQC samples have been collected at a lower frequency than that nominated and have been shaded.

Table O.1: Sampling Frequency Summary

Matrix	Primary (#)	Duplicates (#)	Triplicates (#)	Duplicate (normalised)	Triplicate (normalised)
QAQC meets red	quired frequency				
QAQC does not	meet required from	equency			
Soil	33	2	2	1	1
Groundwater	7	1	1	1	1
Surface Water	2	1	1	1	1

2.2 Soil

2.2.1 Investigation Field QAQC Summary

In accordance with the SAQP and QAQC requirements (RPS, 2020), RPS collected a field duplicate and triplicate samples at a minimum frequency of 1 per 20 primary samples per sample matrix. Table O.2 below presents the field QAQC samples collected during the soil sampling exercise and respective analytes that were analysed.

Table O.2: Soil investigation QAQC summary

			Analyte		
QAQC Type	Primary Sample	QAQC Sample	Metals	Radionuclides	
Field duplicate	TP01-S06	TPZ1	✓	✓	
Field duplicate	TP21-S06	TPZ2	✓	✓	
Field triplicate	TP01-S06	TPZZ1	✓	✓	
	TP21-S06	TPZZ2	✓	√	

2.2.2 Field Duplicates

A total of 35 of the 44 analyte tests (~80%) performed on the field duplicate samples had an RPD within 30% of the original samples. Table F presents all soil sample RPD calculations; Table O.3 below provides a summary of all soil duplicate exceedances.

Table O.3: Soil duplicate RPD failures

Sample ID	Analyte	LOR (mg/kg)	Significance (5 × LOR)	Sample Concentration (mg/kg)
TP01-S06	- Boron	3	15	6
TPZ1	Boron	3	15	4
TP01-S06		1	5	3
TPZ1	Lead	1	5	2
TP01-S06	.,	1	5	3
TPZ1	Vanadium	1	5	2
TP01-S06	Uranium	0.1	0.5	0.3
TPZ1		0.1	0.5	0.2
TP21-S06		1	5	1
TPZ2	Chromium (VI)	1	5	3
TP21-S06		1	5	110
TPZ2	Manganese	1	5	150
TP21-S06		1	5	2
TPZ2	Nickel	1	5	3
TP21-S06		1	5	16
TPZ2	Vanadium	1	5	22
TP21-S06		1	5	1
TPZ2	Zinc	1	5	2

Denotes insignificant error where both primary and QAQC sample concentrations are <5x LOR Denotes significant error where either primary and/or QAQC sample concentrations are <5x LOR

A review of the observed exceedances concludes the following:

- RPS considered seven of the nine total exceedances insignificant as concentrations of both the primary and duplicate samples were <5x LOR of the primary laboratory. There results merely reflect that analytical test precision decreases as analyte concentration approach the limit of detection.
- The two remaining exceedances were considered significant as analyte concentrations of both samples were >5x LOR of the primary laboratory. These exceedances could potentially be a consequence of sample heterogeneity, common in soil samples that contain gravel and similar inclusions that render the soil non-homogeneous. In both exceedances RPS considered significant the duplicate concentration was higher than the primary sample. RPS has adopted a conservative approach and adopted the higher value to characterise the soil quality of the site.

Although a number of soil duplicate RPD failures were identified they are not considered to have affected the integrity of the data collected or the overall site assessment. As such the assessment of field duplicate samples indicates the sampling and analysis procedures applied by RPS and the laboratory were generally reproducible.

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2.2.3 Field Triplicates

A total of 40 of the 44 analyte tests (~91%) performed on the field triplicate samples had an RPD within 30% of the original samples. Table F (contained at the rear of the main report) presents all soil sample RPD calculations; Table O.4 below provides all soil triplicate exceedances.

Table O.4: Soil triplicate RPD failures

Sample ID	Analyte	LOR (mg/kg)	Significance (5 × LOR)	Sample Concentration (mg/kg)
TP01-S06	Chromium (total)	1	5	5
TPZZ1	Chromium (total)	2	10	7
TP01-S06	Chromium (III)	1	5	5
TPZZ1	TPZZ1 Chromium (III)		10	7
TP01-S06			2.5	<0.5
TPZZ1	- Thorium	0.1	0.5	0.8
TP21-S06	Thereine	0.5	2.5	2
TPZZ2	- Thorium	0.1	0.5	3.3

Denotes insignificant error where both primary and QAQC sample concentrations are <5x LOR

Denotes significant error where either primary and/or QAQC sample concentrations are equal to or >5x LOR

A review of the observed exceedances concludes the following:

• RPS considered all four of the observed exceedances as significant as the analyte concentrations of either the primary or secondary sample was >5x LOR of the respective laboratory. These exceedances could potentially be a consequence of sample heterogeneity, common in soil samples that contain gravel and similar inclusions that render the soil non-homogeneous. In all four exceedances the secondary samples concentration was higher than the primary sample. RPS has adopted a conservative approach and adopted the higher value to characterise the soil quality of the site.

Although a number of soil duplicate RPD failures were identified they are not considered to have affected the integrity of the data collected or the overall site assessment. Additionally, all sample concentrations were significantly below adopted guideline values. As such the assessment of field duplicate samples indicates the sampling and analysis procedures applied by RPS and the laboratory were generally reproducible.

2.3 Groundwater

2.3.1 Investigation Field QAQC Summary

In accordance with the SAQP and QAQC requirements (RPS, 2020), RPS collected a field duplicate and triplicate samples at a minimum frequency of 1 per 20 primary samples per sample matrix. Table O.5 below presents the field QAQC samples collected during the soil sampling exercise and respective analytes that were analysed.

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Table O.5: Groundwater investigation QAQC summary

			Analyte					
QAQC Type	Primary Sample	QAQC Sample	Metals	Radionuclides	Nutrients	BTEXN	ТКН	
Field duplicate	DM9S	WZ1	✓	✓	✓	✓	✓	
Field triplicate	DM9S	WZZ1	✓	√	✓	✓	✓	

Note: BTEX = Benzene, Toluene, Ethylbenzene, Xylene and Naphthalene, TRH = Total Recoverable Hydrocarbons

2.3.2 Field Duplicates

A total of 56 of the 57 analyte tests (~98%) performed on the field duplicate samples had an RPD within 30% of the original samples. Tables G and H (contained at the rear of the main report) present all RPD calculations; Table O.6 below provides a summary of all groundwater duplicate exceedances.

Table O.6: Groundwater duplicate RPD failures

Sample ID	Analyte	LOR (mg/L)	Significance (5 × LOR)	Sample Concentration (mg/L)
DM9S	Chromium (III)	0.005	0.025	0.016
WZ1	Chromium (III)	0.005	0.025	0.023

Denotes insignificant error where both primary and QAQC sample concentrations are <5x LOR

Denotes significant error where either primary and/or QAQC sample concentrations are >5x LOR

A review of the observed exceedances concludes the following:

• RPS considers the one observed RPD exceedance insignificant as the concentration of the primary and secondary sample were <5x LOR of their respective laboratories. The results merely reflect that analytical test precision decreases as analyte concentration approach the limit of detection.

As such the assessment of field duplicate samples indicates the sampling and analysis procedures applied by RPS and the laboratory were generally reproducible.

2.3.3 Field Triplicates

A total of 54 of the 57 analyte tests (~95%) performed on the field triplicate samples had an RPD within 30% of the original samples. Tables G and H (contained at the rear of the main report) present all RPD calculations; Table O.7 below provides all groundwater triplicate exceedances.

Table 0.7: Groundwater triplicate RPD failures

Sample ID	Analyte	LOR (mg/L)	Significance (5 × LOR)	Sample Concentration (mg/L)
DM9S	Chromium (III)	0.005	0.025	0.016
WZZ1	Chromium (III)	0.001	0.005	0.026
DM9S	Total Kjeldahl	0.1	0.5	<0.1
WZZ1	Nitrogen	0.1	0.5	0.5
DM9S	Phosphate as P	0.005	0.025	0.033

Sample ID	Analyte	LOR (mg/L)	Significance (5 × LOR)	Sample Concentration (mg/L)
WZZ1		0.01	0.05	0.02

Denotes insignificant error where both primary and QAQC sample concentrations are <5x LOR

Denotes significant error where either primary and/or QAQC sample concentrations are equal to or >5x LOR

A review of the observed exceedances concludes the following:

RPS considered all three RPD exceedances significant as the analyte concentrations of either the primary
or secondary sample was >5x LOR of their respective laboratories. The discrepancy may have been
caused by minor variations in the groundwater samples composition. The secondary sample
concentration was higher in two of the three exceedances. A conservative approach was adopted, and
the higher value have been used for data analysis. As such the RPD failures were not considered to have
affected the related validation assessments.

Although RPD failures were observed, they were not considered to have had an impact on the overall assessment. As such the assessment of field triplicate samples indicates the sampling and analysis procedures applied by RPS, the primary and secondary laboratories were generally reproducible.

2.4 Surface Water

2.4.1 Investigation Field QAQC Summary

In accordance with the SAQP and QAQC requirements, RPS collected a field duplicate and triplicate samples at a minimum frequency of 1 per 20 primary samples per sample matrix. Table O.8 below presents the field QAQC samples collected during the soil sampling exercise and respective analytes that were analysed.

Table O.8: Surface Water investigation QAQC summary

					Analyte		
QAQC Type	Primary Sample	QAQC Sample	Metals	Radionuclides	Nutrients	BTEXN	ТКН
Field duplicate	SW02	SWZ1	✓	✓	✓	✓	✓
Field triplicate	SW02	SWZZ1	✓	✓	✓	✓	✓

Note: BTEX = Benzene, Toluene, Ethylbenzene, Xylene and Naphthalene, TRH = Total Recoverable Hydrocarbons

2.4.2 Field Duplicates

A total of 56 of the 57 analyte tests (~98%) performed on the field duplicate samples had an RPD within 30% of the original samples. Tables I and J (contained at the rear of the main report) present all surface water RPD calculations; Table O.9 below provides a summary of all surface water duplicate exceedances.

Table O.9: Surface Water duplicate RPD failures

Sample ID	Analyte	LOR (mg/kg)	Significance (5 × LOR)	Sample Concentration (mg/kg)
SW01	7:	0.001	0.005	0.004
SWZZ1	Zinc	0.001	0.005	0.011

Denotes insignificant error where both primary and QAQC sample concentrations are <5x LOR Denotes significant error where either primary and/or QAQC sample concentrations are >5x LOR

A review of the observed exceedances concludes the following:

RPS considered the single RPD exceedance significant as the concentration of the secondary sample
was >5x LOR. The discrepancy may have been caused by minor variations in the surface water samples
composition. A conservative approach was adopted, and the higher value have been used for data
analysis. Additionally, the concentrations of the primary and secondary sample were both significantly
below the adopted guideline values. As such the RPD failures were not considered to have affected the
related validation assessments.

As such the assessment of field duplicate samples indicates the sampling and analysis procedures applied by RPS and the laboratory were generally reproducible.

2.4.3 Field Triplicates

A total of 56 of the 57 analyte tests (~98%) performed on the field triplicate samples had an RPD within 30% of the original samples. Tables I and J (contained at the rear of the main report) present all surface water RPD calculations; Table O.10 below provides all surface water triplicate exceedances.

Table 0.10: Surface Water triplicate RPD failures

Sample ID	Analyte	LOR (mg/kg)	Significance (5 × LOR)	Sample Concentration (mg/kg)
SW02	Zina	0.001	0.005	0.004
SWZZ2	Zinc	0.005	0.025	0.006

Denotes insignificant error where both primary and QAQC sample concentrations are <5x LOR

Denotes significant error where either primary and/or QAQC sample concentrations are equal to or >5x LOR

A review of the observed exceedances concludes the following:

• RPS considered the single triplicate RPD exceedance insignificant as the concentrations of both the primary and secondary sample were <5x LOR of their respective laboratories. These results merely reflect that analytical test precision decreases as analyte concentrations approach the limit of detection.

Although an RPD failure was observed, it was not considered to have had an impact on the overall assessment. As such the assessment of field triplicate samples indicates the sampling and analysis procedures applied by RPS, the primary and secondary laboratories were generally reproducible.

2.5 Rinsate, Blank and Trip Blanks

In accordance with SAQP (RPS, 2020) quality assurance and quality control requirements, RPS collected a field, rinsate and trip blank samples at a minimum frequency of one per day of sampling or per batch for trip blanks. Complete results are provided in Tables K and L (contained at the rear of the main report), and present all blank, rinsate and trip blank results. The following Table O.11 presents a summary of the blank, rinsate and trip blank QAQC completed to assess the integrity of the data collected.

Table O.11: Field, rinsate and trip blank QAQC summary

			Ana	lyte		
Matrix	QAQC	Sample ID	Metals	Radionuclides	Nutrients	BTEXN
	Blank	WB1	✓	✓	✓	✓
Groundwater	Rinsate	WR1	✓	✓	✓	✓
	Trip	WTB1	-	-	-	✓

			Analyte			
Matrix	QAQC	Sample ID	Metals	Radionuclides	Nutrients	BTEXN
	Blank	WB2	✓	✓	-	-
	ыапк	WB3	✓	✓	-	-
Soil	Rinsate	WR2	✓	✓	-	-
		WR3	✓	✓	-	-
	Trip	-	✓	✓	-	-
	Blank	WB4	✓	✓	✓	✓
Surface Water	Rinsate	WR4	✓	✓	✓	✓
	Trip	WTB2	-	-	-	✓

Note: BTEX = Benzene, Toluene, Ethylbenzene, Xylene and Naphthalene, TRH = Total Recoverable Hydrocarbons.

Concentrations for analytes in field, rinsate and trip blanks were generally below their respective laboratory LORs however, exceedances were observed in a total of five of the 354 analyses completed. Table O.12 below summaries the exceedances.

Table O.12: Field, rinsate and trip blank QAQC exceedances

Sample ID	Analyte	LOR (mg/L)	Significance (5 × LOR)	Sample Concentration (mg/L)
WB2	Zinc	0.001	0.005	0.002
WB4	Zinc	0.001	0.005	0.002
WR1	Zinc	0.001	0.005	0.002
WR2	Zinc	0.001	0.005	0.004
WR3	Zinc	0.001	0.005	0.004

Denotes insignificant error where QAQC sample concentration is <5x LOR Denotes significant error where QAQC sample concentration is >5x LOR

An evaluation of the observed exceedances concludes the following:

RPS considered the observed zinc exceedances insignificant as they were only marginally higher than the LOR. These concentrations may be attributed to laboratory contamination or the rinsate water used for the decontamination process. Additionally, all zinc concentrations observed in the blanks were significantly lower than the adopted guideline values.

Therefore, the exceedances were not considered to have affected the overall soil, surface and groundwater assessment, with any trace rinsate water used during sample collection having an insignificant impact of resultant primary sample concentrations.

2.6 Summary

Although various QAQC failures were identified, they are not considered to have affected the integrity of the data collected or the resultant overall site assessment, and the data collected is considered suitable to use to characterise the site.

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3 LABORATORY QAQC EVALUATION

3.1 Soil Investigation Laboratory QAQC Summary

In accordance with ISO/IEC 17025:2005, the NATA accredited laboratories were required to perform various internal QAQC procedures to ensure integrity of analytical results.

Standard laboratory methods were used throughout the program by the National Association of Testing Authorities (NATA) accredited laboratories with a summary of QAQC procedures implemented and details any outliers by the laboratory for each area presented below.

3.2 Laboratory Limits of Reporting

All analytes limits of reporting were within normal laboratory established values, with the exception of hydrocarbon for several samples as samples required dilution. All LORs were lower than the lowest adopted screening level, for each analyte.

3.3 Laboratory Method Blanks

No laboratory method blank results were above their respective analyte LORs, indicating no contamination occurred during the sample preparation or subsequent analysis.

3.4 Laboratory Control Samples

All laboratory control samples (LCS) were reported within acceptable criteria. As such, the data provided is considered to be suitable to represent site conditions and acceptable recovery rates for the samples.

3.5 Laboratory Duplicates

NATA accredited laboratories typically extract and or analyse internal duplicates at a frequency of on per ten samples. Internal laboratory duplicates were within the acceptance criteria for each respective analyte. As such, the data provided is considered to be suitable to represent site conditions and acceptable recovery rates for the samples.

3.6 Surrogates

All surrogate recoveries were within the acceptance criteria, indicating minimal sample matrix interferences were observed.

3.7 Matrix Spikes

Matrix spike recoveries were generally within the acceptance criteria, indicating minimal sample matrix interferences were observed. However, the following matrix spike failures were observed for triplicate samples:

- Several metals (Ag, Al, Cr, Cr(VI), Mo, Mn, V and Th) and calcium in the CEC
- Hexavalent chromium matrix spike failed for sample TPZZ1 and TPZZ2 due to low recovery
- Total phosphorous as P matrix spike recovery was not determined as the sample concentration was significantly higher than the spike concentration.

RPS considers both failures insignificant as they are a reflection of the sample matrix and not the analytical method used. Additionally, other QAQC criteria was within acceptable limits and as such it was assumed by the laboratory that analytical data was suitable for reporting.

3.8 Sample Holding Time Evaluation

All samples were transported to the laboratory within the recommended holding time for each analyte. Extraction and analysis typically occurred within the recommended holding time for each analyte, with the exception of pH for one sampling event (15/12/20). Samples were delivered to the laboratory within holding time and as such this is considered a laboratory error.

3.9 Summary

Although QAQC failures were identified, they are not considered to have affected the integrity of the data collected or the resultant overall site assessment. As such, the data collected is considered suitable to use to characterise the site.

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4 DOCUMENTATION AND DATA

4.1 Documentation Completeness

Chain of Custody (CoC) documentation was submitted to the laboratory together with the samples and is provided within Appendix C with the laboratory Certificates of Analysis. These were signed by the personnel accepting the samples and included the following information:

- sampling location and job reference number
- sample ID
- date
- name of sampler
- name of Project Manager
- requested suite of analysis
- type of sample preservation (if any)
- date and time and signature verifying release to the laboratory
- date and time and signature verifying acceptance from the laboratory.

For each QAQC sample the identifier and sample type were noted. The sampler, sampling conditions, date, and place at which the samples were taken are recorded on the log sheet. All QAQC samples are recorded on CoCs.

All QAQC samples submitted to a NATA accredited laboratory for analysis have a signed laboratory report detailing the results of the analysis.

4.2 Data Completeness

All samples designated for chemical analysis were determined based on the historic and current site use and previous findings. All sampling and analysis was undertaken in general accordance with DWER, and NEPC requirements.

4.3 Data Comparability

There are a number of factors that contribute to, or detract from, data comparability. These can be grouped into two general categories, factors related to sample collection and handling, and factors related to the analytical methods used. Sample collection issues include sample support (i.e. exactly what was sampled) and acquisition techniques, environmental conditions at the time of sampling, and sample handling/preservation methods. Analytical issues related to data comparability include sample preparation, clean up, and determinative methods used. Analytical surety in this monitoring investigation was addressed by employing NATA accredited laboratories.

Sample collection issues were addressed by utilising laboratory issued, standard collection bottles appropriate for the analytes of interest, the use of rigorous decontamination procedures, using appropriate preservation and storage techniques and by keeping storage times to a minimum. These measures generally maintain, as much as is practically possible, the comparability of data between chronologically separate sampling events.

4.4 Data Representativeness

The sample set detailed above was determined to be sufficiently representative of the site for the purpose of the program. The sample results were subjected to analytical data validation and it was concluded that the results could be used to confirm the conclusions about the quality of soil, surface and groundwater at the site.

4.5 Data Comparability Checks

The samples were collected by trained field scientists throughout the sampling program. The field scientists followed the RPS field manuals and employed identical sampling methodology and techniques.

Appendix P Laboratory Reports



Envirolab Services (WA) Pty Ltd trading as MPL Laboratories

ABN 53 140 099 207 16-18 Hayden Court Myaree WA 6154 ph 08 9317 2505 fax 08 9317 4163 lab@mpl.com.au www.mpl.com.au

CERTIFICATE OF ANALYSIS 254723

Client Details	
Client	RPS Australia West Pty Ltd
Attention	Alan Foley
Address	Level 2, 27-31 Troode St, WEST PERTH, WA, 6005

Sample Details	
Your Reference	EEC14081.004 - Green Patch
Number of Samples	11 Water
Date samples received	15/12/2020
Date completed instructions received	15/12/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details		
Date results requested by	21/12/2020	
Date of Issue	21/12/2020	
NATA Accreditation Number 2901. This document shall not be reproduced except in full.		
Accredited for compliance with ISO/IEC 17025 - Testing. Tests not covered by NATA are denoted with *		

Results Approved By

Heram Halim, Operations Manager Michael Kubiak, Laboratory Manager Todd Lee, Group Operations Manager Travis Carey, Organics - Team Leader **Authorised By**

Michael Kubiak, Laboratory Manager



Miscellaneous Inorganics							
Our Reference			254723-1	254723-2	254723-3	254723-4	254723-5
Your Reference	UNITS	PQL	DM1RS	DM1RD	DM9S	DM9D	MW02
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		15/12/2020	15/12/2020	15/12/2020	15/12/2020	15/12/2020
Date analysed	-		15/12/2020	15/12/2020	15/12/2020	15/12/2020	15/12/2020
Electrical Conductivity (EC)	μS/cm	1	3,000	1,500	1,300	1,200	1,300
Total Dissolved Solids (grav)	mg/L	5	1,900	890	850	760	850

Miscellaneous Inorganics							
Our Reference			254723-6	254723-7	254723-8	254723-9	254723-10
Your Reference	UNITS	PQL	PB10(JDA02)	PB8(JDA01)	WZ1	WB1	WR1
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		15/12/2020	15/12/2020	15/12/2020	15/12/2020	15/12/2020
Date analysed	-		15/12/2020	15/12/2020	15/12/2020	15/12/2020	15/12/2020
Electrical Conductivity (EC)	μS/cm	1	1,100	780	1,300	3	2
Total Dissolved Solids (grav)	mg/L	5	710	510	830	<5	<5

Ionic Balance							
Our Reference			254723-1	254723-2	254723-3	254723-4	254723-5
Your Reference	UNITS	PQL	DM1RS	DM1RD	DM9S	DM9D	MW02
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		21/12/2020	21/12/2020	21/12/2020	21/12/2020	21/12/2020
Date analysed	-		21/12/2020	21/12/2020	21/12/2020	21/12/2020	21/12/2020
Calcium - Dissolved	mg/L	0.5	160	110	110	70	110
Potassium - Dissolved	mg/L	0.5	19	8.9	5.5	8.6	16
Magnesium - Dissolved	mg/L	0.5	55	29	40	17	20
Sodium - Dissolved	mg/L	0.5	390	160	110	120	140
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	400	370	330	160	410
Carbonate CO₃ ²- as CaCO₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH⁻ as CaCO₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO₃	mg/L	5	400	370	330	160	410
Chloride	mg/L	1	600	250	180	260	160
Sulphate	mg/L	1	230	64	89	41	72
Ionic Balance	%		0.090	-1.7	0.74	-3.7	-2.9
Hardness as CaCO₃	mg/L	3	620	400	440	240	350

Ionic Balance							
Our Reference			254723-6	254723-7	254723-8	254723-9	254723-10
Your Reference	UNITS	PQL	PB10(JDA02)	PB8(JDA01)	WZ1	WB1	WR1
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		21/12/2020	21/12/2020	21/12/2020	21/12/2020	21/12/2020
Date analysed	-		21/12/2020	21/12/2020	21/12/2020	21/12/2020	21/12/2020
Calcium - Dissolved	mg/L	0.5	96	70	110	<0.5	<0.5
Potassium - Dissolved	mg/L	0.5	14	9.0	5.5	<0.5	<0.5
Magnesium - Dissolved	mg/L	0.5	20	13	40	<0.5	<0.5
Sodium - Dissolved	mg/L	0.5	110	75	110	<0.5	<0.5
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	280	290	330	<5	<5
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH⁻ as CaCO₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO₃	mg/L	5	280	290	330	<5	<5
Chloride	mg/L	1	140	67	180	<1	<1
Sulphate	mg/L	1	83	20	89	<1	<1
Ionic Balance	%		0.28	0.066	-0.097	0	0
Hardness as CaCO₃	mg/L	3	320	230	440	<3	<3

Nutrients in Water							
Our Reference			254723-1	254723-2	254723-3	254723-4	254723-5
Your Reference	UNITS	PQL	DM1RS	DM1RD	DM9S	DM9D	MW02
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/12/2020	16/12/2020	16/12/2020	16/12/2020	16/12/2020
Date analysed	-		16/12/2020	16/12/2020	16/12/2020	16/12/2020	16/12/2020
Total Nitrogen	mg/L	0.1	2.1	0.8	1.9	0.3	8.5
Total Kjeldahl Nitrogen	mg/L	0.1	<0.1	0.8	<0.1	0.3	6.3
Nitrate as N	mg/L	0.005	2.0	0.006	1.9	<0.005	2.2
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	0.049
NOx as N	mg/L	0.005	2.0	0.006	1.9	<0.005	2.3
Ammonia as N	mg/L	0.005	0.048	0.33	<0.005	0.18	<0.005
Total Phosphorus	mg/L	0.05	80.0	0.09	<0.05	0.16	1.4
Phosphate as P	mg/L	0.005	0.056	<0.005	0.033	<0.005	<0.005

Nutrients in Water							
Our Reference			254723-6	254723-7	254723-8	254723-9	254723-10
Your Reference	UNITS	PQL	PB10(JDA02)	PB8(JDA01)	WZ1	WB1	WR1
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/12/2020	16/12/2020	16/12/2020	16/12/2020	16/12/2020
Date analysed	-		16/12/2020	16/12/2020	16/12/2020	16/12/2020	16/12/2020
Total Nitrogen	mg/L	0.1	1.2	0.7	1.9	<0.1	<0.1
Total Kjeldahl Nitrogen	mg/L	0.1	0.2	0.7	<0.1	<0.1	<0.1
Nitrate as N	mg/L	0.005	0.92	0.058	1.9	<0.005	<0.005
Nitrite as N	mg/L	0.005	0.021	<0.005	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	0.94	0.059	1.9	<0.005	<0.005
Ammonia as N	mg/L	0.005	0.011	0.005	<0.005	<0.005	<0.005
Total Phosphorus	mg/L	0.05	0.10	0.11	<0.05	<0.05	<0.05
Phosphate as P	mg/L	0.005	0.011	0.012	0.030	<0.005	<0.005

Dissolved Metals in Water							
Our Reference			254723-1	254723-2	254723-3	254723-4	254723-5
Your Reference	UNITS	PQL	DM1RS	DM1RD	DM9S	DM9D	MVV02
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Date analysed	-		17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Dissolved CrVI	mg/L	0.005	<0.005	<0.005	0.18	<0.005	<0.005
Dissolved CrIII	mg/L	0.005	<0.005	<0.005	0.016	<0.005	<0.005
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic-Dissolved	mg/L	0.001	0.002	0.008	0.002	0.003	0.002
Boron-Dissolved	mg/L	0.02	0.2	0.09	0.09	0.04	0.07
Barium-Dissolved	mg/L	0.001	0.051	0.17	0.028	0.49	0.023
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium-Dissolved	mg/L	0.001	0.001	<0.001	0.20	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	0.02	0.57	<0.01	20	0.01
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Manganese-Dissolved	mg/L	0.005	0.009	0.15	<0.005	0.10	<0.005
Molybdenum-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	<0.001	0.001
Nickel-Dissolved	mg/L	0.001	<0.001	0.001	<0.001	<0.001	<0.001
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.002
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Uranium-Dissolved	mg/L	0.0005	0.0008	<0.0005	<0.0005	<0.0005	0.0012
Vanadium-Dissolved	mg/L	0.001	0.001	<0.001	0.001	<0.001	0.005
Zinc-Dissolved	mg/L	0.001	0.002	0.002	0.008	0.003	<0.001

Dissolved Metals in Water							
Our Reference			254723-6	254723-7	254723-8	254723-9	254723 - 10
Your Reference	UNITS	PQL	PB10(JDA02)	PB8(JDA01)	WZ1	WB1	WR1
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Date analysed	-		17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Dissolved CrVI	mg/L	0.005	<0.005	<0.005	0.18	<0.005	<0.005
Dissolved CrIII	mg/L	0.005	<0.005	<0.005	0.023	<0.005	<0.005
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.001	0.002	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.05	0.06	0.08	<0.02	<0.02
Barium-Dissolved	mg/L	0.001	0.014	0.019	0.028	<0.001	<0.001
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	0.20	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	0.01	0.04	<0.01	<0.01	<0.01
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Manganese-Dissolved	mg/L	0.005	0.007	0.012	<0.005	<0.005	<0.005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Uranium-Dissolved	mg/L	0.0005	0.0008	0.0017	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.003	0.008	0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.008	0.009	0.007	<0.001	0.002

vTRH(C6-C10)/MBTEXN in water							
Our Reference			254723-1	254723-2	254723-3	254723-4	254723-5
Your Reference	UNITS	PQL	DM1RS	DM1RD	DM9S	DM9D	MW02
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date analysed	-		17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
TRH C ₆ - C ₉	μg/L	10	<10	<10	<10	<10	<10
TRH C ₆ - C ₁₀	μg/L	10	<10	<10	<10	<10	<10
TRH C ₆ -C ₁₀ less BTEX (F1)	μg/L	10	<10	<10	<10	<10	<10
МТВЕ	μg/L	1	<1	<1	<1	<1	<1
Benzene	μg/L	1	<1	<1	<1	<1	<1
Toluene	μg/L	1	<1	<1	<1	<1	<1
Ethylbenzene	μg/L	1	<1	<1	<1	<1	<1
m+p-xylene	μg/L	2	<2	<2	<2	<2	<2
o-xylene	μg/L	1	<1	<1	<1	<1	<1
Naphthalene	μg/L	1	<1	<1	<1	<1	<1
Surrogate Dibromofluoromethane	%		92	94	97	98	99
Surrogate toluene-d8	%		93	93	95	94	96
Surrogate 4-BFB	%		100	99	97	100	100

vTRH(C6-C10)/MBTEXN in water							
Our Reference			254723-6	254723-7	254723-8	254723-9	254723-10
Your Reference	UNITS	PQL	PB10(JDA02)	PB8(JDA01)	WZ1	WB1	WR1
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date analysed	-		17/12/2020	17/12/2020	17/12/2020	18/12/2020	17/12/2020
TRH C ₆ - C ₉	μg/L	10	<50	<50	<10	<10	<10
TRH C ₆ - C ₁₀	μg/L	10	<50	<50	<10	<10	<10
TRH C ₆ -C ₁₀ less BTEX (F1)	μg/L	10	<50	<50	<10	<10	<10
МТВЕ	μg/L	1	<3	<3	<1	<1	<1
Benzene	μg/L	1	<3	<3	<1	<1	<1
Toluene	μg/L	1	<3	<3	<1	<1	<1
Ethylbenzene	μg/L	1	<3	<3	<1	<1	<1
m+p-xylene	μg/L	2	<6	<6	<2	<2	<2
o-xylene	μg/L	1	<3	<3	<1	<1	<1
Naphthalene	μg/L	1	<3	<3	<1	<1	<1
Surrogate Dibromofluoromethane	%		101	97	95	101	95
Surrogate toluene-d8	%		95	93	95	95	92
Surrogate 4-BFB	%		98	97	99	98	98

vTRH(C6-C10)/MBTEXN in water			
Our Reference			254723-11
Your Reference	UNITS	PQL	WTB1
Date Sampled			14/12/2020
Type of sample			Water
Date analysed	-		17/12/2020
TRH C ₆ - C ₉	μg/L	10	<10
TRH C ₆ - C ₁₀	μg/L	10	<10
TRH C ₆ -C ₁₀ less BTEX (F1)	μg/L	10	<10
МТВЕ	μg/L	1	<1
Benzene	μg/L	1	<1
Toluene	μg/L	1	<1
Ethylbenzene	μg/L	1	<1
m+p-xylene	μg/L	2	<2
o-xylene	μg/L	1	<1
Naphthalene	μg/L	1	<1
Surrogate Dibromofluoromethane	%		99
Surrogate toluene-d8	%		94
Surrogate 4-BFB	%		103

svTRH(C10-C40) in water							
Our Reference			254723-1	254723-2	254723-3	254723-4	254723-5
Your Reference	UNITS	PQL	DM1RS	DM1RD	DM9S	DM9D	MW02
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date extracted	-		18/12/2020	18/12/2020	18/12/2020	18/12/2020	18/12/2020
Date analysed	-		19/12/2020	19/12/2020	19/12/2020	19/12/2020	19/12/2020
TRH C ₁₀ - C ₁₄	μg/L	50	<50	<50	<50	<50	<50
TRH C ₁₅ - C ₂₈	μg/L	100	<100	<100	<100	<100	<100
TRH C ₂₉ - C ₃₆	μg/L	100	<100	<100	<100	<100	<100
TRH >C ₁₀ - C ₁₆	μg/L	50	<50	<50	<50	<50	<50
TRH >C ₁₀ -C ₁₆ less N (F2)	μg/L	50	<50	<50	<50	<50	<50
TRH >C ₁₆ - C ₃₄	μg/L	100	<100	<100	<100	<100	<100
TRH >C ₃₄ - C ₄₀	μg/L	100	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%		94	94	136	90	83

svTRH(C10-C40) in water							
Our Reference			254723-6	254723-7	254723-8	254723-9	254723-10
Your Reference	UNITS	PQL	PB10(JDA02)	PB8(JDA01)	WZ1	WB1	WR1
Date Sampled			14/12/2020	14/12/2020	14/12/2020	14/12/2020	14/12/2020
Type of sample			Water	Water	Water	Water	Water
Date extracted	-		18/12/2020	18/12/2020	18/12/2020	18/12/2020	18/12/2020
Date analysed	-		19/12/2020	19/12/2020	19/12/2020	19/12/2020	19/12/2020
TRH C ₁₀ - C ₁₄	μg/L	50	<50	<50	<50	<50	<50
TRH C ₁₅ - C ₂₈	μg/L	100	<100	<100	<100	<100	<100
TRH C ₂₉ - C ₃₆	μg/L	100	<100	<100	<100	<100	<100
TRH >C ₁₀ - C ₁₆	μg/L	50	<50	69	<50	<50	<50
TRH >C ₁₀ -C ₁₆ less N (F2)	μg/L	50	<50	69	<50	<50	<50
TRH >C ₁₆ - C ₃₄	μg/L	100	<100	<100	<100	<100	<100
TRH >C ₃₄ - C ₄₀	μg/L	100	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%		81	93	98	92	103

svTRH(C10-C40) in water			
Our Reference			254723-11
Your Reference	UNITS	PQL	WTB1
Date Sampled			14/12/2020
Type of sample			Water
Date extracted	-		18/12/2020
Date analysed	-		19/12/2020
TRH C ₁₀ - C ₁₄	μg/L	50	<50
TRH C ₁₅ - C ₂₈	μg/L	100	<100
TRH C ₂₉ - C ₃₆	μg/L	100	<100
TRH >C ₁₀ - C ₁₆	μg/L	50	<50
TRH >C ₁₀ -C ₁₆ less N (F2)	μg/L	50	<50
TRH >C ₁₆ - C ₃₄	μg/L	100	<100
TRH >C ₃₄ - C ₄₀	μg/L	100	<100
Surrogate o-Terphenyl	%		105

Method ID	Methodology Summary
INORG-002	Conductivity and Salinity - measured using a conductivity cell at 25°C based on APHA latest edition Method 2510. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180±10°C
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
INORG-118	Hexavalent Chromium by Ion Chromatographic separation and colourimetric determination.
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Determination of various metals by ICP-AES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
	For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.

QUALITY CONTROL: Miscellaneous Inorganics						Du	Spike Recovery %			
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			15/12/2020	1	15/12/2020	15/12/2020		15/12/2020	
Date analysed	-			15/12/2020	1	15/12/2020	15/12/2020		15/12/2020	
Electrical Conductivity (EC)	μS/cm	1	INORG-002	<1	1	3000	2900	3	105	
Total Dissolved Solids (grav)	mg/L	5	INORG-018	<5	1	1900	[NT]		97	

QUALITY CONTROL: Miscellaneous Inorganics						Du	Spike Recovery %			
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	2	15/12/2020	15/12/2020		[NT]	[NT]
Date analysed	-			[NT]	2	15/12/2020	15/12/2020		[NT]	[NT]
Electrical Conductivity (EC)	μS/cm	1	INORG-002	[NT]	2	1500	[NT]		[NT]	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	[NT]	2	890	900	1	[NT]	[NT]

QUALITY CONTROL: Ionic Balance						Du	Spike Recovery %			
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254723-2
Date prepared	-			21/12/2020	1	21/12/2020	21/12/2020		21/12/2020	21/12/2020
Date analysed	-			21/12/2020	1	21/12/2020	21/12/2020		21/12/2020	21/12/2020
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	160	160	0	104	98
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	19	19	0	106	102
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	55	57	4	105	91
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	390	390	0	105	89
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	INORG-006	<5	1	400	390	3	101	[NT]
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	INORG-006	<5	1	<5	<5	0	101	[NT]
Total Alkalinity as CaCO ₃	mg/L	5	INORG-006	<5	1	400	390	3	101	[NT]
Chloride	mg/L	1	INORG-081	<1	1	600	600	0	88	103
Sulphate	mg/L	1	INORG-081	<1	1	230	230	0	88	105
Hardness as CaCO₃	mg/L	3	METALS-008	<3	1	620	630	2	[NT]	[NT]

QUALITY	CONTROL:	Nutrients	in Water			Du	p l icate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254723-2
Date prepared	-			16/12/2020	1	16/12/2020	16/12/2020		16/12/2020	16/12/2020
Date analysed	-			16/12/2020	1	16/12/2020	16/12/2020		16/12/2020	16/12/2020
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	2.1	2.1	0	96	94
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	2.0	2.0	0	104	111
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	104	100
NOx as N	mg/L	0.005	INORG-055	<0.005	1	2.0	2.0	0	109	111
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.048	0.049	2	100	92
Total Phosphorus	mg/L	0.05	METALS-020	<0.05	1	0.08	0.08	0	96	95
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	0.056	0.056	0	113	113

QUAL I TY (CONTROL: Dis	solved Me	ta l s in Water			Du	plicate	Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254723-2
Date prepared	-			17/12/2020	1	17/12/2020	17/12/2020		17/12/2020	17/12/2020
Date analysed	-			17/12/2020	1	17/12/2020	17/12/2020		17/12/2020	17/12/2020
Dissolved CrVI	mg/L	0.005	INORG-118	<0.005	1	<0.005	<0.005	0	103	104
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		103	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	1	<0.01	[NT]		93	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.002	[NT]		97	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	1	0.2	[NT]		107	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.051	[NT]		86	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		119	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	[NT]		97	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		86	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.001	[NT]		91	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		91	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	1	0.02	[NT]		106	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	[NT]		100	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	1	0.009	[NT]		89	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.001	[NT]		100	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		92	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		94	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		99	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		87	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	0.0008	[NT]		86	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.001	[NT]		94	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.002	[NT]		92	[NT]

QUALITY	CONTROL: Disso	olved Met	a l s in Water			Du	olicate Spike Recov			covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-				6	17/12/2020	17/12/2020			[NT]
Date analysed	-				6	17/12/2020	17/12/2020			[NT]
Dissolved CrVI	mg/L	0.005	INORG-118		6	<0.005	[NT]			[NT]
Silver-Dissolved	mg/L	0.001	METALS-022		6	<0.001	[NT]			[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022		6	<0.01	[NT]			[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022		6	<0.001	[NT]			[NT]
Boron-Dissolved	mg/L	0.02	METALS-022		6	0.05	[NT]			[NT]
Barium-Dissolved	mg/L	0.001	METALS-022		6	0.014	[NT]			[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022		6	<0.0005	[NT]			[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022		6	<0.0001	[NT]			[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022		6	<0.001	[NT]			[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022		6	<0.001	[NT]			[NT]
Copper-Dissolved	mg/L	0.001	METALS-022		6	0.001	[NT]			[NT]
Iron-Dissolved	mg/L	0.01	METALS-022		6	0.01	[NT]			[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021		6	<0.00005	<0.00005	0		[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022		6	0.007	[NT]			[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022		6	<0.001	[NT]			[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022		6	<0.001	[NT]			[NT]
Lead-Dissolved	mg/L	0.001	METALS-022		6	<0.001	[NT]			[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022		6	0.001	[NT]			[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022		6	<0.0005	[NT]			[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022		6	0.0008	[NT]			[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022		6	0.003	[NT]			[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022		6	0.008	[NT]			[NT]

QUALITY	CONTROL: Dis:	olved Met	a l s in Water			Du	Duplicate Spike Reco			covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-				7	17/12/2020	17/12/2020			[NT]
Date analysed	-				7	17/12/2020	17/12/2020			[NT]
Dissolved CrVI	mg/L	0.005	INORG-118		7	<0.005	[NT]			[NT]
Silver-Dissolved	mg/L	0.001	METALS-022		7	<0.001	<0.001	0		[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022		7	<0.01	<0.01	0		[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022		7	<0.001	<0.001	0		[NT]
Boron-Dissolved	mg/L	0.02	METALS-022		7	0.06	0.06	0		[NT]
Barium-Dissolved	mg/L	0.001	METALS-022		7	0.019	0.019	0		[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022		7	<0.0005	<0.0005	0		[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022		7	<0.0001	<0.0001	0		[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022		7	<0.001	<0.001	0		[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022		7	<0.001	<0.001	0		[NT]
Copper-Dissolved	mg/L	0.001	METALS-022		7	<0.001	<0.001	0		[NT]
Iron-Dissolved	mg/L	0.01	METALS-022		7	0.04	0.04	0		[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021		7	<0.00005	[NT]			[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022		7	0.012	0.012	0		[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022		7	<0.001	<0.001	0		[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022		7	<0.001	<0.001	0		[NT]
Lead-Dissolved	mg/L	0.001	METALS-022		7	<0.001	<0.001	0		[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022		7	<0.001	<0.001	0		[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022		7	<0.0005	<0.0005	0		[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022		7	0.0017	0.0018	6		[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022		7	0.008	0.008	0		[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022		7	0.009	0.009	0		[NT]

QUALITY CONTR	OL: vTRH(C	6-C10)/M	IBTEXN in water			Duj	olicate		Spike Red	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date analysed	-			17/12/2020	[NT]			[NT]	17/12/2020	
TRH C ₆ - C ₉	μg/L	10	Org-023	<10	[NT]			[NT]	96	
TRH C ₆ - C ₁₀	μg/L	10	Org-023	<10	[NT]			[NT]	96	
МТВЕ	μg/L	1	Org-023	<1	[NT]			[NT]	[NT]	
Benzene	μg/L	1	Org-023	<1	[NT]			[NT]	94	
Toluene	μg/L	1	Org-023	<1	[NT]			[NT]	96	
Ethylbenzene	μg/L	1	Org-023	<1	[NT]			[NT]	94	
m+p-xylene	μg/L	2	Org-023	<2	[NT]			[NT]	97	
o-xylene	μg/L	1	Org-023	<1	[NT]			[NT]	96	
Naphthalene	μg/L	1	Org-023	<1	[NT]			[NT]	[NT]	
Surrogate Dibromofluoromethane	%		Org-023	99	[NT]			[NT]	97	
Surrogate toluene-d8	%		Org-023	95	[NT]			[NT]	95	
Surrogate 4-BFB	%		Org-023	99	[NT]			[NT]	97	

QUALITY CO	NTROL: svT	RH(C10-0	C40) in water			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254723-4
Date extracted	-			18/12/2020	[NT]		[NT]	[NT]	18/12/2020	18/12/2020
Date analysed	-			19/12/2020	[NT]		[NT]	[NT]	19/12/2020	19/12/2020
TRH C ₁₀ - C ₁₄	μg/L	50	Org-020	<50	[NT]		[NT]	[NT]	104	91
TRH C ₁₅ - C ₂₈	μg/L	100	Org-020	<100	[NT]		[NT]	[NT]	108	94
TRH C ₂₉ - C ₃₆	μg/L	100	Org-020	<100	[NT]		[NT]	[NT]	118	98
TRH >C ₁₀ - C ₁₆	μg/L	50	Org-020	<50	[NT]		[NT]	[NT]	107	93
TRH >C ₁₆ - C ₃₄	μg/L	100	Org-020	<100	[NT]		[NT]	[NT]	112	96
TRH >C ₃₄ - C ₄₀	μg/L	100	Org-020	<100	[NT]		[NT]	[NT]	99	82
Surrogate o-Terphenyl	%		Org-020	95	[NT]		[NT]	[NT]	95	90

Result Definiti	ons
NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control	ol Definitions
Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

MPL Reference: 254723 Page | 21 of 22 Revision No: R00

Report Comments

#6,7 - TRHC6-C10/BTEX: PQL has been raised as the sample/s were foamy and required dilution.

 MPL Reference:
 254723
 Page | 22 of 22

 Revision No:
 R00





Standard S	oite:	_					NO.	THI AND COOK
Mark	oject reference:	EEC14081.004					Tet (61)	8) 9211 1111
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RPS Australia West Pty Ltd, Registered in Australia No. 42 107 962 872 rpsgroup.com





ABN 53 140 099 207 16-18 Hayden Court Myaree WA 6154 ph 08 9317 2505 fax 08 9317 4163 lab@mpl.com.au www.mpl.com.au

DATA QUALITY ASSESSMENT SUMMARY

Report Details	
Envirolab Report Reference	<u>254723</u>
Client ID	RPS Australia West Pty Ltd
Project Reference	EEC14081.004 - Green Patch
Date Issued	21/12/2020

QC DATA

All laboratory QC data was within the Envirolab Group's specifications.

HOLDING TIME COMPLIANCE EVALUATION

All preservation / holding times (based on AS/ASPHA/ISO/NEPM/USEPA reference documents and standards) are compliant.

Certain analyses have had their recommended technical holding times elongated by filtering and/or freezing on receipt at the laboratory (e.g. BOD, chlorophyll/Pheophytin, nutrients and acid sulphate soil tests).

COMPLIANCE TO QC FREQUENCY (NEPM)

Internal laboratory QC rate complies with NEPM requirements (LCS/MB/MS 1 in 20, Duplicates 1 in 10 samples). Note, samples are batched together with other sample consignments in order to assign QC sample frequency.

QC Evaluation	
Duplicate(s) was performed as per NEPM frequency	✓
Laboratory Control Sample(s) were analysed with the samples received	✓
A Method Blank was performed with the samples received	✓
Matrix spike(s) was performed as per NEPM frequency (Not Applicable for Air samples)	✓

Refer to Certificate of Analysis for all Quality Control data.



Envirolab Services (WA) Pty Ltd trading as MPL Laboratories

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CERTIFICATE OF ANALYSIS 254905

Client Details	
Client	RPS Australia West Pty Ltd
Attention	Alan Foley
Address	Level 2, 27-31 Troode St, WEST PERTH, WA, 6005

Sample Details	
Your Reference	EEC14081.004 - Green Patch
Number of Samples	6 Water
Date samples received	17/12/2020
Date completed instructions received	17/12/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details	
Date results requested by	23/12/2020
Date of Issue	23/12/2020
NATA Accreditation Number 2901. T	his document shall not be reproduced except in full.
Accredited for compliance with ISO/II	EC 17025 - Testing. Tests not covered by NATA are denoted with *

Results Approved By

Heram Halim, Operations Manager Todd Lee, Group Operations Manager Travis Carey, Organics - Team Leader **Authorised By**

Michael Kubiak, Laboratory Manager



Miscellaneous Inorganics							
Our Reference			254905-1	254905-2	254905-3	254905-4	254905-5
Your Reference	UNITS	PQL	SW01	SW02	SWZ1	WB4	WR4
Date Sampled			17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Date analysed	-		17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Electrical Conductivity (EC)	μS/cm	1	320	1,200	1,200	2	2
Total Dissolved Solids (grav)	mg/L	5	190	700	670	<5	<5

Ionic Balance							
Our Reference			254905-1	254905-2	254905-3	254905-4	254905-5
Your Reference	UNITS	PQL	SW01	SW02	SWZ1	WB4	WR4
Date Sampled			17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-		22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Calcium - Dissolved	mg/L	0.5	32	63	62	<0.5	<0.5
Potassium - Dissolved	mg/L	0.5	0.6	7.7	7.7	<0.5	<0.5
Magnesium - Dissolved	mg/L	0.5	5.2	26	26	<0.5	<0.5
Sodium - Dissolved	mg/L	0.5	26	150	160	<0.5	<0.5
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	100	230	240	<5	<5
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH⁻ as CaCO₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO₃	mg/L	5	100	230	240	<5	<5
Chloride	mg/L	1	32	210	210	<1	<1
Sulphate	mg/L	1	4	60	60	<1	<1
Ionic Balance	%		2.2	-0.43	0.65	0	0
Hardness as CaCO ₃	mg/L	3	100	260	260	<3	<3

Nutrients in Water							
Our Reference			254905-1	254905-2	254905-3	254905-4	254905-5
Your Reference	UNITS	PQL	SW01	SW02	SWZ1	WB4	WR4
Date Sampled			17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		18/12/2020	18/12/2020	18/12/2020	18/12/2020	18/12/2020
Date analysed	-		18/12/2020	18/12/2020	18/12/2020	18/12/2020	18/12/2020
Total Nitrogen	mg/L	0.1	1.6	0.5	0.5	<0.1	<0.1
Total Kjeldahl Nitrogen	mg/L	0.1	1.6	0.5	0.5	<0.1	<0.1
Nitrate as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus	mg/L	0.05	0.19	<0.05	<0.05	<0.05	<0.05
Phosphate as P	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Dissolved Metals in Water							
Our Reference			254905-1	254905-2	254905-3	254905-4	254905-5
Your Reference	UNITS	PQL	SW01	SW02	SWZ1	WB4	WR4
Date Sampled			17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-		22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Dissolved CrVI	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved CrIII	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium-Dissolved	mg/L	0.01	0.01	<0.01	<0.01	<0.01	<0.01
Arsenic-Dissolved	mg/L	0.001	0.004	0.002	0.002	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.03	0.09	0.09	<0.02	<0.02
Barium-Dissolved	mg/L	0.001	0.019	0.066	0.066	<0.001	<0.001
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	0.44	0.09	0.1	<0.01	<0.01
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	0.00006	<0.00005	<0.00005
Manganese-Dissolved	mg/L	0.005	0.054	0.012	0.012	<0.005	<0.005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.003	0.004	0.011	0.002	<0.001

vTRH(C6-C10)/MBTEXN in water							
Our Reference			254905-1	254905-2	254905-3	254905-4	254905-5
Your Reference	UNITS	PQL	SW01	SW02	SWZ1	WB4	WR4
Date Sampled			17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Type of sample			Water	Water	Water	Water	Water
Date analysed	-		18/12/2020	18/12/2020	18/12/2020	18/12/2020	18/12/2020
TRH C ₆ - C ₉	μg/L	10	<50	<10	<10	<10	<10
TRH C ₆ - C ₁₀	μg/L	10	<50	<10	<10	<10	<10
TRH C ₆ -C ₁₀ less BTEX (F1)	μg/L	10	<50	<10	<10	<10	<10
МТВЕ	μg/L	1	<3	<1	<1	<1	<1
Benzene	μg/L	1	<3	<1	<1	<1	<1
Toluene	μg/L	1	<3	<1	<1	<1	<1
Ethylbenzene	μg/L	1	<3	<1	<1	<1	<1
m+p-xylene	μg/L	2	<6	<2	<2	<2	<2
o-xylene	μg/L	1	<3	<1	<1	<1	<1
Naphthalene	μg/L	1	<3	<1	<1	<1	<1
Surrogate Dibromofluoromethane	%		100	98	98	102	99
Surrogate toluene-d8	%		94	94	95	96	94
Surrogate 4-BFB	%		98	98	101	98	100

vTRH(C6-C10)/MBTEXN in water			
Our Reference			254905-6
Your Reference	UNITS	PQL	WTB2
Date Sampled			17/12/2020
Type of sample			Water
Date analysed	-		18/12/2020
TRH C ₆ - C ₉	μg/L	10	<10
TRH C ₆ - C ₁₀	μg/L	10	<10
TRH C ₆ -C ₁₀ less BTEX (F1)	μg/L	10	<10
МТВЕ	μg/L	1	<1
Benzene	μg/L	1	<1
Toluene	μg/L	1	<1
Ethylbenzene	μg/L	1	<1
m+p-xylene	μg/L	2	<2
o-xylene	μg/L	1	<1
Naphthalene	μg/L	1	<1
Surrogate Dibromofluoromethane	%		101
Surrogate toluene-d8	%		95
Surrogate 4-BFB	%		97

svTRH(C10-C40) in water							
Our Reference			254905-1	254905-2	254905-3	254905-4	254905-5
Your Reference	UNITS	PQL	SW01	SW02	SWZ1	WB4	WR4
Date Sampled			17/12/2020	17/12/2020	17/12/2020	17/12/2020	17/12/2020
Type of sample			Water	Water	Water	Water	Water
Date extracted	-		18/12/2020	18/12/2020	18/12/2020	18/12/2020	18/12/2020
Date analysed	-		22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
TRH C ₁₀ - C ₁₄	μg/L	50	<50	<50	<50	<50	<50
TRH C ₁₅ - C ₂₈	μg/L	100	<100	<100	<100	<100	<100
TRH C ₂₉ - C ₃₆	μg/L	100	<100	<100	<100	<100	<100
TRH >C ₁₀ - C ₁₆	μg/L	50	<50	<50	<50	<50	<50
TRH >C ₁₀ -C ₁₆ less N (F2)	μg/L	50	<50	<50	<50	<50	<50
TRH >C ₁₆ - C ₃₄	μg/L	100	<100	<100	<100	<100	<100
TRH >C ₃₄ - C ₄₀	μg/L	100	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%		75	95	93	84	96

svTRH(C10-C40) in water			
Our Reference			254905-6
Your Reference	UNITS	PQL	WTB2
Date Sampled			17/12/2020
Type of sample			Water
Date extracted	-		18/12/2020
Date analysed	-		22/12/2020
TRH C ₁₀ - C ₁₄	μg/L	50	<50
TRH C ₁₅ - C ₂₈	μg/L	100	<100
TRH C ₂₉ - C ₃₆	μg/L	100	<100
TRH >C ₁₀ - C ₁₆	μg/L	50	<50
TRH >C ₁₀ -C ₁₆ less N (F2)	μg/L	50	<50
TRH >C ₁₆ - C ₃₄	μg/L	100	<100
TRH >C ₃₄ - C ₄₀	μg/L	100	<100
Surrogate o-Terphenyl	%		87

Method ID	Methodology Summary
INORG-002	Conductivity and Salinity - measured using a conductivity cell at 25°C based on APHA latest edition Method 2510. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180±10°C
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
INORG-118	Hexavalent Chromium by Ion Chromatographic separation and colourimetric determination.
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Determination of various metals by ICP-AES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
	For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.

MPL Reference: 254905
Revision No: R00
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QUALITY CONTROL: Miscellaneous Inorganics				Duplicate				Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			17/12/2020	[NT]		[NT]	[NT]	17/12/2020	
Date analysed	-			17/12/2020	[NT]		[NT]	[NT]	17/12/2020	
Electrical Conductivity (EC)	μS/cm	1	INORG-002	<1	[NT]		[NT]	[NT]	105	
Total Dissolved Solids (grav)	mg/L	5	INORG-018	<5	[NT]		[NT]	[NT]	104	

QUALIT	Y CONTRO	L: Ionic B	alance			Du	p l icate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254905-2
Date prepared	-			22/12/2020	1	22/12/2020	22/12/2020		22/12/2020	22/12/2020
Date analysed	-			22/12/2020	1	22/12/2020	22/12/2020		22/12/2020	22/12/2020
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	32	[NT]		95	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	0.6	[NT]		97	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	5.2	[NT]		97	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	26	[NT]		98	[NT]
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	INORG-006	<5	1	100	[NT]		101	[NT]
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	INORG-006	<5	1	<5	[NT]		101	[NT]
Total Alkalinity as CaCO₃	mg/L	5	INORG-006	<5	1	100	[NT]		101	[NT]
Chloride	mg/L	1	INORG-081	<1	1	32	32	0	90	89
Sulphate	mg/L	1	INORG-081	<1	1	4	4	0	88	103
Hardness as CaCO₃	mg/L	3	METALS-008	<3	1	100	[NT]		[NT]	[NT]

QUALIT	Y CONTRO	L: Ionic B	alance			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	5	22/12/2020	22/12/2020			[NT]
Date analysed	-			[NT]	5	22/12/2020	22/12/2020			[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	5	<0.5	<0.5	0		[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	5	<0.5	<0.5	0		[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	5	<0.5	<0.5	0		[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	5	<0.5	<0.5	0		[NT]
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	INORG-006	[NT]	5	<5	[NT]			[NT]
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	INORG-006	[NT]	5	<5	[NT]			[NT]
Total Alkalinity as CaCO₃	mg/L	5	INORG-006	[NT]	5	<5	[NT]			[NT]
Chloride	mg/L	1	INORG-081	[NT]	5	<1	[NT]			[NT]
Sulphate	mg/L	1	INORG-081	[NT]	5	<1	[NT]			[NT]
Hardness as CaCO ₃	mg/L	3	METALS-008	[NT]	5	<3	<3	0		[NT]

QUALITY	CONTROL:	Nutrients	in Water			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254905-2
Date prepared	-			18/12/2020	1	18/12/2020	18/12/2020		18/12/2020	18/12/2020
Date analysed	-			18/12/2020	1	18/12/2020	18/12/2020		18/12/2020	18/12/2020
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	1.6	1.9	17	109	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	1.6	1.9	17	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	118	112
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	107	93
NOx as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	118	112
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	<0.005	<0.005	0	88	95
Total Phosphorus	mg/L	0.05	METALS-020	<0.05	1	0.19	0.20	5	114	[NT]
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	<0.005	<0.005	0	107	125

QUALITY CO	NTROL: Dis	solved Me	ta l s in Water			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254905-2
Date prepared	-			22/12/2020	1	22/12/2020	18/12/2020		22/12/2020	18/12/2020
Date analysed	-			22/12/2020	1	22/12/2020	18/12/2020		22/12/2020	18/12/2020
Dissolved CrVI	mg/L	0.005	INORG-118	<0.005	1	<0.005	<0.005	0	107	103
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		101	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	1	0.01	[NT]		99	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.004	[NT]		100	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	1	0.03	[NT]		101	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.019	[NT]		91	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		103	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	[NT]		94	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		105	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		94	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		96	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	1	0.44	[NT]		106	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	<0.00005	0	97	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	1	0.054	[NT]		96	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		95	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		97	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		96	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		97	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		92	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		94	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		99	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.003	[NT]		97	[NT]

QUALITY CONTR	ROL: vTRH(C	6-C10)/N	IBTEXN in water			Du	plicate		Spike Red	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date analysed	-			18/12/2020	[NT]		[NT]	[NT]	18/12/2020	
TRH C ₆ - C ₉	μg/L	10	Org-023	<10	[NT]		[NT]	[NT]	113	
TRH C ₆ - C ₁₀	μg/L	10	Org-023	<10	[NT]		[NT]	[NT]	113	
МТВЕ	μg/L	1	Org-023	<1	[NT]		[NT]	[NT]	[NT]	
Benzene	μg/L	1	Org-023	<1	[NT]		[NT]	[NT]	113	
Toluene	μg/L	1	Org-023	<1	[NT]		[NT]	[NT]	115	
Ethylbenzene	μg/L	1	Org-023	<1	[NT]		[NT]	[NT]	110	
m+p-xylene	μg/L	2	Org-023	<2	[NT]		[NT]	[NT]	113	
o-xylene	μg/L	1	Org-023	<1	[NT]		[NT]	[NT]	113	
Naphthalene	μg/L	1	Org-023	<1	[NT]		[NT]	[NT]	[NT]	
Surrogate Dibromofluoromethane	%		Org-023	99	[NT]		[NT]	[NT]	100	
Surrogate toluene-d8	%		Org-023	94	[NT]		[NT]	[NT]	96	
Surrogate 4-BFB	%		Org-023	101	[NT]		[NT]	[NT]	98	

QUALITY CON	NTROL: svTl	RH(C10-0	C40) in water			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254905-1
Date extracted	-			18/12/2020	[NT]		[NT]	[NT]	18/12/2020	18/12/2020
Date analysed	-			22/12/2020	[NT]		[NT]	[NT]	22/12/2020	22/12/2020
TRH C ₁₀ - C ₁₄	μg/L	50	Org-020	<50	[NT]		[NT]	[NT]	101	102
TRH C ₁₅ - C ₂₈	μg/L	100	Org-020	<100	[NT]		[NT]	[NT]	97	102
TRH C ₂₉ - C ₃₆	μg/L	100	Org-020	<100	[NT]		[NT]	[NT]	118	122
TRH >C ₁₀ - C ₁₆	μg/L	50	Org-020	<50	[NT]		[NT]	[NT]	101	104
TRH >C ₁₆ - C ₃₄	μg/L	100	Org-020	<100	[NT]		[NT]	[NT]	99	105
TRH >C ₃₄ - C ₄₀	μg/L	100	Org-020	<100	[NT]		[NT]	[NT]	104	104
Surrogate o-Terphenyl	%		Org-020	75	[NT]		[NT]	[NT]	97	88

Result Definiti	ons
NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control	ol Definitions
Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

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Report Comments

#1 - TRHC6-C10/BTEX: PQL has been raised as the sample/s were foamy and required dilution.

 MPL Reference:
 254905
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 Revision No:
 R00



CHAIN OF CUSTODY

Site:	Cheeco patch		and desired					West Perth WA 6005
Project reference:	EEC14081,004							Fax: (618) 9211 1111 Fax: (618) 9211 1122
Scientist(s):	SWW			'd8				environment@rpsgroup.com.au
Sample type(s):	Water			,qT				Page number: 1 of 1
Report to:	Alan Foley & Com Corcoran	oran						Turnaround time: Standard
Invoice to:	west accountspayable@rpsgroup.com	шоо dnos6sds@a						Quote number: 19P347v2
Sample LD.	Date collected	Number of jars / bottles / bags	totaW & HRT	TN, TY MILTIE				Remarks
SWOT	17/12/2020	17	×	×				
Sw02 2	17/12/2020	7	×	×				
SWZ1 3	17/12/2020	7	×	×				
WB4 C	17/12/2020	2	×	×				
WR4 S	17/12/2020	1	×	×				
wra2 6	17/12/2020	m	×					
								28485 75-12 78-12
Total number of bottles/bags/jars Primary destination: MPL	ottles/bags/jars n: MPL	38 Rec	38 Received by:	MC	ŝ	Secondary destination:	Received by:	d by:
Relinquished by:	Shae Miller-White	ð	Organisation:	The state of	Re	Relinquished by:	Organisation:	tation:
Organisation:	RPS	Date:	10:	17-75-21	Ö	Organisation:	Date:	
Date:	17/12/2020	Ţ	Time:	(02)	rd .	Date:	Time:	
	*****			-	-			

RPS Australia West Pty Ltd, Registered in Australia No. 42 107 962 872 rpsgroup.com





ABN 53 140 099 207 16-18 Hayden Court Myaree WA 6154 ph 08 9317 2505 fax 08 9317 4163 lab@mpl.com.au www.mpl.com.au

DATA QUALITY ASSESSMENT SUMMARY

Report Details	
Envirolab Report Reference	<u>254905</u>
Client ID	RPS Australia West Pty Ltd
Project Reference	EEC14081.004 - Green Patch
Date Issued	23/12/2020

QC DATA

All laboratory QC data was within the Envirolab Group's specifications.

HOLDING TIME COMPLIANCE EVALUATION

All preservation / holding times (based on AS/ASPHA/ISO/NEPM/USEPA reference documents and standards) are compliant.

Certain analyses have had their recommended technical holding times elongated by filtering and/or freezing on receipt at the laboratory (e.g. BOD, chlorophyll/Pheophytin, nutrients and acid sulphate soil tests).

COMPLIANCE TO QC FREQUENCY (NEPM)

Internal laboratory QC rate complies with NEPM requirements (LCS/MB/MS 1 in 20, Duplicates 1 in 10 samples). Note, samples are batched together with other sample consignments in order to assign QC sample frequency.

QC Evaluation	
Duplicate(s) was performed as per NEPM frequency	✓
Laboratory Control Sample(s) were analysed with the samples received	✓
A Method Blank was performed with the samples received	✓
Matrix spike(s) was performed as per NEPM frequency (Not Applicable for Air samples)	✓

Refer to Certificate of Analysis for all Quality Control data.



Envirolab Services (WA) Pty Ltd trading as MPL Laboratories

ABN 53 140 099 207 16-18 Hayden Court Myaree WA 6154 ph 08 9317 2505 fax 08 9317 4163 lab@mpl.com.au www.mpl.com.au

CERTIFICATE OF ANALYSIS 254915

Client Details	
Client	RPS Australia West Pty Ltd
Attention	Shae Miller-White
Address	Level 2, 27-31 Troode St, WEST PERTH, WA, 6005

Sample Details	
Your Reference	EEC14081.004 - Greenpatch
Number of Samples	198 Soils
Date samples received	17/12/2020
Date completed instructions received	17/12/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details		
Date results requested by	08/01/2021	
Date of Issue	08/01/2021	
NATA Accreditation Number 2901.	This document shall not be reproduced except in full.	
Accredited for compliance with ISC	/IEC 17025 - Testing. Tests not covered by NATA are denoted with *	

Results Approved By

Heram Halim, Operations Manager Michael Kubiak, Laboratory Manager Michael Mowle, Metals/Inorganics Supervisor **Authorised By**

Michael Kubiak, Laboratory Manager



Miscellaneous Inorg - soil						
Our Reference		254915-6	254915-25	254915-41	254915-73	254915-105
Your Reference	UNITS	TP01-S06	TP04-S01	TP06-S01	TP10-S01	TP14-S01
Date Sampled		15/12/2020	15/12/2020	15/12/2020	15/12/2020	15/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
pH(CaCl ₂)	pH Units	7.8	8.1	8.2	7.9	7.8
Clay in soils <2µm *	% (w/w)	6	3	4	5	11

Miscellaneous Inorg - soil			
Our Reference		254915-143	254915-147
Your Reference	UNITS	TP18-S08	TP19-S03
Date Sampled		16/12/2020	16/12/2020
Type of sample		Soil	Soil
Date prepared	-	22/12/2020	22/12/2020
Date analysed	-	22/12/2020	22/12/2020
pH(CaCl ₂)	pH Units	8.0	7.9
Clay in soils <2µm *	% (w/w)	7	3

ESP/CEC						
Our Reference		254915-6	254915-25	254915-41	254915-73	254915-105
Your Reference	UNITS	TP01-S06	TP04-S01	TP06-S01	TP10-S01	TP14-S01
Date Sampled		15/12/2020	15/12/2020	15/12/2020	15/12/2020	15/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	06/01/2021	06/01/2021	06/01/2021	06/01/2021	22/12/2020
Date analysed	-	07/01/2021	07/01/2021	07/01/2021	07/01/2021	6/01/2021
Calcium	mg/kg	77	550	370	390	760
Potassium	mg/kg	<50	<100	<100	<100	<100
Magnesium	mg/kg	<50	<100	<100	<100	<100
Sodium	mg/kg	<50	<100	<100	<100	<100
Aluminium	mg/kg	<10	<20	<20	<20	<20
Exchangeable Ca	meq/100g	0.4	2.7	1.8	2.0	3.8
Exchangeable K	meq/100g	<0.13	<0.13	<0.13	<0.13	<0.13
Exchangeable Mg	meq/100g	<0.41	<0.41	<0.41	<0.41	<0.41
Exchangeable Na	meq/100g	<0.22	<0.22	<0.22	<0.22	<0.22
Exchangeable Al	meq/100g	<0.07	<0.07	<0.07	<0.07	<0.07
Cation Exchange Capacity	meq/100g	<1	3	2	2	4

ESP/CEC			
Our Reference		254915-143	254915-147
Your Reference	UNITS	TP18-S08	TP19-S03
Date Sampled		16/12/2020	16/12/2020
Type of sample		Soil	Soil
Date digested	-	22/12/2020	22/12/2020
Date analysed	-	6/01/2021	6/01/2021
Calcium	mg/kg	4,500	590
Potassium	mg/kg	<50	<100
Magnesium	mg/kg	510	<100
Sodium	mg/kg	<50	<100
Aluminium	mg/kg	<10	<20
Exchangeab l e Ca	meq/100g	22	3.0
Exchangeab l e K	meq/100g	<0.13	<0.13
Exchangeable Mg	meq/100g	4.2	<0.41
Exchangeable Na	meq/100g	<0.22	<0.22
Exchangeable Al	meq/100g	<0.07	<0.07
Cation Exchange Capacity	meq/100g	26	3

Metals - soil						
Our Reference		254915-1	254915 - 6	254915-9	254915-17	254915-25
Your Reference	UNITS	TP01-S01	TP01-S06	TP02-S01	TP03-S01	TP04-S01
Date Sampled		15/12/2020	15/12/2020	15/12/2020	15/12/2020	15/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	22/12/2020	30/12/2020	22/12/2020	22/12/2020	30/12/2020
Date analysed	-	6/01/2021	30/12/2020	6/01/2021	6/01/2021	30/12/2020
Silver	mg/kg	<1	<1	<1	<1	<1
Aluminium	mg/kg	550	350	1,600	380	620
Arsenic	mg/kg	6	6	7	6	6
Boron	mg/kg	5	6	5	6	5
Barium	mg/kg	7	5	5	5	5
Beryllium	mg/kg	<1	<1	<1	<1	<1
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Cobalt	mg/kg	<1	<1	<1	<1	<1
Chromium	mg/kg	8	5	8	7	6
Copper	mg/kg	<1	<1	<1	3	<1
Mercury	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Manganese	mg/kg	60	19	29	33	33
Molybdenum	mg/kg	<1	<1	1	<1	<1
Nickel	mg/kg	1	<1	1	2	1
Lead	mg/kg	3	3	3	3	3
Selenium	mg/kg	<2	<2	<2	<2	<2
Vanadium	mg/kg	8	3	9	5	6
Zinc	mg/kg	4	<1	2	11	<1
Thorium	mg/kg	0.7	<0.5	0.8	0.6	0.6
Uranium	mg/kg	0.3	0.3	0.3	0.6	0.3
Chromium (VI)	mg/kg	<1	<1	<1	<1	<1
Trivalent Cr in soil	mg/kg	8	5	8	7	6

Metals - soil						
Our Reference		254915-33	254915-41	254915-49	254915-57	254915-61
Your Reference	UNITS	TP05-S01	TP06-S01	TP07-S01	TP08-S01	TP08-S05
Date Sampled		15/12/2020	15/12/2020	15/12/2020		15/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	22/12/2020	30/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	6/01/2021	30/12/2020	6/01/2021	6/01/2021	6/01/2021
Silver	mg/kg	<1	<1	<1	<1	<1
Aluminium	mg/kg	470	330	370	340	350
Arsenic	mg/kg	6	6	7	7	6
Boron	mg/kg	5	5	8	7	6
Barium	mg/kg	5	4	6	5	6
Beryllium	mg/kg	<1	<1	<1	<1	<1
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Cobalt	mg/kg	<1	<1	<1	<1	<1
Chromium	mg/kg	6	5	7	6	6
Copper	mg/kg	<1	<1	<1	<1	<1
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	mg/kg	35	22	18	19	23
Molybdenum	mg/kg	<1	<1	<1	<1	<1
Nickel	mg/kg	1	1	1	1	1
Lead	mg/kg	2	2	3	3	3
Selenium	mg/kg	<2	<2	<2	<2	<2
Vanadium	mg/kg	5	4	3	3	4
Zinc	mg/kg	1	<1	<1	<1	<1
Thorium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	mg/kg	0.3	0.3	0.4	0.4	0.3
Chromium (VI)	mg/kg	<1	<1	<1	<1	<1
Trivalent Cr in soil	mg/kg	6	5	7	6	6

Metals - soil						
Our Reference		254915-65	254915-73	254915-81	254915-85	254915-89
Your Reference	UNITS	TP09-S01	TP10-S01	TP11-S01	TP11-S05	TP12-S01
Date Sampled		15/12/2020	15/12/2020	15/12/2020	15/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	22/12/2020	30/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	6/01/2021	30/12/2020	6/01/2021	6/01/2021	6/01/2021
Silver	mg/kg	<1	<1	<1	<1	<1
Aluminium	mg/kg	330	390	570	370	480
Arsenic	mg/kg	6	6	5	6	6
Boron	mg/kg	5	4	5	5	6
Barium	mg/kg	5	5	6	5	6
Beryllium	mg/kg	<1	<1	<1	<1	<1
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Cobalt	mg/kg	<1	<1	<1	<1	<1
Chromium	mg/kg	5	5	8	10	7
Copper	mg/kg	<1	<1	<1	<1	<1
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	mg/kg	16	30	58	27	27
Molybdenum	mg/kg	<1	<1	<1	<1	<1
Nickel	mg/kg	1	<1	1	1	1
Lead	mg/kg	3	2	3	3	3
Selenium	mg/kg	<2	<2	<2	<2	<2
Vanadium	mg/kg	3	4	8	5	4
Zinc	mg/kg	<1	<1	1	<1	1
Thorium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	mg/kg	0.3	0.2	0.3	0.3	0.3
Chromium (VI)	mg/kg	<1	<1	<1	<1	<1
Trivalent Cr in soil	mg/kg	5	5	8	10	7

Metals - soil						
Our Reference		254915-99	254915-105	254915-116	254915-124	254915-130
Your Reference	UNITS	TP13-S03	TP14-S01	TP15-S05	TP16-S05	TP17-S03
Date Sampled		15/12/2020	15/12/2020	16/12/2020	16/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	22/12/2020	30/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	6/01/2021	30/12/2020	6/01/2021	6/01/2021	6/01/2021
Silver	mg/kg	<1	2	<1	<1	<1
Aluminium	mg/kg	310	3,900	540	510	440
Arsenic	mg/kg	5	8	7	7	6
Boron	mg/kg	5	5	7	6	7
Barium	mg/kg	5	46	7	7	7
Beryllium	mg/kg	<1	<1	<1	<1	<1
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Cobalt	mg/kg	<1	10	<1	1	<1
Chromium	mg/kg	5	250	16	18	15
Copper	mg/kg	<1	14	<1	<1	<1
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	mg/kg	16	3,900	220	210	110
Molybdenum	mg/kg	<1	5	<1	<1	<1
Nickel	mg/kg	<1	45	3	3	2
Lead	mg/kg	3	7	3	3	3
Selenium	mg/kg	<2	3	<2	<2	<2
Vanadium	mg/kg	3	610	31	31	16
Zinc	mg/kg	<1	23	2	2	1
Thorium	mg/kg	<0.5	80	3	3	2
Uranium	mg/kg	0.2	5	0.5	0.5	0.4
Chromium (VI)	mg/kg	<1	46	2	32	<1
Trivalent Cr in soil	mg/kg	5	210	14	<1	15

Metals - soil						
Our Reference		254915-131	254915-142	254915-143	254915-144	254915-147
Your Reference	UNITS	TP17-S04	TP18-S07	TP18-S08	TP18-S09	TP19-S03
Date Sampled		16/12/2020	16/12/2020	16/12/2020	16/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	22/12/2020	22/12/2020	30/12/2020	22/12/2020	30/12/2020
Date analysed	-	6/01/2021	6/01/2021	30/12/2020	6/01/2021	30/12/2020
Silver	mg/kg	<1	<1	1	<1	<1
Aluminium	mg/kg	410	740	3,300	500	630
Arsenic	mg/kg	8	7	7	7	6
Boron	mg/kg	8	7	5	6	6
Barium	mg/kg	6	10	34	7	9
Beryllium	mg/kg	<1	<1	<1	<1	<1
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Cobalt	mg/kg	<1	2	8	<1	1
Chromium	mg/kg	7	37	230	22	29
Copper	mg/kg	<1	1	8	<1	1
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	mg/kg	31	510	3,500	240	390
Molybdenum	mg/kg	<1	<1	6	<1	<1
Nickel	mg/kg	1	6	37	3	5
Lead	mg/kg	4	3	6	3	3
Selenium	mg/kg	<2	<2	3	<2	<2
Vanadium	mg/kg	4	71	530	32	52
Zinc	mg/kg	<1	4	15	2	3
Thorium	mg/kg	<0.5	8	65	4	7
Uranium	mg/kg	0.4	0.8	4	0.5	0.7
Chromium (VI)	mg/kg	<1	16	60	1	2
Trivalent Cr in soil	mg/kg	7	21	170	21	27

Metals - soil						
Our Reference		254915-148	254915-153	254915-166	254915-168	254915-174
Your Reference	UNITS	TP19-S04	TP20-S01	TP21-S06	TP21-S08	TP22-S06
Date Sampled		16/12/2020	16/12/2020	16/12/2020	16/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	6/01/2021	6/01/2021	6/01/2021	6/01/2021	6/01/2021
Silver	mg/kg	<1	<1	<1	<1	<1
Aluminium	mg/kg	340	390	440	330	370
Arsenic	mg/kg	6	7	6	7	5
Boron	mg/kg	6	6	7	6	4
Barium	mg/kg	6	5	6	7	4
Beryllium	mg/kg	<1	<1	<1	<1	<1
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Cobalt	mg/kg	<1	<1	<1	<1	<1
Chromium	mg/kg	9	7	12	8	6
Copper	mg/kg	<1	<1	<1	<1	<1
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	mg/kg	34	29	110	27	12
Molybdenum	mg/kg	<1	<1	<1	<1	<1
Nickel	mg/kg	1	1	2	1	<1
Lead	mg/kg	3	3	3	3	2
Selenium	mg/kg	<2	<2	<2	<2	<2
Vanadium	mg/kg	4	5	16	4	3
Zinc	mg/kg	<1	<1	1	<1	<1
Thorium	mg/kg	<0.5	<0.5	2	<0.5	<0.5
Uranium	mg/kg	0.3	0.3	0.4	0.3	0.2
Chromium (VI)	mg/kg	<1	<1	1	<1	<1
Trivalent Cr in soil	mg/kg	9	7	11	8	6

Metals - soil					
Our Reference		254915-180	254915-191	254915-193	254915-194
Your Reference	UNITS	TP23-S04	TP24-S07	TPZ1	TPZ2
Date Sampled		16/12/2020	17/12/2020	15/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil
Date digested	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	6/01/2021	6/01/2021	6/01/2021	6/01/2021
Silver	mg/kg	<1	<1	<1	<1
Aluminium	mg/kg	410	410	280	490
Arsenic	mg/kg	5	5	5	7
Boron	mg/kg	4	5	4	7
Barium	mg/kg	6	7	5	7
Beryllium	mg/kg	<1	<1	<1	<1
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4
Cobalt	mg/kg	<1	<1	<1	<1
Chromium	mg/kg	6	6	5	15
Copper	mg/kg	<1	<1	<1	<1
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1
Manganese	mg/kg	43	52	21	150
Molybdenum	mg/kg	<1	<1	<1	<1
Nickel	mg/kg	<1	<1	<1	3
Lead	mg/kg	2	3	2	3
Selenium	mg/kg	<2	<2	<2	<2
Vanadium	mg/kg	3	3	2	22
Zinc	mg/kg	<1	<1	<1	2
Thorium	mg/kg	<0.5	<0.5	<0.5	2
Uranium	mg/kg	0.2	0.2	0.2	0.5
Chromium (VI)	mg/kg	<1	<1	<1	3
Trivalent Cr in soil	mg/kg	6	6	5	12

Moisture						
Our Reference		254915-1	254915-6	254915-9	254915-17	254915-25
Your Reference	UNITS	TP01-S01	TP01-S06	TP02-S01	TP03-S01	TP04-S01
Date Sampled		15/12/2020	15/12/2020	15/12/2020	15/12/2020	15/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	29/12/2020	29/12/2020	29/12/2020	29/12/2020	29/12/2020
Moisture	%	1.3	2.6	1.9	1.0	2.5
Moisture						
Our Reference		254915-33	254915-41	254915-49	254915-57	254915-61
Your Reference	UNITS	TP05-S01	TP06-S01	TP07-S01	TP08-S01	TP08-S05
Date Sampled		15/12/2020	15/12/2020	15/12/2020		15/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	29/12/2020	29/12/2020	29/12/2020	29/12/2020	29/12/2020
Moisture	%	0.49	4.9	1.6	1.1	2.9
Moisture						
Our Reference		254915-65	254915-73	254915-81	254915 - 85	254915-89
Your Reference	UNITS	TP09-S01	TP10-S01	TP11-S01	TP11-S05	TP12-S01
Date Sampled		15/12/2020	15/12/2020	15/12/2020	15/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	29/12/2020	29/12/2020	29/12/2020	29/12/2020	29/12/2020
Moisture	%	4.6	1.5	1.7	4.4	0.37
Moisture						
Our Reference		254915-99	254915-105	254915-116	254915-124	254915-130
Your Reference	UNITS	TP13-S03	TP14-S01	TP15-S05	TP16-S05	TP17-S03
Date Sampled		15/12/2020	15/12/2020	16/12/2020	16/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	29/12/2020	29/12/2020	29/12/2020	29/12/2020	29/12/2020
Moisture	%	2.0	7.6	2.3	7.3	6.0
Moisture						
Our Reference		254915-131	254915-142	254915-143	254915-144	254915-147
Your Reference	UNITS	TP17-S04	TP18-S07	TP18-S08	TP18-S09	TP19-S03
Date Sampled		16/12/2020	16/12/2020	16/12/2020	16/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	29/12/2020	29/12/2020	29/12/2020	29/12/2020	29/12/2020
Moisture	%	21	3.9	9.2	2.2	3.2

Moisture						
Our Reference		254915-148	254915-153	254915-166	254915-168	254915-174
Your Reference	UNITS	TP19-S04	TP20-S01	TP21-S06	TP21-S08	TP22-S06
Date Sampled		16/12/2020	16/12/2020	16/12/2020	16/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	29/12/2020	29/12/2020	29/12/2020	29/12/2020	29/12/2020
Moisture	%	1.5	4.2	1.4	2.0	2.8

Moisture					
Our Reference		254915-180	254915-191	254915-193	254915-194
Your Reference	UNITS	TP23-S04	TP24-S07	TPZ1	TPZ2
Date Sampled		16/12/2020	17/12/2020	15/12/2020	16/12/2020
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	29/12/2020	29/12/2020	29/12/2020	29/12/2020
Moisture	%	5.8	2.3	2.1	2.8

Dissolved Metals in Water					
Our Reference		254915-195	254915-196	254915-197	254915-198
Your Reference	UNITS	WB2	WB3	WR2	WR3
Date Sampled		15/12/2020	16/12/2020	15/12/2020	16/12/2020
Type of sample		Water	Water	Water	Water
Date prepared	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Date analysed	-	22/12/2020	22/12/2020	22/12/2020	22/12/2020
Silver-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Aluminium-Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01
Arsenic-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	<0.02	<0.02	<0.02	<0.02
Barium-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Beryllium-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Cadmium-Dissolved	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Chromium-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01
Mercury-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005
Manganese-Dissolved	mg/L	<0.005	<0.005	<0.005	<0.005
Molybdenum-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Lead-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Uranium-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.002	<0.001	0.004	0.004
Dissolved CrVI	mg/L	<0.005	<0.005	<0.005	<0.005
Dissolved CrIII	mg/L	<0.005	<0.005	<0.005	<0.005

Method ID	Methodology Summary
1289.3.6.1	Methods of testing soils for engineering purposes - Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving
INORG-001	pH - Measured using pH meter and electrode base on APHA latest edition, Method 4500-H+ from a 1:5 extract using 0.01M calcium chloride.
INORG-008	Moisture content determined by heating at 105 deg C for a minimum of 12 hours.
INORG-118	Hexavalent Chromium by Ion Chromatographic separation and colourimetric determination.
METALS-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.
METALS-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.
METALS-020	Determination of various metals by ICP-AES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
	For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

QUALITY CO	NTROL: Mis	cellaneou	s Inorg - soil		Duplicate				Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]	
Date prepared	-			22/12/2020	6	22/12/2020	22/12/2020		22/12/2020		
Date analysed	-			22/12/2020	6	22/12/2020	22/12/2020		22/12/2020		
pH(CaCl ₂)	pH Units		INORG-001	[NT]	6	7.8	7.9	1	102		
Clay in soils <2µm *	% (w/w)	1	1289.3.6.1	[NT]	6	6			[NT]		

QUAL	ITY CONTR	OL: ESP/	CEC		Duplicate Spike Re				covery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254915-25
Date digested	-			06/01/2021	6	06/01/2021	06/01/2021		06/01/2021	06/01/2021
Date analysed	-			07/01/2021	6	07/01/2021	07/01/2021		07/01/2021	07/01/2021
Calcium	mg/kg	50	METALS-020	<50	6	77	77	0	106	#
Potassium	mg/kg	50	METALS-020	<50	6	<50	<50	0	107	79
Magnesium	mg/kg	50	METALS-020	<50	6	<50	<50	0	98	85
Sodium	mg/kg	50	METALS-020	<50	6	<50	<50	0	101	70
Aluminium	mg/kg	10	METALS-020	<10	6	<10	<10	0	96	[NT]

Q	UALITY CONTRO	L: Metals	s - soil			Du	Spike Recovery %			
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254915-6
Date digested	-			30/12/2020	1	22/12/2020	22/12/2020		30/12/2020	22/12/2020
Date analysed	-			30/12/2020	1	6/01/2021	6/01/2021		30/12/2020	6/01/2021
Silver	mg/kg	1	METALS-020	<1	1	<1	<1	0	92	83
Aluminium	mg/kg	10	METALS-020	<10	1	550	570	4	93	#
Arsenic	mg/kg	2	METALS-020	<2	1	6	6	0	96	82
Boron	mg/kg	3	METALS-020	<3	1	5	5	0	95	80
Barium	mg/kg	1	METALS-020	<1	1	7	6	15	108	94
Beryllium	mg/kg	1	METALS-020	<1	1	<1	<1	0	94	83
Cadmium	mg/kg	0.4	METALS-020	<0.4	1	<0.4	<0.4	0	97	70
Cobalt	mg/kg	1	METALS-020	<1	1	<1	<1	0	98	72
Chromium	mg/kg	1	METALS-020	<1	1	8	8	0	102	79
Copper	mg/kg	1	METALS-020	<1	1	<1	<1	0	102	90
Mercury	mg/kg	0.1	METALS-021	<0.1	1	<0.1	<0.1	0	108	102
Manganese	mg/kg	1	METALS-020	<1	1	60	52	14	97	81
Molybdenum	mg/kg	1	METALS-020	<1	1	<1	<1	0	101	78
Nickel	mg/kg	1	METALS-020	<1	1	1	1	0	98	71
Lead	mg/kg	1	METALS-020	<1	1	3	3	0	103	76
Selenium	mg/kg	2	METALS-020	<2	1	<2	<2	0	91	76
Vanadium	mg/kg	1	METALS-020	<1	1	8	8	0	98	78
Zinc	mg/kg	1	METALS-020	<1	1	4	3	29	102	70
Thorium	mg/kg	0.5	METALS-022	<0.5	1	0.7	0.8	13	88	#
Uranium	mg/kg	0.1	METALS-022	<0.1	1	0.3	0.3	0	100	102
Chromium (VI)	mg/kg	1	INORG-118	<1	1	<1	<1	0	102	98

	QUALITY CONTRO	L: Metals	s - soil			Du	plicate		Spike Re	ecovery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	254915-142
Date digested	-			[NT]	65	22/12/2020	22/12/2020		22/12/2020	22/12/2020
Date analysed	-			[NT]	65	6/01/2021	6/01/2021		6/01/2021	6/01/2021
Silver	mg/kg	1	METALS-020	[NT]	65	<1	<1	0	89	#
Aluminium	mg/kg	10	METALS-020	[NT]	65	330	310	6	94	#
Arsenic	mg/kg	2	METALS-020	[NT]	65	6	6	0	97	103
Boron	mg/kg	3	METALS-020	[NT]	65	5	6	18	96	97
Barium	mg/kg	1	METALS-020	[NT]	65	5	5	0	107	125
Beryllium	mg/kg	1	METALS-020	[NT]	65	<1	<1	0	95	106
Cadmium	mg/kg	0.4	METALS-020	[NT]	65	<0.4	<0.4	0	98	86
Cobalt	mg/kg	1	METALS-020	[NT]	65	<1	<1	0	98	91
Chromium	mg/kg	1	METALS-020	[NT]	65	5	5	0	102	#
Copper	mg/kg	1	METALS-020	[NT]	65	<1	<1	0	101	118
Mercury	mg/kg	0.1	METALS-021	[NT]	65	<0.1	<0.1	0	108	87
Manganese	mg/kg	1	METALS-020	[NT]	65	16	17	6	98	#
Molybdenum	mg/kg	1	METALS-020	[NT]	65	<1	<1	0	103	#
Nickel	mg/kg	1	METALS-020	[NT]	65	1	<1	0	98	95
Lead	mg/kg	1	METALS-020	[NT]	65	3	2	40	102	95
Selenium	mg/kg	2	METALS-020	[NT]	65	<2	<2	0	92	96
Vanadium	mg/kg	1	METALS-020	[NT]	65	3	3	0	98	#
Zinc	mg/kg	1	METALS-020	[NT]	65	<1	<1	0	101	89
Thorium	mg/kg	0.5	METALS-022	[NT]	65	<0.5	<0.5	0	92	#
Uranium	mg/kg	0.1	METALS-022	[NT]	65	0.3	0.3	0	101	97
Chromium (VI)	mg/kg	1	INORG-118	[NT]	65	<1	<1	0	102	#

QUALITY CONTROL: Metals - soil						Du		Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	[NT]
Date digested	-			[NT]	131	22/12/2020	22/12/2020		30/12/2020	
Date analysed	-			[NT]	131	6/01/2021	6/01/2021		30/12/2020	
Silver	mg/kg	1	METALS-020	[NT]	131	<1	<1	0	[NT]	
Aluminium	mg/kg	10	METALS-020	[NT]	131	410	390	5	[NT]	
Arsenic	mg/kg	2	METALS-020	[NT]	131	8	7	13	[NT]	
Boron	mg/kg	3	METALS-020	[NT]	131	8	7	13	[NT]	
Barium	mg/kg	1	METALS-020	[NT]	131	6	6	0	[NT]	
Beryllium	mg/kg	1	METALS-020	[NT]	131	<1	<1	0	[NT]	
Cadmium	mg/kg	0.4	METALS-020	[NT]	131	<0.4	<0.4	0	[NT]	
Cobalt	mg/kg	1	METALS-020	[NT]	131	<1	<1	0	[NT]	
Chromium	mg/kg	1	METALS-020	[NT]	131	7	7	0	[NT]	
Copper	mg/kg	1	METALS-020	[NT]	131	<1	<1	0	[NT]	
Mercury	mg/kg	0.1	METALS-021	[NT]	131	<0.1	<0.1	0	[NT]	
Manganese	mg/kg	1	METALS-020	[NT]	131	31	30	3	[NT]	
Molybdenum	mg/kg	1	METALS-020	[NT]	131	<1	<1	0	[NT]	
Nickel	mg/kg	1	METALS-020	[NT]	131	1	1	0	[NT]	
Lead	mg/kg	1	METALS-020	[NT]	131	4	3	29	[NT]	
Selenium	mg/kg	2	METALS-020	[NT]	131	<2	<2	0	[NT]	
Vanadium	mg/kg	1	METALS-020	[NT]	131	4	4	0	[NT]	
Zinc	mg/kg	1	METALS-020	[NT]	131	<1	1	0	[NT]	
Thorium	mg/kg	0.5	METALS-022	[NT]	131	<0.5	<0.5	0	[NT]	
Uranium	mg/kg	0.1	METALS-022	[NT]	131	0.4	0.4	0	[NT]	
Chromium (VI)	mg/kg	1	INORG-118	[NT]	131	<1	<1	0	102	

QUALITY CONTROL: Metals - soil						Du		Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date digested	-			[NT]	180	22/12/2020	22/12/2020			[NT]
Date analysed	-			[NT]	180	6/01/2021	6/01/2021			[NT]
Silver	mg/kg	1	METALS-020	[NT]	180	<1	<1	0		[NT]
Aluminium	mg/kg	10	METALS-020	[NT]	180	410	410	0		[NT]
Arsenic	mg/kg	2	METALS-020	[NT]	180	5	5	0		[NT]
Boron	mg/kg	3	METALS-020	[NT]	180	4	5	22		[NT]
Barium	mg/kg	1	METALS-020	[NT]	180	6	7	15		[NT]
Beryllium	mg/kg	1	METALS-020	[NT]	180	<1	<1	0		[NT]
Cadmium	mg/kg	0.4	METALS-020	[NT]	180	<0.4	<0.4	0		[NT]
Cobalt	mg/kg	1	METALS-020	[NT]	180	<1	<1	0		[NT]
Chromium	mg/kg	1	METALS-020	[NT]	180	6	6	0		[NT]
Copper	mg/kg	1	METALS-020	[NT]	180	<1	<1	0		[NT]
Mercury	mg/kg	0.1	METALS-021	[NT]	180	<0.1	<0.1	0		[NT]
Manganese	mg/kg	1	METALS-020	[NT]	180	43	49	13		[NT]
Molybdenum	mg/kg	1	METALS-020	[NT]	180	<1	<1	0		[NT]
Nickel	mg/kg	1	METALS-020	[NT]	180	<1	<1	0		[NT]
Lead	mg/kg	1	METALS-020	[NT]	180	2	2	0		[NT]
Selenium	mg/kg	2	METALS-020	[NT]	180	<2	<2	0		[NT]
Vanadium	mg/kg	1	METALS-020	[NT]	180	3	3	0		[NT]
Zinc	mg/kg	1	METALS-020	[NT]	180	<1	<1	0		[NT]
Thorium	mg/kg	0.5	METALS-022	[NT]	180	<0.5	<0.5	0		[NT]
Uranium	mg/kg	0.1	METALS-022	[NT]	180	0.2	0.2	0		[NT]
Chromium (VI)	mg/kg	1	INORG-118	[NT]	180	<1	<1	0		[NT]

QUALITY	CONTROL: Dis	solved Me	ta l s in Water			Du	plicate		Spike Re	ecovery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254915-19
Date prepared	-			06/01/2021	195	22/12/2020	22/12/2020		06/01/2021	22/12/2020
Date analysed	-			06/01/2021	195	22/12/2020	22/12/2020		06/01/2021	22/12/2020
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		100	105
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	195	<0.01	[NT]		95	91
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		98	99
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	195	<0.02	[NT]		98	102
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		89	94
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	195	<0.0005	[NT]		96	104
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	195	<0.0001	[NT]		91	92
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		102	103
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		92	91
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		89	89
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	195	<0.01	[NT]		109	94
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	195	<0.00005	[NT]		99	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	195	<0.005	[NT]		94	92
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		94	74
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		91	90
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		88	90
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		97	100
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	195	<0.0005	[NT]		83	86
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	195	<0.0005	[NT]		85	80
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	195	<0.001	[NT]		100	98
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	195	0.002	[NT]		92	94
Dissolved CrVI	mg/L	0.005	INORG-118	<0.005	195	<0.005	<0.005	0	104	104

QUALITY CON	NTROL: Diss	olved Me	tals in Water			Du	plicate		Spike Re	ecovery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	254915-196
Date prepared	-			[NT]	[NT]		[NT]	[NT]		22/12/2020
Date analysed	-			[NT]	[NT]		[NT]	[NT]		22/12/2020
Dissolved CrVI	mg/L	0.005	INORG-118	[NT]	[NT]		[NT]	[NT]		101

Result Definiti	ons
NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Contro	ol Definitions
Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

 MPL Reference:
 254915
 Page | 24 of 25

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 R00

Report Comments

Low spike recovery was obtained for this sample. Sample matrix interference is suspected. However, an acceptable recovery was achieved for the LCS.

Clay content analysis conducted by Envirolab Services. Report 258675.

Low (or high) spike recovery was obtained for this sample. Sample matrix interference is suspected. However, an acceptable recovery was achieved for the LCS.

 MPL Reference:
 254915
 Page | 25 of 25

 Revision No:
 R00



ENVIROLAB Empl

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories

ABN 53 140 099 207 16-18 Hayden Court Myaree WA 6154 ph 08 9317 2505 fax 08 9317 4163 lab@mpl.com.au www.mpl.com.au

CERTIFICATE OF ANALYSIS 254915-A

Client Details	
Client	RPS Australia West Pty Ltd
Attention	Alan Foley
Address	Level 2, 27-31 Troode St, WEST PERTH, WA, 6005

Sample Details	
Your Reference	EEC14081.004 - Greenpatch
Number of Samples	4 Soils
Date samples received	17/12/2020
Date completed instructions received	14/01/2021

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details					
Date results requested by	28/01/2021				
Date of Issue	28/01/2021				
Reissue Details	This report replaces R01 created on 21/01/2021 due to: Added Metals Pb Se				
NATA Accreditation Number 2901. This document shall not be reproduced except in full.					
Accredited for compliance with ISO/II	EC 17025 - Testing. Tests not covered by NATA are denoted with *				

Results Approved By

Heram Halim, Operations Manager Michael Mowle, Metals/Inorganics Supervisor **Authorised By**

Michael Kubiak, Laboratory Manager



Metals - soil			
Our Reference		254915-A-106	254915-A-107
Your Reference	UNITS	TP14-S02	TP14-S03
Date Sampled		15/12/2020	15/12/2020
Type of sample		Soil	Soil
Date digested	-	20/01/2021	20/01/2021
Date analysed	-	20/01/2021	20/01/2021
Manganese	mg/kg	80	19
Nickel	mg/kg	2	1
Thorium	mg/kg	1	<0.5

MPL Reference: 254915-A

Moisture			
Our Reference		254915-A-106	254915-A-107
Your Reference	UNITS	TP14-S02	TP14-S03
Date Sampled		15/12/2020	15/12/2020
Type of sample		Soil	Soil
Date prepared	-	20/01/2021	20/01/2021
Date analysed	-	20/01/2021	20/01/2021
Moisture	%	1.7	1.5

MPL Reference: 254915-A

Metals in ASLP (reagent water)			
Our Reference		254915-A-105	254915-A-143
Your Reference	UNITS	TP14-S01	TP18-S08
Date Sampled		15/12/2020	16/12/2020
Type of sample		Soil	Soil
Date prepared	-	19/01/2021	19/01/2021
Date analysed	-	19/01/2021	19/01/2021
pH of final Leachate	pH units	8.6	8.7
Nickel in ASLP	mg/L	0.001	0.002
Lead in ASLP	mg/L	<0.001	[NA]
Selenium in ASLP	mg/L	<0.001	[NA]
Chromium (VI) in ASLP	mg/L	0.18	[NA]

MPL Reference: 254915-A

Method ID	Methodology Summary
INORG-001	pH - Measured using pH meter and electrode in accordance with APHA 21st ED, 4500-H+. The leachate fluid used in the leachability test is the correct leachate fluid for Class 1, Class 2b and Class 4 landfills, as per AS4439.3-1997
INORG-008	Moisture content determined by heating at 105 deg C for a minimum of 12 hours.
INORG-118	Hexavalent Chromium by Ion Chromatographic separation and colourimetric determination.
METALS-020	Determination of various metals by ICP-AES.
METALS-022	Determination of various metals by ICP-MS.

MPL Reference: 254915-A Page | **5 of 10**

QUALIT	TY CONTRO	L: Metals	- soi l			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	254915-A- 107
Date digested	-			20/01/2021	106	20/01/2021	20/01/2021		20/01/2021	20/01/2021
Date analysed	-			20/01/2021	106	20/01/2021	20/01/2021		20/01/2021	20/01/2021
Manganese	mg/kg	1	METALS-020	<1	106	80	68	16	84	96
Nickel	mg/kg	1	METALS-020	<1	106	2	2	0	84	89
Thorium	mg/kg	0.5	METALS-022	<0.5	106	1	1	0	71	113

MPL Reference: 254915-A

QUAI	ITY CONTR	ROL: Mois	ture			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			20/01/2021	[NT]		[NT]	[NT]		[NT]
Date analysed	-			20/01/2021	[NT]		[NT]	[NT]		[NT]
Moisture	%	0.1	INORG-008	<0.1	[NT]	[NT]	[NT]	[NT]		[NT]

MPL Reference: 254915-A

QUALITY CONT	ROL: Metals	in ASLP	(reagent water)			Du	olicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			19/01/2021	105	19/01/2021	19/01/2021		19/01/2021	
Date analysed	-			19/01/2021	105	19/01/2021	19/01/2021		19/01/2021	
Nickel in ASLP	mg/L	0.001	METALS-022	<0.001	105	0.001	0.001	0	97	
Lead in ASLP	mg/L	0.001	METALS-022	<0.001	105	<0.001	<0.001	0	98	
Selenium in ASLP	mg/L	0.001	METALS-022	<0.001	105	<0.001	<0.001	0	96	
Chromium (VI) in ASLP	mg/L	0.005	INORG-118	<0.005	105	0.18	0.19	5	101	[NT]

MPL Reference: 254915-A

Result Definiti	ons
NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

MPL Reference: 254915-A Page | 9 of 10 R02

Quality Control	ol Definitions
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Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
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Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

MPL Reference: 254915-A Page | 10 of 10

Revision No: R02

Meredith Conroy

From:

Alan Foley <Alan.Foley@rpsgroup.com.au>

Sent:

Thursday, 14 January 2021 9:20 AM

To:

Michael Kubiak

Cc:

Colm Corcoran; Zak Langtry; MPL Laboratory

Subject:

RE: Results for Registration 254915 EEC14081.004 - Greenpatch

CAUTION: This email originated from outside of the organisation. Do not act on instructions, click links or open attachments unless you recognise the sender and know the content is authentic and safe.

Michael

Can we please get the following analysis on samples from the above batch

Metals (Mn, Ni, Th)

106 TP14-S02

₩ 107 TP14-S03

ALSP - DI water - Ni

1 105 TP14-S01

4 143 TP18-S08

Regards

Alan

Alan Foley

Principal Scientist - Contamination and Acid Sulfate Soils RPS | Australia Asia Pacific

M +61 457 554 432

E alan.foley@rpsgroup.com.au

From: Michael Kubiak <mkubiak@mpl.com.au>

Sent: Friday, 8 January 2021 10:07 AM

To: Colm Corcoran <Colm.Corcoran@rpsgroup.com.au>; Alan Foley <Alan.Foley@rpsgroup.com.au>

Subject: Results for Registration 254915 EEC14081.004 - Greenpatch

CAUTION: This email originated from outside of RPS.

Please refer to attached for:
a copy of the Certificate of Analysis
a copy of the COC/paperwork received from you
ESDAT Extracts
an Excel or .csv file containing the results

Please note that a hard copy will not be posted.

Enquiries should be made directly to:

Results

Results@mpl.com.au

or

Heram Halim Michael Kubiak hhalim@mpl.com.au mkubiak@mpl.com.au tedwards@mpl.com.au

Tom Edwards

How did we do? Send Feedback





ABN 53 140 099 207 16-18 Hayden Court Myaree WA 6154 ph 08 9317 2505 fax 08 9317 4163 lab@mpl.com.au www.mpl.com.au

DATA QUALITY ASSESSMENT SUMMARY

Report Details	
Envirolab Report Reference	<u>254915-A</u>
Client ID	RPS Australia West Pty Ltd
Project Reference	EEC14081.004 - Greenpatch
Date Issued	28/01/2021

QC DATA

All laboratory QC data was within the Envirolab Group's specifications.

HOLDING TIME COMPLIANCE EVALUATION

All preservation / holding times (based on AS/ASPHA/ISO/NEPM/USEPA reference documents and standards) are compliant except:

Holding Time Exceedances					
Analysis	Sample No	Date Sampled	Date Extracted	Date Analysed	Accepted
Moisture					
	254915-A-106	15/12/2020	20/01/2021	20/01/2021	X
	254915-A-107	15/12/2020	20/01/2021	20/01/2021	X
Metals in ASLP (reagent water)					
Chromium (VI) in ASLP	254915-A-105	15/12/2020	19/01/2021	19/01/2021	Х

Certain analyses have had their recommended technical holding times elongated by filtering and/or freezing on receipt at the laboratory (e.g. BOD, chlorophyll/Pheophytin, nutrients and acid sulphate soil tests).

COMPLIANCE TO QC FREQUENCY (NEPM)

Internal laboratory QC rate complies with NEPM requirements (LCS/MB/MS 1 in 20, Duplicates 1 in 10 samples). Note, samples are batched together with other sample consignments in order to assign QC sample frequency.

QC Evaluation	
Duplicate(s) was performed as per NEPM frequency	✓
Laboratory Control Sample(s) were analysed with the samples received	✓
A Method Blank was performed with the samples received	✓
Matrix spike(s) was performed as per NEPM frequency (Not Applicable for Air samples)	✓

Refer to Certificate of Analysis for all Quality Control data.

Cecilia Tadena

To:

Subject:

Heram Halim

RE: Rebatch 254915-A and 254915

From: Alan Foley <<u>Alan.Foley@rpsgroup.com.au</u>>
Sent: Wednesday, 27 January 2021 2:39 PM
To: MPL Laboratory <<u>lab@mpl.com.au</u>>

Cc: Colm Corcoran < Colm.Corcoran@rpsgroup.com.au >; Heram Halim < HHalim@mpl.com.au >; Zak Langtry

<Zak.Langtry@rpsgroup.com.au>

Subject: Rebatch 254915-A and 254915

CAUTION: This email originated from outside of the organisation. Do not act on instructions, click links or open attachments unless you recognise the sender and know the content is authentic and safe.

Good afternoon

Could we please get the following additional analysis on the following samples from 254915:

ALSP (DI water) – CrVI, Ni, Pb and Se TP18-S08 254915-143

ALSP (DI water) – CrVI, Pb and Se TP14-S01 254915-105

TP14-S01 was leached for Ni in 254915-A so not sure if Pb and Se and be turned on and reported

Regards

Alan

Alan Foley

Principal Scientist - Contamination and Acid Sulfate Soils RPS | Australia Asia Pacific Level 2, 27-31 Troode Street West Perth WA 6005, Australia T +61 8 9211 1111 D +61 9288 0836 M +61 457 554 432 E alan foley@rpsgroup.com.au



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Project reference:	e: EEC14081 004			111	j					
Scientist(s):	SWW		we	ı, C.						
Sample type(s):	Soil		None	CIA				Page number:	1017	
Report to:	Alan Foley & Com Corcoran			,stat				Tumaround time:	Standard	
Invoice to:	west accountspayable@rpsgroup.com			ocu i				Quote number:	19P347v2	
Sample I.D.	Date collected b	Number of jars / bottles / bags	DHC#	Hold				Remarks		
TP01-S01	15/12/2020									
TP01-S02	2 15/12/2020	*		×					5 10	
TP01-S03	15/12/2020	+		×						
ψ +08-104T	15/12/2020			×						
TP01-805 S	15/12/2020			ж						
TP01-806 6	15/12/2020	*	×	×						
TP01-S07	15/12/2020	-		×					9	7
TP01-S08 2	15/12/2020	1		×					-	ENVIR ENVIR
TP02-S01 0	1512/2020	1		×						- Choratories
TP02-502	15/12/2020			×					0	くったスク・ov
TP02-S03	15/12/2020	*		×					100	7-t-0
TP02-504 12	15/12/2020	1		×					al.	S - 00
TP02-S05	15/12/2020	*		×					a	J.W.
102-sos	15/12/2020			ж					4	Freq - SAME 1/2/3 (5)
7P02-S07 (S	15/12/2020	1		×					9,	op - cool / emblant
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TP03-501	15/12/2020	1		×						(C. Ver)
TP03-502 8	8 1512/2020			×						
TP03-S03 q	15/12/2020	1		×						
TP03.504 2	15/12/2020			×						
TPUS 806 24	15/12/2020	1		×						
TP03-506 2	22 1512/2020	1		×						
TP03-807 73	15/12/2020	1		×						
PS 808 24	15/12/2020			×						
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stal number of	Total number of bottles/bags/jars	25								
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Organisation:	RPS	Date:	D-17-23	cr		Organisation:		Date:		
Date:	17/12/2020	Time:		(35)		Date:		Time;		
	40.40									

Biologi selectore: EEC14081 004	EXCLADA ODA						
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PPS Automate West Pry LM, Registered in Autom registrospaceure

suce:	ETC-14081 004						
	the their sections						
Scientist(s): St	SMIV						
Sample type(s): So	Soil					Page number:	3 of 7
Report to: Al	Alam Fokey & Corn Corcoran	26/00				Tumaround time:	Standard
	west accountspayable@rpsgroup.com	DUCE S				Quate number:	199347v2
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opect reference.	- 1			L C					
Scientist(s):	SWW	uoi	T.	10					
Sample type(s):	Soil	toes		10				Page number:	1011
Report to:	Alan Foley & Com Corcoran	143	jun	atas				Turnaround time:	Standard
Involce to:	west accountspayable@rpsgroup com	5000	wo:	mar A				Quote number:	19934742
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roject reference	Project reference: EEC14061 004			2		10				1			
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Sample type(s):	Soil		_	ch		o, Cr					Page number:		7 017
Report to:	Alan Foley & Com Corcoran	Cortoran	00000	sint		late los 1					Tumaround time:		Standard
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ABN 53 140 099 207 16-18 Hayden Court Myaree WA 6154 ph 08 9317 2505 fax 08 9317 4163 lab@mpl.com.au www.mpl.com.au

DATA QUALITY ASSESSMENT SUMMARY

Report Details	
Envirolab Report Reference	<u>254915</u>
Client ID	RPS Australia West Pty Ltd
Project Reference	EEC14081.004 - Greenpatch
Date Issued	08/01/2021

QC DATA

All laboratory QC data was within the Envirolab Group's specifications except:

QC Specification	Exceptions		
QC Type	Reference	Analysis	Comments
Spike Recovery %	254915-142	Aluminium	Fails internal acceptance criteria
Spike Recovery %	254915-142	Chromium	Fails internal acceptance criteria
Spike Recovery %	254915-142	Chromium (VI)	Fails internal acceptance criteria
Spike Recovery %	254915-142	Manganese	Fails internal acceptance criteria
Spike Recovery %	254915-142	Molybdenum	Fails internal acceptance criteria
Spike Recovery %	254915-142	Silver	Fails internal acceptance criteria
Spike Recovery %	254915-142	Thorium	Fails internal acceptance criteria
Spike Recovery %	254915-142	Vanadium	Fails internal acceptance criteria
Spike Recovery %	254915-25	Calcium	Fails internal acceptance criteria
Spike Recovery %	254915-6	Aluminium	Fails internal acceptance criteria
Spike Recovery %	254915-6	Thorium	Fails internal acceptance criteria

See Report 254915-[R00] for QA/QC details





ABN 53 140 099 207 16-18 Hayden Court Myaree WA 6154 ph 08 9317 2505 fax 08 9317 4163 lab@mpl.com.au www.mpl.com.au

HOLDING TIME COMPLIANCE EVALUATION

All preservation / holding times (based on AS/ASPHA/ISO/NEPM/USEPA reference documents and standards) are compliant except:

Holding Time Exceedances					
Analysis	Sample No	Date Sampled	Date Extracted	Date Analysed	Accepted
Miscellaneous Inorg - soil					
pH(CaCl ₂)	254915-6	15/12/2020	22/12/2020	22/12/2020	X
pH(CaCl ₂)	254915-25	15/12/2020	22/12/2020	22/12/2020	X
pH(CaCl ₂)	254915-41	15/12/2020	22/12/2020	22/12/2020	X
pH(CaCl ₂)	254915-73	15/12/2020	22/12/2020	22/12/2020	Χ
pH(CaCl ₂)	254915-105	15/12/2020	22/12/2020	22/12/2020	Χ
pH(CaCl ₂)	254915-143	16/12/2020	22/12/2020	22/12/2020	Χ
pH(CaCl ₂)	254915-147	16/12/2020	22/12/2020	22/12/2020	Х
Metals - soil					
	254915-57		22/12/2020	6/01/2021	#
Moisture					
	254915-57		22/12/2020	29/12/2020	#

Holding Table Comments

No Sample Dates were provided. Holding Times cannot be calculated.

Certain analyses have had their recommended technical holding times elongated by filtering and/or freezing on receipt at the laboratory (e.g. BOD, chlorophyll/Pheophytin, nutrients and acid sulphate soil tests).

COMPLIANCE TO QC FREQUENCY (NEPM)

Internal laboratory QC rate complies with NEPM requirements (LCS/MB/MS 1 in 20, Duplicates 1 in 10 samples). Note, samples are batched together with other sample consignments in order to assign QC sample frequency.

QC Evaluation	
Duplicate(s) was performed as per NEPM frequency	✓
Laboratory Control Sample(s) were analysed with the samples received	✓
A Method Blank was performed with the samples received	✓
Matrix spike(s) was performed as per NEPM frequency (Not Applicable for Air samples)	✓

Refer to Certificate of Analysis for all Quality Control data.



CERTIFICATE OF ANALYSIS

 Work Order
 : EP2014084

 Client
 : RPS Australia West Pty Ltd
 Laboratory

26 Rigali Way Wangara WA Australia 6065 Lauren Biagioni Contact Address WEST PERTH WA 6872 **ALAN FOLEY** PO BOX 170

Environmental Division Perth

: 1 of 6

Telephone : 08 9406 1307

Date Samples Received : 15-Dec-2020 17:22

Date Analysis Commenced : 16-Dec-2020

Issue Date : 23-Dec-2020 22:12

EEC14061,006

Order number

Telephone

Project

Contact Address

Accredited for compliance with ISO/IEC 17025 - Testing EPBQ/015/17 Greenpatch SMW/ZL No. of samples analysed No. of samples received C-O-C number Quote number Sampler

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	Position	Accreditation Category
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
David Viner	SENIOR LAB TECH	Perth Organics, Wangara, WA



 Page
 : 2 of 6

 Work Order
 : EP2014084

 Client
 : RPS Australia West Pty Ltd

 Project
 : EEC14061.006

General Comments

In house developed procedures The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. are fully validated and are often at the client request.

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

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

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

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

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

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

LOR = Limit of reporting

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

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.

Ionic balances were calculated using: major anions - chloride, alkalinity and sulfate; and major cations - calcium, magnesium, potassium and sodium.

Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.



Project Client

: 3 of 6 : EP2014084 : RPS Australia West Pty Ltd : EEC14061.006

Page Work Order

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	WZZ1		1	I	1
		Samplin	Sampling date / time	14-Dec-2020 00:00	-			-
Compound	CAS Number	LOR	Unit	EP2014084-001				
				Result				-
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C		1	mS/cm	1310			-	-
EA015: Total Dissolved Solids dried at 180 ± 5 °C	0 ± 5°C							
Total Dissolved Solids @180°C		10	mg/L	724				•
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	-	mg/L	<1			1	i
Carbonate Alkalinity as CaCO3	3812-32-6	-	mg/L	<1				
Bicarbonate Alkalinity as CaCO3	71-52-3	-	mg/L	302				
Total Alkalinity as CaCO3		-	mg/L	302			-	•
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	- by DA							
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	98	-		-	-
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	-	mg/L	204	-	-	i	i
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	_	mg/L	114			1	ı
Magnesium	7439-95-4	-	mg/L	37				
Sodium	7440-23-5	-	mg/L	112				
Potassium	7440-09-7	-	mg/L	5				
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01			-	-
Arsenic	7440-38-2	0.001	mg/L	0.002				-
Boron	7440-42-8	0.05	mg/L	0.11				•
Barium	7440-39-3	0.001	mg/L	0.030	-		-	-
Beryllium	7440-41-7	0.001	mg/L	<0.001	-		-	-
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	-	-		i
Cobalt	7440-48-4	0.001	mg/L	<0.001				-
Chromium	7440-47-3	0.001	mg/L	0.178			-	
Copper	7440-50-8	0.001	mg/L	<0.001	-			i
Manganese	7439-96-5	0.001	mg/L	<0.001				
Nickel	7440-02-0	0.001	mg/L	<0.001				
Lead	7439-92-1	0.001	mg/L	<0.001				
Selenium	7782-49-2	0.01	mg/L	<0.01	-		-	-
Vanadium	7440-62-2	0.01	mg/L	<0.01			-	-
Zinc	7440-66-6	0.005	mg/L	0.010			1	1
Molybdenum	7439-98-7	0.001	mg/L	<0.001	1	-	-	1



Client Project

: 4 of 6 : EP2014084 : RPS Australia West Pty Ltd : EEC14061.006

Page Work Order

•							
Sub-Matrix: WATER (Matrix: WATER)		Sample ID	WZZ1	1	1		1
	Samplii	Sampling date / time	14-Dec-2020 00:00				
Compound CAS Number	LOR	Unit	EP2014084-001				
			Result				
EG020F: Dissolved Metals by ICP-MS - Continued							
Silver 7440-22-4	0.001	mg/L	<0.001				
Thorium 7440-29-1	0.001	mg/L	<0.001			-	
Uranium 7440-61-1	0.001	mg/L	<0.001				
lron 7439-89-6	0.05	mg/L	<0.05				
EG035F: Dissolved Mercury by FIMS							
Mercury 7439-97-6	0.0001	mg/L	<0.0001	-			
EG049G LL-F: Dissolved Trivalent Chromium - Low Level	<u></u>						
Trivalent Chromium 16065-83-1	0.001	mg/L	0.026				-
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level	ete Analys	ser - Low Leve					
Hexavalent Chromium 18540-29-9	0.001	mg/L	0.152				
EK055G: Ammonia as N by Discrete Analyser							
Ammonia as N 7664-41-7	0.01	mg/L	<0.01		-	1	ı
EK057G: Nitrite as N by Discrete Analyser							
Nitrite as N 14797-65-0	0.01	mg/L	<0.01				
EK058G: Nitrate as N by Discrete Analyser							
Nitrate as N 14797-55-8	0.01	mg/L	1.85	-			
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser	alyser						
Nitrite + Nitrate as N	0.01	mg/L	1.85		-		
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Total Kjeldahl Nitrogen as N	0.1	mg/L	0.5	-			
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser	nalyser						
^ Total Nitrogen as N	0.1	mg/L	2.4	-		-	-
EK067G: Total Phosphorus as P by Discrete Analyser							
Total Phosphorus as P	0.01	mg/L	0.04	-		-	
EK071G: Reactive Phosphorus as P by discrete analyser							
Reactive Phosphorus as P 14265-44-2	0.01	mg/L	0.02	-			
EN055: Ionic Balance							
Ø Total Anions	0.01	med/L	13.8	i	-		
Ø Total Cations	0.01	med/L	13.7	-			
Ø lonic Balance	0.01	%	0.12				
EP080/071: Total Petroleum Hydrocarbons							
C6 - C9 Fraction	20	hg/L	<20	-			
C10 - C14 Fraction	50	hg/L	<50	-		1	



RPS Australia West Pty Ltd EEC14061.006

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Work Order

Client

ı -1 1 1 1 1 1 1 $| \cdot |$ 1 1 1 1 1 1 1 l l l | | | | |1 l 1 1 1 1 1 1 1 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 1 1 1 14-Dec-2020 00:00 EP2014084-001 WZZ1 Result <100 <100 <100 <100 <100 98.0 84.3 <50 <50 <20 <20 101 7 7 7 7 7 Ÿ <5 Sample ID Sampling date / time Unit hg/L hg/L hg/L hg/L hg/L hg/L µg/L hg/L hg/L hg/L hg/L hg/L µg/L hg/L hg/L µg/L hg/L % % % EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions LOR 100 100 50 50 100 100 20 7 N 7 7 2 0 C6_C10 91-20-3 95-47-6 1 100-41-4 17060-07-0 460-00-4 2037-26-5 C6_C10-BTEX | 71-43-2 108-88-3 108-38-3 106-42-3 CAS Number EP080/071: Total Petroleum Hydrocarbons - Continued >C10 - C16 Fraction minus Naphthalene EP080S: TPH(V)/BTEX Surrogates C6 - C10 Fraction minus BTEX ^ >C10 - C40 Fraction (sum) ^ C10 - C36 Fraction (sum) 4-Bromofluorobenzene 1.2-Dichloroethane-D4 meta- & para-Xylene >C34 - C40 Fraction >C16 - C34 Fraction >C10 - C16 Fraction C29 - C36 Fraction C15 - C28 Fraction Sub-Matrix: WATER (Matrix: WATER) C6 - C10 Fraction **EP080: BTEXN** Ethylbenzene ^ Total Xylenes Sum of BTEX ortho-Xylene Naphthalene Toluene-D8 Benzene Toluene Compound (F1)



Surrogate Control Limits

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Sub-Matrix: WATER
Compound
EP080S: TPH(V)/BT
1.2-Dichloroethane-Dr
Tolluene-D8
4-Bromofluorobenzen

D-Matrix: WAIEK		Recovery	Recovery Limits (%)
mpound	CAS Number	Low	High
080S: TPH(V)/BTEX Surrogates			
-Dichloroethane-D4	17060-07-0	61	141
luene-D8	2037-26-5	73	126
3romofluorobenzene	460-00-4	09	125



QUALITY CONTROL REPORT

Environmental Division Perth Lauren Biagioni : 1 of 9 Laboratory Contact RPS Australia West Pty Ltd EP2014084 ALAN FOLEY **Work Order** Contact Address

26 Rigali Way Wangara WA Australia 6065 08 9406 1307 15-Dec-2020 16-Dec-2020 Date Analysis Commenced Date Samples Received Telephone Address WEST PERTH WA 6872 EEC14061,006 PO BOX 170

23-Dec-2020 ssue Date EPBQ/015/17 Greenpatch SMW/ZL No. of samples analysed No. of samples received

C-O-C number

Sampler

Order number

Telephone

Client

Project

Quote number

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

Accredited for compliance with ISO/IEC 17025 - Testing

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Accreditation Category	Perth Inorganics, Wangara, WA	Perth Inorganics, Wangara, WA	Perth Organics, Wangara, WA
Position	Inorganics Supervisor	Laboratory Manager (Perth)	SENIOR LAB TECH
Signatories	Canhuang Ke	Chris Lemaitre	David Viner



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General Comments

In house developed procedures The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. are fully validated and are often at the client request.

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

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

Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot Key

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

LOR = Limit of reporting

RPD = Relative Percentage Difference

= Indicates failed QC

Laboratory Duplicate (DUP) Report

for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: WATER						Laboratory D	Laboratory Duplicate (DUP) Report		
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	TOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA010P: Conductivit	EA010P: Conductivity by PC Titrator (QC Lot: 3431416)	431416)							
EP2014082-003	Anonymous	EA010-P: Electrical Conductivity @ 25°C	1	-	mS/cm	8870	8930	0.698	0% - 20%
EP2014101-007	Anonymous	EA010-P: Electrical Conductivity @ 25°C	-	-	mS/cm	7830	7890	0.791	0% - 20%
EA015: Total Dissolv	EA015: Total Dissolved Solids dried at 180 \pm 5 $^{\circ}$ C (QC Lot: 3432984)	C (QC Lot: 3432984)							
EP2014045-009	Anonymous	EA015H: Total Dissolved Solids @180°C	-	10	mg/L	<10	<10	00.00	No Limit
EP2014045-001	Anonymous	EA015H: Total Dissolved Solids @180°C	-	10	mg/L	222	234	5.25	0% - 20%
ED037P: Alkalinity b	ED037P: Alkalinity by PC Titrator (QC Lot: 3431414)	1414)							
EP2014069-011	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	-	mg/L	>	>	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	-	mg/L	\	>	00.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	-	mg/L	278	278	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3		-	mg/L	278	278	0.00	0% - 20%
EP2014082-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	-	mg/L	۲>	\ \	00.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	_	mg/L	\	^	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	-	mg/L	273	274	0.380	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	-	_	mg/L	273	274	0.380	0% - 20%
ED041G: Sulfate (Tu	ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3425094)	A (QC Lot: 3425094)							
EP2014045-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	-	mg/L	32	32	00.00	0% - 20%
EP2014083-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	-	mg/L	63	59	5.75	0% - 20%
ED045G: Chloride by	ED045G: Chloride by Discrete Analyser (QC Lot: 3425095)	t: 3425095)							
EP2014045-002	Anonymous	ED045G: Chloride	16887-00-6	-	mg/L	28	28	00.00	0% - 20%
EP2014083-001	Anonymous	ED045G: Chloride	16887-00-6	-	mg/L	94	96	1.39	0% - 20%
ED093F: Dissolved N	ED093F: Dissolved Major Cations (QC Lot: 3429411)	9411)							
EP2014069-006	Anonymous	ED093F: Calcium	7440-70-2	-	mg/L	1060	1020	3.53	0% - 20%
		ED093F: Magnesium	7439-95-4	-	mg/L	1590	1560	1.85	0% - 20%
		ED093F: Sodium	7440-23-5	_	mg/L	18000	17900	0.613	0% - 20%



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Recovery Limits (%) 0% - 20% 0% - 20% 0% - 20% 0% - 50% No Limit No Limit 0% - 20% 0% - 50% 0% - 50% No Limit RPD (%) 0.586 0.892 12.9 2.44 4.31 00.0 0.458 00.0 0.00 0.00 0.00 3.84 0.00 8.19 0.00 0.00 22.6 0.00 0.00 0.00 1.84 13.6 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 3.04 0.00 0.00 Laboratory Duplicate (DUP) Report Original Result Duplicate Result <0.0010 <0.010 <0.010 <0.010 <0.010 <0.100 <0.100 <0.100 <0.010 <0.010 <0.010 <0.010 <0.050 0.0232 <0.100 <0.100 <0.100 <0.500 <0.10 <0.10 <0.50 0.102 0.180 <1.00 89400 0.074 <0.10 <1.00 <1.00 <5.00 <5.00 5330 0.387 7.68 1.23 0.147 1600 658 300 <0.0010 <0.010 <0.010 <0.010 <0.010 <0.100 <0.100 <0.100 <0.100 <0.100 <0.010 <0.050 0.0252 <0.100 0.179 <0.500 < 0.010 0.076 <0.010 0.389 <0.10 <0.10 <0.10 0.128 0.168 85600 <0.50 <1.00 <1.00 <5.00 5200 1560 7.98 1.21 748 302 mg/L Unit 0.0001 0.0001 0.001 0.001 0.001 0.001 0.001 0.005 0.05 0.001 0.001 0.001 0.001 0.001 0.001 0.005 0.001 0.001 0.001 0.001 0.001 0.05 0.001 0.001 0.001 0.001 0.05 0.01 0.01 0.05 LOR 0.01 0.01 0.01 0.01 - - Ψ. 7439-89-6 7440-70-2 7440-43-9 7440-02-0 7439-89-6 7440-47-3 7440-42-8 CAS Number 7440-09-7 7439-95-4 7440-23-5 7440-09-7 7440-38-2 7440-41-7 7440-39-3 7440-48-4 7440-50-8 7439-96-5 7440-66-6 7429-90-5 7782-49-2 7440-62-2 7440-42-8 7440-43-9 7440-38-2 7440-41-7 7440-39-3 7440-48-4 7440-50-8 7439-92-1 7439-96-5 7440-02-0 7440-66-6 7429-90-5 7782-49-2 7440-62-2 7439-92-1 7439-98-7 7439-98-7 EG020A-F: Molybdenum EG020A-F: Molybdenum EG020A-F: Manganese EG020A-F: Manganese EG020A-F: Chromium EG020A-F: Aluminium EG020A-F: Vanadium EG020A-F: Chromium EG020A-F: Aluminium EG020A-F: Vanadium ED093F: Magnesium EG020A-F: Cadmium EG020A-F: Selenium EG020A-F: Cadmium EG020A-F: Selenium EG020A-F: Beryllium EG020A-F: Beryllium ED093F: Potassium ED093F: Potassium EG020A-F: Arsenic EG020A-F: Arsenic EG020A-F: Copper EG020A-F: Barium EG020A-F: Barium EG020A-F: Copper EG020A-F: Cobalt EG020A-F: Cobalt ED093F: Calcium EG020A-F: Nickel EG020A-F: Boron EG020A-F: Nickel EG020A-F: Boron ED093F: Sodium ED093F: Dissolved Major Cations(QC Lot: 3429411)- continued EG020A-F: Lead EG020A-F: Lead EG020A-F: Zinc EG020A-F: Zinc EG020A-F: Iron EG020A-F: Iron EG020F: Dissolved Metals by ICP-MS (QC Lot: 3429409) Anonymous Anonymous Anonymous Anonymous Sample ID Laboratory sample ID Sub-Matrix: WATER EP2014069-006 EP2014069-006 EP2014067-001 EP2014067-001

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Recovery Limits (%) 0% - 20% 0% - 20% %09 - %0 0% - 20% 0% - 50% No Limit RPD (%) 00.00 0.00 0.00 0.00 0.00 119 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 2.41 16.0 15.6 5.42 0.00 0.00 0.00 0.00 0.00 Laboratory Duplicate (DUP) Report Duplicate Result <0.100 <0.100 <0.0001 <0.100 <0.0005 <0.001 <0.001 0.72 0.02 <0.01 <0.01 <100 <100 <100 <0.01 <0.01 <0.01 0.39 7.85 <100 0.01 <50 <50 2.0 <20 <20 Original Result < 0.02 mg/l<0.100 <0.100 <0.0005 <0.100 <0.0001 <0.001 <0.001 0.70 90.0 <0.01 <0.01 <0.01 <0.01 <100 <100 <100 <0.01 0.33 <100 8.29 0.01 ^50 <50 - 4.0 <20 mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L hg/L mg/L hg/L Unit mg/L hg/L hg/L hg/L hg/L hg/L hg/L 0.0001 0.0001 0.001 0.001 0.001 0.001 0.001 LOR 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 100 20 9 9 0.1 0.01 20 2 2 7439-97-6 7439-97-6 18540-29-9 18540-29-9 14797-65-0 CAS Number 7440-22-4 7440-61-1 7664-41-7 7664-41-7 14797-65-0 14265-44-2 14265-44-2 | -7440-29-1 EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level(QC Lot: 3436722) EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3425296) EK061G: Total Kjeldahl Nitrogen as N EK061G: Total Kjeldahl Nitrogen as N EK071G: Reactive Phosphorus as P EK071G: Reactive Phosphorus as P EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3425127) EK067G: Total Phosphorus as P EK067G: Total Phosphorus as P EG050G: Hexavalent Chromium EG050G: Hexavalent Chromium EK059G: Nitrite + Nitrate as N EK059G: Nitrite + Nitrate as N EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 3425093) EP071: >C10 - C16 Fraction EP071: >C16 - C34 Fraction EP071: >C34 - C40 Fraction EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3426772) EP071: C15 - C28 Fraction EP071: C10 - C14 Fraction EP071: C29 - C36 Fraction EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3426771) EK055G: Ammonia as N EP080: C6 - C9 Fraction EK055G: Ammonia as N EP080: C6 - C9 Fraction EK057G: Nitrite as N EK057G: Nitrite as N EG020B-F: Thorium EG020B-F: Uranium puno EG020B-F: Silver EG035F: Mercury EG035F: Mercury EK055G: Ammonia as N by Discrete Analyser (QC Lot: 3425126) EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3430189) EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3425092) EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3425296) EG020F: Dissolved Metals by ICP-MS (QC Lot: 3429410) EG035F: Dissolved Mercury by FIMS (QC Lot: 3429412) Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Sample ID WZZ1 WZZ1 Laboratory sample ID Sub-Matrix: WATER EP2014067-002 EP2014045-002 EP2014045-002 EP2014045-002 EP2014027-001 EP2014045-002 EP2014027-003 EP2014156-005 EP2014083-001 EP2014061-001 EP2014027-001 EP2014105-003 EP2014105-003 EP2013804-001 EP2014084-001 EP2014067-001 EP2014069-007 EP2013650-001 EP2014061-001 EP2014083-001 EP2014084-001



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Recovery Limits (%) No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit RPD (%) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 00.0 0.00 Laboratory Duplicate (DUP) Report Original Result Duplicate Result ²20 ₽ 0 27 27 7 2 2 2 <0.002 mg/L <0.001 mg/L <0.002 mg/L <0.002 mg/L <0.005 mg/L <0.002 mg/L <0.02 mg/L <20 ς, 7 2 7 ^2 ĭ hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L Unit LOR 2 8 7 0 2 2 2 0 7 2 2 7 C6_C10 C6_C10 91-20-3 100-41-4 108-38-3 71-43-2 CAS Number 95-47-6 71-43-2 108-88-3 106-42-3 108-88-3 100-41-4 108-38-3 106-42-3 91-20-3 EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3430189) EP080: meta- & para-Xylene EP080: meta- & para-Xylene EP080: C6 - C10 Fraction EP080: C6 - C10 Fraction EP080: Ethylbenzene EP080: Ethylbenzene EP080: Naphthalene EP080: ortho-Xylene EP080: ortho-Xylene EP080: Naphthalene EP080: Benzene EP080: Benzene EP080: Toluene EP080: Toluene EP080: BTEXN (QC Lot: 3430189) Anonymous Anonymous Anonymous Anonymous Sample ID Laboratory sample ID Sub-Matrix: WATER EP2014027-003 EP2014027-003 EP2013804-001 EP2013804-001



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Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target

Sub-Matrix: WATER Method: Compound EA010P: Conductivity by PC Titrator (QCLot: 3431416) EA010-P: Electrical Conductivity @ 25°C EA015: Total Dissolved Solids dried at 180 ± 5°C (QCLot: 3432984) EA015H: Total Dissolved Solids @180°C				10000 10000 10000		1 Doding loster O motor - 4-1	Col Danort	
ot: 34				Method Blank (MB)		Laboratory Control Spike (LCS) Report	co) Nepolic	
ot: 34;				Report	Spike	Spike Recovery (%)	Recovery Limits (%)	Limits (%)
EA010P: Conductivity by PC Titrator (QCLot: 3431416) EA010-P: Electrical Conductivity @ 25°C EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 343)	CAS Number	LOR	Unit	Result	Concentration	SO7	Low	High
EA010-P: Electrical Conductivity @ 25°C EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 343								
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 343) ΓΑ014Η ΤΩΙΑΙ Dissolved Solids @180°C	-	1	mS/cm	-1>	24800 µS/cm	96.2	92.1	105
FA015H: Total Dissolved Solids @180°C.	32984)							
FOUNDITY TOTAL PISSOIVER COINCE (# 100)	-	10	mg/L	<10	2000 mg/L	0.79	88.1	114
				015	1000 mg/L	103	88.1	114
ED037P: Alkalinity by PC Titrator (QCLot: 3431414)								
ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-00	-	mg/L	<u>^</u>		-	-	-
ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	1>	-	1	-	-
ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1>	1	1	-	1
ED037-P: Total Alkalinity as CaCO3	-	_	mg/L	1>	20 mg/L	109	81.2	126
				>	200 mg/L	95.9	0 06	110
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3425094)	25094)							
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	-	mg/L	∑ 7	25 mg/L	97.9	87.7	113
				V	soo mg/L	201	8/./	113
de by Discrete Analyser (QCLot: 3425095)								
ED045G: Chloride	16887-00-6	-	mg/L	Υ Υ	10 mg/L 1000 mg/L	97.1 101	87.9 87.9	114 411
ED093F: Dissolved Major Cations (QCLot: 3429411)								
ED093F: Calcium	7440-70-2	1	mg/L	1>	50 mg/L	101	85.9	113
ED093F: Magnesium	7439-95-4	1	mg/L	-1>	50 mg/L	94.8	88.0	110
ED093F: Sodium	7440-23-5	_	mg/L	\ \	50 mg/L	101	87.3	118
ED093F: Potassium	7440-09-7	_	mg/L	√	50 mg/L	94.6	89.7	108
EG020F: Dissolved Metals by ICP-MS (QCLot: 3429409)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	100	84.0	120
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	92.8	84.0	120
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	102	81.0	120
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	94.5	85.0	120
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	92.7	86.0	120
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	95.2	85.0	120
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	92.0	84.0	120
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	2.06	84.0	120
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	93.7	85.0	120
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	93.3	85.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	93.0	86.0	120



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High 116 113 110 110 109 119 113 116 120 120 120 20 120 117 11 9 103 122 104 137 Recovery Limits (%) 85.0 89.0 73.6 84.0 80.0 47.2 46.2 24.7 88.0 79.0 84.0 80.0 93.0 86.2 90.5 70.0 89.4 39.3 42.5 42.0 Low 92.0 88.7 75.8 Laboratory Control Spike (LCS) Report Spike Recovery (%) 94.4 85.9 91.5 92.7 98.2 94.4 97.0 80.8 87.4 99.2 76.5 98.2 96.4 88.5 96.8 88.1 85.3 SO7 113 102 100 103 107 101 98.7 Concentration 0.1 mg/L 0.1 mg/L 0.05 mg/L 446 µg/L 271 µg/L 0.5 mg/L 0.02 mg/L 359 µg/L 269 µg/L 372 µg/L 0.1 mg/L 4.42 mg/L 378 µg/L 0.1 mg/L 0.1 mg/L 0.01 mg/L 0.5 mg/L 0.5 mg/L 0.5 mg/L 320 µg/L 0.1 mg/L 0.5 mg/L 1 mg/L 10 mg/L Method Blank (MB) Result <0.005 <0.001 <0.001 <0.0001 < 0.001 <0.01 <0.05 <0.05 <0.001 <0.001 Report <0.01 <0.01 <0.01 <0.01 <100 <100 <0.01 <0.01 <100 <100 0.7 ²20 <50 <20 mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L Unit mg/L mg/L mg/L hg/L hg/L hg/L hg/L hg/L hg/L EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level(QCLot: 3436722) EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions(QCLot: 3430189) EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions(QCLot: 3425296 0.005 0.0001 0.05 0.05 0.001 0.001 0.001 0.001 0.001 0.01 LOR 0.01 0.01 0.01 0.01 0.01 0.01 100 0.1 50 100 100 20 20 :K059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3425127) EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3425093) EK061G: Total Kjeldahl Nitrogen By Discrete Analyser(QCLot: 3426772) CAS Number 7439-97-6 14797-65-0 EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3426771) 14265-44-2 | 18540-29-9 7664-41-7 I 7782-49-2 7440-62-2 7440-66-6 7440-42-8 7439-89-6 7440-22-4 7440-29-1 7440-61-1 7440-02-0 EG020F: Dissolved Metals by ICP-MS (QCLot: 3429409) - continued EK055G: Ammonia as N by Discrete Analyser (QCLot: 3425126) EP080/071: Total Petroleum Hydrocarbons (QCLot: 3430189) EK057G: Nitrite as N by Discrete Analyser (QCLot: 3425092) EP080/071: Total Petroleum Hydrocarbons (QCLot: 3425296) EG020F: Dissolved Metals by ICP-MS (QCLot: 3429410) EG035F: Dissolved Mercury by FIMS (QCLot: 3429412) EK061G: Total Kjeldahl Nitrogen as N EK071G: Reactive Phosphorus as P EK067G: Total Phosphorus as P EG050G: Hexavalent Chromium EK059G: Nitrite + Nitrate as N EP071: >C10 - C16 Fraction EP071: >C16 - C34 Fraction EP071: >C34 - C40 Fraction EP071: C15 - C28 Fraction EP071: C10 - C14 Fraction EP071: C29 - C36 Fraction EK055G: Ammonia as N EP080: C6 - C9 Fraction EG020A-F: Vanadium EG020A-F: Selenium EK057G: Nitrite as N EG020B-F: Uranium EG020B-F: Thorium Sub-Matrix: WATER Method: Compound EG020A-F: Nickel EG020A-F: Boron G035F: Mercury EG020B-F: Silver EG020A-F: Zinc EG020A-F: Iron



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Sub-Matrix: WATER				Method Blank (MB)		Laboratory Control Spike (LCS) Report	S) Report	
				Report	Spike	Spike Recovery (%)	Recovery Limits (%)	Limits (%)
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	S27	Low	High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3430189) - col	Fractions (QCI	ot: 3430189) - co	ntinued					
EP080: C6 - C10 Fraction	C6_C10	20	hg/L	<20	370 µg/L	98.8	73.9	115
EP080: BTEXN (QCLot: 3430189)								
EP080: Benzene	71-43-2	_	hg/L	>	20 µg/L	99.3	84.1	114
EP080: Toluene	108-88-3	7	hg/L	<2	20 µg/L	101	81.0	115
EP080: Ethylbenzene	100-41-4	7	hg/L	<2	20 µg/L	95.9	84.4	113
EP080: meta- & para-Xylene	108-38-3	2	hg/L	<2	40 µg/L	99.5	84.3	114
	106-42-3							
EP080: ortho-Xylene	95-47-6	2	hg/L	<2	20 µg/L	94.4	86.5	111
EP080: Naphthalene	91-20-3	5	hg/L	<5	5 µg/L	117	77.0	118

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Matrix Spike (MS) Report

Sub-Matrix: WATER

Laboratory sample ID ED041G: Sulfate (Tur				Spike	SpikeRecovery(%)	Recovery Limits (%)	mits (%)
Laboratory sample ID ED041G: Sulfate (Tur							
ED041G: Sulfate (Tur	Sample ID	Method: Compound	CAS Number	Concentration	MS	Гом	High
	ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3425094)						
EP2014045-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	100 mg/L	116	70.0	130
ED045G: Chloride by	ED045G: Chloride by Discrete Analyser (QCLot: 3425095)						
EP2014045-001 A	Anonymous	ED045G: Chloride	16887-00-6	1000 mg/L	96.6	70.0	130
EG020F: Dissolved M	EG020F: Dissolved Metals by ICP-MS (QCLot: 3429409)						
EP2014067-003 A	Anonymous	EG020A-F: Arsenic	7440-38-2	20 mg/L	104	70.0	130
		EG020A-F: Beryllium	7440-41-7	20 mg/L	108	70.0	130
		EG020A-F: Barium	7440-39-3	20 mg/L	104	70.0	130
		EG020A-F: Cadmium	7440-43-9	5 mg/L	102	70.0	130
		EG020A-F: Chromium	7440-47-3	20 mg/L	101	70.0	130
		EG020A-F: Cobalt	7440-48-4	20 mg/L	103	70.0	130
		EG020A-F: Copper	7440-50-8	20 mg/L	101	70.0	130
		EG020A-F: Lead	7439-92-1	20 mg/L	98.4	70.0	130
		EG020A-F: Manganese	7439-96-5	20 mg/L	96.2	70.0	130
		EG020A-F: Nickel	7440-02-0	20 mg/L	104	70.0	130
		EG020A-F: Vanadium	7440-62-2	20 mg/L	103	70.0	130
		EG020A-F: Zinc	7440-66-6	20 mg/L	108	70.0	130
EG035F: Dissolved M	EG035F: Dissolved Mercury by FIMS (QCLot: 3429412)						
EP2014067-004 A	Anonymous	EG035F: Mercury	7439-97-6	0.05 mg/L	80.2	70.0	130
EG050G LL-F: Dissol	EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level(QCLot: 3436722)	w Level (QCLot: 3436722)					



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Sub-Matrix: WATER				ME	Matrix Spike (MS) Report		
				Spike	SpikeRecovery(%)	Recovery Limits (%)	imits (%)
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG050G LL-F: Dis	EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level (QCLot: 3436722) - continued	Level (QCLot: 3436722) - continued					
EP2013650-001	Anonymous	EG050G: Hexavalent Chromium	18540-29-9	0.05 mg/L	95.2	70.0	130
EK055G: Ammonia	EK055G: Ammonia as N by Discrete Analyser (QCLot: 3425126)						
EP2014045-001	Anonymous	EK055G: Ammonia as N	7664-41-7	1 mg/L	107	70.0	130
EK057G: Nitrite as	EK057G: Nitrite as N by Discrete Analyser (QCLot: 3425092)						
EP2014045-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	6.96	70.0	130
EK059G: Nitrite p	EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3425127)	5127)					
EP2014045-001	Anonymous	EK059G: Nitrite + Nitrate as N	-	0.5 mg/L	106	70.0	130
EK061G: Total Kje	EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3426772)						
EP2014027-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	-	10 mg/L	108	70.0	130
EK067G: Total Ph	EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3426771)						
EP2014027-001	Anonymous	EK067G: Total Phosphorus as P	-	2 mg/L	103	70.0	130
EK071G: Reactive	EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3425093)						
EP2014045-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	102	70.0	130
EP080/071: Total F	EP080/071: Total Petroleum Hydrocarbons (QCLot: 3430189)						
EP2013976-001	Anonymous	EP080: C6 - C9 Fraction		240 µg/L	8.68	77.0	137
EP080/071: Total F	EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions(QCLot: 3430189)	it: 3430189)					
EP2013976-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	290 µg/L	84.6	77.0	137
EP080: BTEXN (QCLot: 3430189)	(CLot: 3430189)						
EP2013976-001	Anonymous	EP080: Benzene	71-43-2	20 µg/L	106	77.0	122
		EP080: Toluene	108-88-3	20 µg/L	105	73.5	126



QA/QC Compliance Assessment to assist with Quality Review

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Page	Laboratory	Telephone	Date Samples Received	Issue Date	No. of samples received	No. of samples analysed	
: EP2014084	RPS Australia West Pty Ltd	: ALAN FOLEY	: EEC14061,006	: Greenpatch	: SMW/ZL		
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reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated report contribute to the overall DQO assessment and reporting for guideline compliance.

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

Summary of Outliers

Outliers: Quality Control Samples

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

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

Outliers: Analysis Holding Time Compliance

NO Analysis Holding Time Outliers exist.

Outliers: Frequency of Quality Control Samples

Quality Control Sample Frequency Outliers exist - please see following pages for full details.



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Outliers: Frequency of Quality Control Samples

Matrix: WATER

Quality Control Sample Type	Co	unt	Rate (%)	(%)	Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
TRH - Semivolatile Fraction	0	10	00'0	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

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

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters. Holding times for <u>VOC in soils</u> vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days, others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: WATER				Evaluation:	× = Holding time	Evaluation: $x = \text{Holding time breach}$; $\sqrt{\ } = \text{Within holding time}$.	holding time.
Method	Sample Date	Ext	Extraction / Preparation			Analysis	
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P) WZZ1	14-Dec-2020	-	-	1	19-Dec-2020	11-Jan-2021	>
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H)	14-Dec-2020				21-Dec-2020	21-Dec-2020	>
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) WZZ1	14-Dec-2020	-	-	-	19-Dec-2020	28-Dec-2020	>
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) WZZ1	14-Dec-2020				16-Dec-2020	11-Jan-2021	>
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) WZZ1	14-Dec-2020		-		16-Dec-2020	11-Jan-2021	>
ED093F: Dissolved Major Cations							
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (ED093F) WZZ1	14-Dec-2020	!			18-Dec-2020	11-Jan-2021	>
EG020F: Dissolved Metals by ICP-MS							
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG020B-F) WZZ1	14-Dec-2020	i	I	-	18-Dec-2020	12-Jun-2021	>
EG035F: Dissolved Mercury by FIMS							
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG035F) WZZ1	14-Dec-2020	l	-	-	18-Dec-2020	11-Jan-2021	>



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Matrix: WATER				Evaluation:	× = Holding time	Evaluation: $x = \text{Holding time breach}$; $\checkmark = \text{Within holding time}$.	holding time.
Method	Sample Date	Ext	Extraction / Preparation			Analysis	
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level							
Clear Plastic Bottle - NaOH Filtered (EG050G LL-F) WZZ1	14-Dec-2020				22-Dec-2020	11-Jan-2021	>
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) WZZ1	14-Dec-2020				16-Dec-2020	11-Jan-2021	>
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) WZZ1	14-Dec-2020				16-Dec-2020	16-Dec-2020	>
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) WZZ1	14-Dec-2020	!			16-Dec-2020	11-Jan-2021	>
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) WZZ1	14-Dec-2020	18-Dec-2020	11-Jan-2021	`	18-Dec-2020	11-Jan-2021	>
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) WZZ1	14-Dec-2020	18-Dec-2020	11-Jan-2021	>	18-Dec-2020	11-Jan-2021	>
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) WZZ1	14-Dec-2020	i			16-Dec-2020	16-Dec-2020	>
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071) WZZ1	14-Dec-2020	17-Dec-2020	21-Dec-2020	>	21-Dec-2020	26-Jan-2021	>
Amber VOC Vial - Sulfuric Acid (EP080) WZZ1	14-Dec-2020	18-Dec-2020	28-Dec-2020	>	18-Dec-2020	28-Dec-2020	>
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071) WZZ1	14-Dec-2020	17-Dec-2020	21-Dec-2020	>	21-Dec-2020	26-Jan-2021	>
Amber VOC Vial - Sulfuric Acid (EP080) WZZ1	14-Dec-2020	18-Dec-2020	28-Dec-2020	>	18-Dec-2020	28-Dec-2020	>
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080) VVZ21	14-Dec-2020	18-Dec-2020	28-Dec-2020	>	18-Dec-2020	28-Dec-2020	>



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Quality Control Parameter Frequency Compliance

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

Matrix: WATER							
Quality Control Sample Type		ŏ	Count		Rate (%)		Quality Control Specification
Analytical Methods	Method	000	Reaular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	20	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	20	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	18	11.11	10.00	>	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	17	11.76	10.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Hexavalent Chromium by DA - Low Level	EG050G LL-F	2	20	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	_	-	100.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	18	11.11	10.00	>	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	18	11.11	10.00	>	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	18	11.11	10.00	>	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	17	11.76	10.53	>	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	16	12.50	10.00	>	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	-	10	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	14	14.29	10.00	>	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	20	10.00	10.00	>	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	~	20	2.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	18	11.11	10.00	>	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	_	17	5.88	5.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Hexavalent Chromium by DA - Low Level	EG050G LL-F	_	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	_	20	5.00	2.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	~	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	-	_	100.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	_	20	5.00	2.00	>	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	_	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	_	18	5.56	5.00	>	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	_	18	5.56	2.00	>	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	18	11.11	10.00	>	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	17	11.76	10.53	>	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	~	20	2.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	~	16	6.25	5.00	>	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	~	10	10.00	2.00	>	NEPM 2013 B3 & ALS QC Standard



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Matrix: WATER				Evaluation	: 🗴 = Quality Cor	ntrol frequency n	Evaluation: * = Quality Control frequency not within specification; 🗸 = Quality Control frequency within specification.
Quality Control Sample Type		Count	ınt		Rate (%)		Quality Control Specification
Analytical Methods	Method	OC	Reaular	Actual	Expected	Evaluation	
Laboratory Control Samples (LCS) - Continued							
TRH Volatiles/BTEX	EP080	1	14	7.14	5.00	>	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Alkalinity by PC Titrator	ED037-P	_	20	5.00	2.00	>	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	_	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	_	18	5.56	5.00	>	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	-	17	5.88	2.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Hexavalent Chromium by DA - Low Level	EG050G LL-F	_	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	~	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	_	20	5.00	2.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	~	-	100.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	~	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	_	18	5.56	5.00	>	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	_	18	5.56	2.00	>	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	_	18	5.56	2.00	>	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	-	17	5.88	5.26	>	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	_	16	6.25	5.00	>	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	-	10	10.00	2.00	>	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	7.14	5.00	>	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	τ-	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	7	18	5.56	5.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Hexavalent Chromium by DA - Low Level	EG050G LL-F	τ-	20	2.00	2.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	~	20	2.00	2.00	>	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	_	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	18	5.56	5.00	>	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	_	18	5.56	2.00	>	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	-	18	5.56	2.00	>	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	_	20	5.00	5.00	>	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	16	6.25	5.00	>	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	10	00.00	2.00	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	_	14	7.14	5.00	>	NEPM 2013 B3 & ALS QC Standard



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 Work Order
 : EP2014084

 Client
 : RPS Australia West Pty Ltd

 Project
 : EEC14061.006

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of 'filterable' residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 CI - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).



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Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Trivalent Chromium by DA - Low Level	EG049G LL-F	WATER	In house: Referenced to APHA 3500 Cr-B & 3120/3125. Trivalent Chromium is the difference between total dissolved hexavalent chromium.
Dissolved Hexavalent Chromium by DA - Low Level	EG050G LL-F	WATER	In house: Referenced to APHA 3500 Cr-A & B. Samples are 0.45µm filtered prior to analysis. Hexavalent chromium is determined directly on water sample by Descrete Analyser as received by pH adjustment and colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM Schedule B(3).
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3 This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)
Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)



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Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel
			and serially extracted three times using DCM for each extract. The resultant extracts are combined, denydrated
			and concentrated for analysis. This method is compliant with NEPM Schedule B(3). ALS default excludes
			sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.



			The Person Name of Street, or other Persons name of Street, or oth				Contract of the Contract of th			
Project reference:	EEC14061,006	15								Tel: (618) 9211 1111 Fax: (618) 9211 1122
Scientist(s)	SMW/ZL	e. Ai		 7						
Sample type(s):	Water	ע' ה או' ב	S	-LN	61					Page number:
Report to:	Alan Foley and Colm Corcoran	W ∴N iT ,ο	EC LD:	8 I.	EG0					Turnaround time:
Invoice to:	west.accountspayable@rpsgroup.com	AJOS		1N						Quote number: EN-222-18
Sample I.D.	Date collected Number of jar bottles / bags	S.								Remarks
WZZ1	14/12/2020	×××	×	×	×					
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Total number of bottles/bags/jars	ttles/bags/jars									N. C.
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Relinquished by:	Shae Miller-White	Organisation:			Relinquished by:	ned by:			Organisation:	A A
Organisation:	RPS	Date:			Organisation:	ion:			Date:	17/12 DO 17:22.
Date:	14/12/2020	. Time:			Date:				Time:	*
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RPS Australia West Pty Ltd, Registered in Australia No. 42 107 962 872 rpsgroup.com



CERTIFICATE OF ANALYSIS

: 1 of 6 Laboratory Contact RPS Australia West Pty Ltd EP2014218 **ALAN FOLEY** Work Order Contact

26 Rigali Way Wangara WA Australia 6065 Lauren Biagioni Address

Environmental Division Perth

17-Dec-2020 17:45 08 9406 1307 : 18-Dec-2020 Date Analysis Commenced Date Samples Received Telephone WEST PERTH WA 6872 EEC14061,006 PO BOX 170

Order number

Sampler

Telephone

Project

Address

Client

31-Dec-2020 13:24 Issue Date

Accredited for compliance with ISO/IEC 17025 - Testing EPBQ/015/17 Greenpatch SMW/ZL No. of samples analysed No. of samples received C-O-C number Quote number

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	Position	Accreditation Category
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth Inorganics, Wangara, WA
David Viner	SENIOR LAB TECH	Perth Organics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA



General Comments

In house developed procedures The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. are fully validated and are often at the client request.

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

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

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

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

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

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

LOR = Limit of reporting

Key

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

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.

Ionic balances were calculated using: major anions - chloride, alkalinity and sulfate; and major cations - calcium, magnesium, potassium and sodium.

Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.



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Sub-Matrix: WATER (Matrix: WATER)			Sample ID	SWZZ1	-	1	I	
		Samplin	Sampling date / time	17-Dec-2020 00:00				
Compound	CAS Number	LOR	Unit	EP2014218-001	1	1	i	i
				Result				
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C		-	mS/cm	1130				
EA015: Total Dissolved Solids dried at 130 ± 5 °C	± 5 °C							
Total Dissolved Solids @130°C		10	mg/L	7H2				-
ED0HxP: Alkalinity by PC Titrator								
	DMO-210-001	-	mg/L	<1				
Carbonate Alkalinity as CaCOH	3812-32-6	-	mg/L	<1				
9 icarbonate Alkalinity as CaCOH	71-52-3	-	mg/L	217				
Total Alkalinity as CaCOH		-	mg/L	217				
ED041M: Sulfate (Turbidimetric) as SO4 2- by DA	by DA							
Sulfate as SO4 - Turbidimetric	14808-79-8	-	mg/L	x4		-	-	-
ED045M: Chloride by Discrete Analyser								
Chloride	16887-00-6	-	mg/L	24H			-	
ED08HF: Dissolved j a\omega\text{r} Cations								
Calcium	7440-70-2	7	mg/L	77				
j agnesium	7439-95-4	1	mg/L	24				
Sodium	7440-23-5	-	mg/L	15x			-	-
Potassium	7440-09-7	_	mg/L	×		-		
EM020F: Dissolved j etals by ICP-j S								
Aluminium	7429-90-5	0.01	mg/L	<0.01				-
Arsenic	7440-38-2	0.001	mg/L	0.002				
9 oron	7440-42-8	0.05	mg/L	80.0			-	-
9 arium	7440-39-3	0.001	mg/L	0.078	-		-	-
9 eryllium	7440-41-7	0.001	mg/L	<0.001		-		
Cadmium	7440-43-9	0.0001	mg/L	<0.0001		-		-
Cobalt	7440-48-4	0.001	mg/L	<0.001				-
Chromium	7440-47-3	0.001	mg/L	<0.001				
Copper	7440-50-8	0.001	mg/L	<0.001		-		-
j anganese	7439-96-5	0.001	mg/L	0.012				
Nickel	7440-02-0	0.001	mg/L	<0.001				-
Lead	7439-92-1	0.001	mg/L	<0.001		-		
Selenium	7782-49-2	0.01	mg/L	<0.01				
Uanadium	7440-62-2	0.01	mg/L	<0.01				
Zinc	7440-66-6	0.005	mg/L	0.007		-		
j olybdenum	7439-98-7	0.001	mg/L	<0.001				



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Allany acar results								
Sub-Matrix: WATER (Matrix: WATER)			Sample ID	SWZZ1	-	1	-	
		Samplin	Sampling date / time	17-Dec-2020 00:00	-	-		-
Compound	CAS Number	LOR	Unit	EP2014218-001				
				Result				
EM020F: Dissolved j etals by ICP-j S - Continued	nued							
Silver	7440-22-4	0.001	mg/L	<0.001				-
Thorium	7440-29-1	0.001	mg/L	<0.001				
6 ranium	7440-61-1	0.001	mg/L	<0.001				
Iron	7439-89-6	0.05	mg/L	0.12		-		
EM0H5F: Dissolved j ercury by Flj S								
j ercury	7439-97-6	0.0001	mg/L	<0.0001				i
EM048M LL-F: Dissolved Trivalent Chromium - Low Level	m - Low Level							
Trivalent Chromium	16065-83-1	0.001	mg/L	<0.001				•
EM050M LL-F: Dissolved Be@valent Chromium by Discrete Analyser - Low Level	ium by Discre	te Analys	er - Low Level					
Be@valent Chromium	18540-29-9	0.001	mg/L	<0.001		1		i
EK055M: Ammonia as N by Discrete Analyser	er							
Ammonia as N	7664-41-7	0.01	mg/L	<0.01				•
EK05xM: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01				
EK053M: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01			-	1
EK058M: Nitrite plus Nitrate as N (NOG) by Discrete Analyser	Discrete Ana	yser						
Nitrite + Nitrate as N	-	0.01	mg/L	<0.01	-	1		1
EK071M: Total K'éldahl Nitrogen 9 y Discrete Analyser	e Analyser							
Total K\eldahl Nitrogen as N		0.1	mg/L	0.4	-	-		-
EK072M: Total Nitrogen as N (TKN + NOG) by Discrete Analyser	y Discrete An	alyser						
^ Total Nitrogen as N		0.1	mg/L	0.4				•
EK07xM: Total Phosphorus as P by Discrete Analyser	Analyser							
Total Phosphorus as P		0.01	mg/L	0.02	-	-		-
EK0x1M: Reactive Phosphorus as P by discrete analyser	rete analyser							
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	-	-		1
EN055: Ionic 9 alance								
Ø Total Anions		0.01	med/L	12.x	-	-	-	•
Ø Total Cations	-	0.01	med/L	12.H	-	-		-
ø Ionic 9 alance		0.01	%	1.x4	-	1		1
EP030/0x1: Total Petroleum Bydrocarbons								
C7 - C8 Fraction	-	20	hg/L	<20				-
C10 - C14 Fraction	-	50	hg/L	<50		-		•



RPS Australia West Pty Ltd EEC14061.006

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> Work Order Client

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Surrogate Control Limits

Project Client

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Sub-Matrix: WATER		Recovery Limits (%)	Limits (%)
Compound	CAS Number	Гом	High
EP030S: TPB(U)/9 TEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	61	141
Toluene-D3	2037-26-5	73	126
4-9 romofluorobenzene	460-00-4	09	125



QUALITY CONTROL REPORT

Environmental Division Perth Lauren Biagioni : 1 of 9 Laboratory Contact RPS Australia West Pty Ltd EP2014218 **ALAN FOLEY Work Order** Contact 26 Rigali Way Wangara WA Australia 6063 Address WEST PERTH WA 6872 PO BOX 170

08 9- 06 1407 41pDecp2020 17pDecp2020 18pDecp2020 Date Analysis Commenced Date Sam5les Received ssue Date **Tele5hone** : pttp: : EEC1-061.006 SMW/ZL 1

This re5ort su5ersedes any 5revious re5ort(s) with this reference. Results a55ly to the sam5le(s) as submitted, unless the sam5ling was conducted by ALS. This document shall not be re5roduced, exce5t in full.

Accredited for compliance with ISO/IEC 17025 - Testing

This Quality Control Re5ort contains the following information:

EPBQ/013/17

No. of sam5les received No. of sam5les analysed

Quote number

Green5atch

CpOpc number

Sam5ler

Order number

Tele5hone

Project

Address

Client

- Laboratory Du5licate (DUP) Re5ort; Relative Percentage Difference (RPD) and Accestance Limits
- Method Blank (MB) and Laboratory Control S5ike (LCS) Re5ort; Recovery and Acce5tance Limits
- Matrix S5ike (MS) Re5ort; Recovery and Accestance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in com5liance with 5rocedures s5ecified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Canhuang Ke	Inorganics Su5ervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth Inorganics, Wangara, WA
David Viner	SENIOR LAB TECH	Perth Organics, Wangara, WA
Ffila Wilson	Metals Chemist	Perth Inorganics Wangara WA



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 : EEC1-061.006

General Comments

In house develosed srocedures The analytical 5rocedures used by ALS have been develo5ed from established internationally recognised 5rocedures such as those 5ublished by the USEPA, APHA, AS and NEPM. are fully validated and are often at the client request.

Where moisture determination has been 5erformed, results are re5orted on a dry weight basis.

Where a resorted less than (<) result is higher than the LOR, this may be due to 5rimany sam5le extract/digestate dilution and/or insufficient sam5le for analysis. Where the LOR of a resorted result differs from standard LOR, this may be due to 5rimany sam5le extract/digestate dilution and/or insufficient sam5le for analysis.

Anonymous = Refers to sam5les which are not s5ecifically 5art of this work order but formed 5art of the QC 5rocess lot

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

LOR = Limit of re5orting

Key

RPD = Relative Percentage Difference

= Indicates failed QC

Laboratory Duplicate (DUP) Report

for the Relative Percent Deviation (RPD) of Laboratory Du5licates are s5ecified in ALS Method QWIpEN/48 and are de5endent on the magnitude of results in com5arison to the level of re5orting. Result < 10 times LOR: The quality control term Laboratory DuSlicate refers to a randomly selected intralaboratory sSlit. Laboratory duSlicates 5rovide information regarding method 5recision and samSle heterogeneity. The Sermitted ranges No Limit; Result between 10 and 20 times LOR: 0% p30%; Result > 20 times LOR: 0% p20%.

SubpMatrix: WATER						Laboratory	Laboratory Duplicate (DUP) Report		
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA010P: Conductivit	EA010P: Conductivity by PC Titrator (QC Lot: 343621) 5	343621) 5							
EP201-190p0-4	Anonymons	EA010pP: Electrical Conductivity @ 23°C	dttt	~	mS/cm	1210	1200	0.301	0% p20%
EP201-216p002	Anonymous	EA010pP: Electrical Conductivity @ 23°C	dttt	-	mS/cm	4970	- 020	1.26	0% p20%
EA01D: Total ±issolv	EA01D: Total ± issolved Solids dried at 160 ° D9C (QC Lot: 34364005	3C (QC Lot: 34364005							
EP201-219p001	SWZZ1	EA013H: Total Dissolved Solids @180°C	dttt	10	mg/L	642	640	0.248	0% p20%
EP201-41-p003	Anonymous	EA013H: Total Dissolved Solids @180°C	attt	10	mg/L	129	128	0.778	%0£d %0
E±03) P: Alkalinity b	E±03) P: Alkalinity by PC Titrator (QC Lot: 34362175	62175							
EP201-190p044	Anonymous	ED047pP: Hydroxide Alkalinity as CaCO4	DMOp210p001	_	mg/L	>	>	0.00	No Limit
		ED047pP: Carbonate Alkalinity as CaCO4	4812p42p6	-	mg/L	4	က	62.0	No Limit
		ED047pP: Bicarbonate Alkalinity as CaCO4	71p82p4	_	mg/L	-9-	-46	6.28	0% p20%
		ED047pP: Total Alkalinity as CaCO4	dttt	_	mg/L	-67		3.67	0% p20%
EP201-190p0-4	Anonymous	ED047pP: Hydroxide Alkalinity as CaCO4	DMOp210p001	-	mg/L	1 >	^	0.00	No Limit
		ED047pP: Carbonate Alkalinity as CaCO4	4812p42p6	_	mg/L	^		0.00	No Limit
		ED047pP: Bicarbonate Alkalinity as CaCO4	71p82p4	_	mg/L	386	3-8	6.80	0% p20%
		ED047pP: Total Alkalinity as CaCO4	dtt	_	mg/L	386	3-8	6.80	0% p20%
E±041G: Sulfate (Tu	E±041G: Sulfate (Turbidimetric5as SO4 2- by ±A (QC Lot: 34310845	A (QC Lot: 34310845							
EP201-267p004	Anonymous	ED0-1G: Sulfate as SO- pTurbidimetric	1-808p79p8	-	mg/L	22	22	0.00	0% p20%
EP201-267p001	Anonymous	ED0-1G: Sulfate as SO- pTurbidimetric	1-808p79p8	_	mg/L	18	18	0.00	%0£d %0
E±04DG: Chloride by	E±04DG: Chloride by ±iscrete Analyser (QC Lot: 343108D5	ot: 343108D5							
EP201-267p004	Anonymous	ED0-3G: Chloride	16887p00p6	_	mg/L	29	72	8.06	0% p20%
EP201-267p001	Anonymous	ED0-3G: Chloride	16887p00p6	_	mg/L	8-	-7	0.00	0% p20%
E±083F: ±issolved N	E±083F: ±issolved Major Cations (QC Lot: 3437) 675	7) 675							
EP201499- p001	Anonymous	ED094F: Calcium	70p70p2	1	mg/L	9-	£-	0.00	0% p20%
		ED094F: Magnesium	7-49p83p	_	mg/L	29	29	0.00	0% p20%
		ED094F: Sodium	70p24p3	_	mg/L	198	198	0.00	0% p20%

ALS

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Recovery Limits (%) 0% p20% 0% p20% 0% p20% 3% p20% %08 p30% No Limit %0Ed %0 No Limit 3% p20% 0% p20% No Limit RPD (%) 0.-36 0.-37 2.10 0.00 00.0 0.00 0.00 0.00 19.0 0.00 0.00 0.00 0.00 0.00 1.87 7.81 0.00 4.8 0.00 Laboratory Duplicate (DUP) Report Original Result Duplicate Result <0.0001 <0.001 <0.001 <0.001 <0.03 <0.001 <0.001 <0.001 <0.001 <0.001 0.004 900.0 0.002 0.466 0.0001 0.002 0.001 0.002 00.0 0.014 <0.01 0.02 <0.01 0.32 0.08-1.01 0.00 0.00 0.011 <0.01 <0.01 <0.01 0.28 <0.03 118 87 12 81 <0.0001 0.0002 <0.001 <0.001 <0.001 <0.001 <0.001 <0.001 <0.001 0.002 <0.001 0.002 0.004 <0.03 0.006 0.468 0.014 <0.03 0.001 0.002 0.00 0.01-<0.01 0.02 <0.01 0.32 0.08-1.00 0.00 0.00 <0.01 <0.01 <0.01 90 84 121 12 mg/L Unit 0.0001 0.001 0.0001 0.001 0.001 0.001 0.001 0.003 0.03 0.001 0.001 0.001 0.001 0.001 0.001 0.003 0.001 0.001 0.001 0.001 0.001 0.03 0.001 0.001 0.001 0.03 0.01 0.01 0.03 LOR 0.01 0.01 0.01 0.01 _ _ **—** - 7-49p89p6 7--0p24p3 7-49p89p6 7--0p-7p4 CAS Number 7--0p70p2 7-49p93p 7--0p-4p9 7--0p48p2 7--0p-1p7 7--0p49p4 7--0p-7p4 7--0p30p8 7-49p86p3 7-49p98p7 7--0p02p0 7--0p66p6 7-29p90p3 7782p-9p2 7--0p62p2 7--0p-2p8 7--0p-4p9 7--0p48p2 7--0p-1p7 7--0p49p4 7--0р-8р 7--0p30p8 7-49p96p3 7--0p02p0 7--0p66p6 7-29p30p3 7782p-9p2 7--0p62p2 7--0p-2p8 7--0p09p7 7--0p09p7 7--0р-8р-7-49p92p1 7-49p92p1 7-49p8p7 EG020ApF: Molybdenum EG020ApF: Molybdenum EG020ApF: Manganese EG020ApF: Manganese EG020ApF: Chromium EG020ApF: Aluminium EG020ApF: Vanadium EG020ApF: Chromium EG020ApF: Aluminium EG020ApF: Vanadium ED094F: Magnesium EG020ApF: Cadmium EG020ApF: Selenium EG020ApF: Cadmium EG020ApF: Selenium EG020ApF: Beryllium EG020ApF: Beryllium ED094F: Potassium ED094F: Potassium EG020ApF: Arsenic EG020ApF: Arsenic EG020ApF: Co55er EG020ApF: Co55er EG020ApF: Barium EG020ApF: Barium EG020ApF: Cobalt EG020ApF: Cobalt EG020ApF: Boron ED094F: Calcium EG020ApF: Nickel EG020ApF: Boron EG020ApF: Nickel ED094F: Sodium E±083F: ±issolved Major Cations(QC Lot: 3437) 675 - continued EG020ApF: Lead EG020ApF: Lead EG020ApF: Zinc EG020ApF: Zinc EG020ApF: Iron EG020ApF: Iron EG020F: ± issolved Metals by ICP-MS (QC Lot: 3437) 645 Anonymous Anonymous Anonymous Anonymous Sample ID Laboratory sample ID SubpMatrix: WATER EP201499- p001 EP201-262p004 EP201-262p004 EP201499- p001

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Recovery Limits (%) 0% p20% 0% p20% 0% p20% No Limit 0% p20% No Limit No Limit 0% p20% No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit RPD (%) 0.00 0.00 0.00 0.00 0.00 0.00 2.-9 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0 0.00 0.00 -.87 Laboratory Duplicate (DUP) Report Duplicate Result <0.0001 <0.001 <0.001 <0.001 0.004 0.023 <0.0001 <0.001 <0.01 <0.01 0.001 <0.01 <0.01 <0.01 <0.01 0.42 0.02 <100 80 % -6.0 <20 <20 <20 <20 8.4 4.91 Original Result <0.02 mg/L <0.02 mg/l <0.001 <0.001 <0.001 <0.0001 <0.0001 <0.001 0.004 0.02 0.001 <0.01 <0.01 <0.01 <0.01 0.02 <0.01 <0.01 <100 0.91 <30 0.42 -.17 **^**50 <30 8.7 0. mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L hg/L hg/L hg/L Unit mg/L mg/L hg/L hg/L 0.0001 0.001 0.001 0.001 0.001 0.001 0.0001 0.001 0.001 LOR 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.1 2 8 100 8 8 20 ## ## ## 7-49p97p6 1-263p-p2 C6 C10 7-49p97p6 183-0p29p9 1-797p63p0 1-263р - р2 CAS Number 7--0p61p1 7--0p61p1 766-p-1p7 766-p-1p7 1-797p63p0 7--0p29p1 7--0p29p1 7--0p22p 7--0p22p EG0D0G LL-F: ± issolved Hexavalent Chromium by ± iscrete Analyser - Low Level(QC Lot: 344D26D5 EP060/0) 1: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 343D2) 65 EK061G: Total Kjeldahl Nitrogen as N EK061G: Total Kjeldahl Nitrogen as N EK071G: Reactive Phos5horus as P EK0D8G: Nitrite plus Nitrate as N (NOx5 by ± iscrete Analyser (QC Lot: 34307215 EK071G: Reactive Phos5horus as P EK067G: Total Phos5horus as P EK067G: Total Phos5horus as P EG030G: Hexavalent Chromium EK0) 1G: Reactive Phosphorus as P by discrete analyser (QC Lot: 34310875 EK039G: Nitrite + Nitrate as N EK039G: Nitrite + Nitrate as N EK071G: Total Kjeldahl Nitrogen By ± iscrete Analyser (QC Lot: 343708D5 EK07) G: Total Phosphorus as P by ± iscrete Analyser (QC Lot: 34370845 EP071: C29 pC46 Fraction EP071: C13 pC28 Fraction EP071: C10 pC1- Fraction EP080: C6 pC10 Fraction EK033G: Ammonia as N EK033G: Ammonia as N EP080: C6 pC9 Fraction EP080: C6 pC9 Fraction EK037G: Nitrite as N EK037G: Nitrite as N EG020BpF: Thorium EG020BpF: Uranium EG020BpF: Thorium EG020BpF: Uranium EG020BpF: Silver EG020BpF: Silver EG043F: Mercury EG043F: Mercury EK0DDG: Ammonia as N by ± iscrete Analyser (QC Lot: 34307205 EK0D) G: Nitrite as N by ± iscrete Analyser (QC Lot: 34310835 EP060/0) 1: Total Petroleum Hydrocarbons (QC Lot: 343D2) 65 EP060/0) 1: Total Petroleum Hydrocarbons (QC Lot: 343DD/05 EG020F: ±issolved Metals by ICP-MS (QC Lot: 3437) 6D5 EG03DF: ± issolved Mercury by FIMS (QC Lot: 3437) 665 Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Anonymous Sample ID SWZZ1 SWZZ1 SWZZ1 Laboratory sample ID SubpMatrix: WATER EP201-189p001 EP201-202p002 EP201-267p004 EP201-202p002 EP201-210p002 EP201-262p006 EP201-210p002 EP201-219p001 EP201-267p004 EP201-084p001 EP201-262p004 EP201-114p001 EP201-208p001 EP201-267p001 EP201-208p001 EP201-219p001 EP201-267p001 EP201-084p001 EP201-219p001 EP201499- p001 EP201-271p00-



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Recovery Limits (%) No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit RPD (%) 0.00 0.00 0.00 00.00 0.00 0.00 0.00 0.00 0.00 00.0 00.0 0.00 Laboratory Duplicate (DUP) Report Original Result Duplicate Result ×100 ×100 <100 <20 **₽** ₩ 27 7 2 8 <u>~</u> 7 Ω Ω γ °ς <0.001 mg/L <0.002 mg/L <0.002 mg/L <0.002 mg/L <0.002 mg/L <0.003 mg/L <100 <100 <100 <20 7 7 2 လူ $\overleftarrow{\mathsf{v}}$ 7 hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L Unit hg/L µg/L LOR 100 100 20 _ 2 2 0 2 _ 7 7 7 က က 7 100p 1p C6_C10 108p48p4 106p-2p4 93p-7p6 71p 4p2 108p8p4 100p 1p 108p48p4 106p-2p4 71p 4p2 CAS Number 108p8p4 91p20p4 91p20p4 EP060/0) 1: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 343D2) 65 - continued EP060/0) 1: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 343DD105 EP080: metap& 5arapXylene EP080: metap& 5arapXylene EP071: >C10 pC16 Fraction EP071: >C16 pC4- Fraction EP071: >C4- pC-0 Fraction EP080: C6 pC10 Fraction EP080: Ethylbenzene EP080: Ethylbenzene EP080: orthopXylene EP080: Na5hthalene EP080: orthopXylene EP080: Na5hthalene EP080: Benzene EP080: Benzene EP080: Toluene EP080: Toluene EP060: BTEXN (QC Lot: 343D2) 65 Anonymous Anonymous Anonymous Sample ID SWZZ1 Laboratory sample ID SubpMatrix: WATER EP201-219p001 EP201-271p00-EP201-084p001 EP201-271p00-



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Method Blank (MB) and Laboratory Control Spike (LCS) Report

SubpMatrix: WATER				Method Blank (MB)		Laboratory Control Spike (LCS) Report	.CS) Report	
-				Report	Spike	Spike Recovery (%)	Recovery	Recovery Limits (%)
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	SO7	Low	High
EA010P: Conductivity by PC Titrator (QCLot: 343621) 5								
EA010pP: Electrical Conductivity @ 23°C	att.	1	mS/cm	^	2-800 µS/cm	97	92.1	103
EA01D. Total ± issolved Solids dried at 160 ° D9C (QCLot: 34364005	t: 34364005							
EA013H: Total Dissolved Solids @180°C	attt	10	mg/L	< 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 40 < 4	2000 mg/L 1000 mg/L	99.9	88.1	+ + +
E± 03) P: Alkalinity by PC Titrator (QCLot: 34362175								
ED047pP: Hydroxide Alkalinity as CaCO4	DMOp210p00	_	mg/L	⊽	dttt	€±±	dttt	ditti
ED047pP: Carbonate Alkalinity as CaCO4	4812p42p6	_	mg/L	₹	att.	attt	att	att.
ED047pP: Bicarbonate Alkalinity as CaCO4	71p32p4	1	mg/L	<1	dttt	dttt	dttt	dttbl
ED047p ² : Total Alkalinity as CaCO4	ctttt	_	mg/L	∇ ∇	20 mg/L 200 mg/L	106 98.3	81.2	126 110
E± 041G: Sulfate (Turbidimetric5as SO4 2- by ±A (QCLot: 34310845	1: 34310845							
ED0-1G: Sulfate as SO- pTurbidimetric	1-808p79p8	-	mg/L	₹	23 mg/L	100	87.7	114
-			1		300 mg/L	106	87.7	114
E± 04DG: Chloride by ± iscrete Analyser (QCLot: 343108D5	8							
ED0-3G: Chloride	16887p00p6	-	mg/L	₹	10 mg/L	99.4	87.9	-11
				₹	1000 mg/L	101	87.9	11-
E±083F: ±issolved Major Cations (QCLot: 3437) 675								
ED094F: Calcium	70p70p2	1	mg/L	۲>	30 mg/L	103	83.9	114
ED094F: Magnesium	7-49рвзр-	1	mg/L	<1	30 mg/L	98.0	88.0	110
ED094F: Sodium	70p24p3	~	mg/L		30 mg/L	101	87.4	118
ED094F: Potassium	70p09p7	1	mg/L	7	30 mg/L	96.1	89.7	108
EG020F: ± issolved Metals by ICP-MS (QCLot: 3437) 645								
EG020ApF: Aluminium	7-29p80ps	0.01	mg/L	<0.01	0.3 mg/L	101	80	120
EG020ApF: Arsenic	70p48p2	0.001	mg/L	<0.001	0.1 mg/L	104	80	120
EG020ApF: Beryllium	70p-1p7	0.001	mg/L	<0.001	0.1 mg/L	100	81.0	120
EG020ApF: Barium	70p49p4	0.001	mg/L	<0.001	0.1 mg/L	101	83.0	120
EG020ApF: Cadmium	70p-4p9	0.0001	mg/L	<0.0001	0.1 mg/L	102	86.0	120
EG020ApF: Chromium	70p-7p4	0.001	mg/L	<0.001	0.1 mg/L	93.3	83.0	120
EG020ApF: Cobalt	70р-8р	0.001	mg/L	<0.001	0.1 mg/L	-`66	80	120
EG020ApF: Co55er	70p30p8	0.001	mg/L	<0.001	0.1 mg/L	101	80	120
EG020ApF: Lead	7-49p82p1	0.001	mg/L	<0.001	0.1 mg/L	-386	83.0	120
EG020ApF: Manganese	7-49pg6pg	0.001	mg/L	<0.001	0.1 mg/L	96.3	83.0	120
EG020ApF: Molybdenum	7-49p98p7	0.001	mg/L	<0.001	0.1 mg/L	100	86.0	120



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High 116 114 110 110 109 114 119 113 116 120 120 120 20 120 117 11 100 104 122 10-Recovery Limits (%) 89.0 8-.0 88.0 83.0 79.0 0. -8 80.0 94.0 -72 -2.3 -2.0 -6.2 63.0 80.0 86.2 90.3 70.0 74.6 74.9 Low 92.0 88.7 73.8 49.4 89.-Laboratory Control Spike (LCS) Report Spike Recovery (%) 94.3 80.9 89.3 9- -6 91.0 91.0 99.8 66 98.3 98.8 83.4 SO7 100 98.-104 102 99.7 86.1 80.7 6 11 103 107 89. Concentration 0.1 mg/L 0.1 mg/L 0.03 mg/L 439 µg/L 472 µg/L 0.3 mg/L 478 µg/L 0.02 mg/L 269 µg/L 0.1 mg/L -.-2 mg/L 0.1 mg/L 0.1 mg/L 0.01 mg/L 0.3 mg/L 0.3 mg/L 0.3 mg/L 420 µg/L 470 µg/L --6 µg/L 0.3 mg/L 0.1 mg/l 1 mg/L 10 mg/L Method Blank (MB) Result <0.003 <0.001 <0.001 <0.0001 < 0.001 <0.01 <0.03 <0.03 <0.001 <0.001 Report <0.01 <0.01 <0.01 <100 <100 <100 <0.01 <0.01 <0.01 0.7 <30 <20 <30 <20 mg/L hg/L mg/L Unit mg/L mg/L mg/L mg/L hg/L hg/L hg/L hg/L hg/L hg/L EG0D0G LL-F: ±issolved Hexavalent Chromium by ±iscrete Analyser - Low Level (QCLot: 344D26D5 EP060/0) 1: Total Recoverable Hydrocarbons - NEPM 2013 Fractions(QCLot: 343DD105 EP060/0) 1: Total Recoverable Hydrocarbons - NEPM 2013 Fractions(QCLot: 343D2)65 0.003 0.0001 0.03 0.03 0.001 0.001 0.001 0.001 0.001 LOR 0.01 0.01 0.01 0.01 0.01 0.01 100 0.01 0.1 100 20 9 20 30 30 EK0D8G: Nitrite plus Nitrate as N (NOx5 by ± iscrete Analyser (QCLot: 34307215 EK0) 1G: Reactive Phosphorus as P by discrete analyser (QCLot: 34310875 EK071G: Total Kjeldahl Nitrogen By ±iscrete Analyser(QCLot: 343708D5 EK07) G: Total Phosphorus as P by ±iscrete Analyser (QCLot: 34370845 œ. CAS Number 1-797p63p0 8 8 8 1-263p-p2 8 8 8 8 8 7-49p97p6 183-0p29p9 766- p- 1p7 C6_C10 2--0p66p6 7--0p-2p8 7-49p89p6 7--0p61p1 7--0p02p0 7782p 9p2 7--0p62p2 7--0p22p 7--0p29p1 EG020F: ±issolved Metals by ICP-MS (QCLot: 3437) 645 - continued EK0DDG: Ammonia as N by ± iscrete Analyser (QCLot: 34307205 EK0D) G: Nitrite as N by ± iscrete Analyser (QCLot: 34310835 EP060/0) 1: Total Petroleum Hydrocarbons (QCLot: 343D2) 65 EP060/0) 1: Total Petroleum Hydrocarbons (QCLot: 343DD105 EG020F: ±issolved Metals by ICP-MS (QCLot: 3437) 6D5 EG03DF: ± issolved Mercury by FIMS (QCLot: 3437) 665 EK061G: Total Kjeldahl Nitrogen as N EK071G: Reactive Phos5horus as P EK067G: Total Phos5horus as P EG030G: Hexavalent Chromium EK039G: Nitrite + Nitrate as N EP071: >C10 pC16 Fraction EP071: >C16 pC4- Fraction EP071: C13 pC28 Fraction EP071: C10 pC1- Fraction EP071: C29 pC46 Fraction EP080: C6 pC10 Fraction EP080: C6 pC9 Fraction EK033G: Ammonia as N EG020ApF: Vanadium EG020ApF: Selenium EK037G: Nitrite as N EG020BpF: Uranium EG020BpF: Thorium SubpMatrix: WATER Method: Compound EG020ApF: Boron EG020ApF: Nickel EG043F: Mercury EG020BpF: Silver EG020ApF: Zinc EG020ApF: Iron



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SubpMatrix: WATER				Method Blank (MB)		Laboratory Control Spike (LCS) Report	S) Report	
				Report	Spike	Spike Recovery (%)	Recovery	Recovery Limits (%)
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	SO7	Low	High
EP060/0) 1: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 343DD105 - co	:013 Fractions (QCI	Lot: 343DD105 - co	ntinued					
EP071: >C4- pC-0 Fraction	attt	100	hg/L	<100	271 µg/L	38.0	27	147
EP060: BTEXN (QCLot: 343D2) 65								
EP080: Benzene	71p 4p2	_	hg/L		20 µg/L	-96	81	11-
EP080: Toluene	108p88p4	2	hg/L	<2	20 µg/L	97.8	81.0	113
EP080: Ethylbenzene	100р 1р	2	hg/L	<2	20 µg/L	94.8	-:-8	114
EP080: metap& 5arapXylene	108p48p4	2	hg/L	<2	-0 µg/L	94.9	84	11-
	106p-2p4							
EP080: orthopXylene	93p-7p6	2	hg/L	<2	20 µg/L	93.8	86.3	111
EP080: Na5hthalene	91p20p4	က	hg/L	<3	3 µg/L	84	77.0	118

Matrix Spike (MS) Report

The quality control term Matrix SSike (MS) refers to an intralaboratory s5lit sam5le s5iked with a re5resentative set of target analytes. The 5ur5ose of this QC 5arameter is to monitor 5otential matrix effects on analyte recoveries. Static Recovery Limits as 5er laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sam5le matrix interference.

Matrix Spike (MS) Report

SubpMatrix: WATER

-							
				Spike	SpikeRecovery(%)	Recovery Limits (%)	mits (%)
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
E±041G: Sulfate (1	E±041G: Sulfate (Turbidimetric5as SO4 2- by ±A (QCLot: 34310845						
EP201-210p001	Anonymous	ED0-1G: Sulfate as SO- pTurbidimetric	1-808p79p8	100 mg/L	11-	70.0	140
E± 04DG: Chloride	E±04DG: Chloride by ± iscrete Analyser (QCLot: 343108D5						
EP201-210p001	Anonymous	ED0-3G: Chloride	16887p00p6	1000 mg/L	110	70.0	140
EG020F: ±issolved	EG020F: ± issolved Metals by ICP-MS (QCLot: 3437) 645						
EP201499-p002	Anonymous	EG020ApF: Arsenic	70p48p2	0.2 mg/L	129	70.0	140
		EG020ApF: Beryllium	70p-1p7	0.2 mg/L	127	70.0	140
		EG020ApF: Barium	70p49p4	0.2 mg/L	126	70.0	140
		EG020ApF: Cadmium	70p-4p9	0.03 mg/L	127	70.0	140
		EG020ApF: Chromium	70p-7p4	0.2 mg/L	118	70.0	140
		EG020ApF: Cobalt	70р-8р	0.2 mg/L	123	70.0	140
		EG020ApF: Co55er	70p30p8	0.2 mg/L	123	70.0	140
		EG020ApF: Lead	7- 49p92p1	0.2 mg/L	120	70.0	140
		EG020ApF: Manganese	7- 49p86p8	0.2 mg/L	121	70.0	140
		EG020ApF: Nickel	70p02p0	0.2 mg/L	123	70.0	140
		EG020ApF: Vanadium	70p62p2	0.2 mg/L	120	70.0	140
		EG020ApF: Zinc	70p66p6	0.2 mg/L	129	70.0	140
EG03DF: ±issolved	EG03DF: ± issolved Mercury by FIMS (QCLot: 3437) 665						
EP201-216p001	Anonymous	EG043F: Mercury	7-49p97p6	0.01 mg/L	74.6	70.0	140
EG0D0G LL-F: ± is	EG0D0G LL-F: ±issolved Hexavalent Chromium by ±iscrete Analyser - Low Level(QCLot: 344D26D5	w Level (QCLot: 344D26D5					



SubpMatrix: WATER

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SubpMatrix: WATER				Ma	Matrix Spike (MS) Report		
				Spike	SpikeRecovery(%)	Recovery Limits (%)	mits (%)
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG0D0G LL-F: ± is	EG0D0G LL-F: ±issolved Hexavalent Chromium by ±iscrete Analyser - Low Level(QCLot	/ Level (QCLot: 344D26D5 - continued					
EP201-114p001	Anonymous	EG030G: Hexavalent Chromium	183-0p29p9	0.03 mg/L	84.8	70.0	140
EK0DDG: Ammoni	EK0DDG: Ammonia as N by ± iscrete Analyser (QCLot: 34307205						
EP201-202p001	Anonymous	EK033G: Ammonia as N	766- p- 1p7	1 mg/L	101	70.0	140
EK0D) G: Nitrite a	EK0D) G: Nitrite as N by ± iscrete Analyser (QCLot: 34310835						
EP201-219p001	SWZZ1	EK037G: Nitrite as N	1-797p63p0	0.3 mg/L	101	70.0	140
EK0D8G: Nitrite p	EK0D8G: Nitrite plus Nitrate as N (NOx5 by ± iscrete Analyser (QCLot: 34307215	07215					
EP201-202p001	Anonymous	EK039G: Nitrite + Nitrate as N	ct tt	0.3 mg/L	-:-6	70.0	140
EK071G: Total Kje	EK071G: Total Kjeldahl Nitrogen By ± iscrete Analyser (QCLot: 343708D5						
EP201-210p002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	dttt	3 mg/L	81.2	70.0	140
EK07) G: Total Ph	EK07) G: Total Phosphorus as P by ± iscrete Analyser (QCLot: 34370845						
EP201-210p002	Anonymous	EK067G: Total Phos5horus as P	dttt	1 mg/L	# Not Determined	70.0	140
EK0) 1G: Reactive	EK0) 1G: Reactive Phosphorus as P by discrete analyser (QCLot: 34310875	S.					
EP201-219p001	SWZZ1	EK071G: Reactive Phos5horus as P	1- 263p - p2	0.3 mg/L	98.6	70.0	140
EP060/0) 1: Total	EP060/0) 1: Total Petroleum Hydrocarbons (QCLot: 343D2) 65						
EP201-084p002	Anonymous	EP080: C6 pC9 Fraction	dttt	2-0 µg/L	91.9	77.0	147
EP060/0) 1: Total	EP060/0) 1: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 343D2) 65	ot: 343D2) 65					
EP201-084p002	Anonymous	EP080: C6 pC10 Fraction	C6_C10	290 µg/L	84.2	77.0	147
EP060: BTEXN (QCLot: 343D2) 65	2CLot: 343D2) 65						
EP201-084p002	Anonymous	EP080: Benzene	71p 4p2	20 µg/L	110	77.0	122
		EP080: Toluene	108p88p4	20 µg/L	107	74.3	126



QA/QC Compliance Assessment to assist with Quality Review

: 1 of 8	: Environmental Division Perth	: 09 8406 1307	: 175Dec5-0-0	: 31Dec5-0-0	<u></u>	<u></u>
Page	Laboratory	Telephone	Date Samples Received	Gsue Date	No. of samples received	No. of samples analysed
: EP2014218	: RPS Australia West Pty Ltd	: ALAN FOLEY	EEC14061,006	: 2 reenpatch	: SI MWL	9999
Work Order	Client	Contact	Project	Site	Sampler	Order number

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

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

Summary of Outliers

Outliers: Quality Control Samples

This report highlights outliers flagged in the Buality Control &C(Report.

- Mo Method Blank value outliers occur.
- NO Duplicate outliers occur.
- NO Laboratory Control outliers occur.
- Matrix Spike outliers exist please see following pages for full details.
- For all regular sample matrices, NO surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

Mo Analysis Holding Time Outliers exist.

Outliers: Frequency of Quality Control Samples

Quality Control Sample Frequency Outliers exist - please see following pages for full details.



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

atrik: WATER

Compound 2 roup Name	Laboratory Sample (Client Sample (Client Sample ®	Analyte	CAS Number Data	Data	Limits Comment	Comment
Matrix Spike (MS) Recoveries							
Ex 0672: Total Phosphorus as P by Discrete Analyser EP- 014- 10500-		Anonymous	Total Phosphorus as P	9999	Not Determined	9999	MS recovery not determined, background level greater than or equal to 4x spike level.

Outliers: Frequency of Quality Control Samples

atrik: WATER

Buality Control Sample Type	Cor	unt	Rate	Rate 0%(Buality Control Specification
I ethod	BC	Regular	Actual	Ekpected	
I atrik Spi) es ℚ S(
TRH 5Semivolatile Fraction	0	6	00.00	V.00	V.00 NEPI - 013 Z3 & ALS BC Standard

Analysis Holding Time Compliance

Gsamples are identified beloq as having been analysed or ektracted outside of recommended holding timeszthis should be ta) en into consideration q hen interpreting results.

This report summarities ektraction Wpreparation and analysis times and compares each qith ALS recommended holding times Geferencing = SEPA SM 946z APHAz AS and NEPI (based on the sample container organics Holding time for leachate methods @.g. TCLP(vary according to the analytes reported. Assessment compares the leach date qith the shortest analyte holding time for the e, uivalent soil method. These are: provided. Dates reported represent first date of ektraction or analysis and preclude subse, uent dilutions and reruns. A listing of breaches of any (is provided herein.

Holding times for VOC in soils vary according to analytes of interest. ; inyl Chloride and Styrene holding time is 7 dayswothers 14 days. A recorded breach does not guarantee a breach for all ; OC analytes and should be verified in case the reported breach is a false positive or; inyl Chloride and Styrene are not) ey analytes of interest\u00e4bncern.

14 dayszmercuny - 9 days & other metals 190 days. A recorded breach does not guarantee a breach for all nonSvolatile parameters.

l atrik: WATER

l atrik: WATER				Evaluation	× J Holding time	Evaluation: * J Holding time breach w/ J Mithin holding time.	n holding time.
Method	Sample Date	Ex	Extraction / Preparation			Analysis	
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P) SM / / 1	15-Dec-2020		999	998	29-Dec-2020	145kan5-0-1	>
EA01±: Total Dissolved Solids dried at 1° 0 3 ± 7C							
Clear Plastic Bottle - Natural (EA01±H) SM / / 1	15-Dec-2020		#	311 2	24-Dec-2020	-4Dec5-0-0	>
ED095P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED095-P) SM / 1	15-Dec-2020	****	111 2	311 2	29-Dec-2020	31Dec5-0-0	>
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) SM / 1	15-Dec-2020		HH.	999	1° -Dec-2020	14 8 ⁄an5-0-1	>
ED04±G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED04±G) SM / / 1	15-Dec-2020	1	999	998	1°-Dec-2020	145kan5-0-1	>



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Evaluation: ★ J Holding time breach w J Mithin holding time. Evaluation > > > > > > > > > > > > > Due for analysis 315Dec5-0-0 145kan5-0-1 185Dec5-0-0 18Dec5-0-0 315Kan5-0-1 315Dec5 0-0 1V3Kun5-0-1 145Kan5-0-1 145Kan5-0-1 145Kan5-0-1 315Kan5-0-1 145kan5-0-1 145Kan5-0-1 145Kan5-0-1 Date analysed 24-Dec-2020 24-Dec-2020 24-Dec-2020 1° -Dec-2020 1°-Dec-2020 29-Dec-2020 1°-Dec-2020 29-Dec-2020 22-Dec-2020 22-Dec-2020 28-Dec-2020 1°-Dec-2020 29-Dec-2020 29-Dec-2020 Evaluation 8 1 1 8 8 8 8 > > 8 > > > Extraction / Preparation Due for extraction -45Dec5 0-0 315Dec5-0-0 315Dec5-0-0 -45Dec5 0-0 145kan5-0-1 145Kan5-0-1 B 1 1 H 1 8 8 Date extracted 22-Dec-2020 22-Dec-2020 22-Dec-2020 22-Dec-2020 29-Dec-2020 29-Dec-2020 I I l l l l l l 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 15-Dec-2020 Sample Date EG0±0G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level EP0° 0/051: Total Recoverable Hydrocarbons - NEPM 2019 Fractions EU0±8G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser EU051G: Reactive Phosphorus as P by discrete analyser Clear Plastic Bottle - Natural (EU051G) Clear Plastic Bottle - Filteredj Lab-acidified (EG020B-F) EU0; 1G: Total Ueldahl Nitrogen By Discrete Analyser EU0; 5G: Total Phosphorus as P by Discrete Analyser Clear Plastic Bottle - Sulfuric Acid (EU0; 5G) Clear Plastic Bottle - Filteredj Lab-acidified (EG09±F) lear Plastic Bottle - Filteredj Lab-acidified (ED089F) Clear Plastic Bottle - NaOH Filtered (EG0±0G LL-F) EU0±±G: Ammonia as N by Discrete Analyser Clear Plastic Bottle - Sulfuric Acid (EU0±±G) Clear Plastic Bottle - Sulfuric Acid (EU0; 1G) Slear Plastic Bottle - Sulfuric Acid (EU0±8G) EP0° 0/051: Total Petroleum Hydrocarbons EU0±5G: Nitrite as N by Discrete Analyser mber Glass Bottle - Knpreserved (EP051) mber Glass Bottle - Knpreserved (EP051) mber VOC Vial - Sulfuric Acid (EP0° 0) mber VOC Vial - Sulfuric Acid (EP0° 0) SM / / 1 Clear Plastic Bottle - Natural (EU0±5G) EG020F: Dissolved Metals by ICP-MS EG09±F: Dissolved Mercury by FIMS ED089F: Dissolved Ma®r Cations Container / Client Sample ID(s) atrik: WATER SM//1 SM//1 SM//1 SM//1 SM/ / 1 SM//1 SM//1 SM/ / 1 SM//1 SM//1



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l atrik: WATER				Evaluation:	★ J Holding time	Evaluation: * J Holding time breach w/ J Mithin holding time.	holding time.
Method	Sample Date	Ex	Extraction / Preparation			Analysis	
Container / Client Sample ID(s)		Date extracted	Date extracted Due for extraction Evaluation Date analysed Due for analysis Evaluation	Evaluation	Date analysed	Due for analysis	Evaluation
EP0°0: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP0° 0)							
SM//1	15-Dec-2020	22-Dec-2020	315Dec5-0-0	>	22-Dec-2020	315Dec5-0-0	>



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Quality Control Parameter Frequency Compliance

The folloqing report summarises the fre, uency of laboratory BC samples analysed qithin the analytical lotto in qhich the submitted sample (qasto ere(processed. Actual rate should be greater than or e, ual to the ekpected rate. A listing of breaches is provided in the Summary of Outliers.

atrik: WATER

Buality Control Sample Type			10/10		Rate (%)		CHAIRV	Quality Control Specification
Analytical Methods	Method	OC	Reaular	Actual	Expected	Evaluation		
Laboratory Duplicates @ = P(
Al) alinity by PC Titrator	ED0373P		0-	10.00	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Ammonia as N by Discrete analyser	Ex 0W2	ı	0-	10.00	10.00	>	NEPI -	- 013 Z3 & ALS BC Standard
Chloride by Discrete Analyser	ED04V2	1	18	10.±9	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Conductivity by PC Titrator	EA0109P	ı	18	10.±9	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Dissolved Hekavalent Chromium by DA 5Log Level	E2 0V02 LLSF	_	4	2±.00	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Dissolved I ercury by FG S	E2 03VF	ı	0-	10.00	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Dissolved Letals by CP9 S 5Suite A	E2 0- 0AF	ı	0-	10.00	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Dissolved Letals by @PS SSuite Z	E2 0- 02 F	ı	0-	10.00	10.00	>	NEPI -	- 013 Z3 & ALS BC Standard
I ajor Cations 5Dissolved	ED083F	ı	0-	10.00	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Nitrite and Nitrate as N QNOk(by Discrete Analyser	Ex 0/82	ı	0-	10.00	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Nitrite as N by Discrete Analyser	Ex 0V72	1	18	10.±9	10.00	>	NEPI -	- 013 Z3 & ALS BC Standard
Reactive Phosphorus as P至y Discrete Analyser	Ex 0712	ı	-	1; .; 5	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Sulfate Gurbidimetric(as SO4 - 5by Discrete Analyser	ED0412	1	18	10.±9	10.00	>	NEPI -	- 013 Z3 & ALS BC Standard
Total Dissolved Solids @High Level(EA01VH	1	18	10.±9	10.±9	>	NEPI -	- 013 Z3 & ALS BC Standard
Total x jeldahl Nitrogen as N Zy Discrete Analyser	Ex 0612		0-	10.00	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Total Phosphorus as P Zy Discrete Analyser	Ex 0672	ı	18	10.±9	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
TRH 5Semivolatile Fraction	EP071	_	o	12.±0	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
TRH; olatiles/ØTEX	EP090	1	0 -	10.00	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Laboratory Control Samples QCS(
Al) alinity by PC Titrator	ED0378P		0 -	10.00	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Ammonia as N by Discrete analyser	Ex 0W2	_	0-	±.00	÷.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Chloride by Discrete Analyser	ED04V2	ı	18	10.±9	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Conductivity by PC Titrator	EA010%	1	18	±.2;	7.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Dissolved Hekavalent Chromium by DA 5Log Level	E2 0V02 LLSF	1	4	2±.00	1. 00	>	NEPI - (- 013 Z3 & ALS BC Standard
Dissolved I ercury by FG S	E2 03VF	_	0-	±.00	÷.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Dissolved I etals by GP9 S 5Suite A	E2 0- 0AF	-	0-	7.00	00.∓	>		- 013 Z3 & ALS BC Standard
Dissolved I etals by GP9 S 5Suite Z	E2 0- 0Z 舒	_	0-	7.00	÷.00	>	NEPI - (- 013 Z3 & ALS BC Standard
I ajor Cations 5Dissolved	ED083F	1	0-	7.00	7.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Nitrite and Nitrate as N QNOk(by Discrete Analyser	Ex 0/82	1	0-	7.00	÷.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Nitrite as N by Discrete Analyser	Ex 0V72	_	18	±.2;	00 +	>	NEPI - (- 013 Z3 & ALS BC Standard
Reactive Phosphorus as PZy Discrete Analyser	Ex 0712	_		66'.	÷.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Sulfate Qurbidimetric(as SO4 - 5by Discrete Analyser	ED0412	1	18	10.±9	10.00	>	NEPI - (- 013 Z3 & ALS BC Standard
Total Dissolved Solids @High Level(EA01VH	ı	18	10.±9	10.±9	>	NEPI - (- 013 Z3 & ALS BC Standard
Total x jeldahl Nitrogen as N Zy Discrete Analyser	Ex 0612	1	0-	7.00	7.00	>		- 013 Z3 & ALS BC Standard
Total Phosphorus as P Zy Discrete Analyser	Ex 0672	-	18	±.2;	÷.00	>	NEPI - (- 013 Z3 & ALS BC Standard
TRH 5Semivolatile Fraction	EP071	_	თ	12.±0	00 +	>	NEPI - (- 013 Z3 & ALS BC Standard



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I atrik: WATER				Evaluation	: * J Buality Co	ntrol fre, uency n	Evaluation: * J Buality Control fre, uency not qithin specification w/ J Buality Control fre, uency qithin specification.
Buality Control Sample Type		Count	unt		Rate (%)		Quality Control Specification
Analytical Methods	Method	OC	Reaular	Actual	Expected	Evaluation	
Laboratory Control Samples QCS(5Continued							
TRH; olatiles/MITEX	EP090	-	0-	1 .00	±.00	>	NEPI -013 Z3 & ALS BC Standard
I ethod Zlan) s ℚ Z(
Al) alinity by PC Titrator	ED037	1	0-	∓.00	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Ammonia as N by Discrete analyser	Ex 0/W2	_	0-	÷.00	+.00	>	NEPI - 013 Z3 & ALS BC Standard
Chloride by Discrete Analyser	ED04V2	-	18	±.2;	+ 00	>	NEPI - 013 Z3 & ALS BC Standard
Conductivity by PC Titrator	EA0109P	_	18	±2;	00 '+	>	NEPI - 013 Z3 & ALS BC Standard
Dissolved Hekavalent Chromium by DA 5Log Level	E2 0V02 LLFF	-	4	2±.00	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Dissolved I ercury by FG S	E2 03VF	-	0-	00.±	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Dissolved Letals by @P4 S 5Suite A	E2 0- 0AF	_	0-	00 . ±	00 '+	>	NEPI - 013 Z3 & ALS BC Standard
Dissolved Letals by @P4 S 5Suite Z	E2 0- 02 F	_	0-	±.00	+,00	>	NEPI - 013 Z3 & ALS BC Standard
I ajor Cations 5Dissolved	ED083F	-	0-	00.±	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Nitrite and Nitrate as N QNOk(by Discrete Analyser	Ex 0V82	_	0-	7.00	+·00	>	NEPI - 013 Z3 & ALS BC Standard
Nitrite as N by Discrete Analyser	Ex 0V72	-	18	±.2;	+; 00	>	NEPI - 013 Z3 & ALS BC Standard
Reactive Phosphorus as PZy Discrete Analyser	Ex 0712	-	+	66'.	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Sulfate Qurbidimetric(as SO4 - 5by Discrete Analyser	ED0412	_	18	±2;	+ 00	>	NEPI - 013 Z3 & ALS BC Standard
Total Dissolved Solids (High Level)	EA01VH	-	18	±.2;	±.2;	>	NEPI - 013 Z3 & ALS BC Standard
Total x jeldahl Nitrogen as N Zy Discrete Analyser	Ex 0612	-	0-	7:00	±.00	>	NEPI - 013 Z3 & ALS BC Standard
Total Phosphorus as P Zy Discrete Analyser	Ex 0672	_	18	±.2;	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
TRH 5Semivolatile Fraction	EP071	_	6	12 <u>.</u> ±0	1. 00	>	NEPI - 013 Z3 & ALS BC Standard
TRH; olatiles@TEX	EP090	_	0-	∓:00	1. 00	>	NEPI - 013 Z3 & ALS BC Standard
I atrik Spi) es ℚ S(
Ammonia as N by Discrete analyser	Ex 0/W2	-	0-	7.00	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Chloride by Discrete Analyser	ED04V2	_	18	±.2;	1. 00	>	NEPI - 013 Z3 & ALS BC Standard
Dissolved Hekavalent Chromium by DA 5Loq Level	E2 0V02 LL €	_	4	2±.00	1. 00	>	-013 Z3 & ALS
Dissolved I ercury by FG S	E2 03VF	_	0-	∓.00	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Dissolved Letals by CP1 S5Suite A	E2 0- 0AF	_	0-	7.00	+·00	>	NEPI - 013 Z3 & ALS BC Standard
Nitrite and Nitrate as N QNOk(by Discrete Analyser	Ex 0V82	_	0-	7.00	+.00	>	NEPI - 013 Z3 & ALS BC Standard
Nitrite as N by Discrete Analyser	Ex 0V72	_	18	±.2;	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Reactive Phosphorus as PZy Discrete Analyser	Ex 0712	_	 	66'.	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Sulfate Qurbidimetric(as SO4 - 5by Discrete Analyser	ED0412	_	18	±.2;	+ .00	>	NEPI - 013 Z3 & ALS BC Standard
Total x jeldahl Nitrogen as N Zy Discrete Analyser	Ex 0612	_	0-	00.±	÷.00	>	NEPI - 013 Z3 & ALS BC Standard
Total Phosphorus as P Zy Discrete Analyser	Ex 0672	_	18	±.2;	±.00	,	NEPI - 013 Z3 & ALS BC Standard
TRH 5Semivolatile Fraction	EP071	0	o	00.0	+ .00	×	-013 Z3 & ALS BC
TRH; olatiles/ITEX	EP090	_	0-	1. 00	1. 00	>	NEPI - 013 Z3 & ALS BC Standard



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 Mor) Order
 : EP- 014-18

 Client
 : RPS Australia Mest Pty Ltd

 Project
 : EEC14061.006

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognibed procedures such as those published by the Environmental Division have been developed from established internationally recognibed procedures such as those published by the Environmental Division have been developed from established internationally recognibed procedures such as those published by the Environmental Division have been developed from established internationally recognibed procedures used by the Environmental Division have been developed from established internationally recognibed from the Environmental Division have been developed from established internationally recognibed from the Environmental Division have been developed from the Environmental Divis developed procedures are employed in the absence of documented standards or by client re, uest. The folloging report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from a hich ALS methods have been developed are provided a ithin the I ethod Descriptions.

Analytical Methods	Wethod	Matrix	a)
Conductivity by PC 1 itrator	EA0103P	MATER	@ house: Referenced to APHA - V10 Z. This procedure determines conductivity by automated GE. This method is compliant q ith NEPI Schedule ZQ(
Total Dissolved Solids (Righ Level(EA01VH	MATER	Ghouse: Referenced to APHA - V40C. A gravimetric procedure that determines the amount of 'filterable' residue in an a, ueous sample. A qellfmiked sample is filtered through a glass fibre filter G um(. The filtrate is evaporated to dryness and dried to constant qeight at 190+VWC. This method is compliant qith NEPI Schedule ZG(
Al) alinity by PC Titrator	ED037&	MATER	Ghouse: Referenced to APHA - 3- 0 Z This procedure determines al) alinity by automated measurement ⊕.g. PC Titrate(on a settled supernatant ali, uot of the sample using pH 4.V for indicating the total al) alinity end point. This method is compliant qith NEPI Schedule ZG(
Sulfate Gurbidimetric(as SO4 - 5by Discrete Analyser	ED0412	MATER	(a) house: Referenced to APHA 4V005504. Dissolved sulfate is determined in a 0.4Vum filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium qith barium chloride. Light absorbance of the ZaSO4 suspension is measured by a photometer and the SO45- concentration is determined by comparison of the reading qith a standard curve. This method is compliant qith NEPI Schedule Z(3)(
Chloride by Discrete Analyser	ED04/2	MATER	G house: Referenced to APHA 4V00 CI 52. The thiocyanate ion is liberated from mercuric thiocyanate through se, uestration of mercury by the chloride ion to form non5onised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highlycoloured ferric thiocynate q hich is measured at 490 nm APHA seal method - 0175f. Φ.
I ajor Cations 5Dissolved	ED083F	MATER	@ house: Referenced to APHA 31-0 and 31-W=SEPA SM 946 56010 and 60-0wCations are determined by either CPSAES or CPS Stechni, ues. This method is compliant q ith NEPI Schedule ZQ Sodium Adsorption Ratio is calculated from Cazl g and Na q hich determined by ALS in house method BM CENTED083F. This method is compliant q ith NEPI Schedule ZQ Hardness parameters are calculated based on APHA - 340 Z. This method is compliant q ith NEPI Schedule ZQ (
Dissolved I etals by CP9 S 5Suite A	E2 0- 0AF	MATER	© house: Referenced to APHA 31- W= SEPA SM 946 560- 0zALS BM ŒNWZ 0-0. Samples are 0.4V,um filtered prior to analysis. The ŒPI S techni, ue utili∪es a highly efficient argon plasma to ioni∪e selected elements. One are then passed into a high vacuum mass spectrometerzq hich separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved I etals by CP9 S 5Suite Z	E2 0- 02 F	MATER	© house: Referenced to APHA 31- W= SEPA SM 946 560- 0zALS BM ŒNN 20-0. Samples are 0.4 Vµm filtered prior to analysis. The ŒPI S techni, ue utili∪es a highly efficient argon plasma to ioni∪e selected elements. One are then passed into a high vacuum mass spectrometerzq hich separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved I ercury by FG S	E2 03VF	MATER	© house: Referenced to AS 3W0zAPHA 311- Hg 5Z @ loq 5njection ©nCl- (© old; apour generation(AAS(Samples are 0.4Vµm filtered prior to analysis. FG 5AAS is an automated flameless atomic absorption techni, ue. A bromate\(\begin{align*} al



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by , uantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate @ house: Referenced to APHA 4V005NO35F. Nitrate is reduced to nitrite by q ay of a chemical reduction follog ed @ house: Referenced to APHA 4V003NH3 2 Ammonia is determined by direct colorimetry by Discrete Analyser. G house: Referenced to APHA 4V009 F Ammonium molybdate and potassium antimonyl tartrate reacts in acid colour development using dephenylcarbaUde. Each run of samples is measured against a fiveちoint calibration concentration measured at 990nm using discrete analyser. This method is compliant qith NEPI Schedule ZQ(coloured molybdenum blue by ascorbic acid. Buantification is by Discrete Analyser. This method is compliant medium qith othophosphate to form a heteropoly acid Shosphomolybdic acid 5q hich is reduced to intensely digestion of a sample ali, uot to brea) phosphorus dogn to orthophosphate. The orthophosphate reacts qith uantification is by comparison against an established V point calibration curve of n3Al) ane standards. This G house: Referenced to APHA 3V00 Cr至 & 31-0VM-V. Trivalent Chromium is the difference betgeen total chromium is determined directly on q ater sample by Descrete Analyser as received by pH adjustment and @ house: Referenced to = SEPA SM 946 5901V The sample ektract is analysed by Capillary 2 CWRB and ® house: Referenced to APHA 3√00 Cr5A & Z. Samples are 0.4√µm filtered prior to analysis. Hekavalent @ house: Referenced to APHA 4V003NO35F. Combined okidised Nitrogen QNO-+NO3(is determined by calculated as the difference betg een the tg o results. This method is compliant gith NEPI Schedule ZQ(@ house: Referenced to APHA 4V003P HzKr) a et alz/ hang et al. This procedure involves sulphuric acid temperature x jeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined ammonium molybdate and antimony potassium tartrate to form a complek q hich is then reduced and its Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant q ith NEPI G house: Referenced to APHA 4V005Norg D CB house(. An ali, uot of sample is digested using a high ⊕ house: Referenced to APHA 1030F. This method is compliant q ith NEPI Schedule Z
 ⊕ colorimetrically by discrete analyser. This method is compliant q ith NEPI Schedule Z@(method is compliant q ith the BC re, uirements of NEPI Schedule ZQ(curve. This method is compliant qith NEPI Schedule ZQ(. This method is compliant q ith NEPI Schedule ZQ(This method is compliant q ith NEPI Schedule ZQ(dissolved and dissolved hekavalent chromium. q ith NEPI Schedule ZC3(Schedule Z@(MATER MATER MATER MATER MATER MATER MATER MATER MATER MATER MATER MATER Matrix E2 0482 LLFF E2 0V02 LLFF EN0W5P2 Ex 0W2 Ex 0V92 Ex 06-2 Ex 0612 Ex 0712 Ex 0V72 Ex 0V82 Ex 0672 EP071 Dissolved Hekavalent Chromium by DA 5 Nitrite and Nitrate as N QNOk(by Discrete Onic Zalance by PCT DA and Turbi SO4 Total x jeldahl Nitrogen as N Zy Discrete Dissolved Trivalent Chromium by DA 5 Reactive Phosphorus as PZy Discrete Fotal Nitrogen as N GxN + Nok(Zy Ammonia as N by Discrete analyser Total Phosphorus as P Zy Discrete Nitrate as N by Discrete Analyser Nitrite as N by Discrete Analyser TRH 5Semivolatile Fraction Discrete Analyser Analytical Methods Log Level Log Level Analyser Analyser Analyser Analyser

@ house: Referenced to APHA 4V00 Norg 5DwAPHA 4V00 P 5H. This method is compliant q ith NEPI Schedule

MATER

Ex 061 NBx 067

Preparation Methods

Tx NWP Digestion

Matrix

@ house: Referenced to = SEPA SM 946 59-60 Mater samples are directly purged prior to analysis by Capillary

MATER

EP090

TRH; olatiles\2012TEX

sample is e, uilibrated in a headspace vial and a portion of the headspace determined by 2 CI S analysis. This

method is compliant q ith the BC re, uirements of NEPI Schedule ZQ(

2 CWS and , uantification is by comparison against an established V point calibration curve. Alternativelyza



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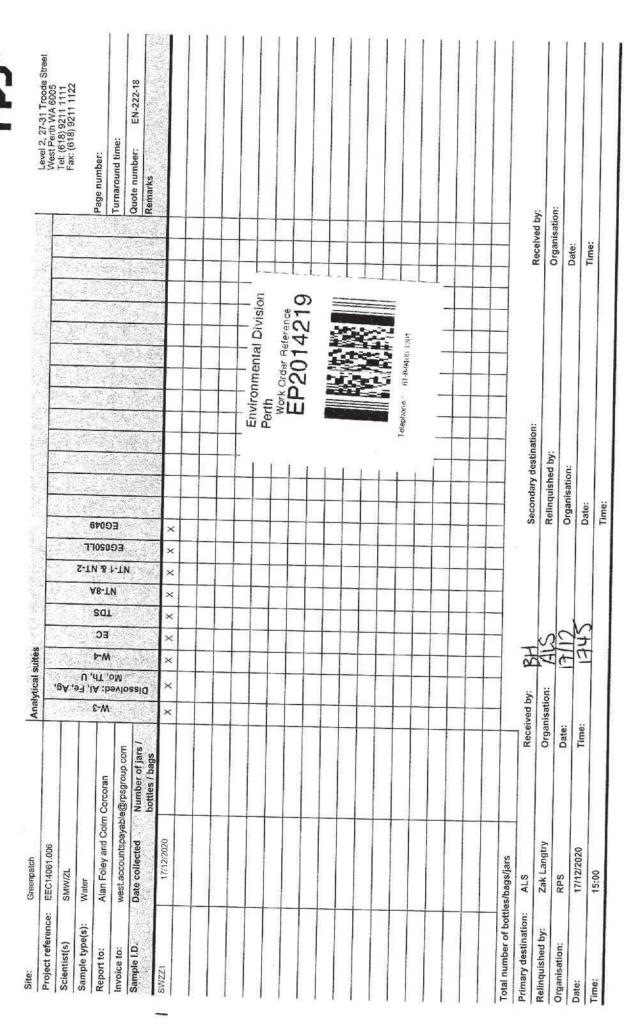
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on of Li, uids	MATER	Method Descriptions (a) house: Referenced to = SEPA SM 946 53V10 100 mL to 1L of sample is transferred to a separatory funnel and serially ektracted three times using DCI for each ektract. The resultant ektracts are combinedzdehydrated and concentrated for analysis. This method is compliant q ith NEPI Schedule Z(Q) (. ALS default ekcludes sediment q hich may be resident in the container.
olatiles Mater Preparation	MAIEK	A V ML all. uot or V ML of a diluted sample is added to a 40 ML : OC vial for burging.





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CERTIFICATE OF ANALYSIS

Laboratory RPS Australia West Pty Ltd EP2014220 Work Order Contact

26 Rigali Way Wangara WA Australia 6065 Lauren Biagioni Contact Address WEST PERTH WA 6872 **ALAN FOLEY** PO BOX 170

Environmental Division Perth

: 1 of 3

29-Dec-2020 17:19 17-Dec-2020 17:45 08 9406 1307 18-Dec-2020 Date Analysis Commenced Date Samples Received Issue Date Telephone EEC14061,006

Order number

Sampler

Telephone

Project

Address

Client

Accredited for compliance with ISO/IEC 17025 - Testing EPBQ/015/17 Greenpatch SMW/ZL No. of samples received No. of samples analysed C-O-C number Quote number

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

This Certificate of Analysis contains the following information:

General Comments

Analytical Results

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

Signatories

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

Accreditation Category	Perth Inorganics, Wangara, WA	Perth Inorganics, Wangara, WA
Position	Laboratory Manager (Perth)	Metals Chemist
Signatories	Chris Lemaitre	Efua Wilson



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General Comments

In house developed procedures The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. are fully validated and are often at the client request.

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

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

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

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

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

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

LOR = Limit of reporting

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

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

• EG048G (Hexavalent Chromium by Alkaline Digest): Poor spike recovery for sample EP2014150-001 and 002 due to possible sample matrix interference. This has been confirmed by repreparation and reanalysis.



Analytical Results

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Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TPZZ1	TPZZ2	1	-	1
		Sampling	Sampling date / time	15-Dec-2020 00:00	16-Dec-2020 00:00			
Compound	CAS Number	LOR	Unit	EP2014220-001	EP2014220-002			
				Result	Result			
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	-	1.0	%	9.4	1.2		-	-
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium 7	7429-90-5	50	mg/kg	410	450		-	
Arsenic 7	7440-38-2	2	mg/kg	<5	<5		i	
Barium 7	7440-39-3	10	mg/kg	<10	<10		i	i
Beryllium 7	7440-41-7	_	mg/kg	<1	<1		-	
Boron 7	7440-42-8	50	mg/kg	<50	<50			
Cadmium 7	7440-43-9	-	mg/kg	\	\		-	-
Chromium 7	7440-47-3	2	mg/kg	7	12			
Cobalt 7	7440-48-4	2	mg/kg	<2	<2			
Copper 7	7440-50-8	2	mg/kg	<5	<5		i	i
Iron 7	7439-89-6	20	mg/kg	1090	1310		-	-
Lead 7.	7439-92-1	2	mg/kg	<5	<5			
Manganese 7.	7439-96-5	2	mg/kg	16	86			
Molybdenum 7	7439-98-7	2	mg/kg	<2	<2			
Nickel 7	7440-02-0	2	mg/kg	<2	<2			
Selenium 7	7782-49-2	2	mg/kg	<5	<5		i	
Silver	7440-22-4	2	mg/kg	<2	<2		-	-
Vanadium 7.	7440-62-2	2	mg/kg	<5	15		-	
Zinc	7440-66-6	2	mg/kg	<5	<5		1	-
EG020T: Total Metals by ICP-MS								
Thorium 7.	7440-29-1	0.1	mg/kg	8.0	3.3		-	-
Uranium 7.	7440-61-1	0.1	mg/kg	0.4	0.5		1	1
EG035T: Total Recoverable Mercury by FIMS								
Mercury 7.	7439-97-6	0.1	mg/kg	<0.1	<0.1		-	
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium 18	18540-29-9	0.5	mg/kg	<0.5	1.2			
EG049: Trivalent Chromium								
Trivalent Chromium 16	16065-83-1	2	mg/kg	7	11		-	-



QUALITY CONTROL REPORT

Environmental Division Perth Lauren Biagioni : 1 of 5 Laboratory Contact RPS Australia West Pty Ltd EP2014220 ALAN FOLEY **Work Order** Contact

26 Rigali Way Wangara WA Australia 6065 Address WEST PERTH WA 6872 PO BOX 170

Address

Client

Project

08 9406 1307 17-Dec-2020 18-Dec-2020 29-Dec-2020 Date Analysis Commenced Date Samples Received ssue Date Telephone EEC14061,006 EPBQ/015/17 Greenpatch SMW/ZL C-O-C number Quote number Order number Telephone

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

Accredited for compliance with ISO/IEC 17025 - Testing

This Quality Control Report contains the following information:

No. of samples received No. of samples analysed

Sampler

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Accreditation Category	Perth Inorganics, Wangara, WA	Perth Inorganics, Wangara, WA
Position	Laboratory Manager (Perth)	Metals Chemist
Signatories	Chris Lemaitre	Efua Wilson



General Comments

In house developed procedures The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. are fully validated and are often at the client request.

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

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

Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot Key

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

LOR = Limit of reporting

RPD = Relative Percentage Difference

= Indicates failed QC

Laboratory Duplicate (DUP) Report

for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: SOIL						Laboratory D	Laboratory Duplicate (DUP) Report		
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG005(ED093)T: Tot	EG005(ED093)T: Total Metals by ICP-AES(QC Lot: 3435163)	ot: 3435163)							
EP2014301-009	Anonymous	EG005T: Cadmium	7440-43-9	-	mg/kg	<u>^</u>	₹	00.00	No Limit
		EG005T: Copper	7440-50-8	2	mg/kg	11	10	18.4	No Limit
		EG005T: Zinc	7440-66-6	2	mg/kg	38	31	19.2	No Limit
EP2014301-009	Anonymous	EG005T: Beryllium	7440-41-7	-	mg/kg	1	_	00.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	70	80	00.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	18	17	00.00	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	11	10	00.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	00.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	10	O	00'0	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	00.00	No Limit
		EG005T: Arsenic	7440-38-2	2	mg/kg	<5	<5	00.00	No Limit
		EG005T: Lead	7439-92-1	2	mg/kg	9	9	00.00	No Limit
		EG005T: Manganese	7439-96-5	2	mg/kg	487	499	2.48	0% - 20%
		EG005T: Selenium	7782-49-2	2	mg/kg	9	9	00.00	No Limit
		EG005T: Vanadium	7440-62-2	2	mg/kg	23	23	00.00	No Limit
		EG005T: Aluminium	7429-90-5	50	mg/kg	4950	2090	2.93	0% - 20%
		EG005T: Boron	7440-42-8	50	mg/kg	06	06	00.00	No Limit
EP2014220-001	TPZZ1	EG005T: Beryllium	7440-41-7	_	mg/kg	۲>	<1	00.00	No Limit
		EG005T: Cadmium	7440-43-9	_	mg/kg	۲>	<1	00.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	<10	<10	00.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	7	7	00.00	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	<2	<2	00.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	00.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	<2	<2	00.00	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	00.00	No Limit



RPS Australia West Pty Ltd

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Recovery Limits (%) No Limit No Limit No Limit No Limit 0% - 50% No Limit No Limit 0% - 20% No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit No Limit RPD (%) 0.00 37.6 0.00 00.00 0.00 3.74 0.00 0.00 0.00 3.22 0.00 00.0 0.00 0.00 0.00 0.00 Laboratory Duplicate (DUP) Report Original Result Duplicate Result <0.5 1090 420 <50 <0.1 <0.1 **%** <5 <5 24 <5 <5 <5 9.4 0.4 0.7 9.6 <0.5 410 <0.1 10.0 <50 1090 <0.1 <5 **^**2 0.4 0.8 ^2 <5 16 <5 9.4 mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg Unit % LOR 0.1 0.5 0.1 2 2 20 50 0.1 0.1 2 2 2 2 2 7439-97-6 18540-29-9 7440-66-6 7429-90-5 | 7440-61-1 7440-29-1 7439-97-6 18540-29-9 CAS Number 7440-38-2 7440-50-8 7439-96-5 7782-49-2 7440-62-2 7440-42-8 7439-89-6 7439-92-1 EG048G: Hexavalent Chromium EG048G: Hexavalent Chromium EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 3435163) - continued EA055: Moisture Content EG005T: Manganese EG020X-T: Uranium EG005T: Aluminium EG020Y-T: Thorium EG005T: Vanadium EG005T: Selenium EG048: Hexavalent Chromium (Alkaline Digest) (QC Lot: 3429945) EG035T: Mercury EG035T: Mercury EG005T: Arsenic EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 3437547) EG035T: Total Recoverable Mercury by FIMS (QC Lot: 3435164) EG005T: Copper EG005T: Boron EG005T: Lead EG005T: Zinc EG005T: Iron EG020T: Total Metals by ICP-MS (QC Lot: 3435165) EG020T: Total Metals by ICP-MS (QC Lot: 3435166) Anonymous Anonymous Anonymous Sample ID TPZZ1 TPZZ1 TPZZ1 Laboratory sample ID EP2014301-009 EP2014220-001 EP2014150-001 EP2014157-004 EP2014220-001 EP2014220-001 EP2014220-001 EP2014220-001 Sub-Matrix: SOIL



RPS Australia West Pty Ltd EEC14061.006 EP2014220 Work Order Project Client

Method Blank (MB) and Laboratory Control Spike (LCS) Report

parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: SOIL				Method Blank (MB)		Laboratory Control Spike (LCS) Report	S) Report	
				Report	Spike	Spike Recovery (%)	Recovery Limits (%)	imits (%)
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	SO7	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 3435163)	63)							
EG005T: Aluminium	7429-90-5	50	mg/kg	<50	6134 mg/kg	110	70.0	130
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	106	81.5	118
EG005T: Barium	7440-39-3	10	mg/kg	<10	143 mg/kg	104	77.5	110
EG005T: Beryllium	7440-41-7	_	mg/kg	\	5.63 mg/kg	115	70.0	130
EG005T: Boron	7440-42-8	50	mg/kg	<50	1	1	1	1
EG005T: Cadmium	7440-43-9	_	mg/kg	₹	4.64 mg/kg	0.76	76.2	106
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	92.8	6.99	138
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	16 mg/kg	98.4	70.0	130
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	102	79.1	113
EG005T: Iron	7439-89-6	50	mg/kg	<50	8400 mg/kg	9.68	70.0	130
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	94.6	78.9	112
EG005T: Manganese	7439-96-5	5	mg/kg	<5	130 mg/kg	9.66	70.0	130
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	7.9 mg/kg	8.96	70.0	130
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	100	81.5	126
EG005T: Selenium	7782-49-2	5	mg/kg	<5	5.37 mg/kg	111	70.0	130
EG005T: Silver	7440-22-4	2	mg/kg	<2	2.1 mg/kg	90.5	70.0	130
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	29.6 mg/kg	102	70.0	130
EG005T: Zinc	7440-66-6	2	mg/kg	<5	60.8 mg/kg	104	81.0	119
EG020T: Total Metals by ICP-MS (QCLot: 3435165)								
EG020X-T: Uranium	7440-61-1	0.1	mg/kg	<0.1	7.3 mg/kg	94.9	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3435166)								
EG020Y-T: Thorium	7440-29-1	0.1	mg/kg	<0.1	10.9 mg/kg	85.0	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3435164)	435164)							
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.154 mg/kg	98.5	81.0	115
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 3429945)	3429945)							
EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	40 mg/kg	80.8	70.0	130
				<0.5	20 mg/kg	105	70.0	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: SOIL

	Recovery Limits (%)
latrix Spike (MS) Report	SpikeRecovery(%)
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Sub-Matrix: SOIL				Mat	Matrix Spike (MS) Report		
				Spike	SpikeRecovery(%)	Recovery Limits (%)	mits (%)
Laboratory sample ID S	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Tota	EG005(ED093)T: Total Metals by ICP-AES (QCLot: 3435163)						
EP2014220-001 TF	TPZZ1	EG005T: Arsenic	7440-38-2	50 mg/kg	97.1	70.0	130
		EG005T: Barium	7440-39-3	50 mg/kg	101	70.0	130
		EG005T: Beryllium	7440-41-7	50 mg/kg	0.96	70.0	130
		EG005T: Cadmium	7440-43-9	12.5 mg/kg	86.8	70.0	130
		EG005T: Chromium	7440-47-3	50 mg/kg	8.06	70.0	130
		EG005T: Cobalt	7440-48-4	50 mg/kg	87.7	70.0	130
		EG005T: Copper	7440-50-8	50 mg/kg	100	70.0	130
		EG005T: Lead	7439-92-1	50 mg/kg	6.68	70.0	130
		EG005T: Manganese	7439-96-5	50 mg/kg	94.9	70.0	130
		EG005T: Nickel	7440-02-0	50 mg/kg	87.2	70.0	130
		EG005T: Vanadium	7440-62-2	50 mg/kg	93.9	70.0	130
		EG005T: Zinc	7440-66-6	50 mg/kg	86.0	70.0	130
EG035T: Total Recov	EG035T: Total Recoverable Mercury by FIMS (QCLot: 3435164)						
EP2014220-001 TF	TPZZ1	EG035T: Mercury	7439-97-6	1 mg/kg	0.66	70.0	130
EG048: Hexavalent Cl	EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 3429945)						
EP2014150-001 An	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	40 mg/kg	# 9.34	70.0	130
EP2014150-002 An	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	20 mg/kg	# 12.2	70.0	130



QA/QC Compliance Assessment to assist with Quality Review

: 1 of 5	: Environmental Division Perth	: 08 9406 1307	: 17-Dec-2020	: 29-Dec-2020	. 2		
Page	Laboratory	Telephone	Date Samples Received	Issue Date	No. of samples received	No. of samples analysed	
: EP2014220	RPS Australia West Pty Ltd	: ALAN FOLEY	: EEC14061,006	: Greenpatch	: SMW/ZL		
Work Order	Client	Contact	Project	Site	Sampler	Order number	

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

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

Summary of Outliers

Outliers: Quality Control Samples

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

- Mo Method Blank value outliers occur.
- NO Duplicate outliers occur.
- NO Laboratory Control outliers occur.
- Matrix Spike outliers exist please see following pages for full details.
- For all regular sample matrices, NO surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

Mo Analysis Holding Time Outliers exist.

Outliers: Frequency of Quality Control Samples

Quality Control Sample Frequency Outliers exist - please see following pages for full details.



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Outliers: Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: SOIL

Compound Group Name	Laboratory Sample ID Client Sample ID	Client Sample ID	Analyte	CAS Number Data	Data	Limits Comment	Comment
Matrix Spike (MS) Recoveries							
EG048: Hexavalent Chromium (Alkaline Digest)	EP2014150001	Anonymous	Hexavalent Chromium	18540-29-9	9.34 %	70.0-130%	Recovery less than lower data quality
EG048: Hexavalent Chromium (Alkaline Digest)	EP2014150002	Anonymous	Hexavalent Chromium	18540-29-9	12.2 %	70.0-130%	Objective Recovery less than lower data quality
							objective

Outliers: Frequency of Quality Control Samples

Matrix: SOIL

Quality Control Sample Type	Count	nrt	Rate	Rate (%)	Quality Control Specification
Method	ac	Regular	Actual	Actual Expected	
Matrix Spikes (MS)					
Total Metals by ICP-MS - Suite X	0	2	00.00	5.00	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite Y	0	2	00.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

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

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container organics Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

14 days, mercuny 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

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

Matrix: SOIL

Matrix: SOIL				Evaluation:	= Holding time	Evaluation: $\mathbf{x} = \text{Holding time breach}$; $\checkmark = \text{Within holding time}$.	holding time.
Method	Sample Date	Ext	Extraction / Preparation			Analysis	
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055)	15-Dec-2020	-	-	-	23-Dec-2020	29-Dec-2020	>
Soil Glass Jar - Unpreserved (EA055) TPZZ2	16-Dec-2020				23-Dec-2020	30-Dec-2020	>
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T)	15-Dec-2020	22-Dec-2020	13-Jun-2021	>	23-Dec-2020	13-Jun-2021	>
Soil Glass Jar - Unpreserved (EG005T) TPZZ2	16-Dec-2020	22-Dec-2020	14-Jun-2021	>	23-Dec-2020	14-Jun-2021	>
EG020T: Total Metals by ICP-MS							
Soil Glass Jar - Unpreserved (EG020Y-T)	15-Dec-2020	22-Dec-2020	13-Jun-2021	>	23-Dec-2020	13-Jun-2021	>
Soil Glass Jar - Unpreserved (EG020Y-T) TPZZ2	16-Dec-2020	22-Dec-2020	14-Jun-2021	>	23-Dec-2020	14-Jun-2021	>



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Matrix: SOIL				Evaluation:	= Holding time	Evaluation: $\mathbf{x} = \text{Holding time breach}$; $\checkmark = \text{Within holding time}$.	n holding time.
Method	Sample Date	Ext	Extraction / Preparation			Analysis	
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T) TPZZ1	15-Dec-2020	22-Dec-2020	12-Jan-2021	>	23-Dec-2020	12-Jan-2021	>
Soil Glass Jar - Unpreserved (EG035T) TPZZ2	16-Dec-2020	22-Dec-2020	13-Jan-2021	>	23-Dec-2020	13-Jan-2021	>
EG048: Hexavalent Chromium (Alkaline Digest)							
Soil Glass Jar - Unpreserved (EG048G) TPZZ1	15-Dec-2020	18-Dec-2020	12-Jan-2021	`	21-Dec-2020	25-Dec-2020	>
Soil Glass Jar - Unpreserved (EG048G) TPZZ2	16-Dec-2020	18-Dec-2020	13-Jan-2021	>	21-Dec-2020	25-Dec-2020	>



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Quality Control Parameter Frequency Compliance

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

Evaluation: * = Quality Control frequency not within specification; ' < = Quality Control frequency within specification. NEPM 2013 B3 & ALS QC Standard Quality Control Specification Evaluation × Expected Rate (%) 10.00 10.00 10.00 10.00 10.00 10.00 5.00 5.00 5.00 5.00 2.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00 18.18 27.27 50.00 50.00 50.00 50.00 50.00 50.00 50.00 18.18 Actua/ 60.6 15.38 9.09 60.6 60.6 60.6 0.00 0.00 Reaular 7 7 7 7 7 7 7 7 N 2 7 N 0 2 2 N N Count 90 0 က 0 EA055 EG035T EG048G EG035T EG005T EG048G EG035T EG005T EG020Y-T EG048G EG035T EG020Y-T EG048G EG005T EG020X-T EG020Y-T EG020Y-T EG005T EG020X-T EG020X-T EG020X-T Method Hexavalent Chromium by Alkaline Digestion and DA Finish Hexavalent Chromium by Alkaline Digestion and DA Finish Hexavalent Chromium by Alkaline Digestion and DA Finish Hexavalent Chromium by Alkaline Digestion and DA Finish -aboratory Control Samples (LCS) Total Metals by ICP-MS - Suite X Total Metals by ICP-MS - Suite Y Total Metals by ICP-MS - Suite Y Total Metals by ICP-MS - Suite Y Total Metals by ICP-MS - Suite X Total Metals by ICP-MS - Suite Y Total Metals by ICP-MS - Suite X Total Metals by ICP-MS - Suite X Total Metals by ICP-AES Quality Control Sample Type Total Metals by ICP-AES Total Metals by ICP-AES Total Metals by ICP-AES Total Mercury by FIMS Total Mercury by FIMS Total Mercury by FIMS Total Mercury by FIMS Method Blanks (MB) Analytical Methods Moisture Content



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Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Total Metals by ICP-AES	EG005T	NOS	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Total Metals by ICP-MS - Suite X	EG020X-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite Y	EG020Y-T	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	SOIL	In house: Referenced to USEPA SW846, Method 3060. Hexavalent chromium is extracted by alkaline digestion. The digest is determined by photometrically by automatic discrete analyser, following pH adjustment. The instrument uses colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM Schedule B(3)
Trivalent Chromium by Alkaline Digestion and DA Finish	EG049G-AIK	SOIL	In house: Referenced to APHA 3500 Cr-A&B & 3120 and USEPA USEPA SW846, Method 3060. The difference between Total and Hexavalent Chromium. The total Chromium is determined by ICPAES and the Hexavalent chromium is extracted by alkaline digestion and the digest is determined by photometrically by automatic discrete analyser. The instrument uses colour development using dephenylcarbazide. This method is compliant with NEPM Schedule B(3)
Preparation Methods	Method	Matrix	Method Descriptions
Alkaline digestion for Hexavalent Chromium	EG048PR	SOIL	In house: Referenced to USEPA SW846, Method 3060A.
Hot Block Digest for metals in soils sediments and sludges	EN00	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).



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