APPENDIX F. WATER MANAGEMENT PLAN (URS, 2015B)

URS

Report

Water Management Plan

AUSTRALIA

Jandabup Sand Quarry Project, Tenements M70/1248 and M70/1250

29 October2015
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Prepared for:
Holcim (Australia) Pty Ltd

Prepared by URS Australia Pty Ltd

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Checked by	Rob Wallis		29/10/2015	Senior Principal Hydrogeologist
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Client Contact Details:
Joanna Russell
Holcim (Australia) Pty Ltd
18 Brodie Hall Drive
Bentley WA 6102

Issued by:
URS Australia Pty Ltd
Level 3, 3 Forrest Place
Perth WA 6000
PO Box 6004, East Perth 6892
Australia
T: +61 8 9326 0100
F: +61 8 9326 0296

URS

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ABBREVIATIONS

Abbreviation	Description
AER	Annual Environmental Report
bgl	below ground level
BoM	Bureau of Meteorology
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
DER	Department of Environment Regulation
DO	Dissolved Oxygen
DoW	Department of Water
EC	Electrical Conductivity
kg/kL	Kilograms per kilolitre
kL	Kilolitres
kL/day	Kilolitres per day
kL/year	Kilolitres per year
kL/m^2	Kilolitres per square metre
kL/yr	Kilolitre per year
L/m^2	Litres per square metre
m AHD	Metres above the Australian Height Datum
m	metres
m^2	Square metres
mm	Millimetres
MGL	Maximum Groundwater Level
mg/L	Milligrams per litre
mg/m^2	Milligrams per square metre
FPC	Forest Products Commission
LOR	Limit of Reporting
P1 DWSPA	Priority 1 Drinking Water Source Protection Area
PRAMS	Perth Regional Aquifer Management System
SCP	Swan Coastal Plain
TDS	Total dissolved solids
TRH	Total Recoverable Hydrocarbons
UWPCA	Underground Water Pollution Control Area
WHPZs	Wellhead Protection Zones
WIR	Water Information Reporting
WMP	Water Management Plan

1 INTRODUCTION

1.1 Background

Holcim (Australia) Pty Ltd (Holcim) is proposing to extract sand within Mining Tenements M70/1248 and M70/1250, located at Jandabup (Figure 1-1). It is the intention of Holcim to prepare and lodge a Mining Proposal by the end of October 2015, and to start extraction as soon as practical in 2016. The expected duration of the Holcim Jandabup Sand Quarry Project is currently estimated to be 25 years. This may vary depending on the adopted maximum groundwater level (MGL), market conditions, and raw material quality. At this stage, the quarry schedule is still being finalised. The current quarry plan is provided in Figure 1-2.

Holcim plans to extract the silica sand by simple excavate and truck techniques (Enviroworks, 2015a). Topsoil and vegetation will be stockpiled for later use in rehabilitation. The high quality silica sand will be excavated with a front end loader, and transported to its destination using dedicated haulage trucks. On-site infrastructure is expected to comprise perimeter fencing, an unsealed access road and quarry ramp, office, lunch room, weighbridge, active quarry area, progressive rehabilitation area, excavator and haulage trucks, water storage tank, refuelling area and storage tank, and on-site ablution facilities. No washing of the sand is planned, so no fines or slimes will be generated.

To support the Mining Proposal, Holcim is required to assess water related risks and develop a management plan to address these risks. The Department of Water (DoW, *pers. comm.,* Evangelista, A., 16 January 2015) recommended for Holcim to prepare a Water Management Plan (WMP) that addresses the requirements in:

- *Statewide Policy No. 1: Policy and Guidelines for Construction and Silica Sand Mining in Public Drinking Water Source Areas* (WRC, 1999) and;
- *Water Quality Protection Note No. 15 – Extractive industries near sensitive water resources* (DoW, 2013).

This WMP contains details of the local groundwater levels, depth of excavation/clearance above water table, water requirements and supply, fuel and chemical management, stormwater management, wastewater management, waste management, pre- and post-development monitoring, site closure and rehabilitation.

This WMP addresses a number of key issues that have been considered in the preparation of the Mining Proposal including:

- Concerns by the DoW that mining should not be located in Wellhead Protection Zones (WHPZs) (DoW 2013). This includes existing drinking water supply bores in the project area, which are protected by a 500m exclusion zone for any groundwater disturbing activities around such bores within a Priority 1 Drinking Water Source Protection Area (P1 DWSPA). This is to minimise risk to water quality supply infrastructure, limit impact of any petroleum hydrocarbon contamination and foster retention of natural vegetation buffers.
- Maintaining the quarry floor 3m above the water table during and after quarrying since the site is in a P1 DWSPA. DoW policy allows this to be reduced to 2m in some circumstances (WRC 1999, DoW 2013).

- Demonstration that there is sufficient clearance above the water table and that adequate environmental management of activities is undertaken within the P1 DWSPA.
- That the quarry will not contribute to a breach of ministerial conditions that have been set with regards to the performance of water resource management measures in place for Lake Jandabup by the DoW and Water Corporation (WAWA 1995, DoW 2008).
- That site activities will meet restrictions to the storage of fuels and chemicals, and strict guidelines for rehabilitation (DoW, 2013; WAPC, 2001; WAPC, 2003; WAPC, 2005).
- Groundwater resources in the Project area that are managed by the DoW under the:
  - Rights in Water and Irrigation Act (resource allocation as PDSWAs); and
  - Metropolitan Water Supply, Sewerage and Drainage Act (pollution prevention as Underground Water Pollution Control Area – UWPCAs).

1.2 Objectives

The primary objective of this Water Management Plan (WMP) is to ensure that water-related impacts of the Project to water resources and quality are effectively managed.

1.3 Water Management Plan Scope

This WMP addresses the following:

- Future maximum groundwater level;
- Identified risks, knowledge gaps and ongoing studies;
- Water requirements, usage, and quality criteria for the project;
- Sources of water including licensing, monitoring and reporting;
- Water management measures (including waste, stormwater, wastewater, fuel and chemicals, dust management);
- Monitoring procedures, standards and reporting requirements;
- Water aspects of site rehabilitation; and
- Post-quarrying planning, site closure risks, and activities.

2 PHYSICAL ENVIRONMENT

2.1 Site Location

The proposed sand quarry is located approximately 23km north of Perth, at Jandabup (Figure 1-1). Holcim plans to operate the sand quarry in two granted Mining leases, M70/1248 and M70/1250 (Enviroworks, 2015a).

2.2 Geology, Soils and Landforms

The project area lies on the Quaternary, Bassendean Dune system within the Swan Coastal Plain (SCP), which is bounded to the east by the Darling Scarp (Davidson 1995). The Bassendean Dune system forms an undulating eolian sand plain that unconformably overlies Cretaceous and Tertiary strata (Davidson 1995). Locally, the Bassendean Sand contains variable amounts of silt and organic matter.

The topography near the project area ranges between 25m and 75m AHD (Davidson 1995). Generally, the ground surface falls to the west, although locally, the sand dunes have formed swales and valleys in which rich soils have developed. Prior to the establishment of the Gnangara Pine Forest, these areas supported dense stands of Banskia Woodland vegetation.

2.3 Land-use

The Gnangara State Forest pine plantation was established in the Project area during the 1960s. Quarrying Tenements M70/1248 and M70/1250 are located on State Forrest 65, which is managed by the Forrest Product Commission (FPC). Based on historical air-photo imagery assessed in URS (2015a), the Project site appears to have been deforested between 2005 and 2010, with the exception of a small area in the southern part of M70/1250.

The other significant changes in land-use near the Project site are the establishment of the Jandabup Water Corporation Treatment Plant in the 1970s, and the urbanisation of adjacent areas in the late-1990s and early-2000s. The historical imagery also indicates that areas surrounding Lake Jandabup have become increasingly urbanised since the 1970s.

2.4 Acid Sulphate Soils

Wetlands and damplands in the region are highly susceptible to changes in water balance and seasonal water levels. These changes can lead to the acidification of local groundwater and surface water due to the oxidation of sulphide minerals that have accumulated in a typically reducing (anoxic), organic-rich environment. Oxidation of these minerals occurs when the water table remains below the typical seasonal range, often as a result of changes to land-use and local groundwater recharge and discharge rates.

Soil mapping in the Project area (DER/DPI, 2015) has identified a moderate to high risk of occurrence of acid-sulphate soils occurring in wetland areas including Lake Jandabup, Hawkins Road Swamp and an unnamed dampland area on the Project's eastern boundary (Figure 2-1). However, for the majority of the Project area, the risk is moderate to low as the water table does not occur within 3 m of natural soil surface.

2.5 Existing Water Use

There are 25 licensed superficial aquifer drawpoints located within 1km of the site (URS, 2015a). Of the identified licensed drawpoints, five are controlled by the Water Corporation. Three of these drawpoints (W220, W230 and W240) are located along the boundary of Quarrying Tenements M70/1248 and M70/1250. These drawpoints were originally part of the Gnangara Drinking Water Supply Scheme. However, available data, and discussions with the Water Corporation, indicate that these have not been used to supply drinking water since the mid- to late-1980s. Production bores, W220 and W210 (900m to the south) are still operated by the Water Corporation under the direction of the DoW to supply supplementation water to Lake Jandabup (pers. comm. Bendotti, P., Water Corp., 15 May 2015).

The closest licenced, off-site drawpoints are located along the western side of the Project site. These bores (as close as 125 m) are hydraulically, down-gradient of the site. They are used for private rural abstraction purposes.

2.6 Hydrology

Surface water features and wetlands located in the vicinity of the Project area are presented on Figure 2-1. A number of geomorphic wetlands exist within and/or surrounding the project area including:

- Lake Jandabup to the west
- Hawkins Road Swamp to the northwest
- A dampland area to the east of Mining Tenement M70/1250.

Wetlands, including Lake Jandabup and Hawkins Road Swamp, have formed in the internal swales within the Bassendean Dune System. Lake Jandabup is a groundwater throughflow lake, whereby the water table on the up-gradient side is marginally higher than the lake surface, resulting in a discharge of shallow groundwater to the lake. On the down- gradient side of the lake, the water table is slightly lower than the lake surface, resulting in underflow and seasonal outflows to Superficial Formations to the west (Davidson 1995).

These wetlands are also influenced by direct rainfall, evapotranspiration and local groundwater abstractions by licensed and private bore owners. These influences have historically had a direct impact on the water levels in the lakes and swamps.

Lake Jandabup is a regionally-significant wetland that is subject to Ministerial Statement 687 containing the following Ministerial Criteria (WAWA, 1995; DoW, 2008):

- An absolute summer minimum of 44.3 m AHD.
- An absolute spring minimum peak of 44.2 m AHD.
- A preferred spring minimum peak of 44.7 m AHD.
- The water level is only allowed between preferred and absolute minimum at a rate of two in every six years.

DoW surface water quality results indicate that wetlands in the vicinity of the project area, particularly near Lake Mariginiup, were slightly acidic (pH 3.7- 6.4) and fresh to brackish (15 - 3,100 mg/L) (DoW, 2009).

There are no significant surface drainage lines or creeks within the proposed project area. The superficial geology comprising Bassendean Sand (a dune sand formation) has a high infiltration capacity where it has not been covered with fine-grained soils, or been modified by roads and hardstand features. These conditions make land-use a key factor for water resources in the region.

2.7 Hydrogeology

The hydrogeology described in this section has been derived primarily from a definitive study "*Hydrogeology and Groundwater Resources of the Perth Region Western Australia*" (Davidson, 1995). The stratigraphic sequence of the Cainozoic and Mesozoic formations in the project area is as follows (Davidson, 1995);

- 0 – 50 m – Superficial Formations
- 50 – 250 m –Osborne Formation
- 250 – 560 m – Leederville Formation
- 560 – 810 m – South Perth Shale

The Superficial Formations are the focus of this report as there is no likelihood that the Project will influence the deeper formations.

The Superficial Formations (comprising mainly sand and silty sand) form an extensive unconfined aquifer system on the Swan Coastal Plain. The superficial aquifer associated with these formations is inhomogeneous, ranging from predominantly clayey sediments (Guildford Clay) to the east, adjacent to the Darling Fault, a sandy succession (Bassendean Sand and Gnangara Sand) in the central coastal plain, to sand and limestone (Tamala Limestone) closer to the coast.

The water table elevation in these formations is dependent on topography, aquifer permeability and local recharge and discharge rates and locations. Groundwater levels generally fluctuate by about 1 m seasonally in the central sandy and coastal plain areas. The water table is dominated by two regionally-significant groundwater mounds, the Gnangara Mound and the Jandakot Mound.

Groundwater quality in the Superficial Formations is variable across the system, with the salinity ranging from 130 to 12,000 mg/L total dissolved solids (TDS). However, salinity concentrations rarely exceed 1,000 mg/L TDS. The groundwater quality type in the Bassendean Sand is described as sodium chloride rich (Davidson 1995).

3 ADMINISTRATIVE REQUIREMENTS

This plan incorporates the following administrative requirements:

1. The person responsible for implementing the Water Management Plan will be:

   Position: Jandabup Quarry Manager

   Contact Details: 18 Brodie Hall Drive
   Bentley, Western Australia 6102
   AUSTRALIA
   13 11 88

2. The annual reporting year is defined as; 1 January to 31 December.

3. Holcim will comply with the reporting requirements outlined in Section 3.1.

4. Holcim will comply with management measures outlined in Section 6.

3.1 Reporting Requirements

Reporting requirements for the WMP will be:

- An annual monitoring data summary will be incorporated into the Annual Environmental Report. The summary will not be required when a three-yearly monitoring data review is conducted.
- A monitoring data review will be submitted with the Annual Environmental Report (AER) every three years. This review will include a full assessment of all available monitoring data and predictions that have been used to define future outcomes and water management triggers.
- This WMP will be reviewed every three years and included in the AER for that year. This will include an update of any changes to the water management measurements, protocols and monitoring/reporting frequencies.

Reports will be submitted to the Department of Environment Regulation (DER) and Department of Water in electronic format.

3.2 Relevant Guidelines, Policies and Standards

The following guidelines, policies, standards and other relevant resources have been considered in the development of this Water Management Plan:

- Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy (NR&MRC, 2015).
- Water Quality Protection Note No. 15 – Extractive industries near sensitive water resources (DoW, 2013).
- Holcim Tenement Conditions for M70/1248 and M70/1250 (DMP, 2012)
- Review of Ministerial Conditions on the Groundwater Resources of the Gnangara Mound (DoW, 2008)

- Gnangara Underground Water Pollution Control Area Drinking Water Source Protection Review (DoW, 2007).
- Statement of Planning Policy No 2.2 Gnangara Groundwater Protection (WAPC, 2005).
- Department of Environment Water Quality Protection Note: Land use compatibility in Public Drinking Water Source Areas (DoE, 2004).
- Statement of planning policy 2.7: Public drinking water source policy (WAPC, 2003).
- Western Australian Planning Commission Gnangara Land Use and Water Management Strategy (WAPC, 2001).
- Statewide Policy No. 1: Policy and Guidelines for Construction and Silica Sand Mining in Public Drinking Water Source Areas (WRC, 1999)
- Water Authority of Western Australia Review of Proposed Changes to Environmental Conditions, Gnangara Mound Groundwater Resources (WAWA, 1995).
- Environmental Protection Gnangara Mound Crown Land Policy, Environmental Protection Act, 1986. EP301, 1992. (Government Gazette, 1992)
- Rights in Water and Irrigation Act 1914 (resource allocation as PDSWAs).
- Metropolitan Water Supply, Sewerage and Drainage Act 1909 (pollution prevention as Underground Water Pollution Control Area – UWPCAs).

4 PROPOSED ACTIVITIES AND POTENTIAL RISKS

The expected duration of the Holcim Jandabup Sand Quarry Project is currently estimated to be 25 years. This may vary depending on the adopted maximum groundwater level (MGL), market conditions, and raw material quality. The main water-related activities of the Project include;

- Quarrying activities (excavate and truck silica sand)
- Dust suppression - water sourced from a groundwater resource.

The activities that pose potential risk to the water environment are detailed in Section 4.1 and 4.2 below.

4.1 Quarrying Activities

Holcim plan to extract the silica sand by simple excavate and truck techniques (Enviroworks, 2015a). Topsoil and vegetation will be stockpiled for later use in rehabilitation. The high quality silica sand will be excavated with a front end loader, and transported to its destination using dedicated haulage trucks. On-site infrastructure is expected to comprise perimeter fencing, an unsealed access road and quarry ramp, weighbridge, office building, lunch room, active quarry area, progressive rehabilitation area, excavator and haulage trucks, water storage tank, and on-site ablution facilities. No washing of the sand is planned, so no fines or slimes will be generated.

4.1.1 Potential Risks to the Water Environment

The Project is situated within a Priority 1 Drinking Water Source Protection Area (P1 DWSPA) that is managed by the DoW to ensure the resource utilised for drinking water by the Water Corporation, is secure. In addition to this, there are three existing water bores and associated infrastructure present along the southern and western perimeters of the Holcim quarrying tenements. As they are located within a P1 DWSPA, each is surrounded by a well head protection zone of 500m radius.

Bordering the Project site are three other water-sensitive features:

- Lake Jandabup (west) that is subject to a Ministerial Condition in managing the level;
- Hawkins Road Swamp (northwest); and
- A dampland area to the east of Mining Tenement M70/1250.

The following potential risks from quarrying activities have been identified:

- Water table mounding beneath cleared quarry areas. While this may actually supplement the local groundwater resource, it presents a risk to the quarrying operation in maintaining sufficient clearance to avoid interaction with local groundwater either during or after quarrying. These changes are unlikely to present a significant risk to the groundwater quality, given the source is rainwater and the pathway is barren silica sand. The receptor in this case is the local groundwater resource.
- There is a potential for the contamination of groundwater at the water table and surface water if there is a significant unplanned leak or unmanaged spill. Leaks or spills could potentially arise from refuelling of on-site excavators or from the on-site ablutions. Haulage trucks will be refuelled off-site and on-site machinery will also be serviced off-

site, thereby minimising the risk of releases of oils and lubricants. Releases of hydrocarbons (hydraulic oils and lubricants) are still possible due to unexpected failure of hoses or lubricant delivery systems on board the excavator or trucks. Managing this risk is the primary purpose of a DoW requirement for maintaining a 3m clearance above the MGL during operations.

- Changes to the surface hydrology including erosion, inundation and changes to existing groundwater – surface water interaction processes within the water sensitive features.

4.2 Water Supply for Dust Suppression

It is currently planned to source 50,000kL per year of water for dust suppression from a local source. Discussions with the DoW and arrangements with potential water providers are still ongoing.

4.2.1 Potential Risks to the Water Environment

Based on the proposed Project activities related to the water supply for dust suppression and proximity of water-sensitive features nearby, the following potential risks have been identified:

- Changes to local groundwater quality due to dust suppression across the quarry floor, ramps and un-rehabilitated areas. There is a minor risk to local groundwater resources from the application of water containing low concentrations of salt, which may accumulate at the water table.
- Drawdown associated with water supply abstraction. Long-term drawdown in the Jandabup area, as with other areas across the Gnangara Mound, is managed by the DoW, Water Corporation and Forest Products Commission. In this case, the Project water supply is planned to be derived from an established local Water Corporation bore using a small portion of an existing DoW allocation used for supplementation of Lake Jandabup. The receptor in this case is the local water resource and potentially nearby groundwater users.

5 SUMMARY OF IMPACT ASSESSMENTS

This section provides an outline of impact assessments that have been undertaken to understand the risks to water resources and critical water infrastructure. Water resources, in this case, are predominantly groundwater-related due to the lack of surface water in the area other than Lake Jandabup. In this instance, Lake Jandabup is primarily a groundwater discharge feature in that it expresses the water table that fluctuates seasonally due to rainfall and evaporation rates. Three other water features including Hawkins Road Swamp, Little Dunbar Swamp and Snake Swamp generally do not contain surface water, but are sites where surface water and groundwater interact.

5.1 Groundwater Impacts

A detailed assessment of groundwater impacts and constraints to the Jandabup Sand Quarry project is documented in the *Jandabup Sand Quarry Project, Tenements M70/1248 and M70/1250 Groundwater Impact Assessment* (URS, 2015a). The three main groundwater issues are:

- maintaining 3m of clearance between the quarry floor and the water table at all times
- minimising impacts to sensitive groundwater features
- minimising impacts to existing groundwater users
- minimising impacts to the groundwater quality

A summary of these aspects are provided below.

5.1.1 Maintaining 3m Clearance above the Water Table

In order to ensure the quarry floor, even after closure, remains 3m above the water table, the assessment determined the future Maximum Groundwater Level (MGL). The quarry floor elevation was subsequently designed to remain 3m above the current MGL in addition to a buffer of between 1.0m and 2.0m to account for changes relating to the future MGL. The buffer was determined following consideration of additional potential future land-use changes.

The MGL is variable across the site due to local influences from Lake Jandabup and the extent of historical pine plantation areas. Sensitivity analyses undertaken during the impact assessment indicated that the MGL is sensitive to future changes to rainfall totals, expansion of urbanisation from the west, and removal of remaining pine plantation areas to the north and east.

Current predictions are based on a range of assumed parameters such as:

- net recharge rates from various land-uses in the Jandabup area
- changes to recharge rates due to climate change
- the timing and extent of urbanisation and pine plantation removal programmes.

The assessment assumed reasonably worst-case conditions, but ongoing monitoring will be required to determine the actual influence the above assumptions will have on the MGL.

5.1.2 Minimising Impacts to Sensitive Water Features

Sensitive water features are present outside, but near the Project site at:

- Lake Jandabup (west) that is subject to a Ministerial Condition in managing the level;
- Hawkins Road Swamp (northwest); and
- An unnamed acid sulphate soil risk area (east).

The assessment considered changes to both the groundwater level and quality from the Project. Quarrying activities are expected to result in minor mounding beneath disturbed areas that have little or no vegetation (quarry floor, access tracks and rehabilitation areas). While access tracks themselves may have lower infiltration rates due to vehicular compaction, the runoff to adjacent areas is likely to result in locally higher recharge rates.

Changes to the groundwater elevation were characterised by including a nominal quarrying schedule into the predictive numerical model (URS, 2015c). High rates of recharge (45% monthly rainfall), equal to the highest rates in the adopted DoW model were applied to simulated quarry areas that represent one year of quarrying activities. Based on this analysis, the water table is predicted to rise by between 0.05m and 0.15m within the Project area. Significant mounding (<0.1m) is not expected to extend to any of the sensitive groundwater features.

The assessment was based on an adopted recharge rate within the disturbed areas. As this rate is nominal, a sensitivity analysis was undertaken to determine if a significant increase would result if the actual rate was substantially higher. The analysis indicated that a substantially higher rate would still not result in a significantly higher mound.

5.1.3 Minimising Impacts to Existing Water Users

The nearest existing users of water resources near the project site are the Water Corporation bores that are either decommissioned, or used for Lake Jandabup supplementation purposes. Also nearby, are a number of private bore owners along the western and south-western sides of the Project site. Impacts to these users were assessed in two ways:

- Mapping groundwater mounding changes; and
- Characterising drawdown impacts due to groundwater abstraction (for the dust suppression supply)

As described in Section 5.3, water table mounding due to quarrying is not expected to be significant (>0.1m) beyond the Project boundaries. Even if groundwater levels were to rise more than this, impacts to the existing bore owners are expected to be insignificant.

With the aid of the Department of Water Holcim is investigating a number of options to source water for the project. Once the location of the source has been determined a separate impact assessment may be required as part of the DoW groundwater licensing process

5.1.4 Minimising Impacts to the Water Quality

Water quality impacts were assessed in terms of planned activities such as dust suppression, which is expected to contribute to a salt loading at the water table beneath such disturbed areas. Unplanned impacts to groundwater and surface water were not specifically assessed as they would be addressed based on prevailing conditions at the affected site. Monitoring and management measures to detect and respond to such events are detailed in Section 6.

The accumulation of salt from dust suppression across the quarry during the operational period could, theoretically, result in an increase in salinity at the water table of up to about 39mg/L TDS. In reality, the salt will not migrate to the water table instantly, as some will remain in the unsaturated zone for a period of time. However, assuming the salt did reach the water table instantly, the indicative increase is considered insignificant in the context of local groundwater quality variability. As such, no adverse impact is expected.

5.2 Surface Water

Flooding is not considered an issue in the areas that operations will be occurring. The Bassendean Sands in the area have a high hydraulic conductivity and rainfall infiltrates rapidly. Considering the high infiltration rate, potential impacts to nearby surface water bodies such as Hawkins Road Swamp are considered low.

5.3 Acid-sulphate Soils

Soil mapping in the Project area has identified a moderate to high risk of occurrence of acid-sulphate soils occurring in wetland areas including Lake Jandabup, Hawkins Road Swamp and an unnamed dampland area on the Project's eastern boundary. However, for the majority of the Project area, the risk is low as the water table does not occur within 3m of natural soil surface.

The natural acidification of groundwater may be caused by a number of natural processes including:

- Dissociation of humic acids.
- Oxidation of sulphur and nitrogen compounds in the soil.
- Oxidation and hydrolysis of ferrous iron in the soil.
- Uptake of cations from the soil by the vegetation.
- Declining groundwater levels due to dry conditions.

When ASS is exposed through the process of clearing of vegetation, draining or excavating, the exposure of iron sulphide (e.g. pyrite) to oxygen activates oxidation and produces sulfuric acid. Following a rainfall recharge event, the acid can be transported to waterways or infiltrate to the water table.

The disturbance of ASS can lead to acidic waters entering estuarine and coastal systems and resulting in:

- Contamination of groundwater resources by acid, arsenic, heavy metals and other contaminants.
- Increased metal availability (iron and aluminium precipitation).
- Toxicity effects on aquatic organisms through direct acid exposure and smothering by precipitates.
- Changes in pH levels can result in the toxicity of several pollutants to increase (including aluminium).
- Reduced nutrient availability.

5.4 Significant Water Infrastructure

The Water Corporation maintains water infrastructure that is located along three sides of the Project area (north, south and west). This infrastructure includes: three bores (W220, W230 and W240), bore headworks and compounds, buried delivery pipelines and above-ground power lines. Responsibility of ensuring this water infrastructure remains unaffected by projects such as Holcim's rests with the DoW.

An impact assessment was undertaken by AECOM (2015) to determine whether the planned disturbance buffer between the quarry and the water infrastructure was adequate. The assessment considered the likelihood of already stable quarry walls impacting on any of the infrastructure through instability of the slopes. It was concluded that even with a range of material properties (sand density), a 50m buffer provides adequate distance to avoid disturbance.

6 OPERATIONAL MANAGEMENT MEASURES

6.1 Objectives

Holcim will implement a number of management measures to ensure that impacts to key water resources are not adversely affected. The measures are aligned with the relevant policies, guidelines and standards outlined in Section 3.2 and relate to the following key objectives:

- Maintain clearance of the quarry above the water table.
- Minimising impacts to sensitive water features.
- Minimising impacts to existing water users.
- Minimising impacts to water quality.

The overriding objective is to avoid or minimise the above impacts either as a result of storage or handling, or other activities related to sand quarrying operations. Management of the above is risk-based, which considers the consequences and likelihood of the potential impact.

This section is structured to identify water-specific management measures applicable to the following locations or activities:

- Quarrying
- Dust suppression
- On-site facilities
- Unplanned discharges
- Impacts to the water resource and environment
- Impacts to existing water users
- Water monitoring and event response triggers
- Stakeholder engagement and response

6.2 Quarrying

Quarrying will not intersect, and will remain at least 3m above the water table both during and after operations in line with DoW requirements (DoE 2004). To achieve this, Holcim will monitor and review groundwater levels within and around the Project site.

During the operational period and after September (winter) 2016, the monitoring will be conducted at frequencies as detailed in Table 7-3. These data will be regularly reviewed to determine whether the adopted future MGL is valid and whether the quarry floor needs to be adjusted to maintain the required separation.

6.3 Dust suppression

Holcim will adhere to the Jandabup Sand Quarry Environmental Management Plan (Enviroworks, 2015c). The objective of this guideline is to minimise the impact of mining activities and protect the amenity of residents surrounding the sand quarry; by ensuring dust levels meet the requirements of the Ambient Air Quality National Environmental Protection Measure (NEPM) for PM_{10} (particulates of less than 10 microns in size).

The above approach will require a suitable source of clean water. For this management plan, the quality of this water supply is not expected to lead to excessive accumulation of salt, or other solutes in groundwater at the water table. However, changes that may possibly result will be monitored by regularly sampling and testing groundwater from the monitoring bores. The data will be compared to baseline data from on-site and off-site bores to determine if the observed changes are out of sync with regional changes. Should adverse changes to the groundwater quality be detected, the reasons for the change will be investigated to derive whether an alternative source or method of application is required.

6.4 On-site facilities

Holcim will be using on-site facilities including a portable ablution block and vehicle refuelling facilities. The ablution facilities will incorporate an above ground storage tank that will be pumped out regularly. The refuelling facilities will include a storage tank and bowser. Both of these facilities will be managed in accordance with the following requirements:

Waste management (DoW, 2013)

- Extractive industry operations are likely to generate waste from employee amenities, mechanical servicing and wash down of mechanical equipment.
- Servicing of mechanical components of machinery involving liquids, such as coolants, hydraulic oils, lubricants or brake fluids (apart from routine maintenance) shall not be undertaken within Priority 1 and Priority 2 source protection areas. Effective containment measures will be put in place to prevent fuel, lubricants, coolant and hydraulic fluid losses to the environment during running repairs.
- The management and disposal of wastes from on-site employee amenities should meet the requirements of the Health Act, 1911, and the local government authority. The wastewater system (septic tanks or other approved treatment and effluent disposal units) should be installed on site in accordance with the Health regulations and guidelines (see recommendations under heading On-site wastewater treatment and disposal systems).

Management measures to minimise the risk of from the generation of waste and waste disposal include:

- Running repairs will occur on site, however major servicing of machines and equipment will occur off site. A running repairs maintenance area, equipment storage area and fuelling facility will be located within a fenced compound. An equipment storage area for the storage of heavy equipment will be located within the fenced compound. The running repairs maintenance area will contain one bay with a containment apron.
- Washdown of operating equipment will only occur if washdown bay design and procedures are first approved by the DoW.
- Hydrocarbons and chemical containers, such as lubricants will be regularly removed from site for disposal at a licensed landfill facility or recycling centre.
- Sewage waste will be transported off-site for treatment and disposal by a licensed contractor. No effluent will be released onsite.
- Instruction will be provided to site personnel on waste management.
- A sump will operate at the site to collect waste water from the washdown bay and maintenance areas that will be covered to minimise the collection of runoff and risks

associated with overflow. Water collected in the sump will be regularly removed by a licensed operator and disposed of at an approved waste facility. The sump will be constructed to a DoW-approved design.

6.5 Unplanned Discharges

6.5.1 Management Context

According to *Water Quality Protection Note No. 15. Extractive industries near sensitive water resources* (DoW, 2013), the following requirements must be adhered to at sites within Public Drinking Water Source Protection Areas (PDWSA) and Underground Water Pollution Control Areas (UWPCA):

- All vehicle and plant fuelling facilities (including mobile power generators) should be placed and operated within low-permeability (less than 10^{-9} m/s) bunded compounds designed to allow effective recovery of any fuel spill without fluid loss to the environment.
- Any underground tank systems near sensitive water resources should have double-walled construction and be adequately protected against corrosion.
- Bulk chemical storage (above-ground and with more than 250L capacity) requires DoW written approval in any PDWSA.
- The installation of underground chemical storage tank (UST) systems is prohibited in P1 and P2 areas of underground water pollution control areas (UWPCAs).
- Elevated chemical storage tank systems are prohibited in WHPZs. Elevated chemical tank systems (including fuels) within UWPCA should have a maximum capacity of 5,000L, unless approved by the Department of Water.

Accidents and emergency response;

An environmental response program should be in place for accidental chemical spills. The program should include adequate warning and communications systems, support equipment, designated employee responsibility and training of response personnel. The Department of Environment Regulation should be advised immediately of any significant chemical spills (phone: 1300 784 782) and the Water Corporation should be advised of any spill in a PDWSA (phone 13 13 75 with the details and proposed corrective actions).

6.5.2 Unplanned Discharge Management Measures

Hydrocarbons

Unplanned discharges may occur for a number of reasons including leaks or unmanaged spill. Leaks or spills could potentially arise from refuelling of on-site excavators or from the on-site ablutions. Haulage trucks will be refuelled outside of the WHPZs and on-site machinery will be serviced off-site, thereby minimising the risk of releases of oils and lubricants. Releases of hydrocarbons (hydraulic oils and lubricants) are still possible due to unexpected failure of hoses or lubricant delivery systems on board the excavator or trucks. Managing this risk is the primary purpose of a DoW requirement for maintaining a 3m clearance above the current MGL during operations. To support this plan, a hydrocarbon risk assessment has been undertaken by Holcim that is presented in Appendix B.

To minimise the occurrence of an unplanned discharge, hydrocarbons on site will be managed according to the JSQ Guideline 1.1 “Hydrocarbon Management” as follows:

- Diesel will be stored onsite in one self-bunded 20,000L or four 5,000L capacity storage tanks. The risk of diesel storage failure is considered low, as the fuel will be stored in a self-bunded, double skinned tank. A risk assessment has been undertaken for the onsite plant & vehicle maintenance, fuel storage & refuelling activities.
- During operations at the Jandabup Sand Quarry (JSQ), the principles of reduce, reuse and recycle will be employed to minimise the amount of waste produced.
- All hydrocarbon wastes including waste oils, absorbent material and materials contaminated with hydrocarbons will be collected and stored in the fenced waste compound in the north east of the project site, prior to being disposed offsite by a licensed contractor.
- All hydrocarbon substance storage containers and areas will be clearly identified with appropriate signage and labelling.
- The purchase, storage and transport of fuel will be carried out in accordance with:
  - Poisons Act 1964;
  - Poisons Regulations 1965;
  - Mines Safety and Inspection Act 1994;
  - Mines Safety and Inspection Regulations 1995; and
  - Dangerous Goods Safety Act 2004.
- Dangerous Goods Safety Regulations 2007; Raise the awareness of the workforce about the hydrocarbon management plan. All employees will undergo site specific awareness training during inductions. The hydrocarbon component of the training will include:
  - Hydrocarbon purchase, storage and use at Jandabup Sand Quarry.
  - Issues relating to the management of hydrocarbons on the site and staff responsibilities (correct fuelling, storage and disposal).
  - The adverse impact of hydrocarbon spills to soils, surface water, groundwater and safety risk to personnel onsite.
  - The measures to prevent hydrocarbon spills and procedures for clean-up of hydrocarbon spills.
  - How staff report hydrocarbon spills.
- Equipment and vehicle maintenance will only take place in the designated maintenance compound so that any spills and runoff can be collected in the sump.
- Accidental oil spills will be mopped up with absorbent material (using spill kits) and waste will be segregated for removal and disposal offsite by a licensed contractor (see Waste Management Plan). All spills are to be reported to the site manager and SHE Coordinator (Perth Region) for Incident Investigation.
- The oil/water separator in the maintenance area will be checked regularly and the waste removed and disposed offsite by a licensed contractor.

- Remote fuelling will be conducted by a fuel truck or light vehicle with a fuel trailer. Remote fuelling will only be carried out for immobile equipment on site such as; generator sets, bore pump and screening plant.
- Spill kits will be stored in the fuel truck or fuel trailer used on site for remote fuelling and be employed in the event of a spill during remote fuelling.
- In the event of a spill while remote fuelling, any affected sand material which cannot be immediately treated, will be excavated and transported to a hardstand area for storage prior to disposal in a licensed facility.
- The storage, handling and disposal of hazardous materials will be undertaken in a manner that complies with all relevant legal requirements.
- Storage of minor quantities of hazardous substances and dangerous goods will only occur in designated areas, which are appropriately signed, bunded or contained. These areas are to be maintained in a clean and tidy state to minimise potential for spills or littering.
- All hydrocarbons (grease, fuel, oils and lubricants) stored on site will be stored in segregated, bunded areas according to Australian Standard (AS) 1940 and DMP and DER requirements.
- Hydrocarbons and other hazardous materials shall not be delivered to on site storage areas without appropriate bunding/containment.
- Controlled wastes (including waste oil) will be collected and disposed of in accordance with the Environmental Protection (Controlled Waste) Regulations 2004 which requires:
  - A licensed contractor to remove, transport and dispose of controlled wastes
  - Sufficient information be provided to enable categorisation of the waste and selection of an appropriate disposal site
  - Waste types and packaging to be suitable for transportation prior to collection.
- Soil contaminated by hydrocarbons will be segregated into designated sites for storage, then removed from site.
- Hydrocarbons and oily wastes (e.g. fuels, greases, de-greaser, emulsified oils and oily waste water) are to be managed using the following practices:
  - Minimal generation of waste and associated contaminants
  - Appropriate storage and handling procedures
  - Segregation of hydrocarbon waste from stormwater and other water
  - Clean-up procedures for spills
- Should an unplanned spill event occur, the nominated clean-up procedures listed below will be adopted.

Chemicals

All hazardous substances brought to site will be required to undergo assessment. The assessment process comprises:

- All chemicals will be stored outside of the WHPZs.

- Determining whether the relevant chemical is already registered on the Hazardous Substance Register (SHE Guideline 3.20A) for use at JSQ. If the chemical is already registered on the Hazardous Substance Register, the chemical can be brought on site and used under the conditions of the Material Safety Data Sheet (MSDS) and relevant JSA's associated with the chemical use tasks(s). If the chemical is not on the Hazardous Substance Register a risk assessment must be undertaken as required in SHE Guideline 3.20: Hazardous Substances – Handling and Storage.
- An assessment of the new chemical by the Site Manager and the SHE Coordinator (Perth Region). If approved, the chemical will be added to the Hazardous Substance Register and a copy of the MSDS associated with the chemical shall be submitted to the Site Manager, be retained on site and be accessible by all personnel and contractors.

Other Wastes

Wastes associated with on-site ablutions will be contained and transported off-site for treatment and disposal by a licensed contractor. Unplanned releases from this source are therefore not anticipated. Should an unplanned spill event occur, the nominated clean-up procedures listed below will be adopted.

6.5.3 Clean-up Procedures for Spills.

- Regular housekeeping and inspections of dangerous goods and hazardous substances will occur to ensure that storage and handling is appropriate.
- Material Safety Data Sheets (MSDS) will maintained and easily accessible/located on-site for all hazardous substances and dangerous goods stored on site.
- The workforce will be trained on handling dangerous goods and hazardous substances in line with associated MSDS.
- A Spill Response Procedure will be implemented by Holcim.
- Hydrocarbon/hazardous material spills will be reported in accordance with Holcim Incident Management Procedures.
- Appropriate emergency equipment (including spill kits) will be made available on-site and replenished when required.
- All spills will be immediately contained and cleaned up. All wastes from clean-up will be appropriately stored and disposed.
- All site personnel will receive training on the Spill Response Procedure.
- Copies of the Spill Response Procedure will be available with spill kits and in designated storage areas.
- The Site Supervisor shall:
  - Provide advice in a timely nature as required by personnel regarding the management of hydrocarbons.
  - Ensure changes to management requirements are communicated to the workforce.
  - Ensure inspections are done on hydrocarbon storage areas.
  - Ensure training on Hydrocarbon Management is made available for operational personnel.

6.6 Stormwater Management

6.6.1 Management Context

According to *Water Quality Protection Note No. 15. Extractive industries near sensitive water resources* (DoW, 2013), the following requirements in relation to stormwater and surface water management must be adhered to at sites within Public Drinking Water Source Protection Areas (PDWSA) and Underground Water Pollution Control Areas (UWPCA):

- All stormwater runoff from disturbed land should be contained on-site initially to achieve effective removal of sediment and turbidity. Over-land stormwater flows from outside the quarry area should be diverted via bypass drains or earthen bunds around disturbed surfaces and any stockpiles.
- Guidance on stormwater system design, management, treatment and disposal is given in the *Stormwater Management Manual for Western Australia* and WQPN 52 – *Stormwater Management at Industrial Sites*.

6.6.2 Stormwater Management Measures

Stormwater on site will be managed as follows:

- Tree stumps will be retained as long as possible to assist soil stabilization.
- A buffer zone of 100m will be maintained between operations and naturally vegetated geomorphic wetlands.
- Stockpiles of erodible material will be located away from roads and pavements to minimise sediment transport in runoff.
- Each stage will be progressively rehabilitated at completion.
- Vegetative cover will be established to minimise erosion.
- Holcim will provide spill response equipment at the site.
- Hydrocarbon and chemical management measures will ensure surface water contamination does not occur.

6.7 Water Environment and Resource Management

6.7.1 Management Context

Water resources in the Jandabup area include sensitive surface water sites and groundwater reserved for drinking water within the superficial aquifer. Potential impacts to the water environment are detailed in Section 5. In summary, the key aspects that will need to be carefully managed include:

- maintaining 3m of clearance between the quarry floor and the water table at all times
- minimising impacts to sensitive groundwater features
- minimising impacts to existing groundwater users
- minimising impacts to the groundwater quality
- avoiding impacts to important existing water infrastructure adjacent to the Project.

Flooding is not considered an issue in the areas that operations will be occurring. The Bassendean Sands in the area have a high hydraulic conductivity and rainfall infiltrates rapidly. Considering the high infiltration rate, potential impacts to nearby surface water bodies such as Hawkins Road Swamp are considered low.

6.7.2 Management Measures

A range of management measures will be employed to avoid or minimise impacts to the water environment and local resources. Measures for each aspect listed above are provided in Table 6-1.

Table 6-1 Water Environment and Resource Management Measures

Aspect	Management Measure
Maintain 3m of clearance between the quarry floor and the water table at all times	Quarry design incorporating a floor level that will be 3m above the future MGL. Regular groundwater level monitoring and data reviews to ensure the future MGL will be 3m below the quarry floor.
Minimise impacts to sensitive groundwater features	Regular groundwater monitoring and data reviews to ensure Project-related changes are identified, and if required, changes to onsite practices identified and put in place.
Minimise impacts to existing groundwater users	Regular groundwater monitoring (levels and quality) and reviews to ensure Project-related changes are minimal. Engagement with local groundwater users will be undertaken to ensure any Project-related changes are minimised.
Minimise impacts to water quality	Water used for dust suppression will be of potable quality and/or compatible with the existing groundwater quality. Regular monitoring of local monitoring bores and surface water bodies (when present) and reviews of data to identify unplanned changes. Holcim will provide spill response equipment at the site
Changes in surface water flows to Hawkins Road Swamp leading to flora and fauna impacts (e.g. flooding or water shadow).	A buffer zone of 100m will be maintained between operations and naturally vegetated geomorphic wetlands.
Avoiding impacts to important existing water infrastructure adjacent to the Project	A 50m undisturbed buffer will be maintained between Project disturbance and existing water infrastructure. Regular visual inspections of the disturbance perimeter to detect unplanned changes within the buffer area.

6.8 Acid-sulphate Soil Management

6.8.1 Management Context

The DER has produced the Acid Sulphate Soils Guideline Series (Guideline Series), which include:

- Identification and investigation of acid sulphate soils (ASS) and acidic landscapes (DEC, 2015a)
- Treatment and management of soils and water in acid sulphate soil landscapes (DEC, 2015b)

The DER ASS identification and investigation guideline (DEC, 2015a) outline that projects involving the disturbance of ASS must assess the risk associated with disturbance by considering potential impacts. Activities that have the potential to disturb ASS, either directly, or by affecting the elevation of the water table, need to be managed appropriately to avoid environmental harm.

Water Quality Protection Note No. 15 – Extractive industries near sensitive water resources (DoW, 2013) has the following advice in relation to ASS:

- A scientific assessment of areas such as coal measures and (present or former) peat swamps should be conducted to detect and avoid disturbance of soils likely to generate acids when exposed to air after dewatering. These areas are prone to the release of toxic metals likely to damage water resource values.
- Quarries near wetlands and waterways should not disturb peat land, floodways or the groundwater table, unless the development proposal has undergone an Environmental Impact Assessment and is approved by the Minister for the Environment.
- In all coastal plain and sedimentary basin areas, a qualified and experienced hydrogeologist (in consultation with DoW) should determine the probable maximum water table for the site.

6.8.2 ASS Management Measures

Management measures to minimise the risk of ASS include:

- Holcim will avoid disturbance of high ASS risk areas. Holcim commits to the exclusion of mining from a 100m buffer around mapped high to moderate risk ASS soils (including 100m around all wetlands whether mapped as high to moderate risk or not).
- If mining is proposed within the 100m buffer, Holcim commits to the provision of a management plan which will include the results of ASS investigations and will incorporate the results into management strategies to be presented with a new mining proposal to be submitted for approval.
- Overburden will be stockpiled and used for rehabilitation.
- Excavation will not intersect the water table. Excavation depth is limited to 3m above maximum groundwater level determined in the groundwater impact assessment (URS, 2015c).

6.9 Water Triggers

The purpose of this section is to define triggers where changes to the water environment exceed defined conditions whereby the quarry may be impacting the water environment, or the water environment is impacting the quarry design. While many aspects of the water management plan include risk avoidance strategies in line with established guidelines (WRC, 2000), residual risks remain. The primary objective of the triggers is to identify when changes to the water environment are outside of the expected range of conditions, before an impact has occurred. They do not constitute a threshold to an event that might occur when an impact has occurred.

For groundwater, the triggers are aimed at managing expected outcomes and underlying assumptions that were adopted in the recent hydrogeological assessment to determine the future maximum groundwater level (MGL). The MGL affects the floor level adopted in the quarry design. It also involves managing expected Project-specific outcomes in relation to groundwater quality.

For surface water, the triggers are aimed at managing expected outcomes from the interaction of the Jandabup Sand Quarry with nearby sensitive surface water features. Given there will be no surface water discharges from the site, outcome management are focussed on surface water quality and interactions with groundwater.

Triggers adopted in this plan include:

1. Data Reliability Triggers
2. Impact Prevention Triggers
3. Impact Response Triggers

Details of the rationale and actions for each trigger type are described below.

6.9.1 Data Reliability Triggers

Data Reliability Trigger Rationale

These triggers are intended to minimise errors associated with the monitoring programme. Data management errors can lead to misinterpretation of trends and short term responses by the water environment to nearby influences.

Checks and controls will be built into the field record sheets and data management software that will identify a range of QA/QC events such as decimal point errors either in the field, or transposition errors between field records and the database. Other checks will be used to ensure numeric data are entered correctly and are within the expected range for the data concerned.

Data Reliability Trigger Actions

The response to these triggers will depend on when a potential error is identified that may involve raw field data, laboratory reports or office-based transcription errors. Specific actions include:

- In the field, readings that differ substantially from the recent historical range will be remeasured. To do this, field sheets will be equipped with recent readings by which an on-the-spot comparison will be made.

- The QA/QC reports accompanying laboratory data will be reviewed to ensure there have been no significant events associated with sample preservation and analysis. Should issues be identified, an assessment of the impact of the event on the integrity of the data will be undertaken. Findings from this assessment will be logged in a QA/QC register.
- In the office, field data that is being transposed to the environmental database will be screened to ensure significant errors such as decimal points, or reporting units are avoided. This will be undertaken by a visual inspection of the collated data against recent historical readings. Should a potential error be identified, the raw field readings or laboratory report will be checked to verify or correct the reading.

6.9.2 Impact Prevention Triggers

Impact Prevention Trigger Rationale

Investigation prevention triggers are inherently more complex than Data Reliability Triggers as they are set to identify whether changes are within the expected range associated with both natural variation and Project influences. These triggers consider short term and long term trends rather than individual readings. In general, however, the response to breaching these triggers will be to undertake an investigation into the cause of the deviation from the expected trend and, if required, development of new or different site protocols that will remedy the exceedance. These triggers are intended to allow Holcim to avoid an impact before it occurs.

Outcomes of these investigations will be provided to the DoW and DER in the annual environmental review when the breach is to a long term trend, or within 7 days of becoming aware of the breach for short term events or trends. The investigations will include details of the contributing factors behind the event, the magnitude of the exceedance, and a work programme, if required, to rectify the exceedance. Approval for required changes to water management practices will be sought from the DoW and DER (as appropriate) before any change is implemented.

Specific Impact Prevention Triggers included in this Plan include:

- MGL Trigger
- Water Quality Triggers

MGL Trigger

A groundwater level trigger framework has been developed to address deviations from expected long term trends. Deviations may occur when the (averaged) groundwater level trend exceeds the historical seasonal range on more than one occasion. Such deviations may occur if the groundwater balance (recharge plus throughflow, minus discharge and abstraction) does not remain within the bounds of assumptions included in the model predictions. Historical changes to the water table in the Jandabup area have occurred since the 1970s as depicted on a local hydrograph shown on Figure 6-1. Water balance stressors are ongoing and expected to change the water balance in the future. The actual future water balance may result in a long term water table level trend that is higher, lower, or similar to what has been predicted. In any case, a deviation indicates that the predictions need to re-validated.

This trigger will activate if the groundwater level, averaged over the calendar year, deviates from the expected trend envelope i.e. annual average level +/- observed averaged seasonal variation for two or more calendar years.

Water Quality Triggers

The site is located within in a P1 DWSPA and the Gnangara UWPCA, whereby high-quality drinking water for public use is the primary beneficial land value. In addition, there are Wellhead Protection Zones (WHPZs) located within the Holcim Tenements. Groundwater quality triggers to protect groundwater resources in these areas are associated with either a significant change to the long term trend, or a short term breach in the water quality assessment criteria. These triggers will apply to field readings and laboratory analysis results from monitoring bores located within the quarry site (HM-series bores) and nominated off-site bores.

Groundwater quality results from bores located on-site (HM-series bores) will be compared against assessment criteria drawn from a series of guidelines including:

- Environmental Protection (Gnangara Mound Crown Land) Policy Approval Order 1992, Environmental Quality Objectives for Groundwater, Schedule 1 (Government Gazette, 1992)
- Australian Drinking Water Guidelines (NH&MRC, 2015)

In the case of parameters that do not meet existing criteria within these guidelines, the results will then be compared to the established baseline ranges across the site, and background ranges from bores in undisturbed areas. This trigger will only be activated if the data consistently exceed the above assessment criteria and outside of the established baseline / background range by more than 10%. In this context, consistent exceedances will be a trend deviation after three or more readings are above the guideline, or outside of the established range.

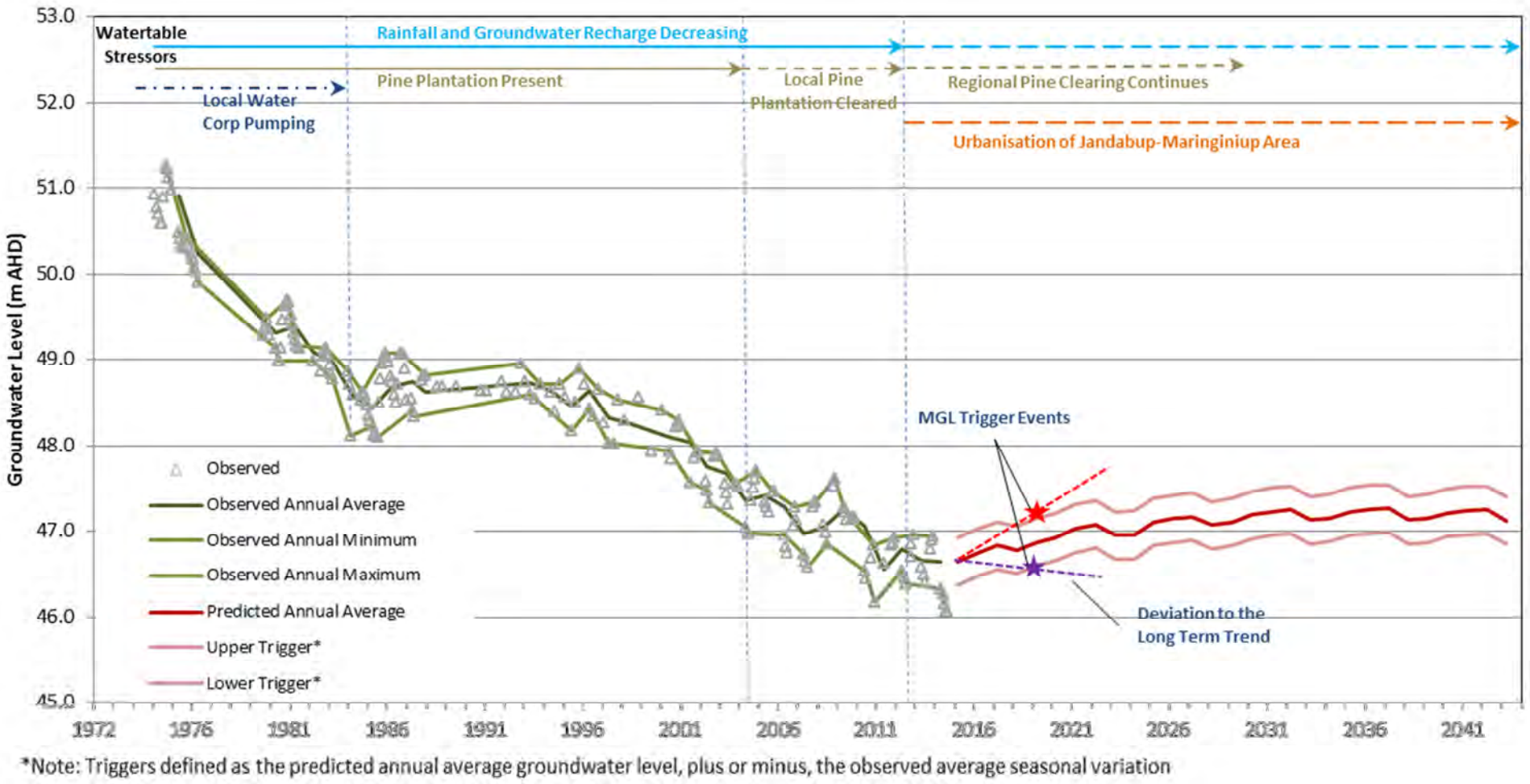

Figure 6-1 Groundwater Level MGL Triggers

Impact Prevention Trigger Actions

The following actions will be undertaken if the above trigger conditions are identified:

MGL Trigger

Undertake a detailed review of the monitoring data and variance from the predicted long term trends for all nominated monitoring sites. This review will include a review of the local and regional hydrographs to determine the extent of the trigger breach, and an assessment of water balance components that have influenced the deviated levels, including groundwater recharge, abstraction and monthly rainfall data. Depending on the extent and scale of the breach, forecasts of the future MGL will also be reviewed. The results of these assessments will be provided to the DoW and DER in the Annual Environmental Report if is a localised event, or in a stand-alone report if it is site-wide.

Water Quality Triggers

Once triggered, an investigation will be undertaken to determine the cause, or causes, for the event. The investigation will include a review of relevant QA/QC checks, as well as trend and root-cause analyses. The investigation will develop recommendations for further investigations, if required, and a work programme to mitigate any Project-specific causes. Background conditions will feature in these analyses to account for ongoing changes to the region due to external factors such as groundwater abstraction and climate change. The results of these investigations will be submitted to the DoW and DER within 30 days of becoming aware of the trigger being activated. Details of the event, findings and mitigation activities will be provided to the DoW and DER in the Annual Environmental Report.

6.9.3 Impact Response Triggers

Impact Response Trigger Rationale

Due to the sensitive nature of water resources in the Jandabup area, responding to impacts in a timely manner will be important to ensure the effects are minimised. Impact response triggers are associated with unplanned discharges such as spills or significant leaks that require significant intervention to minimise impacts to the water environment. This trigger may be activated following an observation of a spill or leak of a chemical or hydrocarbon substance exceeding 100L. Spills of leaks within the WHPZs will be deemed to have breached an impact trigger, irrespective of its magnitude.

Impact Response Trigger Actions

The DoW and DER will be notified within 24hrs of becoming aware of such an event. Spill containment procedures referred to in Section 6.5 will apply. In addition, an investigation will be undertaken to determine the root cause of the discharge with recommendations for changes aimed at preventing its re-occurrence. A remediation plan will be provided to the DoW and DER within 7 days of becoming aware of the trigger breach. Remediation activities, once agreed with the DoW and DER will be implemented as soon as is practicable.

6.10 Water Monitoring

Holcim installed eight monitoring bores between December 2014 and January 2015 (URS, 2015b). The locations of Holcim's bores and off-site regional monitoring bore network are presented in Figure 7-1.

A pre-quarrying groundwater monitoring programme commenced in May 2015 with the purpose of collecting baseline data. This programme has captured one winter peak to date and comprises both monthly and biannual aspects (Table 6-2). The operational programme (Table 6-3) will commence following the onset of quarrying operations, currently scheduled for early 2016. The operational programme focuses on the key risks to the groundwater resource identified in Section 4 and will be subject to assessment against defined trigger levels (Section 6.5). The comprehensive suite of analytes will be requested biannually and comprises:

> ***General water suite*** *(chloride, sulphate, alkalinity, acidity, pH, electrical conductivity, total dissolved solids, calcium, magnesium, sodium, potassium, iron, manganese and aluminium, carbonate, bicarbonate, total hardness),* ***Nutrients*** *(TKN, Total P, ammonia, NO_3),* ***Organic suite*** *(TPH/TRH(C6-C36 or 40)/BTEX).*

Parameters listed in the general water suite include components that comprise the major chemistry of groundwater. These parameters may be affected by dust suppression activities and long term changes to the water table due to external factors such as landuse changes and climate change. Nutrients and hydrocarbons are important to detect unplanned discharges from on-site ablutions, onsite refuelling, and ongoing changes to background conditions due to external factors that have been identified during the baseline study.

Holcim will review the appropriateness of the biannual suite of analytes outlined in the operational programme once the pre-quarrying programme is finished.

Table 6-2 Pre-Quarrying Groundwater Monitoring Programme

Frequency	Bore Locations	Parameters	Methodology and QA/QC
Monthly	On-site – HMB01, HMB02, HMB03, HMB04, HMB05, HMB06, HMB07B, HMB08	Groundwater levels Groundwater quality (EC, pH, temperature, DO)	Groundwater levels to be measured to the nearest cm using a water level meter. Field groundwater quality readings to be taken using a downhole water quality meter.
	Off-site – JB10B, JB12A*, JB9C, W230, W240, WCM Redrill, WE1B, WE2C*, WM24, WM35, WM23.	Groundwater levels	Collected from the DoW and Water Corporation bores near the project footprint.
Biannually	On-site – HMB01, HMB02, HMB03, HMB04, HMB05, HMB06, HMB07B, HMB08	Groundwater quality (comprehensive suite including hydrocarbon screening, pesticides and herbicides)	Groundwater sampling to be undertaken using low-flow sampling (peristaltic). *In situ* analysis of groundwater to be conducted using a water quality meter. QA/QC samples to be taken; • Duplicates and triplicates (1 in 20 primary samples) • Field and rinsate blanks (1 per day of sampling) Samples to be analysed by a NATA accredited laboratory.
	Off-site – JB10B, JB12A*, JB9C, W230, W240, WCM Redrill, WE1B, WE2C*, WM24, WM35, WM23.	Groundwater levels Groundwater quality (EC, pH, temperature, DO)	Collected from nearby private groundwater users (if possible)
*NB: *Bore WE2B has replaced WE2C in the programme due to a blockage downhole. JB12B has replaced JB12A in the programme due to inconsistencies with data readings.* *Rationale for this programme outlined in URS (2014).*			

Table 6-3 Operational Groundwater Monitoring Programme

Frequency	Bore Locations	Parameters	Methodology and QA/QC	Rationale
Monthly	WHPZ bores: HMB07B, W230, JB10B, W240	Groundwater levels	Groundwater levels to be measured to the nearest cm using a water level meter.	Monthly measurements to ensure seasonal variations and short-term trends are captured. These levels will be assessed against assigned trigger values. Monthly data will improve the understanding of the effects climate change and land use are having on the local water table, and will identify any project attributable impacts to the water table.
Quarterly	JB12B, JB9C, WCM Redrill, WE1B, WE2B, WM24, WM35, WM23. HMB01, HMB02, HMB03, HMB04, HMB05, HMB06, HMB08	Groundwater levels	Groundwater levels to be measured to the nearest cm using a water level meter.	Quarterly measurements to capture seasonal trends. These levels will be assessed against assigned trigger values. This data will support the on-site monitoring data and to provide a greater spatial representation of groundwater levels in the shallow water table zone.
	WHPZ bores: HMB07B, W230, JB10B, W240	Groundwater quality (EC, pH, temperature)	Field groundwater quality readings to be taken using a water quality meter.	There is a minor risk to local groundwater resources from the application of water containing low concentrations of salt, which may accumulate at the water table.
Annually	WHPZ bores: HMB07B, W230, JB10B, W240 On-site bores: HMB01, HMB02, HMB03, HMB04, HMB05, HMB06, HMB08	Groundwater quality (comprehensive suite)	Groundwater sampling to be undertaken using low-flow sampling (peristaltic). *In situ* analysis of groundwater to be conducted using a water quality meter. QA/QC samples to be taken at the following frequency; • Duplicates and triplicates (1 in 20 primary samples) • Field and rinsate blanks (1 per day of sampling) Samples to be analysed by a NATA accredited laboratory.	Potential identified risk for the contamination of groundwater at the water table if there is a significant unplanned leak or unmanaged spill. Hydrocarbons and nutrients were detected above assessment levels (NH&MRC, 2015) in samples taken during the pre-quarrying programme detected. Potential unplanned release of these substances includes on-site hydrocarbons and ablution facilities. The laboratory results will be assessed against appropriate assessment levels.
	Off-site bores: JB12B, JB9C, WCM Redrill, WE1B, WE2B, WM24, WM35, WM23.	Groundwater levels Groundwater quality (EC, pH, temperature)	Groundwater levels to be measured to the nearest cm using a water level meter. Field groundwater quality readings to be taken using a water quality meter.	There is a potential for water table mounding beneath cleared quarry areas. The monitoring will aim to identify any changes in water levels before r nearby water-sensitive features. There is a minor risk to local groundwater resources from the application of water containing low concentrations of salt, which may accumulate at the water table.
It is recognised that some of the proposed monitoring bores to be installed within the mine footprint may be destroyed as quarrying operations commence.				

7 REHABILITATION AND SITE CLOSURE

Holcim's quarrying programme is to remove sand without introducing any wastes. On this basis, it is considered to be a non-polluting activity. At closure, any areas, including groundwater, affected by spills or leaks will have been remediated. Progressive rehabilitation will return the site to safe, stable conditions after the sand has been removed. As a result of these actions, there are no identified contamination sources after closure.

Following the completion of quarrying operations:

- all buildings and infrastructure will be removed
- any hard stand surfaces will be incorporated into the final landform if suitable, or removed from site
- overburden and oversize screened material will be incorporated into the final landform if suitable, or removed from site
- all remaining areas will be seeded and vegetated according to the agreed prescriptions.

A Closure Plan which complies with the DMP 2015 Closure Guideline has been prepared under a separate cover. All rehabilitation management measures will be incorporated into the Closure Plan (Enviroworks, 2015b).

The closure plan will be further developed during the quarry life. Ongoing developments following successive reviews of monitoring data will be used to review the quarry floor elevation. It is important to ensure that the quarry design remains cognisant of such developments, as the quarry floor will constitute the final landform across most of the site. For the water environment, ongoing consideration of the quarry floor level is important to ensure that the water table will remain at least 3m below the surface after closure.

7.1 Management Context

According to Water Quality Protection Note 15 (DoW 2013), the management measures for site closure and rehabilitation should include;

- The operator should arrange a rehabilitation plan, update it as needed and ensure it is fully implemented at pit closure. Where quarry operations are undertaken over a long period (e.g. hard rock quarries), progressive rehabilitation should be initiated prior to pit closure.
- The rehabilitation plan should include measures to prevent adverse environmental impacts such as dust, erosion, silt deposition and turbidity in local waters, a re-contoured land surface and revegetation of disturbed soil suited to the next land use. The rehabilitation plan should satisfy relevant government regulatory agencies.
- In addition to standard details required by other regulatory agencies, the rehabilitation plan should include:
  - details of proposed post-closure rehabilitated land use
  - a plan detailing the finished land surface profile
  - detailed information on the types, sources and quantities of materials to be used for backfilling

  - an assessment of the potential groundwater contamination threats posed by the materials used for backfilling, including leach test analysis for any imported materials used on-site that may pose a threat to water quality
  - proposals for any fertiliser and pesticide application at the site
  - methods of site remediation and clean-up after the end of extractive operations
- Upon closure of mined-out pits in P1 areas of PDWSAs, the land surface should be restored to achieve a final 3m soil buffer above the maximum water table level, and then be revegetated with native vegetation.
- The site should be rehabilitated to a condition that ensures the retention of the local water resource values. A qualified and experienced environmental consultant should prepare the plan for the operator and submit it to us for approval. Additional information is provided in our WQPN 84 Revegetation of disturbed land

7.2 Closure Management Measures

An indicative groundwater monitoring programme for closure is provided in Table 7-1. This programme will commence at closure and will continue for duration of 5 years. In effect, the final closure plan will benefit from over 20 years of monitoring and data reviews. The aim of this programme will be to validate the water level predictions presented in the recent groundwater impact assessment (URS, 2015c) and to identify any previously unknown Project-related contamination to the groundwater resource.

The final closure plan will reflect any revisions that arise from the operational monitoring programme results. The findings from ongoing monitoring near areas that have been rehabilitated will be incorporated into the Project during the operational phase.

Table 7-1 Indicative Closure Groundwater Monitoring Programme

Frequency	Bore Locations	Parameters	Methodology and QA/QC	Rationale
Quarterly	WHPZ bores: HMB07B, W230, JB10B, W240 On-site bores; HMB01, HMB02, HMB03, HMB04, HMB05, HMB06, HMB08	Groundwater levels	Groundwater levels to be measured to the nearest cm using a water level meter.	Quarterly measurements to ensure seasonal variations and short-term trends are captured. These levels will be assessed against assigned closure criteria values. Validating water levels predictions (URS, 2015). Monitoring at this frequency for five years will improve the understanding of the effects climate change and land use are having on the local water table post-closure.
Biannual	JB12B, JB9C, WCM Redrill, WE1B, WE2B, WM24, WM35, WM23.	Groundwater levels Groundwater quality (EC, pH, temperature)	Groundwater levels to be measured to the nearest cm using a water level meter. Field groundwater quality readings to be taken using a water quality meter.	Biannual measurements to capture winter peaks and summer troughs. These levels will be assessed against assigned closure criteria values. These data will support the on-site monitoring data and to provide a greater spatial representation of groundwater levels in the shallow water table zone.
Annual	WHPZ bores: HMB07B, W230, JB10B, W240 On-site bores: HMB01, HMB02, HMB03, HMB04, HMB05, HMB06, HMB08	Groundwater quality (comprehensive suite)	Groundwater sampling to be undertaken using low-flow sampling (peristaltic). *In situ* analysis of groundwater to be conducted using a water quality meter. QA/QC samples to be taken at the following frequency; • Duplicates and triplicates (1 in 20 primary samples) • Field and rinsate blanks (1 per day of sampling) Samples to be analysed by a NATA accredited laboratory.	Identification of previously unidentified contamination of groundwater at the water table due to an unplanned leak or unmanaged spill. These levels will be assessed against assigned closure criteria values.
It is recognised that some of the proposed monitoring bores to be installed within the mine footprint may be destroyed during quarrying operations. The monitoring programme will be reviewed during operations and revised in the final Closure Plan.				

8 SUMMARY OF COMMITMENTS

Holcim will undertake the commitments detailed in Table 6-1.

Table 8-1 Summary of Commitments

Environmental Impact/Issue	Management Commitment
Surface Water	• Tree stumps will be retained as long as possible to assist soil stabilization. • A buffer zone of 100 m will be maintained between operations and naturally vegetated geomorphic wetlands. • Stockpiles of erodible material will be located away from roads and pavements to minimise sediment transport in runoff. • Each stage will be progressively rehabilitated at completion. • Vegetative cover will be established to minimise erosion. • Holcim will provide spill response equipment at the site. • Hydrocarbon and chemical management measures will ensure surface water contamination does not occur. • At closure, any hard stand surfaces will be removed and used to re-contour the landscape.
Groundwater	• Excavation depth will limited to 3m above maximum groundwater level. • Contamination and spills management will be implemented according to the emergency response plan • All potentially contaminated surface water runoff will be detained and/or treated before discharge to the environment, minimising the risk of contamination to groundwater via infiltration. • Waste management will ensure that all wastes are disposed of appropriately minimising the risk of groundwater contamination.
Topsoil /Acid Sulphate Soils (ASS)	• Holcim will avoid disturbance of high ASS risk areas. Holcim commits to the exclusion of mining from a 100 metre buffer around mapped high to moderate risk ASS soils (including 100 metres around all wetlands whether mapped as high to moderate risk or not). • If mining is proposed within the 100 metre buffer, Holcim commits to the provision of a management plan which will include the results of ASS investigations and will incorporate the results into management strategies to be presented with a new mining proposal to be submitted for approval. • Overburden will be stockpiled and used for rehabilitation. • Excavation will not intersect the water table. Excavation depth is limited to 3m above maximum groundwater level determined in the recent groundwater impact assessment (URS, 2015c). • Based on precedents set by other sand mining operations in the pine plantation (including Rocla's adjacent Hawkins Rd Quarry), the topsoil will not be stripped separately, as the native seed bank will be negligible after growing pines since the 1960's. • Overburden and oversize material stockpiles will be used to re-contour the landscape at quarry closure and are thus temporary.
Monitoring	• A groundwater monitoring programme will be implemented including eight dedicated groundwater monitoring bores installed by Holcim and selected monitoring bores installed by the DoW and Water Corporation. • Monitoring includes a pre-quarrying programme to establish baseline groundwater levels and quality across the site. This will continue until December 2016, completing a two year baseline phase. • An operational phase programme will commence in 2017 that will include the same monitoring sites but with slightly different frequencies and parameters. This programme will collect operational data at sites near the active quarry area, near rehabilitated areas, and ongoing background data from undisturbed areas. • Water monitoring data will be collated annually and presented in the Annual Environmental Review. A summary of trends and significant events affecting the water environment will be included in this review. • Every three years, the data will be subjected to a detailed review in sync with the WMP and Closure Plan reviews. This review will include a re-assessment of all available data and validate predictions used to characterise impacts and the MGL. • The water management plan will be reviewed every three years in line with regular reviews of the closure plan.
Administration	• The Jandabup Quarry Manager is nominated as the responsible person to ensure all aspects of the Water Management Plan are undertaken.

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10 LIMITATIONS

10.1 Geotechnical & Hydro Geological Report

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Holcim (Australia) Pty Ltd and only those third parties who have been authorised in writing by URS to rely on the report.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the contract dated 1 January 2014.

The methodology adopted and sources of information used by URS are outlined in this the Report.

Where this report indicates that information has been provided to URS by third parties, URS has made no independent verification of this information unless required as part of the agreed scope of work. URS assumes no liability for any inaccuracies in or omissions to that information.

This Report was prepared between March and October 2015.The information in this report is considered to be accurate at the date of issue and is in accordance with conditions at the site at the dates sampled. Opinions and recommendations presented herein apply to the site existing at the time of our investigation and cannot necessarily apply to site changes of which URS is not aware and has not had the opportunity to evaluate. This document and the information contained herein should only be regarded as validly representing the site conditions at the time of the investigation unless otherwise explicitly stated in a preceding section of this report. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. The borehole logs indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the uniformity of conditions and on the frequency and method of sampling as constrained by the project budget limitations. The behaviour of groundwater and some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this report and our experience. Future advances in regard to the understanding of chemicals and their behaviour, and changes in regulations affecting their management, could impact on our conclusions and recommendations regarding their potential presence on this site.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, URS must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time.

Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

Except as required by law, no third party may use or rely on, this Report unless otherwise agreed by URS in writing. Where such agreement is provided, URS will provide a letter of reliance to the agreed third party in the form required by URS.

To the extent permitted by law, URS expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this Report. URS does not admit that any action, liability or claim may exist or be available to any third party.

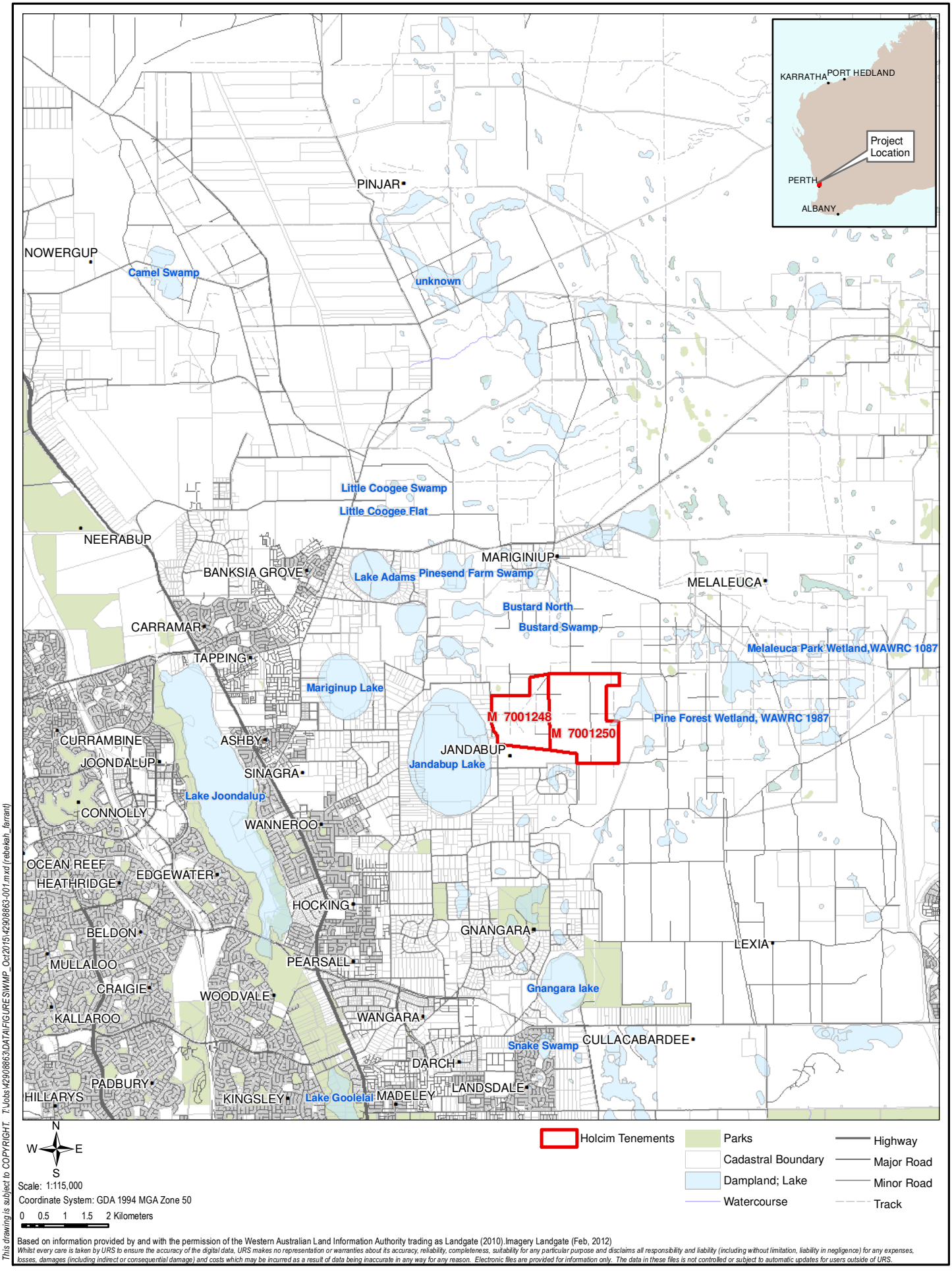
URS does not represent that this Report is suitable for use by any third party.

Except as specifically stated in this section, URS does not authorise the use of this Report by any third party.

It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the relevant property.

Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

FIGURES



Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).Imagery Landgate (Feb, 2012)

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JANDABUP SAND QUARRY PROJECT
WATER MANAGEMENT PLAN

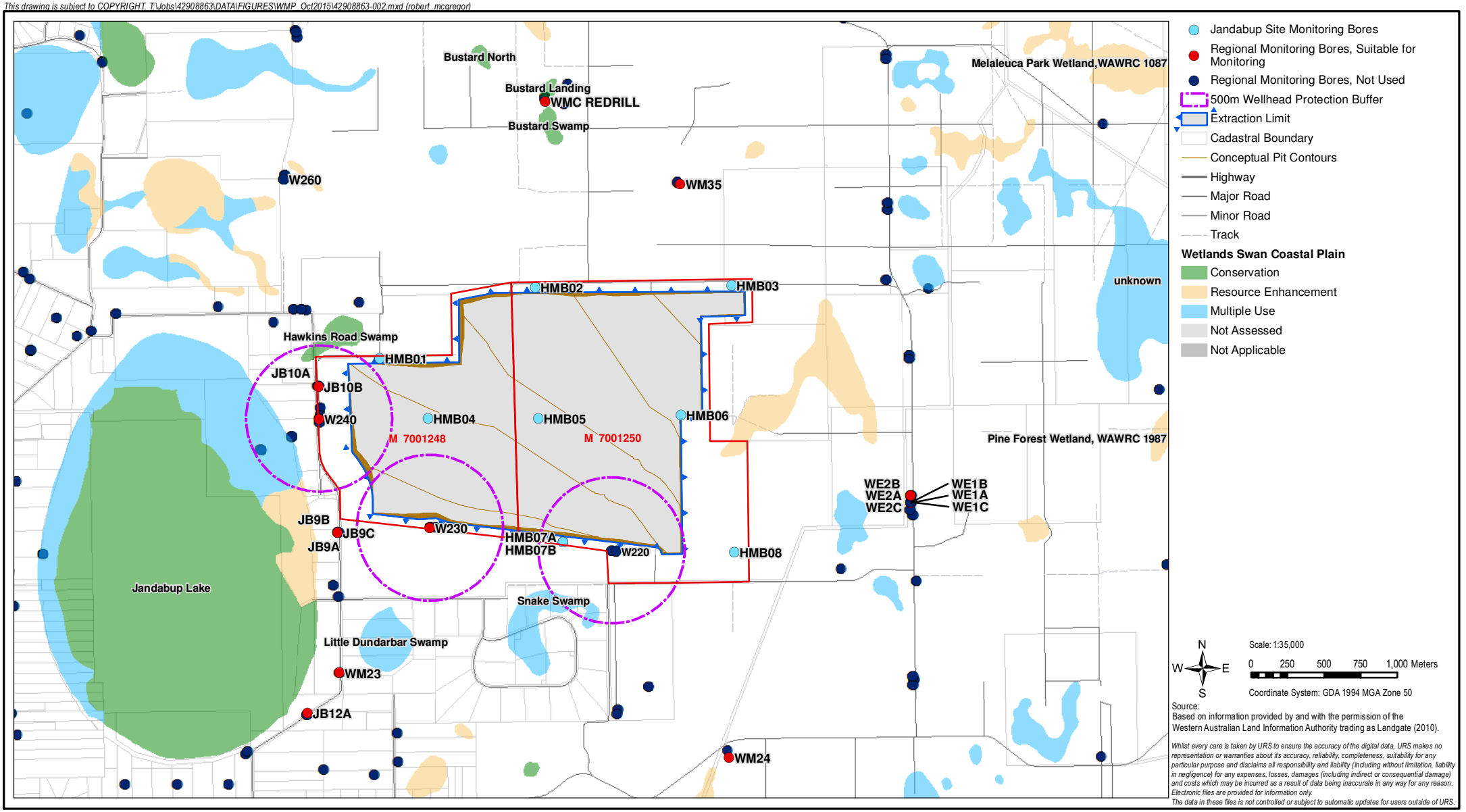
PROJECT LOCATION

URS

INTRODUCTION

Figure: **1-1**

File No: **42908863-001.mxd** Drawn: **RNM** Approved: **RF** Date: **5/10/2015** Rev.- A4



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JANDABUP SAND QUARRY PROJECT
WATER MANAGEMENT PLAN

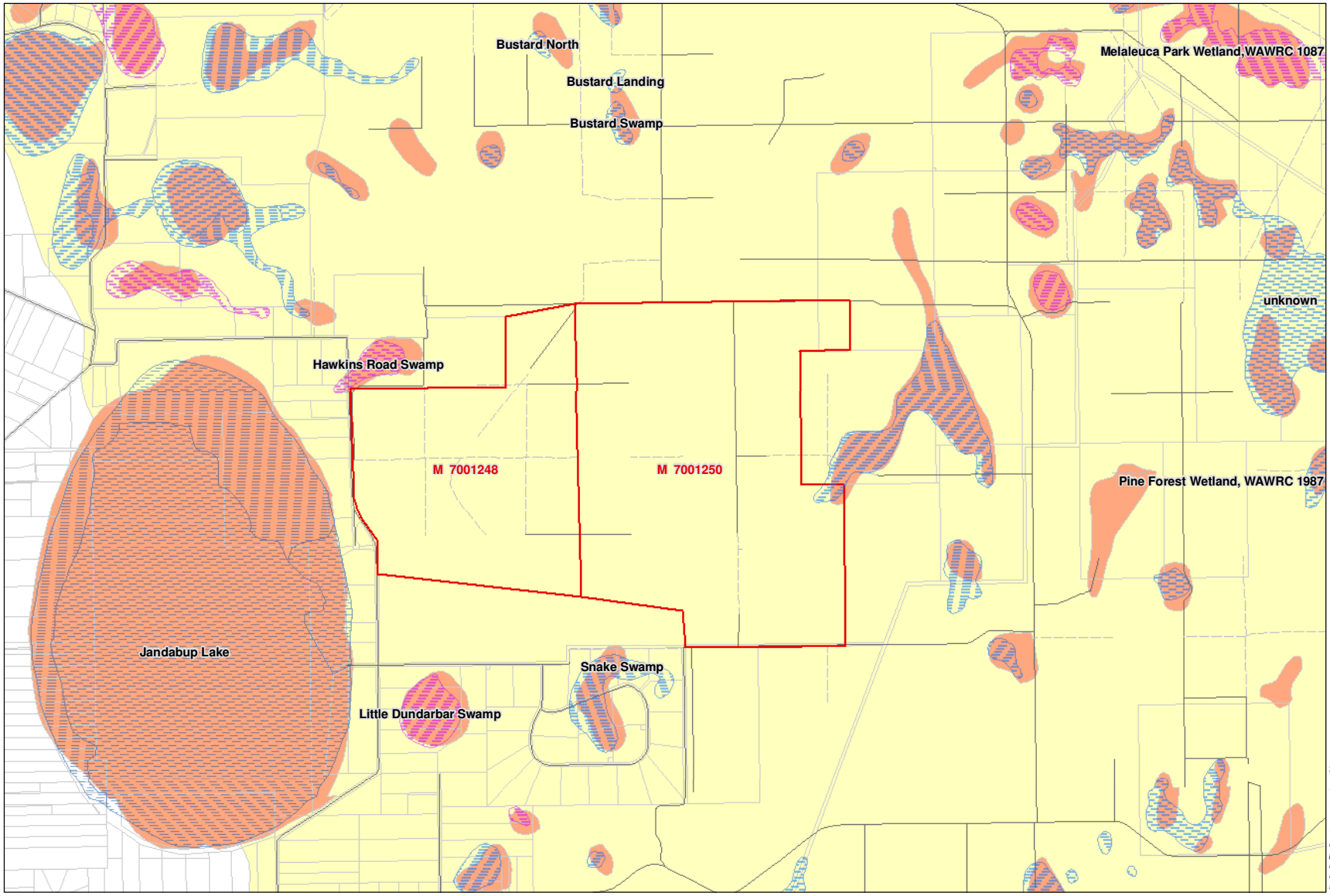
HOLCIM MINE PLAN

URS

INTRODUCTION

Figure: **1-2**

File No: **42908863-002.mxd** Drawn: **RNM** Approved: **RW** Date: **28/10/2015** Rev. **A** A4



Wetlands Swan Coastal Plain

- Dampland
- Sumpland
- Lake
- Cadastral Boundary
- Minor Road
- Track

Acid Sulphate Soils (DER/DPI 2015)

- High to moderate risk
- Moderate to low risk

N
W E
S

Scale: 1:35,000

0 250 500 750 1,000 Meters

Coordinate System: GDA 1994 MGA Zone 50

Source:
Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010). Bush Forever information from Department of Planning (DOP) via Landgate SLIP Portal

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JANDABUP SAND QUARRY PROJECT
WATER MANAGEMENT PLAN

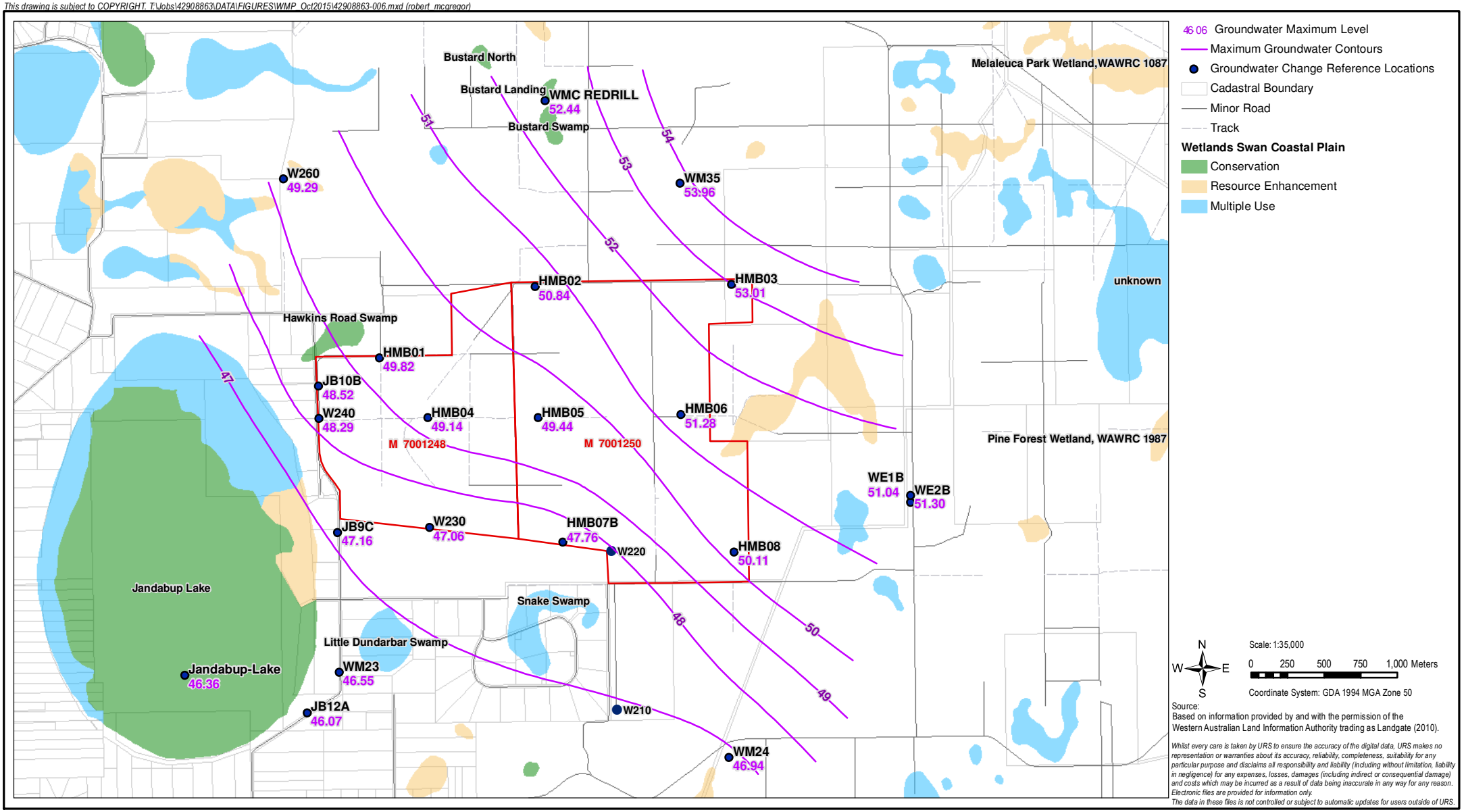
WATER DEPENDENT FEATURES

URS

PHYSICAL ENVIRONMENT

Figure: **2-1**

File No: **42908863-003.mxd** Drawn: **RNM** Approved: **RW** Date: **5/10/2015** Rev. **A** A4



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JANDABUP SAND QUARRY PROJECT
WATER MANAGEMENT PLAN

MAXIMUM GROUNDWATER LEVEL

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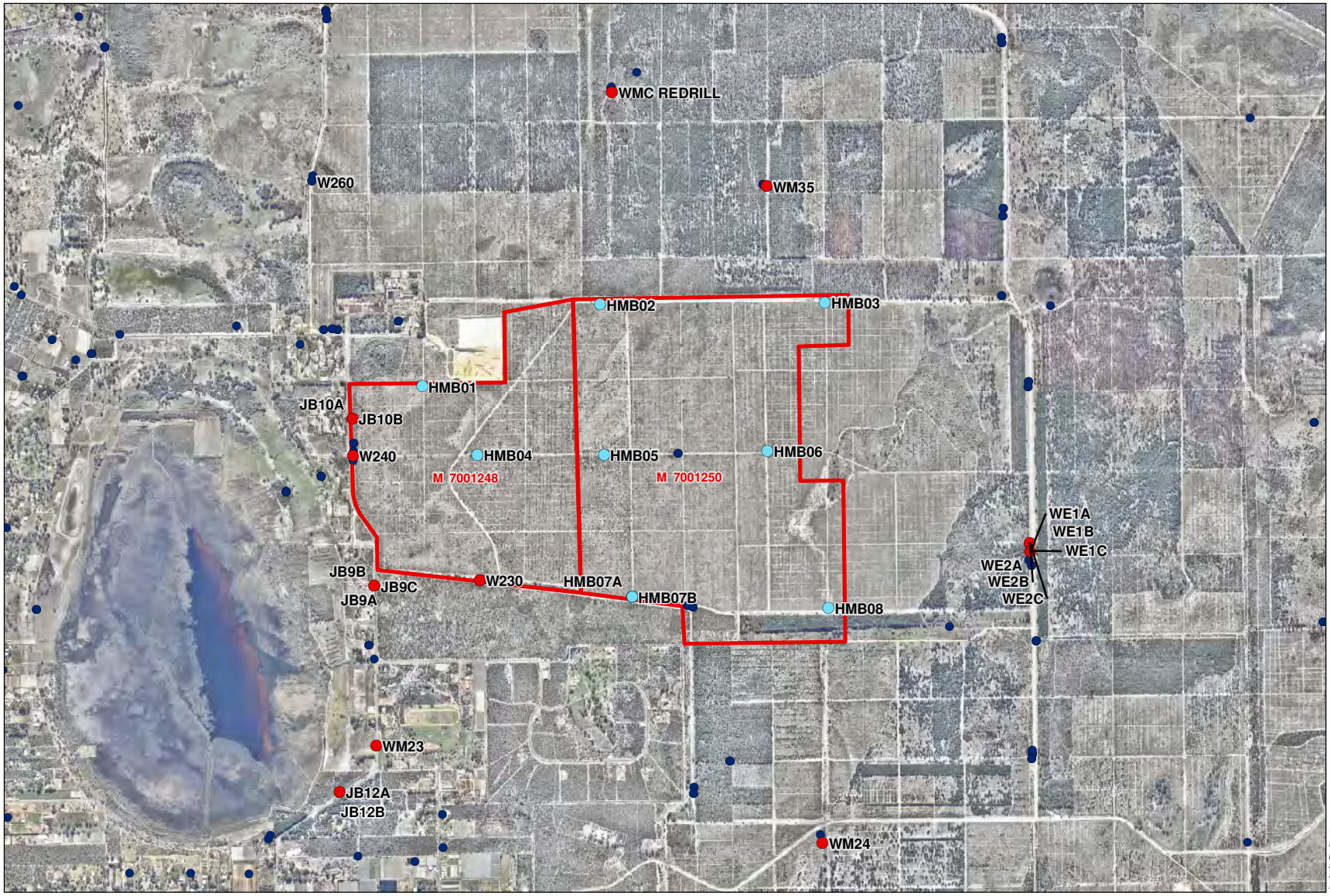
IMPACT ASSESSMENT

Figure: **5-1**

File No: **42908863-006.mxd** Drawn: **RNM** Approved: **RW** Date: **26/10/2015** Rev. **A** A4



- Jandabup Site Monitoring Bores
- Regional Monitoring Bores, Holcim Programme
- Regional Monitoring Bores, Not Used
- Holcim Tenements

N
W E
S

Scale: 1:35,000

0 250 500 750 1,000 Meters

Coordinate System: GDA 1994 MGA Zone 50

Source:
Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).
Nearmap Imagery (27/06/2015)

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JANDABUP SAND QUARRY PROJECT
WATER MANAGEMENT PLAN

MONITORING BORE LOCATIONS

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MANAGEMENT

Figure: **7-1**

File No: **42908863-005.mxd** Drawn: **RNM** Approved: **RW** Date: **8/10/2015** Rev. **A** A4

APPENDIX A HOLCIM MINING TENEMENT CONDITIONS

Government of Western Australia
Department of Mines and Petroleum

eMiTS MAINTENANCE

Tenement Endorsement and Conditions Extract

Tenement: M 70/1248
Show History: Yes
Working versions only: No

#	ENDORSEMENTS	Status	Start Date	End Date
1	The Lessee's attention is drawn to the provisions of the: • Aboriginal Heritage Act 1972 and any Regulations thereunder; • Water and Rivers Commission Act 1995 and any Regulations thereunder; • Country Areas Water Supply Act 1947 and any Regulations thereunder; • Metropolitan Water Supply Sewerage and Drainage Act 1909 and any Regulations thereunder; • Identification of environmental sensitive wetlands listed within the RAMSAR Convention 1971, ANCA's Directory of important wetlands, the National Estates Register and the Environmental Protection Policies 1999.	Active	15/02/2012	
2	The Lessee's attention is drawn to the Environmental Protection Act 1986 and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004, which provides for the protection of all native vegetation from damage unless prior permission is obtained.	Active	15/02/2012	

#	CONDITIONS	Status	Start Date	End Date
1	Survey.	Active	15/02/2012	
2	All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe immediately after completion.	Active	15/02/2012	
3	All disturbances to the surface of the land made as a result of exploration, including costeans, drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Mines and Petroleum (DMP). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DMP.	Active	15/02/2012	
4	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration program.	Active	15/02/2012	
5	Unless the written approval of the Environmental Officer, DMP is first obtained, the use of drilling rigs, scrapers, graders, bulldozers, backhoes or other mechanised equipment for surface disturbance or the excavation of costeans is prohibited. Following approval, all topsoil being removed ahead of mining operations and separately stockpiled for replacement after backfilling and/or completion of operations.	Active	15/02/2012	
6	The lessee submitting a plan of proposed operations and measures to safeguard the environment to the Executive Director, Environment Division, DMP for his assessment and written approval prior to commencing any developmental or productive mining or construction activity.	Active	15/02/2012	
7	Mining on any road, road verge or road reserve being confined to below a depth of 15 metres from the natural surface.	Active	15/02/2012	
	In respect to Underground Water Pollution Control Area 1 and Geomorphic Wetlands 4 the following shall apply:	Active	15/02/2012	
8	Written notification, where practicable, of the time frame, type and extent of proposed ground disturbing activities being forwarded to the Department of Water 7 Ellam Street Victoria Park seven days prior to commencement of those activities.	Active	15/02/2012	
9	Any significant waterway (flowing or not), wetland or its fringing vegetation that may exist on site not being disturbed or removed without prior written approval from the Department of Water.	Active	15/02/2012	
10	The rights of ingress to and egress from the Lease being at all reasonable times preserved to officers of the Department of Water for inspection and investigation purposes.	Active	15/02/2012	
11	The storage and disposal of hydrocarbons, chemicals and potentially hazardous substances being in accordance with the Department of Water's Guidelines and Water Quality Protection Notes .	Active	15/02/2012	
12	Measures such as effective sediment traps and stormwater retention facilities being implemented to preserve the natural values of receiving catchments and those of adjacent areas of native vegetation.	Active	15/02/2012	
13	Groundwater quality monitoring bores being installed, maintained and utilised for water quality monitoring on and near the mine-site and downstream where aquifers are present.	Active	15/02/2012	
14	Petroleum hydrocarbon and other chemical storage areas being appropriately contained using bunded retention compounds incorporating stormwater disposal and the removal of sediments.	Active	15/02/2012	
	In respect to Underground Water Pollution Control Area 1 the following shall apply:	Active	15/02/2012	
15	All proposed exploration activities within Public Drinking Water Source Areas complying with the Department of Water's Water Quality Protection Note Land Use Compatibility in Public Drinking Water Source Areas.	Active	15/02/2012	
16	All Mining Act tenement activities within Public Drinking Water Source Areas being prohibited unless the prior written approval has been obtained from the Department of Water.	Active	15/02/2012	
17	All Mining Act tenement activities are prohibited within 2 kilometres of the maximum storage level of a reservoir including the reservoir itself, unless the prior written approval of the Department of Water is first obtained.	Active	15/02/2012	

#	CONDITIONS	Status	Start Date	End Date
18	Storage and use of hydrocarbons and potentially hazardous substances requiring the prior written approval or appropriate permits from the Department of Water.	Active	15/02/2012	
19	All hydrocarbon or other pollutant spillage being reported to the Department of Water. Remediation being carried out to the satisfaction of the Department of Water.	Active	15/02/2012	
20	All Mining Act tenement activities are prohibited within a 300-metre radius of any observation well in a Public Drinking Water Source Priority P1, P2 & P3 Areas unless the written approval of the Department of Water is first obtained.	Active	15/02/2012	
21	All Mining Act tenement activities are prohibited within a 500-metre radius in a P1 area or a 300-metre radius in a P2 or P3 area of any Public Drinking Water Source production well or dam, unless the written approval of the Department of Water is first obtained.	Active	15/02/2012	
22	All mining operations being carried out in accordance with the Department of Water Water Quality Management in Mining and Mineral Processing and relevant Water Quality Protection Notes.	Active	15/02/2012	
23	Mining operations below the water table are prohibited in Public Drinking Water Source Areas unless written permission has been given by the Department of Water.	Active	15/02/2012	
24	Disposal of domestic and industrial waste (other then approved tailings) is prohibited within a in Public Drinking Water Source Areas.	Active	15/02/2012	
25	Underground petroleum hydrocarbon and other chemical storage tanks are prohibited within Public Drinking Water Source Priority P1, P2 areas, Wellhead Protection Zones and Reservoir Protection Zones.	Active	15/02/2012	
26	Underground petroleum hydrocarbon and other chemical storage tanks are prohibited within Public Drinking Water Source Priority P3 areas, unless written approval has been obtained from the Department of Water.	Active	15/02/2012	
27	Mineral processing activities and tailings storage are prohibited within Public Drinking Water Source Priority P1 and P2 areas, Wellhead Protection Zones and Reservoir Protection Zones.	Active	15/02/2012	
28	Mineral processing activities and tailings storage are prohibited in Public Drinking Water Source Priority P3 areas unless written approval has been obtained from the Department of Water.	Active	15/02/2012	
29	Mechanical plant servicing is prohibited within Public Drinking Water Source Priority P1 and P2 areas, Wellhead Protection Zones and Reservoir Protection Zones.	Active	15/02/2012	
30	Mechanical plant servicing is prohibited in Public Drinking Water Source Priority P3 areas unless written approval has been obtained from the Department of Water.	Active	15/02/2012	
31	Mining operations in Public Drinking Water Source Areas must use dry soil extraction methods and leave an undisturbed soil profile above maximum groundwater levels as follows: • Priority 1 area - 3 metres • Priority 2 area - 2 metres • Priority 3 area - 2 metres • Future Public Drinking Water Source areas or Priority not determined areas - 3 metres.	Active	15/02/2012	
32	All mining operations being carried out in accordance with the Department of Water Water Quality Management in Mining and Mineral Processing and relevant Water Quality Protection Notes.	Active	15/02/2012	
33	Mining operations below the water table are prohibited in Public Drinking Water Source Areas unless written permission has been given by the Department of Water.	Active	15/02/2012	
34	Disposal of domestic and industrial waste (other then approved tailings) is prohibited within a in Public Drinking Water Source Areas.	Active	15/02/2012	
35	Underground petroleum hydrocarbon and other chemical storage tanks are prohibited within Public Drinking Water Source Priority P1, P2 areas, Wellhead Protection Zones and Reservoir Protection Zones.	Active	15/02/2012	
36	Underground petroleum hydrocarbon and other chemical storage tanks are prohibited within Public Drinking Water Source Priority P3 areas, unless written approval has been obtained from the Department of Water.	Active	15/02/2012	
37	Mineral processing activities and tailings storage are prohibited within Public Drinking Water Source Priority P1 and P2 areas, Wellhead Protection Zones and Reservoir Protection Zones.	Active	15/02/2012	
38	Mineral processing activities and tailings storage are prohibited in Public Drinking Water Source Priority P3 areas unless written approval has been obtained from the Department of Water.	Active	15/02/2012	
39	Mechanical plant servicing is prohibited within Public Drinking Water Source Priority P1 and P2 areas, Wellhead Protection Zones and Reservoir Protection Zones.	Active	15/02/2012	
40	Mechanical plant servicing is prohibited in Public Drinking Water Source Priority P3 areas unless written approval has been obtained from the Department of Water.	Active	15/02/2012	
41	Mining operations in Public Drinking Water Source Areas must use dry soil extraction methods and leave an undisturbed soil profile above maximum groundwater levels as follows: • Priority 1 area - 3 metres • Priority 2 area - 2 metres • Priority 3 area - 2 metres • Future Public Drinking Water Source areas or Priority not determined areas - 3 metres.	Active	15/02/2012	
	In respect to Geomorphic Wetlands 4 the following shall apply:	Active	15/02/2012	
42	All Mining Act tenement activities prohibited within 200 metres of RAMSAR or ANCA listed wetlands unless written permission of Department of Environment and Conservation, in consultation with the Department of Water, is first obtained.	Active	15/02/2012	
43	All Mining Act tenement activities prohibited within 200 metres of "Conservation" and "Resource Enhancement" Category wetlands unless written permission of the Department of Water is first obtained.	Active	15/02/2012	

#	CONDITIONS	Status	Start Date	End Date
44	Abstraction of groundwater from within 500 metres of a wetland is prohibited unless authorised by the Department of Environment.	Active	15/02/2012	
	Consent to mine on State Forest 65 given subject to the following:	Active	15/02/2012	
45	Prior to commencing mining or construction activity, the lessee submitting an environmental management plan (EMP) to the Director of Environment, Department of Mines and Petroleum and to the Director, Department of Environment and Conservation. The EMP shall be to the requirements of the Director General of the Department of Environment and Conservation.	Active	15/02/2012	
46	Unless otherwise agreed with the Director General, Department of Environment and Conservation, at least 20 working days prior to the accessing State Forest, the holder providing the Director General, Department of Environment and Conservation with an itinerary and program of the locations of operations on the lease area, with at least seven days advance notice of any changes to that itinerary.	Active	15/02/2012	
47	The licensee to prepare and implement a rehabilitation plan to the the satisfaction of the Director General, Department of Environment and Conservation and areas within the lease being rehabilitated to the standard and condition agreed by the Director General, Department of Environment and Conservation.	Active	15/02/2012	
48	The lessee submitting an Annual Environmental Report to the Director of Environment, Department of Mines and Petroleum and to the Director General, Department of Environment and Conservation outlining operations and rehabilitation conducted in the previous 12 months and the proposed operations and rehabilitation programs for the next 12 months. This report to be provided in February of each year.	Active	15/02/2012	
49	The tenement holder shall implement and adhere to all environmental management plans or other plans prepared in accordance with the conditions of this tenement.	Active	15/02/2012	
50	Rights being reserved to persons authorised by the Director General, Department of Environment and Conservation to enter the lease and carry out land management operations and other duties and exercise such powers as may be necessary or expedient for the administration of the Conservation and Land Management Act 1984 and Regulations and the Wildlife Conservation Act 1950 and Regulations, the Bush Fires Act 1954 and Regulations and the Emergency Management Act 2005 and Regulations.	Active	15/02/2012	
51	The lessee taking all such necessary precautions as may be indicated by the Director General, Department of Environment and Conservation to prevent the occurrence or spread of any fire within or adjacent to the leased area.	Active	15/02/2012	
52	Access to and from, and the movement of vehicles within State Forest being restricted to roads and tracks approved by the Director General, Department of Environment and Conservation.	Active	15/02/2012	
53	Gating and fencing to be established to the reasonable requirements of the Director General, Department of Environment and Conservation.	Active	15/02/2012	
54	At the time of consideration of a Mining Proposal, the lessee to ensure that timing of extraction of sand meets the requirements of any land use development schedules as determined by the Minister for Mines and Petroleum.	Active	15/02/2012	

-- End of Report --

Government of Western Australia
Department of Mines and Petroleum

eMITS MAINTENANCE

Tenement Endorsement and Conditions Extract

Tenement: M 70/1250
Show History: Yes
Working versions only: No

#	ENDORSEMENTS	Status	Start Date	End Date
1	The Lessee's attention is drawn to the provisions of the: • Aboriginal Heritage Act 1972 and any Regulations thereunder; • Water and Rivers Commission Act 1995 and any Regulations thereunder; • Country Areas Water Supply Act 1947 and any Regulations thereunder; • Metropolitan Water Supply Sewerage and Drainage Act 1909 and any Regulations thereunder; • Identification of environmental sensitive wetlands listed within the RAMSAR Convention 1971, ANCA's Directory of important wetlands, the National Estates Register and the Environmental Protection Policies 1999; and • Commonwealth Defence (Areas Control) Regulations 1989	Active	15/02/2012	
2	The Lessee's attention is drawn to the Environmental Protection Act 1986 and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004, which provides for the protection of all native vegetation from damage unless prior permission is obtained.	Active	15/02/2012	

#	CONDITIONS	Status	Start Date	End Date
1	Survey.	Active	15/02/2012	
2	All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe immediately after completion.	Active	15/02/2012	
3	All disturbances to the surface of the land made as a result of exploration, including costeans, drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Mines and Petroleum (DMP). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DMP.	Active	15/02/2012	
4	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration program.	Active	15/02/2012	
5	Unless the written approval of the Environmental Officer, DMP is first obtained, the use of drilling rigs, scrapers, graders, bulldozers, backhoes or other mechanised equipment for surface disturbance or the excavation of costeans is prohibited. Following approval, all topsoil being removed ahead of mining operations and separately stockpiled for replacement after backfilling and/or completion of operations.	Active	15/02/2012	
6	The lessee submitting a plan of proposed operations and measures to safeguard the environment to the Executive Director, Environment Division, DMP for his assessment and written approval prior to commencing any developmental or productive mining or construction activity.	Active	15/02/2012	
7	Mining on any road, road verge or road reserve being confined to below a depth of 15 metres from the natural surface.	Active	15/02/2012	
	In respect to Underground Water Pollution Control Area 1 and Geomorphic Wetlands 4 the following shall apply:	Active	15/02/2012	
8	Written notification, where practicable, of the time frame, type and extent of proposed ground disturbing activities being forwarded to the Department of Water 7 Ellam Street Victoria Park seven days prior to commencement of those activities.	Active	15/02/2012	
9	Any significant waterway (flowing or not), wetland or its fringing vegetation that may exist on site not being disturbed or removed without prior written approval from the Department of Water.	Active	15/02/2012	
10	The rights of ingress to and egress from the Lease being at all reasonable times preserved to officers of the Department of Water for inspection and investigation purposes.	Active	15/02/2012	
11	The storage and disposal of hydrocarbons, chemicals and potentially hazardous substances being in accordance with the Department of Water's Guidelines and Water Quality Protection Notes .	Active	15/02/2012	
12	Measures such as effective sediment traps and stormwater retention facilities being implemented to preserve the natural values of receiving catchments and those of adjacent areas of native vegetation.	Active	15/02/2012	
13	Groundwater quality monitoring bores being installed, maintained and utilised for water quality monitoring on and near the mine-site and downstream where aquifers are present.	Active	15/02/2012	
14	Petroleum hydrocarbon and other chemical storage areas being appropriately contained using bunded retention compounds incorporating stormwater disposal and the removal of sediments.	Active	15/02/2012	
	In respect to Underground Water Pollution Control Area 1 the following shall apply:	Active	15/02/2012	
15	All proposed exploration activities within Public Drinking Water Source Areas complying with the Department of Water's Water Quality Protection Note Land Use Compatibility in Public Drinking Water Source Areas.	Active	15/02/2012	
16	All Mining Act tenement activities within Public Drinking Water Source Areas being prohibited unless the prior written approval has been obtained from the Department of Water.	Active	15/02/2012	

#	CONDITIONS	Status	Start Date	End Date
17	All Mining Act tenement activities are prohibited within 2 kilometres of the maximum storage level of a reservoir including the reservoir itself, unless the prior written approval of the Department of Water is first obtained.	Active	15/02/2012	
18	Storage and use of hydrocarbons and potentially hazardous substances requiring the prior written approval or appropriate permits from the Department of Water.	Active	15/02/2012	
19	All hydrocarbon or other pollutant spillage being reported to the Department of Water. Remediation being carried out to the satisfaction of the Department of Water.	Active	15/02/2012	
20	All Mining Act tenement activities are prohibited within a 300-metre radius of any observation well in a Public Drinking Water Source Priority P1, P2 & P3 Areas unless the written approval of the Department of Water is first obtained.	Active	15/02/2012	
21	All Mining Act tenement activities are prohibited within a 500-metre radius in a P1 area or a 300-metre radius in a P2 or P3 area of any Public Drinking Water Source production well or dam, unless the written approval of the Department of Water is first obtained.	Active	15/02/2012	
22	All mining operations being carried out in accordance with the Department of Water Water Quality Management in Mining and Mineral Processing and relevant Water Quality Protection Notes.	Active	15/02/2012	
23	Mining operations below the water table are prohibited in Public Drinking Water Source Areas unless written permission has been given by the Department of Water.	Active	15/02/2012	
24	Disposal of domestic and industrial waste (other then approved tailings) is prohibited within a in Public Drinking Water Source Areas.	Active	15/02/2012	
25	Underground petroleum hydrocarbon and other chemical storage tanks are prohibited within Public Drinking Water Source Priority P1, P2 areas, Wellhead Protection Zones and Reservoir Protection Zones.	Active	15/02/2012	
26	Underground petroleum hydrocarbon and other chemical storage tanks are prohibited within Public Drinking Water Source Priority P3 areas, unless written approval has been obtained from the Department of Water.	Active	15/02/2012	
27	Mineral processing activities and tailings storage are prohibited within Public Drinking Water Source Priority P1 and P2 areas, Wellhead Protection Zones and Reservoir Protection Zones.	Active	15/02/2012	
28	Mineral processing activities and tailings storage are prohibited in Public Drinking Water Source Priority P3 areas unless written approval has been obtained from the Department of Water.	Active	15/02/2012	
29	Mechanical plant servicing is prohibited within Public Drinking Water Source Priority P1 and P2 areas, Wellhead Protection Zones and Reservoir Protection Zones.	Active	15/02/2012	
30	Mechanical plant servicing is prohibited in Public Drinking Water Source Priority P3 areas unless written approval has been obtained from the Department of Water.	Active	15/02/2012	
31	Mining operations in Public Drinking Water Source Areas must use dry soil extraction methods and leave an undisturbed soil profile above maximum groundwater levels as follows: • Priority 1 area - 3 metres • Priority 2 area - 2 metres • Priority 3 area - 2 metres • Future Public Drinking Water Source areas or Priority not determined areas - 3 metres.	Active	15/02/2012	
	In respect to Geomorphic Wetlands 4 the following shall apply:	Active	15/02/2012	
32	All Mining Act tenement activities prohibited within 200 metres of RAMSAR or ANCA listed wetlands unless written permission of Department of Environment and Conservation, in consultation with the Department of Water, is first obtained.	Active	15/02/2012	
33	All Mining Act tenement activities prohibited within 200 metres of "Conservation" and "Resource Enhancement" Category wetlands unless written permission of the Department of Water is first obtained.	Active	15/02/2012	
34	Abstraction of groundwater from within 500 metres of a wetland is prohibited unless authorised by the Department of Environment.	Active	15/02/2012	
	Consent to mine on State Forest 65 given subject to the following:	Active	15/02/2012	
35	Prior to commencing mining or construction activity, the lessee submitting an environmental management plan (EMP) to the Director of Environment, Department of Mines and Petroleum and to the Director General, Department of Environment and Conservation. The EMP shall be to the requirements of the Director General of the Department of Environment and Conservation.	Active	15/02/2012	
36	Unless otherwise agreed with the Director General, Department of Environment and Conservation, at least 20 working days prior to accessing State Forest, the holder providing the Director General, Department of Environment and Conservation with an itinerary and program of the locations of operations on the lease area, with at least seven days advance notice of any changes to the itinerary.	Active	15/02/2012	
37	The licensee to prepare and implement a rehabilitation plan to the satisfaction of the Director General, Department of Environment and Conservation and areas within the lease being rehabilitated to the standard and condition agreed by the Director General, Department of Environment and Conservation.	Active	15/02/2012	
38	The lessee submitting an Annual Environmental Report to the Director of Environment, Department of Mines and Petroleum and to the Director General, Department of Environment and Conservation outlining operations and rehabilitation conducted in the previous 12 months and the proposed operations and rehabilitation programs for the next 12 months. This report to be provided in February of each year.	Active	15/02/2012	
39	The tenement holder shall implement and adhere to all environmental management plans or other plans prepared in accordance with the conditions of this tenement.	Active	15/02/2012	
40	Rights being reserved to persons authorised by the Director General, Department of Environment and Conservation to enter the lease and carry out land management operations and other duties and exercise such powers as may be necessary	Active	15/02/2012	

#	CONDITIONS	Status	Start Date	End Date
	or expedient for the administration of the Conservation and Land Management Act 1984 and Regulations, the Wildlife Conservation Act 1950 and Regulations, the Bush Fires Act 1954 and Regulations and the Emergency Management Act 2005 and Regulations.			
41	The lessee taking all such necessary precautions as may be indicated by the Director General, Department of Environment and Conservation to prevent the occurrence or spread of any fire within or adjacent to the leased area.	Active	15/02/2012	
42	Access to and from, and the movement of vehicles within State Forest being restricted to roads and tracks approved by the Director General, Department of Environment and Conservation.	Active	15/02/2012	
43	Gating and fencing to be established to the reasonable requirements of the Director General, Department of Environment and Conservation.	Active	15/02/2012	
44	At the time of consideration of a Mining Proposal, the lessee to ensure that timing of extraction of sand meets the requirements of any land use development schedules as determined by the Minister for Mines and Petroleum.	Active	15/02/2012	

-- End of Report --

APPENDIX B HYDROCARBON RISK ASSESSMENT

Appendix B - Environmental Aspects & Impacts Register for Aggregate Sites

Site:	Jandabup
Completed by:	Joanna Russell
Date Completed:	13/10/2015

Hazard / Aspect	Potential Impact	Current Controls	Risk Rating With Current Controls		
			Consequence	Likelihood	Risk Rating
Plant & Vehicle Maintenance					
Vehicle & Plant Maintenance	Contamination of land or water due to fluid release during maintenance tasks.	Fluids released during machinery maintenance operations are collected and removed to an approved disposal site or are recycled.	Minor	Unlikely	Low
Vehicle & Plant Maintenance	Contamination of land or water due to fluid release during maintenance tasks.	Good housekeeping ensures that there is no spillage of oils or lubricants onto unsealed areas.	Minor	Possible	Low
Vehicle & Plant Maintenance	Air emissions due to excessive vehicle exhaust.	Mobile haulage equipment is maintained to OEM requirements to maintain emission standards. 10 second rule used as a trigger for the scheduling of repairs or maintenance.	Minor	Possible	Low
Vehicle & Plant Maintenance	Creation of noise emissions through maintenance activities	Maintenance activities that occur outside normal operating hours need to ensure that noise impacts on neighbours are minimised.	Minor	Unlikely	Low
Storage & Handling of liquid fuels and chemicals					
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facilities.	All liquid fuels and chemicals are stored in a bunded area in accordance with the Holcim Bunding Guidelines.	Minor	Unlikely	Low
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facility maintenance.	Bunded areas must be regularly maintained. This includes checking and inspecting the integrity of bund and actively minimising ponding of stormwater by regular inspection and clean out of the bund after significant rain events.	Minor	Unlikely	Low
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facility maintenance.	Maintenance of refuelling equipment is incorporated into the site maintenance schedule.	Minor	Unlikely	Low
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facility site selection.	Storage areas are located away from waterways and areas prone to flooding.	Minor	Unlikely	Low
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facility site selection.	Spill response equipment is available and maintained to allow ready use in the event of a fuel spill. All appropriate personnel have been trained in its use.	Minor	Unlikely	Low
Storage of bulk hydrocarbons					
Storage of bulk hydrocarbons (fuel)	Contamination of land or water due to release of fuel due to poor storage facilities.	All liquid fuels are stored in a self bunded, double skinned tank	Minor	Unlikely	Low
Storage of bulk hydrocarbons (fuel)	Contamination of land or water due to release of fuel due to unattended transfer.	Operators remain with their vehicle at all times during the delivery of fuel and chemicals to permit immediate response in the event of any spill or leakage.	Minor	Unlikely	Low
Storage of bulk hydrocarbons (fuel)	Contamination of land or water due to release of fuel due to poor storage facility maintenance.	Bunded areas must be regularly maintained. This includes checking and inspecting the integrity of bund and actively minimising ponding of stormwater by regular inspection and clean out of the bund after significant rain events.	Minor	Unlikely	Low
Refuelling of mobile equipment					
Refuelling of mobile equipment	Degradation of land or stored water due to fuel spillages.	Fuel delivery lines on mobile fuel carts are fitted with a breakaway coupling to avoid fuel losses in the event of a drive away incident.	Minor	Unlikely	Low
Refuelling of mobile equipment	Degradation of land or stored water due to fuel spillages.	Spill response equipment is available and maintained to allow ready use in the event of a fuel spill. All appropriate personnel have been trained in its use.	Minor	Unlikely	Low
Refuelling of mobile equipment	Degradation of land or stored water due to fuel spillages.	All spills are cleaned up promptly, reported and investigated with the generation of corrective actions as required.	Minor	Unlikely	Low
Spill Response					
Spill response	Contamination of land or water due to poor emergency response.	Spill response equipment is available and readily accessible in high-risk areas	Minor	Unlikely	Low
Spill response	Contamination of land or water due to poor emergency response.	A documented spill response procedure is in place and employees have been trained in its use.	Minor	Unlikely	Low
Spill response	Contamination of land or water due to poor emergency response equipment availability.	Spill response equipment is regularly maintained including replacement of used equipment.	Minor	Unlikely	Low
Vehicle Washdown					
Vehicle Washdown	Degradation of land due to poor washdown practices	Washing of vechiles will only occur on hard stand areas.	Minor	Unlikely	Low
Vehicle Washdown	Degradation of land due to wash down water leaving hard stand area	Hard stand area will drain to a containment sump.	Minor	Unlikely	Low
Vehicle Washdown	Degradation of land due to over flow of containment sump	Maintenance areas that will be covered to minimise the collection of runoff and risks associated with overflow. Water collected in the sump will be regularly removed by a licensed operator and disposed of at an approved waste facility.	Minor	Unlikely	Low
Waste Management					
Waste Management	Generation of wastes due to cross contamination of waste types	Wastes are appropriately segregated (e.g.. oils separated from general refuse)	Minor	Unlikely	Low
Waste Management	Non-compliance with state based legislative waste requirements.	Wastes including waste oil, batteries, filters, coolant, tyres and scrap steel are suitably stored, labelled and disposed of or recycled at appropriately licensed facilities.	Minor	Unlikely	Low
Waste Management	Non-compliance with state based legislative waste requirements.	All transport and disposal practices meet State regulations including waste tracking where required.	Minor	Unlikely	Low
Waste Management	Generation of wastes due to poor housekeeping processes	All rubbish, equipment, structures and waste material is removed on a progressive basis from the premises and recycled wherever possible or disposed of at an approved disposal site.	Minor	Unlikely	Low
Waste Management	Generation of wastes due to poor housekeeping processes	Waste is stored in an area that will not contaminate any watercourse, waterway, groundwater, wetland or lake and soil.	Minor	Unlikely	Low
Waste Management	Generation of wastes due to poor housekeeping processes	Empty drums are stored in a designated hardstand area until collected for recycling.	Minor	Unlikely	Low
Waste Management	Generation of wastes due to poor housekeeping processes	Any leakage from empty drums is contained and not permitted to enter waterways or come into contact with soil.	Minor	Possible	Low
Closure					
Spill response	Contamination of land due to poor storage of hydrocarbons	Hydrocarbon Management Plan Spill response kits and procedures Phase 1 Assessment prior to decommission Sealed maintenance pad and self bunded fuel bund	Significant	Unlikely	Low
Spill response	Contamination of water due to poor storage of hydrocarbons	Hydrocarbon Management Plan Spill response kits and procedures Phase 1 Assessment prior to decommission Sealed maintenance pad and self bunded fuel bund Groundwater monitoring during approvals, operations and closure phases	Significant	Unlikely	Low

Appendix B - Environmental Risk Matrix

Step 1 - Consider the Consequence

What are the consequences of the most reasonable worst case scenario considering a credible failure of existing controls?

Consequence	Disaster	Severe	Serious	Significant	Minor
Environment On Site & Off Site	Major event, unconfined impact, severe permanent damage with low likelihood of recovery.	Significant permanent damage; reversible damage with recovery time of years; high potential for prosecution	Minor permanent damage; temporary damage that is widespread or that has moderate impact	Damage that is near source confined, temporary and minor	No measurable damage to environment
Compliance With Legal and Other Requirements	Blatant or serious breech of legal requirement, leading to operation being suspended or severely reduced. Prosecution expected.	Breach of external requirement (license, legislation, regulation, contract etc) with high potential for prosecution and/or high impact.	Non-compliance with external requirement with moderate potential for impact.	Repeated non-compliance with internal procedure, non-compliance with external requirement with low potential impact	Minor non-compliance with internal procedures.
Community Perception and Reputation	Significant adverse media attention (state or national level), loss of reputation or work nationally or across product groups.	Prosecution, significant impacts on social license to operate, loss of reputation or ability to secure work across product groups.	Local adverse media attention, loss of reputation or ability to secure work in local area, complaints that result in changes to external requirements.	Multiple community complaints or complaints that require changes to internal operating procedures.	Community complaint resolved with no changes to existing operating procedures.

Note: Temporary environmental damage has a duration of up to approximately one week to rectify

Step 2 - Consider the Likelihood

What is the likelihood that the proposed consequence will occur with a credible failure of existing controls?

Likelihood	Certain	Likely	Possible	Unlikely	Rare
Description	Event that is expected to occur on multiple occasions	Event that is likely to occur at least once	Event that may occur	Event that is unlikely to occur	Event that may occur only in exceptional circumstances
Frequency	Event is likely to occur more than twice a year.	Event is likely to occur once or twice a year.	Event is likely to occur more than once or twice in a 10 year period	Event is likely to occur once or twice in a 10 year period	Event is likely to occur once or twice in a 100 year period

Step 3 - Determine Risk Rating from the Risk Matrix

Liklihood	Consequence				
	Disaster	Severe	Serious	Significant	Minor
Certain	High	High	High	Medium	Medium
Likely	High	High	Medium	Medium	Low
Possible	High	Medium	Medium	Low	Low
Unlikely	Medium	Medium	Low	Low	Low
Rare	Medium	Low	Low	Low	Low

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URS Australia Pty Ltd
Level 3, 3 Forrest Place
Perth WA 6000
PO Box 6004, East Perth, 6892
Australia
T: 61 8 9326 0100
F: 61 8 9326 0296

www.urs.com.au

APPENDIX G. CLOSURE PLAN (ENVIROWORKS CONSULTING, 2015C)

Closure Plan Holcim Hawkins Road Sand Quarry – Tenements M70/1248 and M70/1250

Holcim (Australia) Pty Ltd

H04 – J06

30 October 2015

Version 1

Contact:
Jo Russell, Planning & Environment Manager WA/NT
Holcim (Australia) Pty Ltd
Phone: 08 9212 2146
Email: joanna.russell@holcim.com

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REPORT DETAILS

Project Number: H04 – J06
Report Name: Closure Plan Holcim Hawkins Road Sand Quarry – Tenements M70/1248 and M70/1250

AUTHORISATION FOR ISSUE

Report Version Date**:** 30 October 2015			
Approved for Issue Director	Name: Laura Todd	Signature: 	Date: 30/10/2015

Please Note: This document is considered uncontrolled once printed.

MINE CLOSURE PLAN CHECKLIST

Please cross reference page numbers from the Mine Closure Plan where appropriate, and provide comments or reasons for No (N) or Not Applicable (NA) answers. For Mine Closure Plan revisions please indicate where updates have been made to the previous revision and a brief summary of the change.

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
1	Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist.)	Y	vi				
Public Availability							
2	Are you aware that from 2015 all MCPs will be made publicly available?	Y	52				
3	Is there any information in this MCP that should not be publicly available?	N	52				
4	If "Yes" to Q3, has confidential information been submitted in a separate document/section?						
Cover Page, Table of Contents							
5	Does the MCP cover page include: • Project Title • Company Name • Contact Details (including telephone numbers and email addresses) • Document ID and version number • Date of submission (needs to match the date of this checklist)	Y	Cover Page				*E.g. company name change*
Scope and Purpose							
6	State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements)	Y	5				*E.g. As part of Mining Proposal*
Project Overview							
7	Does the project summary include: • Land ownership details (include any land management agency responsible for the land / reserve and the purpose for which the land / reserve [including surrounding land] is being managed) • Location of the project; • Comprehensive site plan(s); • Background information on the history and status of the project.	Y	6				
Legal Obligations and Commitments							
8	Does the MCP include a consolidated summary or register of closure obligations and commitments?	Y	Appendix A				
Stakeholder Engagement							
9	Have all stakeholders involved in closure been identified?	Y	11		N		

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
10	Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?	Y	12		Y	60	*E.g. new stakeholders identified and stakeholder engagement register updated*
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	11		Y	61	*E.g. stakeholder strategy included*
Post-mining land use(s) and Closure Objectives							
12	Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram?	Y	12 & Figure 7		Y	62	*E.g. Updated closure objectives*
13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?	Y	18				
14	Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the Contaminated Sites Act 2003?	N	N/A				
Development of Completion Criteria							
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y	Appendix B		Y	62	*E.g. Completion criteria further developed*
Collection and Analysis of Closure Data							
16	Does the MCP include baseline data (including pre-mining studies and environmental data)?	Y	22				
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	Y	23 and 37				
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	Y	35				
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	35 & 38				
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	41		Y	64	*E.g. MCP updated as a new Mining Proposal was submitted*
Identification and Management of Closure Issues							
21	Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y	35, 38 & Appendix D				
22	Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues?	Y	37 & Appendix C				

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
Closure Implementation							
23	Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y	38		Y	66	*E.g. Updated as a new Mining Proposal for the operation was approved*
24	Does the MCP include a closure work program for each domain or feature?	Y	38				
25	Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?	Y	Figures 2 to 5				
26	Does the MCP contain a schedule of research and trial activities?	Y	42				
27	Does the MCP contain a schedule of progressive rehabilitation activities?	Y	42				
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	43				
29	Does the MCP contain a schedule of decommissioning activities?	Y	43				
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y	44				
Closure Monitoring and Maintenance							
31	Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?	Y	45 to 47				
Financial Provisioning for Closure							
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	48		Y	67	*E.g. Costings updated to reflect current market values*
33	Does the MCP include a process for regular review of the financial provision?	Y	**Error! Bookmark not defined.**				
Management of Information and Data							
34	Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?	Y	51				

Corporate Endorsement:
"I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of Mines."

Name: Jo Russell **Signed**: 

Position: Planning & Environment Manager – WA/NT **Date**: 30 October 2015

(NB: The corporate endorsement must be given by tenement holder(s) or a senior representative authorised by the tenement holder(s), such as a Registered Manager or Company Director)

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EXECUTIVE SUMMARY

Holcim (Australia) Pty Ltd (Holcim) proposes to develop a Sand Quarry on tenements M70/1248 and M70/1250, located in Jandabup north of Perth, approximately 8 km north east of Wanneroo and within the Local Government Area of Wanneroo (Figure 1).

Up to 1,200,000 tonnes is proposed to be extracted annually. It is estimated approximately 30,000,000 tonnes will be extracted over the 25 year quarry life. Up to 1,000,000 tonnes is proposed to be screened annually. The sand will be screened onsite and then trucked offsite Holcim concrete plants and/or customer locations.

This Conceptual Mine Closure Plan (Closure Plan) has been prepared to meet the Department of Mines and Petroleum (DMP) *Guidelines for Preparing Mine Closure Plans, June 2011* (Department of Mines and Petroleum, 2015) and follows the Holcim Closure principles. It has been developed to provide more certainty to the long-term elements of the mine planning cycle and to provide greater flexibility around the shorter term mine planning. The Closure Plan document will be updated through the life of the mining operation.

The proposed guiding closure principles for the quarry operations are summarised as follows:

- All buildings and infrastructure will be removed from site;
- All rubbish, debris, improvements or alterations associated with Holcim operations will be removed;
- There should be no significant, physical off-site impacts;
- Landforms remaining after mining should be stable and in keeping with others in the region;
- The established vegetative cover will be self-sufficient and minimise erosion;
- Any final excavation face is left safe with all loose material removed and the side sloped to a batter of not more than 1 in 3 m s; and
- There should be no unsafe areas where members of the general public could be exposed to health and safety risks resulting from inadequate mine closure.

Closure data gaps which have been identified through this Closure Plan are outlined in Table E1 below.

Table E1: Closure Data Gaps

Area of Closure	Data Gaps	Proposed Actions to Obtain Data
Closure Implementation Plan	A broad plan of closure implementation is included in Section 9 of this Closure Plan. However a detailed plan and schedule of specific tasks and milestones has not yet been finalised.	A more detailed plan of closure implementation will be completed within 5 years. However finalisation of this may not occur for 10 years given detailed scheduling will be conducted closer to the end of mine life which is 25 years away.
Monitoring and Maintenance Schedule	A framework for monitoring and maintenance post closure is included in Section 10 of this Closure Plan. However a detailed schedule of specific tasks and milestones has not yet been finalised.	A more detailed schedule of post closure monitoring and maintenance will be developed within 5 years. However finalisation of this may not occur for 10 years given detailed scheduling will be conducted closer to the end of mine life which is 25 years away.

Area of Closure	Data Gaps	Proposed Actions to Obtain Data
Closure Monitoring and Maintenance Program	A framework for monitoring and maintenance post closure is included in Section 10 of this Closure Plan. However detailed processes and procedures have not yet been developed.	A conceptual Closure Monitoring and Maintenance Program will be developed within 5 years including: • A schedule of required activities. • Monitoring methodology (including detailed procedures). • Quality control (including a specific procedure). • A remedial strategy, should monitoring indicate inadequate performance of closure activities (a documented remediation strategy). However finalisation of this program may not occur for 10 years given detailed planning will be conducted closer to the end of mine life which is 25 years away.
Rehabilitation / Revegetation Trials	Given mining has not commenced, there has not yet been an opportunity to carry out and monitoring rehabilitation/revegetation trials.	Once areas are available for rehabilitation, trials will commence and will be monitored.
Methodology for Restoration of Pine Plantation into Native Vegetation	Holcim has commenced gathering information on Restoration of Pine Plantation into Native Vegetation as described in Section 7.2.1. However its full methodology for rehabilitation of native vegetation has not yet been developed in detail.	It is expected that a detailed methodology for Restoration of Pine Plantation into Native Vegetation will be developed and refined during the first 10 years of the mine life, through rehabilitation trials and progressive rehabilitation monitoring and refinement.

Key closure risks identified to date and management programs/plans in place or proposed are outlined below in Table E2.

Table E2: Key Closure Risks and Management Issues

Closure Risk	Management Measure
Unsuccessful re-vegetation	This Closure Plan: • Closure implementation strategies as outlined in Section 9 of the Closure Plan and re-vegetation processes as outlined in Appendix E of the Closure Plan will ensure the success of rehabilitation so that a suitable native vegetative cover is established. • If the end land use changes to require other than native vegetation establishment this objective will be revisited.
Contamination of soil or groundwater (contaminated sites)	• The storage, handling and disposal of hazardous materials will be undertaken in a manner that complies with all relevant legal requirements. • No bulk storage of hazardous substances or dangerous goods will occur on site (except fuel). • Storage of minor quantities of hazardous substances and dangerous goods will only occur in designated areas, which are appropriately signed, bunded or contained. These areas are to be maintained in a clean and tidy state to minimise potential for spills or littering. • All hydrocarbons (grease, fuel, oils and lubricants) will be contained within bunds according to the requirements of Australian Standard 1940. • Hydrocarbons and other hazardous materials shall not be delivered to on site storage areas without appropriate bunding/containment. • Controlled wastes (including waste oil) will be collected and disposed of in accordance with the *Environmental Protection (Controlled Waste) Regulations 2004* which requires:

Closure Risk	Management Measure
	o A licensed contractor to remove, transport and dispose of controlled wastes o Sufficient information be provided to enable categorisation of the waste and selection of an appropriate disposal site o Waste types and packaging to be suitable for transportation prior to collection. • Soil contaminated by hydrocarbons will be segregated into designated sites for storage, then removed from site. • Hydrocarbons and oily wastes (e.g. fuels, greases, de-greaser, emulsified oils and oily waste water) are to be managed using the following practices: o Minimal generation of waste and associated contaminants o Appropriate storage and handling procedures o Segregation of hydrocarbon waste from stormwater and other water o Clean-up procedures for spills. • Regular housekeeping and inspections of dangerous goods and hazardous substances will occur to ensure that storage and handling is appropriate. • Material Safety Data Sheets (MSDS) will maintained and easily accessible/located on-site for all hazardous substances and dangerous goods stored on site. • The workforce will be trained on handling dangerous goods and hazardous substances in line with associated MSDS. • A Spill Response Procedure will be implemented by Holcim. • Hydrocarbon/hazardous material spills will be reported in accordance with Holcim Incident Management Procedures. • Appropriate emergency equipment (including spill kits) will be made available on-site and replenished when required. • All spills will be immediately contained and cleaned up. All wastes from clean-up will be appropriately stored and disposed. • All site personnel will receive training on the Spill Response Procedure. • Copies of the Spill Response Procedure will be available with spill kits and in designated storage areas. • The Site Supervisor shall: o Provide advice in a timely nature as required by personnel regarding the management of hydrocarbons. o Ensure changes to management requirements are communicated to the workforce. o Ensure inspections are done on hydrocarbon storage areas. o Ensure training on Hydrocarbon Management is made available for operational personnel. • All hydrocarbon, dangerous goods and hazardous substance management measures will be incorporated into the Environmental and Water Management Plans.
Disturbance of Acid Forming Material (Generation of Acid Drainage)	This Closure Plan and Mining Proposal: • Holcim will avoid disturbance of high ASS risk areas. Holcim commits to the exclusion of mining from a 100 metre buffer around mapped high to moderate risk ASS soils (including 100 metres around all wetlands whether mapped as high to moderate risk or not). • If mining is proposed within the 100 metre buffer, Holcim commits to the provision of a management plan which will include the results of ASS investigations and will incorporate the results into management strategies to be presented with a new mining proposal to be submitted for approval. • Excavation will not intersect the water table. Excavation depth is limited to 3m above maximum groundwater level determined by URS (2015a). • All ASS management measures will be incorporated into the Environmental and Water Management Plans.
Disruption of Surface or Groundwater	This Closure Plan and Mining Proposal: • Tree stumps will be retained as long as possible to assist soil stabilization. • A buffer zone of 100 m will be maintained between operations and naturally vegetated geomorphic wetlands. • Stockpiles of erodible material will be located away from roads and pavements to minimise sediment transport in runoff. • Each stage will be progressively rehabilitated at completion.

Closure Risk	Management Measure
	• Vegetative cover will be established to minimise erosion. • Holcim will provide spill response equipment at the site. • Bunds will be established along the access road to contain stormwater runoff and settle out sediment. • Hydrocarbon and chemical management measures will ensure surface water and groundwater contamination does not occur. • Excavation depth is limited to 3m above maximum groundwater level determined by URS (2015a). • Waste management will ensure that all wastes are disposed of appropriately minimising the risk of surface water and groundwater contamination. • All water management measures will be incorporated into the Environmental and Water Management Plans. • Appropriate groundwater monitoring will be undertaken. • At closure, any hard stand surfaces will be removed and used to recontour the landscape.

1 SCOPE AND PURPOSE

1.1 SCOPE

Holcim (Australia) Pty Ltd (Holcim) proposes to develop a Sand Quarry on tenements M70/1248 and M70/1250, located in Jandabup north of Perth, approximately 8 km north east of Wanneroo and within the Local Government Area of Wanneroo (Figure 1).

Up to 1,200,000 tonnes is proposed to be extracted annually. It is estimated approximately 30,000,000 tonnes will be extracted over the 25 year quarry life. Up to 1,000,000 tonnes is proposed to be screened annually. The sand will be screened onsite and then trucked offsite Holcim concrete plants and/or customer locations.

This Conceptual Mine Closure Plan (Closure Plan) has been prepared to meet the *Guidelines for Preparing Mine Closure Plans, June 2011* (Department of Mines and Petroleum, 2015). It has been submitted as part of the 2015 Mining Proposal for the Holcim Hawkins Road Sand Quarry.

The aim of the mine closure guideline is to ensure that, for every mine in WA, a planning process is in place so the mine can be closed, decommissioned and rehabilitated in an ecologically sustainable manner consistent with agreed post-mining outcomes and land uses without unacceptable liability left to the State (Department of Mines and Petroleum, 2015).

1.2 PURPOSE

The closure plan follows the Holcim closure principles and will be updated through the life of the quarry operation.

The excavation sequence will be optimised within the constraints of the closure objectives of the plan. This plan proposes closure principles that will guide the management of quarry landforms, water resources, re-vegetation, infrastructure and support facilities throughout the life of the operations.

The proposed guiding closure principles for the quarry operations are summarised as follows:

- There should be no significant, physical off-site impacts;
- Landforms remaining after mining should be stable and in keeping with others in the region;
- The established vegetative cover will be self-sufficient and minimise erosion;
- Any final excavation face is left safe with all loose material removed and the side sloped to a batter of not more than 1 in 3 m; and
- There should be no unsafe areas where members of the general public could be exposed to health and safety risks resulting from inadequate mine closure.

2 PROJECT OVERVIEW

2.1 LAND OWNERSHIP

Tenement number M70/1329 is held by Holcim.

2.1.1 CONTACT DETAILS

The contact details for the proponent are listed below:

Jo Russell
Planning & Environment Manager – WA/NT
Phone 08 9212 2146
Fax 08 9212 2002
Mobile 0429 791 431
Email joanna.russell@holcim.com
18 Brodie Hall Drive Bentley WA 6102
PO Box 1269 Bentley DC WA 6983

2.2 LOCATION AND SITE PLANS

The proposed quarry is located within Gnangara-Moore River State Forest in the City of Wanneroo. Tenements M70/1248 and M70/1250 fall within the Gnangara Pine Plantation, which has been progressively harvested since 2003 until the current time. The proposed project is located north of Perth, approximately 8 km north east of Wanneroo, within the Local Government Area of the City of Wanneroo (Figure 1).

Proposed site layout plans are provided as follows:

- Figure 1: Location
- Figure 2: Site Layout
- Figure 3: Site Compound Layout
- Figure 4: Mine Staging Plan
- Figure 5: Site Access Routes.

2.3 OVERVIEW OF OPERATIONS

2.3.1 HISTORY

The project area is located within the banksia woodland belt of the Swan Coastal Plain (SCP). The native vegetation was cleared approximately 85 years ago to establish the Gnangara Pine Plantation. The pine plantation is being progressively harvested as part of the Gnangara Sustainability Strategy (GSS), which is a joint project between the Department of Water (DoW), Department of Agriculture and Food WA (DAFWA), Department of Parks and Wildlife (DPaW), Department of Planning (DoP), Forest Products Commission (FPC), Water Corporation and CSIRO (Department of Water, 2009b). The GSS is a State Government initiative which aims to provide a framework for a whole of government approach to address land use and water planning issues associated with the Gnangara groundwater system. Three pine plantations have been targeted for harvesting by 2029. The project area has not been previously mined or excavated.

2.3.2 EXISTING FACILITIES

There are some unsealed roads that transect the project area. These are vested with the Department of Parks and Wildlife. There are also some unsealed tracks, likely used by logging contractors and recreational Four-Wheel Drives (4WDs).

There is no scheme water supply to the site. Bottled water will be supplied to staff as drinking water. Rainwater will be captured and stored onsite. Additional water will be sourced as describe in Section 3.10.

Power will be supplied by either diesel generators or grid connection where possible.

Existing public road infrastructure will be utilised.

2.3.3 PREDICTED MINE LIFE

Up to 1,500,000 tonnes is proposed to be extracted annually. It is estimated approximately 47,000,000 tonnes will be extracted over the 25 year quarry life.

2.3.4 PROPOSED MINING OPERATIONS KEY COMPONENTS

The key components of the proposed project area are:

- Excavation areas
- Rehabilitation areas
- Stockpiles for topsoil
- Stockpiles of sand product
- Access roads
- Site compound
- Workshop/fuel storage area
- Weighbridge
- Screening plant.

A summary of the proposed project components is presented in Table 1 and Figures 2 – 5.

Table 1: Project Key Characteristics

Project Component	Characteristic
Excavation	
Life of quarry	25 years
Annual material excavated	Up to 1,200,000 tonnes of sand
Total estimated material excavated	Up to 30,000,000 tonnes of sand
Total area of quarry footprint	357.8 ha
Maximum depth of mining above groundwater table	Excavation depth is limited to 3m above maximum groundwater level determined by URS (2015A).
Processing	
Annual material screened	Up to 1,000,000 tonnes of sand
Total material screened	Up to 25,000,000 tonnes of sand
Indicative Machinery List	
Water cart	Either 40000 or 12000 L capacity, used for dust suppression of haul road, pit floor and stockpiles.
Front end loaders	Two Komatsu 470 loaders or similar.

Project Component	Characteristic
Grader	One CAT 14H grader or similar. For maintaining roads on an as required basis.
Light vehicles	Two for site operators.
Power generation	Western Power Grid supply off Hawkins Road and/or diesel generators
Screening Plant	The screening plant and stockpiling conveyor are track mounted mobile units and move with the quarry faces sand is excavated.
Water supply	Bottled water will be supplied to staff as drinking water. Rainwater will be captured and stored onsite. It is currently planned to source water for dust suppression, from a groundwater source being negotiated with DoW. Holcim will obtain necessary approvals for any water supply bores as required.
Transport	
Truck movements and hours	Approximately 150 loaded and return truck movements each per day of operation (depending on truck size).
Workforce	
Operation	4-5 personnel during operation
Hours of operation	0700 to 1700 Monday to Saturday (excluding public holidays)

2.3.5 SITE LAYOUT

Proposed site layout plans are provided as follows:

- Figure 1: Location
- Figure 2: Site Layout
- Figure 3: Site Compound Layout
- Figure 4: Mine Staging Plan
- Figure 5: Site Access Routes.

2.3.5.1 SUPPORTING INFRASTRUCTURE

Supporting infrastructure comprises of

- laydown area;
- fuel storage facility;
- site office and carpark;
- lunch room and ablutions;
- weighbridge and wheel wash facility; and
- power and communication lines.

During operations, temporary sand stockpiles are located within the extraction area prior to being loaded on to trucks and removed off site. Sand is either; extracted and directly loaded onto trucks, or undergoes a process of screening and washing. A process of screening is required for concrete sand and some construction sand products. A mobile screening is located at the site along with its own generator.

Once loaded onto trucks, the sand is weighed at the weighbridge facility and transported to customer locations offsite. Trucks are required to drive through a wheel wash bay, prior to leaving site. The wheel wash facility contains one bay with a containment apron and a wheel wash bay with a drive-in sump and an oil water separator. Water is collected in a closed-circuit system before being re-used for wheel washing. The wheel wash facility is lined by concrete. A demountable office will also be located at the weighbridge.

Supporting infrastructure associated with the Project includes lunch room with supporting ablution block, car park, laydown area and fuel storage facility, truck wash out bay and power and communication lines. A fenced laydown area no larger than 0.4 ha, will be used for the storage of heavy equipment and fuel. A lunch room with ablution facilities will be located alongside the maintenance area.

2.3.6 PROPOSED DISTURBANCE

The total mine footprint will be approximately 407 ha. The table below details the disturbance area. It should be noted that the project will cause no new disturbance as it is proposed in a previously disturbed pine plantation area.

Table 2: Areas of Proposed Disturbance (all within previously cleared pine plantation)

Description	Tenement M70/1248 Proposed Disturbance (ha) – within cleared pine plantation	Tenement M70/1250 Proposed Disturbance (ha) – within cleared pine plantation	Total Disturbance (ha)
Mining Area	135	211.8	346.8
Site and Infrastructure Compounds	1	0	1
Internal Site Roads	5	5	10
Tenement Total Disturbance (ha)	**141**	**216.8**	**357.8**
Tenement Undisturbed Area (ha)	**33.6**	**77.2**	
Tenement TOTAL Area (ha)	**174.6**	**294**	

2.4 WASTE ROCK AND PROCESSING WASTE

Waste material from mining and screening will be mostly organic material leftover from pine stumps, and rocky oversize material. The sand will be screened and the oversize fraction will be stockpiled. This will be returned to the pit during rehabilitation of each stage.

The screening plant and stockpiling conveyor are track mounted mobile units and move with the quarry faces sand is excavated. Other than the screening of sand, there is no processing proposed. Therefore there will be no tailings or other processing wastes produced.

3 IDENTIFICATION OF CLOSURE OBLIGATIONS AND COMMITMENTS

Mine closure planning should be an integral part of mine development and operations planning and as such the level of information required will correspond to the life span of the mine and reflect the various stages of the life cycle of the project (Department of Mines and Petroleum, 2015).

In WA, the main legislative obligations and potential liabilities are created under the *Mining Act 1978* (Mining Act), *Mines Regulations Act 1946* and *Mines Safety and Inspection Regulations 1995*, administered by the DMP. All mining operations in WA are also subject to the *Environmental Protection Act 1986* (EP Act). The EP Act overrides all other Acts, including the Mining Act and is administered by the Environmental Protection Authority (EPA) and the Department of Environment and Regulation (DER). An approval to mine issued under the Mining Act does not override the requirements to obtain an environmental approval under the EP Act. Consequently, the requirements of both Acts and their regulators must be satisfied.

A number of closure legal obligations also exist within regulatory instruments relevant to the operation including:

- Mining Act tenement conditions; and
- Approvals submissions prepared by Holcim.

These legal obligations have been collated within Appendix A, the Closure Legal Obligations Register.

4 STAKEHOLDER ENGAGEMENT

4.1 STAKEHOLDER ENGAGEMENT STRATEGY

4.1.1 IDENTIFICATION OF STAKEHOLDERS

The key stakeholder relevant to the approval and closure planning of the quarry has been identified as the Department of Mines and Petroleum (DMP).

Other relevant stakeholders include:

- Department of Parks and Wildlife (DPaW)
- City of Wanneroo
- Department of Water (DoW)
- Department of Environment and Regulation (DER)
- Environmental Protection Authority (EPA).

4.1.2 PROCESS

The process utilised for stakeholder consultation includes:

- The development of a stakeholder database.
- Providing information to all stakeholders on the project.
- Seeking feedback from stakeholders on potential environmental and social impacts, impact management and project design.
- Documentation of all issues raised and how they have been considered during project development.
- Consideration of all issues raised in project design and management plans.

Methods used to facilitate consultation include:

- Letters
- Emails
- Phone Discussions
- Meetings.

4.1.3 ENAGEMENT PRIOR TO NEXT REVISION OF CLOSURE PLAN

Prior to the next revision of the Mine Closure Plan the following stakeholder engagement will be undertaken:

- Meet with relevant stakeholders to discuss Closure Plan status, end land use, completion criteria and current rehabilitation status/success.
- Obtain feedback at these meetings from stakeholders regarding required updates to the Closure Plan.
- Provide relevant draft sections of Closure Plan to each stakeholder for review prior to submission of revised Closure Plan.
- If necessary make further changes to Closure Plan as result of stakeholder reviews, prior to submission of revised Closure Plan.

4.2 STAKEHOLDER CONSULTATION TO DATE

To date the proponent (Holcim) have made a number of contacts with stakeholders and plans to build on this platform of communication through ongoing consultation. The details of stakeholder consultation undertaken to date is outlined in Table 3 below.

Table 3: Consultation Register

Stakeholder	Who Was Consulted	Date	Method	Topics Discussed	Issues Raised by Stakeholder	Outcome / Response
DoW	Amy Evangelista Natural Resource Manager	25/11/15	Meeting	Overview given of proposed project and proposed groundwater studies	DoW nominated initial contact points for further discussions. DoW provided advice on: - Methodology for determination of MGL – level needs to be carefully considered given changing land use and rainfall patters. - Management of wellhead protection zones (WHPZ's) for existing water corp bores in the area discussed - Baseline water quality monitoring - Water Source Planning – Holcim should plan for a water source for dust suppression - Hydrogeological assessment – Holcim should use the "composite scenario" when assessing future water table elevations.	Holcim made note of designated contact points and other DoW advice. DoW advice was incorporated into planning groundwater assessment and management for the project.
DoW	Amy Evangelista Natural Resource Manager	3/12/15	Email	Memo emailed to DoW covering the drilling and monitoring bore construction activities planned by Holcim at their Jandabup Project site	DoW agreed that the monitoring program should proceed and indicated the bores construction could commence	Holcim commenced construction of monitoring bores
DoW	Amy Evangelista Natural Resource Manager	16/1/15	Email	DoW advised that: - Extractive industry is permissible in P1 Drinking Water Source Area if there is sufficient clearance above water table and sufficient environmental management. - DoW recommended a Water Management Plan be developed - The quarry should not be located in a WHPZ	Holcim noted DoW advice and committed to development of a Water Management Plan	N/A

Stakeholder	Who Was Consulted	Date	Method	Topics Discussed	Issues Raised by Stakeholder	Outcome / Response
DoW	Amy Evangelista Natural Resource Manager	23/2/15	Email	Holcim provided two reports to DoW: - Phase 1 Desktop Study and Recommendations - Phase 3 Monitoring Bore Completion Report	DoW indicated it was generally happy with the proposed monitoring program, however sought clarification on the duration of monitoring.	Holcim clarified that monitoring would be ongoing for the life of the project.
DoW	Amy Evangelista Natural Resource Manager	4/6/15	Email	Holcim provided DoW with correspondence from Water Corporation showing that the watercorp bores within the project are no longer used and proposed removal of the WHPZ.	DoW confirmed that the WHPZ's could be removed and indicated it would investigate the process to do so.	N/A
DoW	Bree Lyons Natural Resource Management Officer	16/7/15	Email	Well head protection zone (WHPZ), separation to MGL and determination of MGL.	DoW advised that: -It would investigate removal of WHPZ -3m separation to MGL will be required. DoW provided advice on how MGL should be determined.	Holcim requested further clarification on the methodology to determine MGL
DoW	Bree Lyons Natural Resource Management Officer	16/7/15	Email	Holcim requested further clarification on determination of MGL. Based on discussions with DoW hydrogeologists Holcim propose determination of MGL using long term data to establish a future predicted MGL based on a set of pre-defined criteria using an agreed model.	N/A. Holcim requested a meeting to discuss further.	Meeting arranged for 28/7/15
DoW	James Mackintosh Program Manager Land Use Planning Swan Avon Region	28/7/15	Meeting	DoW advised that contrary to previous advice, the WHPZs will remain, irrespective of any discussions and correspondence that have been had with the Water Corporation. Discussion was held regarding the methodology for determination of MGL.	Although the WHPZs will remain, this will not preclude mining by Holcim as no activities are planned to extent below the water table provide appropriate management is in place.	Holcim committed to provide DoW with proposed MGL assessment methodology for review after the meeting.
DoW	James Mackintosh Program Manager Land Use Planning Swan Avon Region	5/8/15	Email	Memo provided to Water Protection Branch outlining proposed approach for ongoing groundwater assessment and determination of MGL.	DoW responded indicating that the proposed approach for ongoing groundwater assessment and determination of MGL was acceptable, and that DoW will do PRAMS modelling to verify the results.	Holcim commenced the ongoing groundwater assessment and determination of MGL via modelling.

Stakeholder	Who Was Consulted	Date	Method	Topics Discussed	Issues Raised by Stakeholder	Outcome / Response
DoW	James Mackintosh Program Manager Land Use Planning Swan Avon Region	17/9/15	Meeting	DoW advised that they are close to completing their latest update to the PRAMS model and that this will provide the foundation for the determination of an MGL for the Holcim Jandabup Project.	The Holcim groundwater assessment will be submitted in November with the Mining Proposal. DoW advised that the Project's groundwater assessment and adopted model would be reviewed by the DoW with a view to resolve differences relating to regional changes predicted by PRAMS once those results were available	N/A
DoW	Carlie Slodecki Land Use Planning – Swan Avon Region	22/10/15	Phone Email	Fuel Storage	5000 litres is the total volume (of all tanks) permitted in a P1 area, which is substantiated by the following statement (highlighted below) in *Water Quality Protection Note No. 56 - Tanks for elevated chemical storage* (DoW, 2006). Therefore if Holcim are proposing to store greater than 5,000 L, in accordance with the policy, justification of special circumstances warranting additional storage and assessment of environmental risk and mitigation measures must be submitted by the proponent to the DoW for approval (which can be addressed in the required Water Management Plan).	Additional fuel storage will be requested in the water Management Plan.
City of Wanneroo	Josh Coppola Planning Advisor: Extractive Industries	22/10/15	Meeting	• Drilling program • Project update • Traffic management • Environmental impacts • Community engagement, door knocking local residents	Assess the Traffic Impact will be assessed once the assessment is finalised. The City of Wanneroo believes a Development Approval is required, Holcim have received conflicting advice.	Holcim will send a copy of the community information sheet to the Planning department and Councillors
City of Wanneroo	Josh Coppola Planning Advisor: Extractive Industries	13/4/15	Meeting	• Project Background • Traffic management • Environmental impacts • Community engagement	The City recommends that Holcim: • Assess the Traffic Impact as required.	Holcim have conducted a traffic study which will be provided to the City for review.
EPASU	Mark Jefferies Manager Mining and Industrial Assessments	25/5/15	Email	Requested a meeting to discuss proposed Jandabup Quarry	Agreed to meet	Meeting set for 10/6/15
EPASU	Mark Jefferies Manager Mining and Industrial Assessments	9/6/15	Email	Emailed briefing note, intended for discussion at meeting the following day	N/A	N/A

Stakeholder	Who Was Consulted	Date	Method	Topics Discussed	Issues Raised by Stakeholder	Outcome / Response
EPASU	Mark Jefferies Manager Mining and Industrial Assessments	10/6/15	Meeting	Discussed Briefing Note on Proposed Jandabup Sand Quarry. Discussed Perth to Peel Strategic Assessment and likely end land use.	Indicated briefing note contained useful information on project key characteristics and environmental factors. Confirmed it was Holcim's decision on whether to refer the project to the EPA. Indicated that if Holcim chose not to refer the project, DMP would discuss the Mining Proposal and need for referral with EPA.	Holcim indicated it would consider the need for referral to the EPA. If Holcim decides not to refer to the EPA, it understands that DMP will discuss this with EPA on receipt of the Mining Proposal.
EPASU	Richard Sutherland Principal Environmental Officer, Mining and Industrial Assessments (South)	23/9/15	Meeting	Discussed whether the project required referral to the EPA under Section 38 of the EP Act because the tenements fall within the *Environmental Protection (Gnangra Mound Crown Land) Policy (EPP) (1992).*	Project does require referral due to the EPP.	Holcim committed to refer the project to EPA.
DPaW	Dan Coffey Area Manager South, Environmental Management Branch	13/5/15	Phone Call	Requested meeting to discuss proposed Jandabup Quarry	Agreed to meet	Meeting set for 12/6/15
DPaW	Dan Coffey Area Manager South, Environmental Management Branch	11/6/15	email	Emailed briefing note, intended for discussion at meeting the following day	N/A	N/A
DPaW	Dan Coffey Area Manager South, Environmental Management Branch	12/6/15	Meeting	Discussed briefing note and intended end land use. Discussed proposed rehabilitation methods.	DPaW suggested that Holcim prepare a Rehabilitation Plan and provide to DPaW for comment, prior to submission of Mining Proposal. DPaW also suggested that Holcim collaborate regarding rehabilitation research with other companies operating in the area.	Holcim agreed to provide rehabilitation plan to DPaW prior to submission of Mining Proposal. Holcim also indicated it would collaborate with other companies in area on rehabilitation research.
DPaW	Dan Coffey Area Manager South, Environmental Management Branch	22/7/15	Email	Provided a copy of the Draft Rehabilitation Plan for comment by DPaW	Verbal feedback provided on plan by phone. DPaW enquired about additional completion criteria.	Feedback incorporated into plan. Holcim responded that additional completion criteria will be provided to DPaW for comment within the Closure Plan.
DPaW	Dan Coffey Area Manager South, Environmental Management Branch	22/7/15	Email	Draft Rehabilitation Plan	• Additional completion criteria required. • Rehabilitation Plan should be incorporated into Mine Closure Plan	Feedback incorporated into plan. Holcim responded that additional completion criteria will be provided to DPaW for comment within the Closure Plan.

Stakeholder	Who Was Consulted	Date	Method	Topics Discussed	Issues Raised by Stakeholder	Outcome / Response
DMP	Clare Grosser Team Leader, Operations Environment	10/6/15	Email	Requested meeting to discuss proposed Jandabup Quarry	Agreed to meet	Meeting set for 15/6/15
DMP	Clare Grosser Team Leader, Operations Environment	10/6/15	email	Emailed briefing note, intended for discussion at meeting the following day	N/A	N/A
DMP	Clare Grosser Team Leader, Operations Environment	15/6/15	Meeting	Discussed briefing note and intended end land use. Discussed proposed rehabilitation methods. Discussed consultation that has occurred with other regulatory stakeholders. Discussed proposed environmental management.	DMP indicated that Holcims regulatory consultation and proposed environmental management seemed adequate to date. DMP indicated it would discuss the need for referral with EPA once the Mining Proposal was received. DMP indicated Holcim should consider submitting clearing permit application ASAP to ensure this is in the system early.	Holcim indicated it was planning on submitting the Mining Proposal in the next few months and it would submit the clearing permit application in the next few weeks.
DMP	Clare Grosser Team Leader, Operations Environment	25/9/15	Meeting	Discussed whether the project required referral to the EPA under Section 38 of the EP Act because the tenements fall within the *Environmental Protection (Gnangra Mound Crown Land) Policy (EPP) (1992).*	Project does require referral due to the EPP.	Holcim committed to refer the project to EPA.
FPC	Andrew Milne FPC	17/6/15	Meeting	Advised FPC of Holcim Proposed Jandabup Quarry	No issues raised, but asked to be kept informed of planned access routes.	Holcim indicated it would keep FPC informed of planned access routes.
DIA	Cesar Rodriguez, Manager Advice and Approvals	16/6/15	Meeting	Advised DIA of Proposed Jandabup Quarry	No issues raised, but indicated consultation with relevant indigenous representatives should take place.	Holcim plan to undertake a Heritage Study which will include consultation with relevant indigenous representatives.

Stakeholder	Who Was Consulted	Date	Method	Topics Discussed	Issues Raised by Stakeholder	Outcome / Response
Neighboring Residents	Residents on Townsend Road, Hawkins Road, Wirrega Road, Panini Way.	October	Door knocking	Summary of the Proposed Jandabup Quarry	Residents mainly raised concerns over the visual amenity, dust, noise, hours of operation and truck routes. 3 residents mentioned the article in the West Australian on the 7th of October, 2 did not appear to have concerns. One was concerned that the bores would be extracting water. 3 residents mentioned that they had not been consultant when the neighbouring operation was approved. 2 residents mentioned the drying of Lake Jandabup from the pine plantation. 5 residents raised concerns over illegal dumping and off road vehicle use in the area.	Truck movements are limited by mine pit opening time at 7am. Operations will be undertaken from 0700–1700 Monday - Saturday (excluding public holidays) only. A 300 m buffer will be maintained between the proposed quarry and all residents, this includes a 200m strip of vegetation to screen the operation HAUS has water trucks and sprinklers to reduce dust levels. A noise assessment determined that the operation will operate within the Australia Noise Limits. A hotline will be established for residents to call if they have complaints during operations.

5 POST-MINING LAND USE AND CLOSURE OBJECTIVES

5.1 POST-MINING LAND USE

The post-mining land use will be discussed with relevant stakeholders and incorporated into this Closure Plan.

The pine plantation is being progressively harvested as part of the Gnangara Sustainability Strategy, which is a joint project between the Department of Water, Department of Agriculture and Food WA, Department of Parks and Wildlife, Department for Planning and Infrastructure, Forest Products Commission, Water Corporation and CSIRO (Department of Water, 2009b). The Gnangara Sustainability Strategy is a State Government initiative which aims to provide a framework for a whole of government approach to address land use and water planning issues associated with the Gnangara groundwater system. Three pine plantations have been targeted for harvesting by 2029.

The Gnangara Sustainability Strategy and the East Wanneroo Structure Plan indicate the eastern portion of the tenement is designated for post pine banksia rehabilitation or parkland, with an area in the western portion of the tenement remaining subject to further planning (Figure 6). In addition, land use planning for the area is broadly is being addressed through the Strategic Assessment of the Perth and Peel Regions (SAPPR) (Department of Premier and Cabinet, Under Development). Public release of the draft SAPPR documents, including a Strategic Conservation Plan (SCP) and Impact Assessment Report, is expected early 2016.

In the absence of any changes to end use it has been determined that the whole site is to be rehabilitated to native woodland. In the event that the proposed end use changes, this approach will need to be revised. The proposed mine is expected to have a life of 25 years. The land will be rehabilitated progressively in accordance with the rehabilitation plan agreed upon with DPaW.

Therefore, Holcim will:

- Establish a safe and stable land surface which supports native vegetation growth focussing on providing food resource for Carnaby's Cockatoo.
- Revegetate the mine landforms to establish vegetation appropriate for the area and final land use.

5.1.1 POTENTIAL LEGACIES THAT MAY RESTRICT POST-MINING LAND USE

There are no major legacies known that will restrict the post mining land use. Evaluation of potential closure issues and the reason they are not considered to be legacies is outlined below in Table 4.

Table 4: Analysis of Potential Legacies

Potential Legacy	Analysis
Final Voids	Any final excavation face is left safe with all loose material removed and the side sloped to a batter of not more than 1 in 3 m, final proposed contours shown in Figure 7.
Acid Forming Material	It is unlikely that any existing ASS will be exposed. Therefore this is unlikely to present a legacy.
Unsuccessful Re-vegetation	Re-vegetation processes as outlined in Appendix E will ensure the success of rehabilitation so that a suitable vegetative cover is established.
Contaminated Sites	Fuels and chemicals will be stored appropriately and any spills or leaks from machinery will be cleaned up immediately. Contaminated absorbent material will be disposed of in accordance with legal requirements and contaminated soil will be taken offsite by a licensed waste contractor in accordance with relevant legislation. Contaminated absorbent

Potential Legacy	Analysis
	material and soil will be disposed of to a licensed landfill facility. Therefore contaminated sites are unlikely to occur as a legacy for closure.

5.2 CLOSURE OJECTIVES

Closure objectives have been developed are documented in Table 5 below.

Table 5: Closure Objectives

Area	Objective
Compliance	• All legally binding conditions and commitments relevant to rehabilitation and closure will be met.
Landforms	• Within the constraints imposed by the physical nature of the materials, design the final landform to be similar to the existing regional landforms and suitable for the chosen end land use. • Establish a safe and stable land surface which supports native vegetation growth focussing on food resource for Carnaby's Cockatoo. • Pit perimeters will be altered to blend in with the topography of the surrounding environment.
Re-vegetation	• Revegetate the mine landforms to establish native vegetation appropriate for the area and final land use.
Water	• Surface and groundwater hydrological patterns/flows not significantly affected. • Any surface water runoff shall have quality compatible with maintenance of local land and water values. • There shall be no long term reduction in the availability of water to meet local environmental values. • Minimise impacts on downstream vegetation.
Infrastructure and Waste	• During decommissioning and through closure, wastes will be managed in accordance with legal requirements and waste minimisation principles. • No infrastructure left on site unless agreed to by regulators and post mining land managers/owners.

5.3 CONCEPTUAL CLOSURE LANDFORM DESIGN

Holcim have developed a conceptual final landform design showing finished levels (Figure 7) based on the following guidance documents:

- Code of Practice for Small Quarries, Victoria (Department of Primary Industries, 2010).
- Mine Code of Practice, Tasmania (Department of Primary Industries, Water and Environment, 1999).

As shown in Figure 7, this landform design incorporates blending in with the surrounding landscape as far as practicable by contouring of batters. The closure landform design process is described further in the sub-sections below.

5.3.1 LANDFORM RECONSTRUCTION

Once mining of each stage is completed, the excavation area will be recontoured with oversize screened material and reshaped. Overburden will be spread evenly over the recontoured landscape and other areas where waste has been picked up. Surfaces will be ripped or ploughed along the contour to minimise erosion from water runoff and relieve compaction.

5.3.2 OVERBURDEN REPLACEMENT

Any overburden will be stockpiled for use in rehabilitation.

If topsoil is deemed unsuitable for rehabilitation, trials will be conducted into vegetation establishment into overburden. The extractive industry has experience in the establishment of native vegetation cover within overburden, without the provision of a separate topsoil layer and Holcim considers this to be an effective approach for this project if necessary.

5.3.3 PROGRESSIVE RE-VEGETATION

Rehabilitation will focus on revegetation with native species. Therefore, Holcim will:

- After mining each stage, progressively establish a safe and stable land surface which supports native vegetation growth focussing on providing food resource for Carnaby's Cockatoo.
- Revegetate the mine landforms to establish vegetation appropriate for the area and final land use.

Broadcast seeding will likely be required with possibly some seedling planting out to encourage native cover establishment. Local provenance species will be used, which will assist in providing a ground cover, limiting erosion and controlling weeds. Re-vegetation will occur progressively where possible, to ensure that minimal areas are left open. Throughout the mine life, as soon as an area becomes available for rehabilitation it will be re-vegetated.

If the end land use changes to require other than native vegetation establishment this objective will be revisited and Holcim will make plans accordingly.

Rehabilitation and re-vegetation techniques are discussed further in Appendix E (Preliminary Rehabilitation Plan).

5.3.4 DECOMMISIONING

At the end of the quarry life Holcim will undertake the following actions to decommission the site:

- All buildings and infrastructure will be removed;
- Any contaminated sites as a result of the projects operations are registered and appropriately decommissioned;
- Roads will be rehabilitated or access retained in accordance DPaW requirements;
- Any hard stand surfaces will be removed and used to recontour the landscape;
- Overburden and scalps (oversize screened material) will be used to recontour the landscape; and
- All remaining open areas will be revegetated.

6 DEVELOPMENT OF COMPLETION CRITERIA

The DMP guidelines (Department of Mines and Petroleum, 2015) state that for each site a specific set of completion criteria needs to be developed, to determine whether the rehabilitation end point has been reached. Where possible, completion criteria should be developed from actual rehabilitation trials and site experience rather than arbitrary baseline studies conducted on reference (local pristine) sites, which may have little similarity to mine soils.

Completion criteria are necessary to provide the basis on which successful rehabilitation and mine closure and achievements of closure objectives are determined. They must be developed in consultation with key stakeholders. Completion criteria should be developed in consultation with DMP/EPA and should be appropriate to the developmental status of the project, follow the S.M.A.R.T principle and be:

- Specific enough to reflect a unique set of environmental, social and economic circumstances;
- Measurable to demonstrate that rehabilitation is trending towards analogue indices;
- Achievable or realistic so that the criteria being measured are attainable;
- Relevant to the objectives that are being measured and the risks being managed and flexible enough to adapt to changing circumstances without compromising objectives;
- Time-bound so that the criteria can be monitored over an appropriate time frame to ensure the results are robust for ultimate relinquishment (Department of Mines and Petroleum, 2015).

Detailed completion criteria, based on the Closure Objectives described have been developed and are included as Appendix B. These closure completion criteria will be reviewed as part of regular reviews of the Mine Closure Plan and stakeholder consultation regarding closure.

7 COLLECTION AND ANALYSIS OF CLOSURE DATA

Collection and analysis of closure data must meet the following minimum requirements (Department of Mines and Petroleum, 2015):

- Use of recognised or acceptable methodologies and standards.
- Incorporate appropriate quality management systems and procedures (e.g. ISO9000).
- Consideration of the wider receiving environment, receptors and exposure pathways.
- Provide a base on which to develop criteria or indicators for closure monitoring and performance.

Information from baseline studies undertaken prior to the commencement of mining operations and on-going monitoring is essential to establish achievable closure outcomes and goals, as well as to identify issues requiring management through the mine closure process (Department of Mines and Petroleum, 2015).

Holcim have gathered (and continues to gather) environmental data to enable planning and monitoring of effective rehabilitation and closure of the quarry.

7.1 BASELINE DATA

The following sub-sections describe the available baseline data.

7.1.1 CLIMATE

The proposed mine is located just outside the Perth metropolitan area. The climate is classified as Mediterranean. The nearest open Climate station is at the Pearce Royal Australian Air Force (RAAF) base. This area experiences hot, dry summers and cool wet winters. Table 6 below displays the average annual climate data for RAAF Pearce Station No. 009053 (Bureau of Meteorology, 2015).

Table 6: Climatic Means from RAAF Pearce Station from 1937 to 2015 (Bureau of Meteorology, 2015)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Pearce RAAF - BoM# 009053														
Mean Maximum Temperature (°C)	33.5	33.3	30.6	26.4	22.0	18.9	17.8	18.4	20.0	23.4	27.2	30.3	25.2	1940 - 2015
Mean Minimum Temperature (°C)	17.0	17.6	16.0	13.4	10.8	9.4	8.4	8.2	8.8	10.1	12.5	14.5	12.2	1940 - 2015
Mean Rainfall (mm)	7.6	12.2	15.1	34.8	84.9	132.3	133.8	104.2	70.1	36.2	23.7	10.6	679.2	1937 - 2015

7.1.2 TOPOGRAPHY

Topography for the site is shown in Figure 8. Elevation ranges from 50 m Australian Height Datum (AHD) to 80 M AHD.

7.1.3 REGIONAL GEOLOGY

The SCP consists of Pliocene to Quaternary sediments (collectively termed 'superficial formations' which comprise aeolian, alluvial, swamp, estuarine and shoreline sediments that were deposited on a gently

seaward-sloping unconformity surface on top of Mesozoic sedimentary rocks (Bettenay, McArthur, & Hingston, 1960). The latter rocks include the Leederville Formation (Cretaceous) and the Yarragadee Formation (Jurassic). Three major dune systems, oriented in a N-S direction, transect the SCP. The Bassendean dunes are the oldest (Pleistocene), lowest and most leached of the series. To the west of the Bassendean dune system are the siliceous Spearwood dunes which overlie limestone, and adjacent to the coast are the calcareous Quindalup dunes, the youngest unit (Bettenay, McArthur, & Hingston, 1960). The superficial formations (i.e. sands, sandstone and limestone) support Perth's two major aquifers: the Gnangara mound north of the Swan River (Department of Water, 2009a), and the Jandakot mound south of the river.

Department of Mines and Petroleum (DMP) surface geology mapping identifies the following surface geology types within the project area (Figure 9):

- Most of the tenement is mapped as "S10: Sand – very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted of eolian origin."
- Small pockets of the tenement (outside the proposed area of disturbance) are mapped as "CPS: Peaty Clay, dark green and black with variable sand content of lacustrine origin."

7.1.4 WASTE SAND MATERIAL & PROCESS TAILINGS

Waste material from mining and screening will be mostly organic material leftover from pine stumps, and rocky oversize material. Some sand will be screened and the oversize fraction will be stockpiled. This will be returned to the pit during rehabilitation of each stage, prior to overburden return.

The screening plant and stockpiling conveyor are track mounted mobile units and move with the mine faces sand is excavated. Other than the screening of sand, there is no processing proposed. Therefore there will be no tailings or other processing wastes produced.

7.1.5 SOIL & SOIL PROFILES

The project area overlies Bassendean Sands (Bettenay, McArthur, & Hingston, 1960). The Bassendean Sands have low relief with minor variations in topography, which translate to variable depth to the water table. It consists of low hills of siliceous sand interspersed with poorly drained areas including both seasonal and permanent swamps (Salama, Silberstein, & Pollock, 2005). This dune system originated along a coastline, perhaps as calcareous sand, but leaching has continued for so long that all carbonate has been lost and the steep relief so characteristic of beach dunes has been modified. The Bassendean Sands are characterized by a higher percentage of coarse and medium sands, than the neighboring Spearwood Sands occurring to the west.

Soil mapping by Department of Agriculture and Food WA (Figure 10) classifies soil types across the project area as follows:

- 212Bs_G: Pale deep sands and semi-wet soils
- 212Bs_Ja: Pal deep sands (low gently sloping dunes)
- 212Bs_Ws: Wet soils (often peaty) (Winter wet depressions).

7.1.6 ACID SULPHATE SOILS

Acid sulphate soils (ASS) are naturally occurring soils and sediments containing iron sulfides, most commonly pyrite. When ASS is exposed to air the iron sulfides in the soil react with oxygen and water to produce a variety of iron compounds and sulfuric acid. The resulting acid can release other substances, including heavy metals, from the soil and into the surrounding environment. These materials are

characterised by bright yellow or straw coloured mottles of the mineral jarosite and often contain dark reddish coloured streaks. ASS have a soil pH 4 or less (Department of Environment, 2003).

Potential ASS (known as ASS) are soils or sediments which contain iron sulfides and/or other sulfidic minerals that have not been oxidised by exposure to air. The waterlogged layer may be peat, clay, loam or silty sand and is usually dark grey and soft. ASS are not known to be associated with environmental problems in their undisturbed state. While the natural exposure of these soils or sediments to air (e.g. during severe droughts) is associated with the generation of acid, the acidity tends to occur as low frequency, low magnitude, short duration events after drought breaking rains (Department of Environment, 2003).

If disturbed, ASS have the capacity to directly impact upon the basic natural assets of soil, water, biota and air, and thus upon most human endeavours, including agriculture, fishing, aquaculture, recreation, tourism, as well as human health and visual amenity. Impacts can include:

- Soil acidification
- Degradation of water-dependent ecosystems and ecosystem services
- Loss of habitat and biodiversity
- Invasion and dominance of wetlands.

The Department of Environment and Regulation have compiled ASS risk maps for several regions of Western Australia which provide broad-scale indication of the areas where ASS is most likely to exist. ASS categories within the project area are displayed in Figure 11. Most of the tenement is classified as “Low Probability” of ASS occurrence. There are some small pockets within the Mining Tenement application area which are classified as having a “High Probability” of acid sulphate soils occurrence – however these areas are not within the proposed mine site disturbance (Figure 11). Furthermore, Holcim has committed to the exclusion of mining from a 100 metre buffer around mapped high to moderate risk ASS soils (including 100 metres around all wetlands whether mapped as high to moderate risk or not). If mining is proposed within the 100 metre buffer, Holcim has committed to the provision of a management plan which will include the results of ASS investigations and will incorporate the results into management strategies to be presented with a new mining proposal to be submitted for approval.

As the proposed activities will not disturb the ground below the water table or any areas of high probability of ASS occurrence, it is unlikely that any ASS will be exposed or disturbed.

7.1.7 SURFACE WATER HYDROLOGY

7.1.7.1 SURFACE DRAINAGE

There are no significant surface drainage lines or creeks within the proposed project area (Figure 12). Therefore all runoff is assumed to be via shallow dispersed flow.

The shallow geology of the project area consists predominantly of Bassendean sands. High infiltration is therefore expected. The lack of visible surface channelisation suggests that percolation of rainfall to groundwater is more significant than surface runoff.

7.1.7.2 WETLANDS

Categorisation of wetlands has been undertaken by Hill *et al.* (1996) for the SCP into a series of “Geomorphic Wetlands” as follows:

- “Conservation Category Wetlands” are those which support high levels of attributes and functions.

- "Resource Enhancement Wetlands" are those that have been partly modified but still support substantial functions and attributes.
- "Multiple Use Wetlands" are classified as those wetlands with few ecological attributes but which still provide important hydrologic functions.

A number of geomorphic wetlands exist within and/or surrounding the proposed project area as shown in Figure 12 including:

- Lake Jandabup to the west
- Hawkins Road Swamp to the northwest
- A dampland area to the east of Mining Tenement M70/1250.

Wetlands, including Lake Jandabup and Hawkins Road Swamp, have formed in the internal swales within the Bassendean Dune System. Lake Jandabup is a groundwater throughflow lake, whereby the water table on the up-gradient side is marginally higher than the lake surface, resulting in a discharge of shallow groundwater to the lake. On the down- gradient side of the lake, the water table is slightly lower than the lake surface, resulting in underflow and seasonal outflows to Superficial Formations to the west (URS, 2015b).

These wetlands are also influenced by direct rainfall, evapotranspiration and local groundwater abstractions by licensed and private bore owners. These influences have historically had a direct impact on the water levels in the lakes and swamps. Lake Jandabup is a regionally-significant wetland that is subject to Ministerial Statement 687 containing the following Ministerial Criteria (WAWA, 1995; DoW, 2008):

- An absolute summer minimum of 44.3 m AHD.
- An absolute spring minimum peak of 44.2 m AHD.
- A preferred spring minimum peak of 44.7 m AHD.
- The water level is only allowed between preferred and absolute minimum at a rate of two in every six years.

An operational and disturbance 100 m buffer is proposed from all naturally vegetated geomorphic wetlands (Figure 12). Appropriate water quality management and contamination prevention measures as described will prevent impacts to Jandabup Lake which is located approximately 500 m to the west of the proposed quarry.

7.1.7.3 SURFACE WATER QUALITY

Surface water data was requested from the DoW for a 5 km radius of the tenements. There are 44 surface water sampling points, mostly in the vicinity of Mariginiup Lake. These points were sampled intermittently between 1962 and 2009. The data is summarised in Table 7. The Electrical Conductivity data classifies the water as at the low end of brackish.

Table 7: Summary of Surface Water Monitoring Data within 5 km radius of Tenements (DoW, 2009)

Surface Water Parameters	Minimum	Maximum
pH	3.7	6.4
Total Dissolved Solids (calc @180°C)-HCO_3 (mg/L)	15	3100
Electrical Conductivity (compensated 25ºC in situ) (µS/cm)	1406	1990
Total Nitrogen (mg/L)	0.05	14

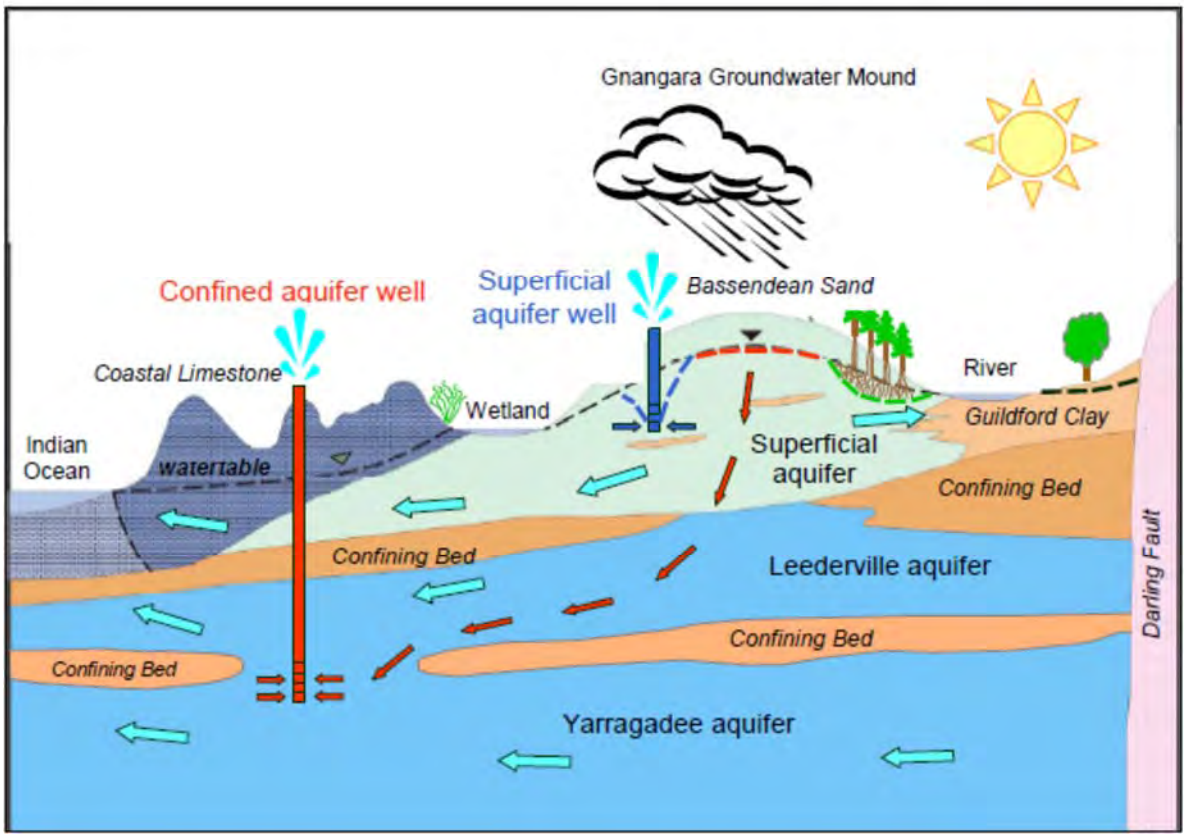
7.1.8 GROUNDWATER HYDROGEOLOGY

7.1.8.1 REGIONAL HYDROGEOLOGY

The Perth Basin contains Western Australia's most important groundwater resources. It has extensive aquifers and renewable resources from the relatively high rainfall. Large supplies can be pumped from most parts of the basin, although some areas have high groundwater salinity, and some areas are now fully allocated. The Gnangara Mound is one of the SCP's two major aquifers (Department of Water, 2009a).

The two major superficial aquifers in the SCP (the Gnangara mound north of the Swan River, and the Jandakot mound south of the river) are directly recharged by rainwater. The underlying mainly confined Leederville and Yarragadee formations contain vast amounts of water.

Regional groundwater levels in the superficial aquifer are a smoothed replica of the topography of the area. The water level forms a mound at the highest part of the area which discharges eastward and southward into the Swan River, northward toward Gingin River and westward to the ocean. At low points in the landscape, the water table frequently intersects the land surface to form lakes and swamps (Salama, Silberstein, & Pollock, 2005). Under natural conditions, the major outflows from the aquifers are due to evaporation from open water surfaces and transpiration by native vegetation and pine plantations. Other losses occur through groundwater recharge to the deeper aquifers at some localised points. The rate of groundwater flow from north to south on the Gnangara Mound is about 30 m per day beneath the Bassendean Dunes, and about 90 m per day east to west beneath the coastal strip (Salama, Silberstein, & Pollock, 2005). Insert 1 displays the interconnectivity between the wetlands, the superficial aquifer and the underlying aquifers.



Insert 1: Schematic of Water Balance of Gnangara Mound and Swan Coastal Plain (Silberstein, et al., 2007).

Of the two superficial aquifers, the Gnangara mound is by far the more significant in terms of size and public water supply. It stores >20,000 GL of good quality water, with the crest of the 'mound' being 70 m above sea level at maximum saturation. At present it supplies up to 60% of Perth's drinking water as well as supplying irrigation for horticulture and agriculture, and for public open space and garden bores. The aquifer is also important for sustaining numerous groundwater dependent ecosystems such as phreatophytic (groundwater-dependent) terrestrial vegetation, mound springs and caves, besides the wetlands. The increased demand from Perth's growing population, combined with decreasing winter rainfall, has resulted in serious aquifer depletion (nearly 600 GL since 1979), with drawdowns reported to be as much as 6 m at the top of the mound. Water balance studies such as Silberstein *et al.* (2007) show that the watertable has dropped < 6 m from 1975 to 1998. It is declining in storage by 50 GL per year. Consequently, many of the groundwater dependent seasonal wetlands on the mound have been experiencing prolonged and more severe summer drying. The two most common biogeochemical impacts of water table drawdown on the Gnangara mound wetlands are acidification at one extreme, and eutrophication at the other.

7.1.8.2 LOCAL HYDROGEOLOGY

The project is located within a drinking water source protection area known as the Gnangara Underground Water Pollution Control Area (Figure 13). Analysis of long term groundwater level data for surrounding DoW monitoring bores shows a fairly steady decline in water levels in all of the bores. The length of time for which records are available varies between the bores from 10 to 46 years (with an average of 33 years). This decline is well documented for the Gnangara mound and is caused by a combination of reduced rainfall, groundwater abstraction and evapotranspiration from pine plantations.

A Groundwater Assessment has been prepared for this project (URS, 2015a). To. To manage the risk of groundwater contamination, it is proposed to limit excavation depth to 3 m above the Maximum Groundwater Level (MGL) determined by URS (2015a) as well as implement contamination prevention measures as described in Table E2.

7.1.8.3 WATER QUALITY

Groundwater data was requested from the DoW for a 5 km radius of the centre point of the tenements. There are 531 bores recorded within this radius, mostly clustered around Boundary Road and Mariginup Lakes. These bores have been monitored for a range of water quality variables (metals, nutrients, major ions, organics and microorganisms). The relevant groundwater data is summarised in Table 8. The data reveals some bores show signs of eutrophication (elevated nitrogen), and elevated microorganisms (coliforms), which can be an indicator of faecal contamination.

Table 8: Summary of Groundwater Monitoring Data for Bores within 5 km Radius of the Tenements (DoW, WIN Database Search 2009)

Groundwater Parameters	Minimum	Maximum
Coliforms (CFU/dL)	10	<70
Total Organic Carbon (mg/L)	23	21200
Total Kjedhal Nitrogen (mg/L)	0.17	390

Existing potential impacts to groundwater quality include regional acidic groundwater and the nearby Water Corporation groundwater treatment plant. The water treatment process includes coagulation and mixing, flocculation, sedimentation, filtration, disinfection and fluoridation. The three most common salts used are aluminium sulfate (alum), ferrous sulfate and ferric chloride. Disinfection includes the use of chlorine. The chemical reaction between chlorine and organic material can produce halogenated hydrocarbons such as trihalomethanes which are harmful to human health. Fluoride salts are a by-product of fluoridation.

7.1.9 FLORA AND VEGETATION

A flora survey and fauna habitat assessment was undertaken – the full survey report is included as Appendix B (EnviroWorks Consulting, 2015). The potentially significant species and associations of flora expected to occur within the vicinity of the project area were identified and compiled by searching DPaW databases. The on-site floristic survey was undertaken in Winter and Spring (13th May, 7th, 8th and 10th September) in accordance with Environmental Protection Authority (EPA) Guidance Statement Number 51 (2004) *Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*. Vegetation mapping undertaken as a result of this survey is provided in Figure 14.

7.1.9.1 LOCAL NATIVE VEGETATION PLANT COMMUNITIES

Two native vegetation community types were identified locally (both outside the proposed mine disturbance area) (Figure 14):

- The first community (low woodland of *Banksia attenuate, Banksia menziesii* and *Allocasuarina fraseriana*) in uncleared areas.
- The second community (Open Low Woodland of *Eucalyptus rudis – Melaleuca preissiana* over wetland) includes areas of wetland vegetation which occur on seasonally wet sands.

The quarry footprint area was cleared approximately 85 years ago to establish the Gnangara Pine Plantation. The pine planation within the proposed quarry footprint was harvested recently, as part of the Gnangara Sustainability Strategy (GSS).

7.1.9.2 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

A Threatened or Priority Ecological Community (TEC or PEC) is one that has been endorsed by WA's Environment Minister as being subject to processes that threaten to destroy or significantly modify it across much of its range. A search of the Department of Parks and Wildlife (DPaW) TEC/PEC database for 10 km buffer around the tenement indicated 17 TECs / PECs occur within the within the search area as listed below.

However none of these DPaW TEC/PEC records occur within the proposed mine disturbance area (Figure 15). No TEC's/PEC's were identified within the study through field visits – this is to be expected given the study area is predominantly cleared pine plantation (EnviroWorks Consulting, 2015). It is highly unlikely that TECs or PECs would exist within the proposed mine disturbance area which consists of no native vegetation – it occurs exclusively on pine plantation.

DPaW TEC / PEC records occurring within 10 km buffer of proposed tenement:

1. Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain, CAVES SCP01, Critically Endangered
2. *Banksia attenuata* woodland over species rich dense shrublands, SCP20a, Endangered
3. *Banksia ilicifolia* woodlands, SCP22, Priority 3
4. Coastal shrublands on shallow sands, SCP29a, Priority 3
5. Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain), Mound Springs SCP, Critically Endangered
6. *Eucalyptus calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain, SCP3c, Critically Endangered
7. Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain, SCP15, Vulnerable

8. Herb rich saline shrublands in clay pans, SCP07, Vulnerable
9. Herb rich shrublands in clay pans, SCP08, Vulnerable
10. Low lying *Banksia attenuata* woodlands or shrublands, SCP21c, Priority 3
11. *Melaleuca huegelii - Melaleuca acerosa* (currently M. systena) shrublands on limestone ridges (Gibson et al. 1994 type 26a), Limestone ridges (SCP 26a), Endangered
12. Northern Spearwood shrublands and woodlands, SCP24, Priority 3
13. Shrublands and woodlands on Muchea Limestone, Muchea Limestone, Endangered
14. Shrublands on calcareous silts of the Swan Coastal Plain, SCP18, Vulnerable
15. Shrublands on dry clay flats, SCP10a, Endangered
16. Southern *Eucalyptus gomphocephala - Agonis flexuosa* woodlands, SCP25, Priority 3
17. Swan Coastal Plain *Banksia attenuata - Banksia menziesii* woodlands, SCP23b, Priority 3.

7.1.9.3 VEGETATION CONDITION

The native vegetation within the study area is in completely degraded to very good ecological condition, according to the rating scale outlined in Keighery (1994). Much of the area has had a long history as a *Pinus pinaster* plantation. Parts of the plantation have been removed within the last 20 years and the native vegetation which is present is re-growth and young rehabilitation. Uncleared native vegetation is generally in good to very good ecological condition apart from localised disturbances and weed invasion associated with tracks and human activities (EnviroWorks Consulting, 2015).

7.1.9.4 NATIVE FLORA

155 native plant species representing 110 genera and 39 families were recorded within the study area. The most common native plant families included Proteaceae, Myrtaceae and Fabaceae. Species of Eucalyptus, Banksia, Melaleuca and Nuytsia floribunda dominate the tree and taller shrub flora while Myrtaceae, Ericaceae and Fabaceae species are most common within the lower shrubs. Macrozamia fraseri and Xanthorrhoea preissii plants are common. The native ground flora is species rich with Cyperaceae, Restionaceae, Haemodoraceae and Asteraceae being the most common families (EnviroWorks Consulting, 2015).

7.1.9.5 CONSERVATION SIGNIFICANT FLORA

A significant flora search requested from DPaW for a 10 km buffer around the proposed mining tenement, showed 37 species of conservation significance recorded previously within the search area as listed below.

None of these DPaW records occur within the proposed project area. The recorded location of Pimelea calcicola is from Hepburn Heights and has been incorrectly placed within the Jandabup search area likely due to data entry or recording errors (Figure 16).

No conservation significant flora species were located during field studies. It is unlikely that conservation significant flora species occur within the pine plantation areas, however they could be present within the Bush Forever Sites. Field studies were considered to be optimal in timing for the detection of conservation significant flora – refer to Appendix B (EnviroWorks Consulting, 2015).

Conservation significant flora species records from DPaW search of 10 km buffer around tenement are listed below:

1. *Acacia anomala*, Status: Threatened
2. *Acacia benthamii*, Status: Priority 2
3. *Anigozanthos humilis subsp. Chrysanthus*, Status: Priority 4
4. *Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)*, Status: Priority 1
5. *Caladenia huegelii*, Status: Threatened

6. *Calectasia sp. Boundary Road (C. Tauss 557)*, Status: Priority 1
7. *Chamaescilla gibsonii*, Status: Priority 3
8. *Conostylis bracteata*, Status: Priority 3
9. *Cyathochaeta teretifolia*, Status: Priority 3
10. *Dampiera triloba*, Status: Priority 3
11. *Darwinia foetida*, Status: Threatened
12. *Dasymalla axillaris*, Status: Threatened
13. *Drosera occidentalis subsp. occidentalis*, Status: Priority 4
14. *Drosera x sidjamesii*, Status: Priority 1
15. *Eleocharis keigheryi*, Status: Threatened
16. *Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)*, Status: Priority 3
17. *Grevillea curviloba subsp. curviloba*, Status: Threatened
18. *Grevillea curviloba subsp. incurva*, Status: Threatened
19. *Guichenotia tuberculata*, Status: Priority 3
20. *Hibbertia helianthemoides*, Status: Priority 4
21. *Hydrocotyle lemnoides*, Status: Priority 4
22. *Hypolaena robusta*, Status: Priority 4
23. *Jacksonia sericea*, Status: Priority 4
24. *Phlebocarya pilosissima subsp. pilosissima*, Status: Priority 3
25. *Pimelea calcicola*, Status: Priority 3
26. *Pithocarpa corymbulosa*, Status: Priority 3
27. *Platysace ramosissima*, Status: Priority 3
28. *Poranthera moorokatta*, Status: Priority 2
29. *Schoenus griffinianus*, Status: Priority 3
30. *Stenanthemum sublineare*, Status: Priority 2
31. *Stylidium longitubum*, Status: Priority 3
32. *Stylidium trudgenii*, Status: Priority 3
33. *Tetraria sp. Chandala (G.J. Keighery 17055)*, Status: Priority 2
34. *Thelymitra variegata*, Status: Priority 3
35. *Trichocline sp. Treeton (B.J. Keighery & N. Gibson 564)*, Status: Priority 2
36. *Tripterococcus paniculatus*, Status: Priority 4
37. *Verticordia serrata var. linearis*, Status: Priority 3

7.1.9.6 WEEDS

The Department of Agriculture and Food WA (DAFWA) and the Agriculture Protection Board maintains a list of Declared Weeds for Western Australia. Declared weeds are required to be eradicated by the *Agricultural and Related Resources Protection Act 1976*. If a plant is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to control that plant on their properties. Declarations specify a category, or categories, for each plant according to the control strategies or objectives which the Agriculture Protection Board believes are appropriate in a particular place.

DAF Declared Plant Priority Classes include:

- P1 - Prohibits movement of plants or their seeds within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
- P2 - Eradicate infestation to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
- P3 - Control infestation in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants.

- P4 - Prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants.
- P5 - Infestations on public lands must be controlled.

During the field survey 61 weed species were recorded. All species are common weeds associated with disturbance and agriculture. One species *Emex australis* (Doublegee) is a Priority 1 Declared Plant within some W.A. local government areas under the Agriculture and Related Resources Act 1976. Weeds were most common within the plantation areas and along tracks. The majority of species are not considered to be serious environmental problems (EnviroWorks Consulting, 2015).

7.1.9.7 DIEBACK

Dieback refers to the introduced plant disease caused by *Phytophthora cinnamomi*. Although there are many species of *Phytophthora*, this is the species that causes the most severe and widespread damage to native plants in Western Australia. Up to 25% of native Western Australian plants are susceptible to *Phytophthora cinnamomi* (Komerek, Shearer, Smith, & Fairman, 1994). It is a microscopic fungus-like pathogen that destroys root systems. It is spread by the movement of water and soil, and management relates to controlling these (Dieback Working Group, 2005). There are no proven eradication methods, and limiting the spread to prevent further damage is the most cost effective measure.

P. cinnamomi is not native to Western Australia. It first arrived in Western Australia on soil around the roots of cultivated plants, shortly after European settlement. It was spread extensively throughout the Southwest when infected gravel was used for road construction. *P. cinnamomi* is now widespread throughout the Southwest of Western Australia. It is confined to areas with more than 400 mm annual rainfall, and extends between Eneabba and Esperance. It has infested forest, heathland and woodland communities, and is present in much of the bushland around Perth.

The rate of uphill spread via root to root contact amongst host plants has been reported as approximately one metre per annum under ideal environmental conditions. The cross slope and down-slope rate of spread occurs much faster due to the influence of surface and sub-surface water-flows on the dispersal of zoospores. Native animals, feral animals and people act as vectors aiding the wide and rapid spread of dieback, thereby enabling it to establish new centres of infestation in previously un-infested areas.

Dieback is mapped by the presence of dead and dying indicator species which are known to be susceptible to the disease. Dieback has created management issues for road construction, timber harvesting, mining and other industries since land managers realised that the movement of soil is the most important method of transporting and spreading the pathogen.

The project area is considered Un-interpretable. As native vegetation has not been present since the 1960's, there is a lack of indicator species to map the pathogen. Therefore the site will be managed using the precautionary principle in regard to dieback.

7.1.10 FAUNA AND HABITAT

7.1.10.1 CONSERVATION SIGNFICANT FAUNA

A significant fauna search requested from DPaW for a 10 km buffer around the proposed mining tenement, showed 28 species of conservation significance recorded previously within the search area as listed below.

However none of these DPaW records occur within the proposed quarry disturbance footprint (Figure 17). No threatened fauna were observed during field studies. There was little evidence of fauna presence apart from kangaroos and birds. The project area is not considered significant fauna habitat given it is pine plantation currently under an existing program of clearing by DPaW (EnviroWorks Consulting, 2015).

Conservation significant fauna species records from DPaW search of 10 km buffer around tenement are listed below:

1. *Botaurus poiciloptilus (Australasian Bittern)*, Status: Threatened
2. *Calidris ferruginea (Curlew Sandpiper)*, Status: Threatened
3. *Calyptorhynchus baudinii (Baudin's Cockatoo (long-billed black-cockatoo), Baudin's Cockatoo)*, Status: Threatened
4. *Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo))*, Status: Threatened
5. *Dasyurus geoffroii (Chuditch, Western Quoll)*, Status: Threatened
6. *Falco peregrinus (Peregrine Falcon)* Status: Schedule 4 (Specially Protected)
7. *Falco peregrinus subsp. macropus (Australian Peregrine Falcon)* Status: Schedule 4 (Specially Protected)
8. *Actitis hypoleucos (Common Sandpiper)*, Status: International Agreement (Migratory)
9. *Ardea modesta (Eastern Great Egret)*, Status: International Agreement (Migratory)
10. *Calidris ruficollis (Red-necked Stint)*, Status: International Agreement (Migratory)
11. *Glareola maldivarum (Oriental Pratincole)*, Status: International Agreement (Migratory)
12. *Haliaeetus leucogaster (White-bellied Sea-Eagle)*, Status: International Agreement (Migratory)
13. *Limosa lapponica (Bar-tailed Godwit)*, Status: International Agreement (Migratory)
14. *Merops ornatus (Rainbow Bee-eater)*, Status: International Agreement (Migratory)
15. *Plegadis falcinellus (Glossy Ibis)*, Status: International Agreement (Migratory)
16. *Pluvialis squatarola (Grey Plover)*, Status: International Agreement (Migratory)
17. *Tringa glareola (Wood Sandpiper)*, Status: International Agreement (Migratory)
18. *Tringa nebularia (Common Greenshank)*, Status: International Agreement (Migratory)
19. *Tringa stagnatilis (Marsh Sandpiper)*, Status: International Agreement (Migratory)
20. *Xenus cinereus (Terek Sandpiper)*, Status: International Agreement (Migratory)
21. *Hylaeus globuliferus (bee)*, Status: Priority 3
22. *Leioproctus contrarius (bee)*, Status: Priority 3
23. *Neelaps calonotos (Black-striped Snake)*, Status: Priority 3
24. *Tyto novaehollandiae subsp. novaehollandiae (Masked Owl (southern subsp))*, Status: Priority 3
25. *Ardeotis australis (Australian Bustard)*, Status: Priority 4
26. *Ixobrychus minutus (Little Bittern)*, Status: Priority 4
27. *Macropus irma (Western Brush Wallaby)*, Status: Priority 4
28. *Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*, Status: Priority 5

7.1.10.2 FAUNA HABITAT

The pine plantation vegetation and regrowth areas provide limited shelter and nesting locations and food resources (flowers, fruit, leaves) for terrestrial, arboreal and aerial species.

It should be noted that pine wildings, do represent potential foraging habitat for Carnaby's cockatoo which will feed on pine cones. However, the impact on Carnaby's feeding resources due to pine removal in the area is not likely considered to be an issue as pine removal more broadly is being addressed through the Strategic Assessment of the Perth and Peel Regions (SAPPR) (Department of Premier and Cabinet, Under Development). Public release of the draft SAPPR documents, including a Strategic Conservation Plan (SCP) and Impact Assessment Report, is expected early 2016.

The lack of large trees means the area does not contain habitat for large arboreal or aerial species. There is no breeding habitat for significant bird species (such as tree hollows). The low species richness of the native flora and the sparseness of this vegetation limits the habitat values of these areas (EnviroWorks Consulting, 2015).

The areas of native vegetation and wetlands may provide fauna habitat. The Banksia woodland communities may provide foraging resources for Carnaby's Cockatoo (EnviroWorks Consulting, 2015), however these areas are outside the proposed sand quarry footprint.

7.1.11 SOCIAL ENVIRONMENT

7.1.11.1 ABORIGINAL HERITAGE

Aboriginal sites are places of importance and significance to Aboriginal people and to the cultural heritage of Western Australia. Aboriginal sites include:

- Archaeological - places where material remains associate with past Aboriginal land use.
- Anthropological - places of spiritual importance and significance to Aboriginal people.

The WA *Aboriginal Heritage Act 1972* protects places and objects that may be of importance and significance to Aboriginal people in Western Australia. The Department of Indigenous Affairs maintains a register of Aboriginal sites that are protected under the Aboriginal Heritage Act. It is an offence under this legislation to disturb an Aboriginal site. 'Disturb' is defined as "...excavate, destroy, damage, conceal, or in any way alter any Aboriginal site without prior authorisation of the Registrar of Aboriginal sites and/or consent of the Minister for Indigenous Affairs".

There are several recorded Aboriginal Heritage sites nearby, with the closest mapped site (ID 22160) located approximately 500 m to the north west (Figure 18).

Land clearing (including soil disturbance) for pine establishment commenced in the 1960's. It is highly likely that any heritage sites if present, would have been destroyed during this initial land clearing and pine forest establishment process. Therefore it is considered highly unlikely that any aboriginal heritage sites would remain within the pine plantation due to historical disturbance. In addition recent clearing of pines by the Forest Products Commission has resulted in significant additional disturbance.

Holcim commissioned Australian Heritage Management Services to undertake a heritage study over the project area. No heritage sites were identified during this survey (Australian Heritage Management Solutions, 2015) – refer to Appendix D for the full study report.

The potential for risk of disturbance to aboriginal heritage sites is therefore considered low.

7.1.11.2 EUROPEAN HERITAGE

There are no known European heritage sites within the tenement boundaries – the closest is Delamare House approximately 3 km to the north west of the tenement (Figure 19).

7.1.11.3 LAND USE AND PLANNING CONTEXT

The Wanneroo town centre is approximately 8 km from the proposed project. The project falls within the City of Wanneroo (Figure 1).

The City of Wanneroo is WA's fastest growing local government authority spanning both urban and rural areas (City of Wanneroo, 2014). The City of Wanneroo covers 686 square kilometres and has a population of approximately 180,000 people (Profile ID, 2014). With an abundance of residential, commercial and industrial land, the City of Wanneroo is undergoing significant development. The City encompasses a wide array of landscapes; from coastal plains to wetlands, from market gardens to residential homes, from thick bushland to urban development and industrial centers (City of Wanneroo, 2014).

The project is located within reserved land (Figure 20). The reserved land is designated as DPaW Managed Land, State Forest Number 65. The area is within the Gnangara Pine Plantation. The pines within the tenements have recently been cleared as part of the Gnangara Sustainability Strategy.

The Wanneroo Groundwater Treatment Plant (GWTP) and Diamond Poultry Farm are located nearby (Figure 20). Bulk dangerous goods are stored onsite at the GWTP; chlorine gas, fluorsocilic acid, hydrochloric acid and sodium hydroxide. Any failure or damage to chlorine equipment which results in a liquid chlorine leak is considered an extremely serious situation. In extreme cases it could be potentially fatal to Water Corporation personnel or members of the public. Concentrations above 37.0 ppm will cause throat irritation, above 74.3 ppm coughing and above 2,460 ppm will almost certainly cause death. Buffers are in place for residential development; these do not apply to mining and industrial premises. If approved, this quarry must be included in the Wanneroo GWTP Contingency Plan.

The tenements fall within the area zoned as State Forest and Water Catchment by the City of Wanneroo (Figure 20). Currently, Perth obtains a large proportion its water supply as groundwater from the Gnangara Mound and the project is within the associated drinking water protection area (Figure 13).

There is some 4WD tourism in the area. The public has 4WD access to most areas managed by the DPaW. The Gnangara Pine Plantation is one of only two metro areas gazetted by the DPAW for Off-Road Vehicle (for motorcycles only) (Department of Environment and Conservation, 2009a; ExploreOz.com, 2009).

The Gnangara Sustainability Strategy and the East Wanneroo Structure Plan indicate that the eastern portion of the tenement is designated for post pine banksia rehabilitation or parkland, with an area in the western portion of the tenement remaining subject to further planning (refer to Figure 6).

In the absence of any changes to end use it has been determined that the whole site is to be rehabilitated to natural woodland. In the event that the proposed end use changes, this approach will need to be revised.

7.2 OTHER CLOSURE RELATED DATA

Holcim has commenced collection of other closure related data with the objective of building a “base” of information and knowledge important to the closure of a sand quarry located within previous pine plantation. The sub-section below describes information collected to date which is providing background information and experience of other organisations in the restoration of forestry plantation into native vegetation.

7.2.1 RESTORATION OF FORESTRY PLANTATION

Listed below are a number of projects and research conducted by other organisations on the restoration of forestry plantation into native vegetation. Holcim is using this information to gain a knowledge base which will be utilised in the planning and implementation of its rehabilitation program.

- Restoration of Skyline Tier Scamander Plantation, Tasmania (Bushways Environmental Services, 2009)
- Benefits of Restoring Skyline Tier Scamander Plantation, Tasmania. (Bushways Environmental Services, 2011).
- Native Restoration Management Plan – Scamander Pine Plantation, Tasmania. (Bushways Environmental Services, 2013).
- Post-pine forest restoration, Western Australia. (Botanic Gardens and Parks Authority, Under Completion 2014 - 2020)
- Plantation Restoration in Tasmania Methodology and Prioritisation (Fitzgeral N and Dudley T, 2015)
- Rehabilitation of former pine plantations: a practitioner’s manual. School of Forest and Ecosystem Science (Kasel S, Jewell C and Gosby K, 2005)
- Kasel S & Meers T (2004) Restoration of former pine plantations in Australia: revegetation techniques, pine wildling control and the importance of land use history (Kasel S and Meers T, 2004)
- Post-Pine Banksia woodland restoration (Stanbury K, Under Completion 2015 - 2016).

7.2.2 BENCHMARKING ACROSS SIMILAR MINE SITES

Holcim benchmarks its performance across its own mine sites and within the extractive industry to obtain applicable learnings relevant to rehabilitation closure. To date the following applicable learnings have been gained through this process:

- Rehabilitation of the site should occur on a progressive basis. This requires extracted areas to be rehabilitated while extraction moves to another area.
- Final rehabilitation should be planned to create a safe and stable landform.
- Landscaping should occur to minimise the visual impact of the site. Native vegetation can be planted to visually screen the site during operations and post operations where visual amenity may be an issue.
- Where possible stripped topsoil should be direct returned to active rehabilitation areas to achieve superior re-growth. However this is not always possible, due to requirements to minimise open areas.
- Topsoil storage length should be minimised to ideally less than 3 years to maximise seedbank viability.
- Topsoil stockpile height should be minimised to maximise seed bank viability.
- 3:1 batters maximise rehabilitation success.

7.3 DATA ANALYSIS AND IMPLICATIONS FOR MINE CLOSURE

Baseline and other data has been analysed by Holcim to commence its rehabilitation and closure planning. A data gap analysis is provided in the sub-section below.

7.3.1 CLOSURE DATA GAP ANALYSIS

Holcim has performed a closure data gap analysis to determine additional data required to enable full planning for decommissioning and closure as outlined below in Table 9.

Table 9: Closure Data Gap Analysis

Area of Closure	Data Gaps	Proposed Actions to Obtain Data
Closure Implementation Plan	A broad plan of closure implementation is included in Section 9 of this Closure Plan. However a detailed plan and schedule of specific tasks and milestones has not yet been finalised.	A more detailed plan of closure implementation will be completed within 5 years. However finalisation of this may not occur for 10 years given detailed scheduling will be conducted closer to the end of mine life which is 25 years away.
Monitoring and Maintenance Schedule	A framework for monitoring and maintenance post closure is included in Section 10 of this Closure Plan. However a detailed schedule of specific tasks and milestones has not yet been finalised.	A more detailed schedule of post closure monitoring and maintenance will be developed within 5 years. However finalisation of this may not occur for 10 years given detailed scheduling will be conducted closer to the end of mine life which is 25 years away.

Area of Closure	Data Gaps	Proposed Actions to Obtain Data
Closure Monitoring and Maintenance Program	A framework for monitoring and maintenance post closure is included in Section 10 of this Closure Plan. However detailed processes and procedures have not yet been developed.	A conceptual Closure Monitoring and Maintenance Program will be developed within 5 years including: • A schedule of required activities. • Monitoring methodology (including detailed procedures). • Quality control (including a specific procedure). • A remedial strategy, should monitoring indicate inadequate performance of closure activities (a documented remediation strategy). However finalisation of this program may not occur for 10 years given detailed planning will be conducted closer to the end of mine life which is 25 years away.
Rehabilitation / Revegetation Trials	Given mining has not commenced, there has not yet been an opportunity to carry out and monitoring rehabilitation/revegetation trials.	Once areas are available for rehabilitation, trials will commence and will be monitored.
Methodology for Restoration of Pine Plantation into Native Vegetation	Holcim has commenced gathering information on Restoration of Pine Plantation into Native Vegetation as described in Section 7.2.1. However its full methodology for rehabilitation of native vegetation has not yet been developed in detail.	It is expected that a detailed methodology for Restoration of Pine Plantation into Native Vegetation will be developed and refined during the first 10 years of the mine life, through rehabilitation trials and progressive rehabilitation monitoring and refinement.

8 IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES

8.1 RISK MANAGEMENT PROCESS

The International Standard for risk management ISO31000 provides principles, framework and a process for managing risk. It defines likelihood as a general description of the probability or frequency that an event may occur. Consequence is defined as the outcome or impact of an event. Values have been assigned for the Likelihood and Consequence for each risk identified in order to determine the risk using Holcim's risk matrix below. Further details on using Holcim's risk matrix are included as Appendix C.

8.1.1 RISK MATRIX

Holicm's risk assessment matrix is provided below. For further details on its application refer to Appendix C.

Table 10: Holcim's Risk Matrix

Likelihood	Consequence				
	Disaster	Severe	Serious	Significant	Minor
Certain	High	High	High	Medium	Medium
Likely	High	High	Medium	Medium	Low
Possible	High	Medium	Medium	Low	Low
Unlikely	Medium	Medium	Low	Low	Low
Rare	Medium	Low	Low	Low	Low

8.2 CLOSURE RISK IDENTIFICATION

The Mine Closure Guidelines (Department of Mines and Petroleum, 2015), require a structured risk management process to be undertaken to identify, assess and manage the potential risks associated with closure issues, particularly those listed below:

1. Acid and metalliferous drainage
2. Dispersive materials
3. Rehabilitation
4. Radiation management
5. Pit Lake Management.

Of these issues only acid sulphate soils and rehabilitation are considered relevant to this project.

8.2.1 MATERIALS CHARACTERISATION

As part of risk identification the Closure Guidelines (Department of Mines and Petroleum, 2015) require adequate characterisation of materials including potentially problematic materials (such as acid-generating or sulphidic mineral waste, sodic, radioactive and asbestiform materials).

As part of its risk assessment Holcim has undertaken materials characterisation. There will be no tailings or processing waste produced. There are no sodic, radioactive or asbestiform materials present within the sand resource – it is predominantly silica sand.

The only material of concern is naturally occurring acid sulphate soil, which may have acid generating properties, however to avoid this risk Holcim has committed to the exclusion of mining from a 100 metre buffer around mapped high to moderate risk ASS soils (including 100 metres around all wetlands whether mapped as high to moderate risk or not). If mining is proposed within the 100 metre buffer, Holcim has committed to the provision of a management plan which will include the results of ASS investigations and will incorporate the results into management strategies to be presented with a new mining proposal to be submitted for approval.

In terms of rehabilitation and closure materials, it is recognised that topsoil in the area may be deemed unsuitable for rehabilitation given the high proportion of pine and weeds in the existing topsoil seedbank. Further investigation will be conducted on the suitability of existing topsoil for rehabilitation. If topsoil is deemed unsuitable for revegetation, trials will be conducted into vegetation establishment into overburden or other growth media. The extractive industry has experience in the establishment of native vegetation cover within alternative growth media, without the provision of a separate topsoil layer and Holcim considers this to be an effective approach for this project if necessary.

8.2.2 CONTAMINATED SITES

As part of risk identification, the Closure Guidelines (Department of Mines and Petroleum, 2015) require the potential for contamination over the life to be considered so that the contamination can be removed, treated, contained or managed to meet the purposes of the agreed post-mining land use(s) and where practicable, to maximise the beneficial use(s) of the land after mining.

As part of its closure risk assessment, Holcim has considered the potential for contamination, and is implementing management measures to avoid the creation of contaminated sites.

8.3 HOLCIM CLOSURE RISK REGISTER

Holcim has undertaken a systematic review and analysis of risk associated with closure to produce a closure risk register for this project (refer to Appendix D).

Key closure risks identified to date and management programs/plans in place or proposed are outlined below in Table 11.

Table 11: Key Closure Risks and Management Issues

Closure Risk	Management Measure
Unsuccessful re-vegetation	This Closure Plan: • Closure implementation strategies as outlined in Section 9 of the Closure Plan and re-vegetation processes as outlined in Appendix E of the Closure Plan will ensure the success of rehabilitation so that a suitable native vegetative cover is established. • If the end land use changes to require other than native vegetation establishment this objective will be revisited.
Contamination of soil or groundwater (contaminated sites)	• The storage, handling and disposal of hazardous materials will be undertaken in a manner that complies with all relevant legal requirements. • No bulk storage of hazardous substances or dangerous goods will occur on site (except fuel). • Storage of minor quantities of hazardous substances and dangerous goods will only occur in designated areas, which are appropriately signed, bunded or contained. These areas are to be maintained in a clean and tidy state to minimise potential for spills or littering. • All hydrocarbons (grease, fuel, oils and lubricants) will be contained within bunds according to the requirements of Australian Standard 1940.

Closure Risk	Management Measure
	• Hydrocarbons and other hazardous materials shall not be delivered to on site storage areas without appropriate bunding/containment. • Controlled wastes (including waste oil) will be collected and disposed of in accordance with the *Environmental Protection (Controlled Waste) Regulations 2004* which requires: o A licensed contractor to remove, transport and dispose of controlled wastes o Sufficient information be provided to enable categorisation of the waste and selection of an appropriate disposal site o Waste types and packaging to be suitable for transportation prior to collection. • Soil contaminated by hydrocarbons will be segregated into designated sites for storage, then removed from site. • Hydrocarbons and oily wastes (e.g. fuels, greases, de-greaser, emulsified oils and oily waste water) are to be managed using the following practices: o Minimal generation of waste and associated contaminants o Appropriate storage and handling procedures o Segregation of hydrocarbon waste from stormwater and other water o Clean-up procedures for spills. • Regular housekeeping and inspections of dangerous goods and hazardous substances will occur to ensure that storage and handling is appropriate. • Material Safety Data Sheets (MSDS) will maintained and easily accessible/located on-site for all hazardous substances and dangerous goods stored on site. • The workforce will be trained on handling dangerous goods and hazardous substances in line with associated MSDS. • A Spill Response Procedure will be implemented by Holcim. • Hydrocarbon/hazardous material spills will be reported in accordance with Holcim Incident Management Procedures. • Appropriate emergency equipment (including spill kits) will be made available on-site and replenished when required. • All spills will be immediately contained and cleaned up. All wastes from clean-up will be appropriately stored and disposed. • All site personnel will receive training on the Spill Response Procedure. • Copies of the Spill Response Procedure will be available with spill kits and in designated storage areas. • The Site Supervisor shall: o Provide advice in a timely nature as required by personnel regarding the management of hydrocarbons. o Ensure changes to management requirements are communicated to the workforce. o Ensure inspections are done on hydrocarbon storage areas. o Ensure training on Hydrocarbon Management is made available for operational personnel. • All hydrocarbon, dangerous goods and hazardous substance management measures will be incorporated into the Environmental and Water Management Plans.
Disturbance of Acid Forming Material (Generation of Acid Drainage)	This Closure Plan and Mining Proposal: • Holcim will avoid disturbance of high ASS risk areas. Holcim commits to the exclusion of mining from a 100 metre buffer around mapped high to moderate risk ASS soils (including 100 metres around all wetlands whether mapped as high to moderate risk or not). • If mining is proposed within the 100 metre buffer, Holcim commits to the provision of a management plan which will include the results of ASS investigations and will incorporate the results into management strategies to be presented with a new mining proposal to be submitted for approval. • Excavation will not intersect the water table. Excavation depth is limited to 3m above maximum groundwater level determined by URS (2015a). • All ASS management measures will be incorporated into the Environmental and Water Management Plans.
Disruption of Surface or Groundwater	This Closure Plan and Mining Proposal: • Tree stumps will be retained as long as possible to assist soil stabilization. • A buffer zone of 100 m will be maintained between operations and naturally vegetated

Closure Risk	Management Measure
	geomorphic wetlands. • Stockpiles of erodible material will be located away from roads and pavements to minimise sediment transport in runoff. • Each stage will be progressively rehabilitated at completion. • Vegetative cover will be established to minimise erosion. • Holcim will provide spill response equipment at the site. • Bunds will be established along the access road to contain stormwater runoff and settle out sediment. • Hydrocarbon and chemical management measures will ensure surface water and groundwater contamination does not occur. • Excavation depth is limited to 3m above maximum groundwater level determined by URS (2015a). • Waste management will ensure that all wastes are disposed of appropriately minimising the risk of surface water and groundwater contamination. • All water management measures will be incorporated into the Environmental and Water Management Plans. • Appropriate groundwater monitoring will be undertaken. • At closure, any hard stand surfaces will be removed and used to recontour the landscape.

9 CLOSURE IMPLEMENTATION

In summary, closure implementation will be managed utilising the following strategies:

- Geospatial planning:
  - Description of domains or features - including area of disturbance, stage of rehabilitation and estimated closure date.
  - Applicable land use objectives, landform designs, closure completion criteria and/or performance indicators for reach domain or feature.
- A schedule of work for research, investigation and trials tasks – showing key tasks and key milestones and approximate timing required for each task.
- A schedule of work for progressive rehabilitation tasks – showing key tasks and key milestones and approximate timing required for each task.
- Availability and management of closure material sources – including topsoil, competent waste rock and subsoil.
- Identification and management of information gaps, including review of monitoring data and other data.
- Key tasks for premature closure.
- Decommissioning tasks – including management of contaminated sites.
- A schedule of work for performance monitoring and maintenance tasks.

Each of these strategies is detailed further below.

9.1 GEOSPATIAL PLANNING

Figures 2 to 5 provide a geospatial layout plan, showing each type of disturbance as a domain or feature which will ultimately require closure and rehabilitation. The site layout plan will be maintained over the life of the operation using modern ground survey techniques and Geographic Information Systems (GIS) technology to ensure it is accurate and up to date.

Table 12 below provides closure planning for each domain/feature currently identified for the project.

Table 12: Domain/Feature Closure Planning

Domain/Feature	Area of Disturb-ance	Stage of Rehab.	Approx. Closure Date	Land Use Objectives	Completion Criteria
Final Landform (i.e. final contoured land surface) Note: the project does not include waste dumps, tailings facilities or other stockpiles on site.	N/A	N/A	End of 30 Year Mine Life	• Visual amenity of constructed landforms is compatible with that of local landforms. • Materials with poor growth characteristics do not limit rehabilitation. • Constructed landforms are structurally stable. • The constructed soil surface similar to pre-mining surface. • Landform surface material promotes water infiltration and reduces erosion and crusting.	• Refer to Appendix B
Access Roads	N/A	N/A	End of 30 Year Mine Life	• Access roads have been de-commissioned and removed, or handed to another party	
Site Infrastructure (buildings, hardstand areas, fences, gates, monitoring equipment etc)	N/A	N/A	End of 30 Year Mine Life	• Any built infrastructure is removed, unless otherwise agreed by DPaW (current land manager) and so long as the maintenance of the infrastructure is not inconsistent with overall closure objectives.	

9.2 SCHEDULE OF RESEARCH AND TRIALS

Trials for the rehabilitation program will focus on:

- Managing the weed bank in the existing topsoil;
- Establishing plants in the sand strata without topsoil (where topsoil is deemed unsuitable), with a view to examining methods to treat and improve the medium to make it more receptive to the growth of plants;
- Management of the topsoil if removed;
- Importation of topsoil from land that is being cleared in the proximity of the sites;
- Selection of the best species to suit the rehabilitation being requested including a preference for species that would be useful for the Carnaby Cockatoo; and
- Appropriate performance targets and criteria.

Table 13 below provides a schedule of research and trials currently planned. It is expected this schedule will evolve over time as new information comes to light through progressive rehabilitation.

Table 13: Schedule of Research and Trials

Trial / Research	Schedule
Investigation into species useful to Carnaby Cockatoo	Year 1
Investigation regarding suitability of existing topsoil	Years 1 - 5
Weed control trials	Years 1 - 5
Trials of rehabilitation using overburden or other materials to replace topsoil	Years 1 - 10

9.3 SCHEDULE OF PROGRESSIVE REHABILITATION

Industry accepted rehabilitation and re-vegetation procedures will be implemented (where possible progressively) throughout operations. Areas which have not been progressively rehabilitated will be rehabilitated after closure using appropriate rehabilitation and re-vegetation techniques. The re-vegetation programme will aim to re-establish native vegetation that is appropriate to the agreed final land use.

A Preliminary Rehabilitation Plan has been developed in consultation with DPaW and is included in Appendix E.

The broad schedule for closure rehabilitation and re-vegetation at the end of mine life is outlined below:

Table 14: Rehabilitation / Re-vegetation Activity Schedule

Activity	Schedule
Re-profiling of the land surface to blend in with surrounding landforms.	Years 1 - 2
Spreading with topsoil / growth medium to encourage re-vegetation.	Years 1 - 2
Spreading / placing cleared vegetation to encourage re-vegetation and create fauna habitat.	Years 1 - 2
Monitoring rehabilitation success.	Years 2 - 5
Seeding and / or infill planting with seedlings if necessary as a remediation measure to improve rehabilitation success.	Years 3 - 5

9.4 AVAILABILITY OF CLOSURE MATERIALS

In terms of rehabilitation and closure materials, it is recognised that topsoil in the area may be deemed unsuitable for rehabilitation given the high proportion of pine and weeds in the existing topsoil seedbank. Further investigation will be conducted on the suitability of existing topsoil for rehabilitation. If topsoil is deemed unsuitable for revegetation, trials will be conducted into vegetation establishment into overburden or other growth media. The extractive industry has experience in the establishment of native vegetation cover within alternative growth media, without the provision of a separate topsoil layer and Holcim considers this to be an effective approach for this project if necessary.

9.5 INFORMATION GAPS

Section 7.3.1 details data gaps that have been identified in relation to closure planning.

Holcim has identified that currently its key information gap is the lack of a proven technique for successful restoration of pine plantation into native vegetation.

Therefore Holcim has commenced collection of other closure related data with the objective of building a "base" of information and knowledge in this area. Section 7.2.1 describes information collected to date which is providing background information and experience of other organisations which will be used to assist in filling current knowledge gaps, along with Holcim's own trials and research as outlined above in Section 9.3.

9.6 PREMATURE CLOSURE

As described in Section 11 the closure provision account includes costs set aside for unexpected closure and/or sudden placement of the site into care and maintenance. Should unexpected closure occur, this Closure Plan will be refined with further detail, then implemented to rehabilitate areas no longer required for future operations. Parts of the operation likely to be required for future mining or other uses will be put into "care and maintenance" until future plans are confirmed. Care and maintenance would involve ensuring staff and equipment were available to ensure the ongoing management of the site, to minimise environmental impacts resulting from infrastructure and facilities that remain on site in accordance with regulatory requirements.

In the unlikely event temporary closure of the site was required the following work would be undertaken:

- All mobile equipment and materials are removed from site.
- All fixed plant would be turned off and left in a condition that would prevent safety and environmental risks.
- Progressive rehabilitation for the current mining activities would completed as far as practicable.
- Any product or topsoil stockpiles remaining on site would be recorded and marked (GPS location recorded, documented in register and stockpile is signposted).

9.7 DECOMMISSIONING TASKS

Holcim commit to rehabilitating the excavation areas, access roads, removing all waste and demobilising all mobile equipment within 5 years of operations cessation. Given no buildings or fixed plant exist on site decommissioning of such items is not required.

The only infrastructure that may require decommissioning are the access roads, fencing, gates and monitoring equipment. Ongoing use requirements of other parties (e.g. DPaW) will be determined prior to

final closure. If such infrastructure is not required for ongoing use, and is required to be decommissioned and rehabilitated this will be done in years 3 to 5 after cessation of mining.

9.8 SCHEDULE OF MONITORING AND MAINTENANCE

After closure Monitoring and Maintenance activities will be implemented in the key phases outlined below in Table 15. Timeframes have been estimated from the closure date onwards based on current best available information. These timeframes may be modified in subsequent reviews of this Closure Plan. A more detailed Monitoring and Maintenance schedule will be developed closer to the end of mine life.

Table 15: Monitoring and Maintenance Schedule

Phase	Task / Activity	Timeframe
1	Maintenance and monitoring of rehabilitated areas to ensure closure objective have been met	Years 1 - 5
2	If required, remedial works for areas that may not perform as expected.	Years 3 - 5
3	If required, decommissioning and rehabilitation of access road.	Years 3 - 5
4	Confirmation of completion criteria met and relinquishment of site or specific areas.	Years 3 - 5

10 CLOSURE MONITORING AND MAINTENANCE

As outlined above in Section 9.8, closure monitoring and maintenance would be an ongoing process during years 1 to 5 of closure.

10.1 MONITORING AND MAINTENANCE FRAMEWORK

The sub-sections below detail the monitoring and maintenance framework proposed.

10.1.1 RE-VEGETATION MONITORING

The monitoring program will be largely driven by the requirements of the related research trials.

Subject to the design and requirements of research trials the monitoring program should constitute the following elements:

- Short-term monitoring (e.g. 2nd Spring – 15 months) will focus on establishment success and the need for any short term remedial action including weed control.
- Long-term vegetation observations will provide data regarding plant mortality, health, and reproduction to enable analysis of system function, dynamics and resilience. Long-term observations include:
    - Native seedling recruitment (derived from the topsoil, from seed broadcasting, and tubestock) following each Spring for years 3 & 5, following rehabilitation operations;
    - Plant reproductive and regenerative capability over time;
    - Recruitment and persistence of weeds with subsequent management, which may include spraying for removal if necessary;
    - The need for supplementary planting of tubestock.

10.1.2 RE-VEGETATION PERFORMANCE CRITERIA

The following re-vegetation performance criteria are proposed:

- There will be adequate cover, richness and density of plants to suit the final land use. Holcim commits to the development and agreement of interim target metrics for rehabilitation establishment following initial investigations into the performance of current best practice rehabilitation methodologies.
- All surfaces will be stable with vegetation cover and no erosion.
- There will be no increase of weeds above baseline and weeds will be of such a density that they do not adversely compromise rehabilitation success.
- Long-term observations of the vegetation will provide data for plant mortality, health and reproduction and will enable analysis of system function, dynamics and resilience.

10.1.3 GROUNDWATER MONITORING

An indicative groundwater monitoring programme for closure is provided in Table 16. This programme will commence at closure and will continue for duration of 5 years. The final closure plan will reflect any revisions that arise from the operational monitoring programme results. The findings from ongoing monitoring near areas that have been rehabilitated will be incorporated into the Project during the operational phase.

Table 16: Indicative Closure Groundwater Monitoring Programme

Frequency	Bore Locations	Parameters	Methodology and QA/QC	Rationale
Quarterly	WHPZ bores: HMB07B, W230, JB10B, W240 On-site bores; HMB01, HMB02, HMB03, HMB04, HMB05, HMB06, HMB08	Groundwater levels	Groundwater levels to be measured to the nearest cm using a water level meter.	Quarterly measurements to ensure seasonal variations and short-term trends are captured. These levels will be assessed against assigned closure criteria values. Validating water levels predictions. Monitoring at this frequency for five years will improve the understanding of the effects climate change and land use are having on the local water table post-closure.
Biannual	JB12B, JB9C, WCM Redrill, WE1B, WE2B, WM24, WM35, WM23.	Groundwater levels Groundwater quality (EC, pH, temperature)	Groundwater levels to be measured to the nearest cm using a water level meter. Field groundwater quality readings to be taken using a calibrated water quality meter.	Biannual measurements to capture winter peaks and summer troughs. These levels will be assessed against assigned closure criteria values. These data will support the on-site monitoring data and to provide a greater spatial representation of groundwater levels in the shallow water table zone.
Annual	WHPZ bores: HMB07B, W230, JB10B, W240 On-site bores: HMB01, HMB02, HMB03, HMB04, HMB05, HMB06, HMB08	Groundwater quality (comprehensive suite)	Groundwater sampling to be undertaken using low-flow sampling (peristaltic). *In situ* analysis of groundwater to be conducted using a calibrated water quality meter. QA/QC samples to be taken at the following frequency; • Duplicates and triplicates (1 in 20 primary samples) • Field and rinsate blanks (1 per day of sampling) Samples to be analysed by a NATA accredited laboratory.	Identification of previously unidentified contamination of groundwater at the water table due to an unplanned leak or unmanaged spill. These levels will be assessed against assigned closure criteria values.
It is recognised that some of the proposed monitoring bores to be installed within the mine footprint may be destroyed during quarrying operations. The monitoring programme will be reviewed during operations and revised in the final Closure Plan.				

10.2 CLOSURE MONITORING METHODOLOGY

Holcim will implement the following methodology for all closure monitoring.

- Provide and communicate a documented schedule of monitoring required including:
  - Type
  - Frequency
  - Location.

- Provide and communicate procedures for all monitoring including step by step details regarding:
  - Sampling / field data collection
  - Sample preservation and transport (if needed)
  - Sample analysis
  - Data recording
  - Data analysis
  - Reporting.

10.3 CLOSURE MONITORING QUALITY CONTROL

Holcim will implement appropriate procedures for quality control of all closure monitoring including:

- Sampling / field work quality control
- Laboratory quality control (if relevant)
- Data analysis quality control
- Reporting quality control.

These procedures will be aligned with the international standards for quality control as documented within the ISO 9000 series.

10.4 REMEDIAL STRATEGY

Should monitoring indicated that Holcim is not on the path to successfully meeting its Closure Criteria, Holcim will undertake remedial works to rectify the situation. Remedial works may include (but are not limited to):

- Erosion control and soil stabilisation measures.
- Weed control measures.
- Growth media creation to replace inadequate topsoil.
- Infill planting to meet revegetation criteria.
- Additional seeding to meet revegetation criteria.
- Provision of additional fauna habitat.
- Clean up of any contamination.

11 FINANCIAL PROVISION FOR CLOSURE

In accordance with international accounting standards and internal policies, Holcim maintains financial provisions where there is any legal or constructive obligation to rehabilitate a site. A legal obligation can exist by contract or through respective approvals and regulations. A construction obligation can be as committed through public communication or internal policy. Holcim, being an international company undertakes financial reporting in accordance with strict standards.

Holcim is currently reviewing closure provisioning processes annually to align with Holcim's internal requirements internationally. Any update on closure provisioning will be included in subsequent MCPs.

11.1 CLOSURE COSTING METHODOLOGY

Holcim has in place closure provisioning processes in which the annual costs of rehabilitation activities, decommissioning activities and closure programmes are calculated out to final closure. A 'closure provision' is then created to address site final closure costs. A closure cost has been estimated for the project, as per Holcim policies the provision will be reviewed in the first 6 months of operation. Key aspects of the closure costing methodology are outlined in the sub-sections below.

Holcim utilises a schedule of rates for various required activities to estimate closure costs.

The schedule of rates is kept up to date on the basis of current undiscounted costs, current legal requirements and current technology.

11.2 COSTS INCLUDED

Closure costs are calculated to reflect, as far as possible, the real cost of closure and include:

- Decommissioning costs (which occur at or near the end of Operation life) such as:
  - Demolition and removal of unwanted facilities and services on the site.
  - Remediation: the clean-up of contaminated areas of soil or water to an agreed quality.
  - Maintenance and monitoring: the management of the site through to relinquishment.
- Rehabilitation costs, which include the cost of rehabilitating disturbed areas that (for an operational or environmental reason), were not progressively rehabilitated during the life of the Operation.
- Project management costs, which include the human resourcing, facilities and administration related support required to implement closure activities.

Examples of items included in each category above are further detailed in Table 17 below.

Table 17: Examples of Items Included in Provision Accounts

Closure Category	Example Items Included

Decommissioning	• Decommissioning and removal of infrastructure, plant and equipment.
	• Waste disposal.
	• Remediation of contamination:
	  o Survey program
	  o Remediation program
	  o Maintenance and monitoring.

Closure Category	Example Items Included
Rehabilitation	• Earthmoving and landscape forming. • Re-vegetation. • Post Closure management of surface water drainage and erosion. • Maintenance and monitoring programs.
Project Management	• Ongoing stakeholder consultation. • Administration support. • Office and accommodation facilities. • Specialist and consultant fees. • Legal requirements.

11.3 UNEXPECTED CLOSURE

The provision includes costs set aside for unexpected closure and / or sudden placement of the site into care and maintenance.

11.4 CLOSURE COSTING DOCUMENTATION

Holcim maintains thorough documentation of is closure provisions and assumptions behind cost estimates in company accounting databases and reports.

12 MANAGEMENT OF INFORMATION AND DATA

This Closure Plan will be made publicly available.

12.1 REVIEW OF THE CLOSURE PLAN

This Closure Plan will be reviewed every 3 years.

12.2 REPORTING

Reporting on rehabilitation management is required by Mining Tenement Conditions as part of the Annual Environmental Report (AER). The following rehabilitation reporting will occur:

- AER – Briefly report rehabilitation performance, additional treatments, outcomes and proposed changes.
- Years 3 & 5. Provide a detailed performance review in conjunction with monitoring of comprehensive parameters.
- Refine the R & D program to address identified gaps based on monitoring. E.g. diversity, sustainability, soil attributes.

Details on reporting required are outlined in Table 18 below.

Table 18: Holcim's Rehabilitation and Closure Reporting Requirements

Reporting Requirement	Description	Frequency	Relevant Guideline	Authority
Annual Environmental Report (AER) / Annual Monitoring Report.	• Summary of progress, performance and monitoring of the mine; and • Summary of new rehabilitation activities (location and area (in ha) of re-vegetation).	Annually	DMP Guidelines for the Preparation of an Annual Environmental Report	AER provided to the DMP. Provide copies to other interested parties if requested.
Incident Reports	Incident reports will be prepared and submitted in the event of a significant environmental incident or non-compliance.	As required	Not Applicable	DMP and if relevant DER

12.3 RECORDS AND DATA MANAGEMENT

Holcim will maintain copies of all environmental approvals, licences and permits relevant to the quarry. These records will be updated as necessary to include new operating approvals and updated licences.

In addition Holcim maintains a Legal Obligations Register which summarises all environmental legal obligations relevant to closure (Appendix A).

Holcim's Environmental Management System (EMS) is based on ISO14001 and includes high quality processes for the retention of mine records and all information and data relevant to mine closure. It is anticipated that the EMS will be utilised as a framework for management of closure data, records and information. It is anticipated that through the EMS a closure database will be established for each domain or feature, where all available information is collated and reviewed with the objective of building a "base" of information for that particular domain or feature. Information may include, but not be limited to, the current status of the domain or feature, information from spatial datasets and databases, design and construction information, operation and monitoring information or other information that meets a specific purpose (e.g. maps, area statistics, species lists or modelled environmental impacts). All technical reports relevant to closure will be referenced and included in the database.

13 CONFIDENTIALITY

This plan is required to be made publicly available in accordance with Guidelines for Preparing Mine Closure Plans (Department of Mines and Petroleum, 2015), and therefore it is not considered confidential.

14 GLOSSARY

14.1 UNITS, SYMBOLS AND PREFIXES

14.1.1 UNITS

g	Gram; a unit used to express weight
L	Litre; a unit used to express volume
m	Metre; a unit used to express length
bcm	Bank cubic meters; a unit used to describe the volume of in-situ rock
dB	Decibel; unit used to express sound intensity
h	Hour; a unit used to express time
ha	Hectare; a unit used to express area
m2	Square metre; a unit used to express area
m3	Cubic metre; unit used to express volume.
V	Volt; a unit used to express the potential difference across a conductor
VA	Volt-amp; a unit used to express apparent power; is equal to voltage applied multiplied by current drawn
VPD	Vehicles per day
yr	Year
s	Second; a unit used to express time
ppm	Parts per million; a unit used to express concentration
ppt	Parts per thousand; a unit used to express concentration
T	Tonne

14.1.2 SYMBOLS

%	percentage (proportion out of one hundred)
/	Per
p	per
$	Australian dollars
a	annum; year
°C	degree Celsius

14.1.3 PREFIXES

G	10^{9}
M	10^{6}
k	10^{3}
d	10^{-1}
c	10^{-2}
m	10^{-3}.
µ	10^{-6}
N	10^{-9}

14.2 WORDS AND ABBREVIATIONS

Term	Definition/Expansion
acid	Substance with a pH less than 7.0; the lower the pH the higher the corrosive ability of the substance.
acidic	Having a pH less than 7.0.
AHD	Australian Height Datum
ALARP	As low as reasonably practicable.
amenity	The desirability of an area.
amphibians	Animals (such as frogs) adapted to live both on land and in water.
ARI	Average recurrence interval; a measure of the rarity of a rainfall event.
artefact	Anything made by human workmanship, particularly by previous cultures (such as chipped and modified stones used as tools).
background	The conditions (e.g., noise levels, bird populations) already present in an area before the commencement of a specific activity (e.g., a mining operation).
best practice	A best practice is a process, technique, or use of technology, equipment or resource that has a proven record of success.
bioregion	A complex land area composed of a cluster of interacting ecosystems that are repeated in similar form. It describes the dominant landscape scale attributes of climate, lithology, geology, landforms and vegetation. It is based on the Interim Biogeographic Regionalisation for Australia (see IBRA).
biodiversity	The diversity of different species of plants, animals and microorganisms, including the genes they contain, in the ecosystem of which they are part.
bore	A well, usually of less than 20 cm diameter, sunk into the ground and from which water is pumped.
bund	An earth, rock, or concrete embankment constructed to prevent the inflow or outflow of liquids or the transmission of noise.
catchment	The entire land area from which water (e.g., rainfall) drains to a specific water course or waterbody.
clay	A discrete mineral species, belonging to the layered silicate group of less than 2 microns in diameter.
compaction	The process of close packing of individual grains in a soil or sediment as a response to pressure.
concentration	The amount of a substance per unit of mass or volume of the medium in which it occurs.
conservative	A prediction, assumption, or measurement that errs on the side of safety.
contractor	Specialist brought in to perform a specific task, such as the construction of mine infrastructure or the excavation (mining) of the open pit.
DER	Department of Environment and Regulation (WA)
DoE	Department of Environment (Federal)
DPaW	Department of Parks and Wildlife (WA)
density	The mass of a substance divided by its volume.
DIA	Department of Indigenous Affairs (WA)
DoCEP	Department of Consumer and Employment Protection (WA)
DoW	Department of Water (WA)
DRF	Declared Rare Flora.
DSP	District Structure Plan
ecosystem	An interacting system of animals, plants, other organisms and non-living parts of the environment.
emission	A discharge of a substance (e.g., dust) into the environment.
endemic	Native to, or restricted to, a certain country or area.

Term	Definition/Expansion
environment	A general term for all the conditions (physical, chemical, biological and social) in which an organism or group of organisms (including human beings) exists.
EPA	Environmental Protection Authority.
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
erosion	The wearing away of the land surface (whether natural or artificial) by the action of water, wind and ice.
fauna	A general term for animals (birds, reptiles, marsupials, fish etc.), particularly in a defined area or over a defined time period.
feed	Material being fed into a process.
flora	A general term for plants, particularly those found in a defined area or characteristic of a defined time period.
foraging	Searching for food over a wide area.
grade	The concentration of metal, e.g., iron either in an individual rock sample or averaged over a specified volume of rock.
gradient	Rate of change of a given variable (such as temperature or elevation) with distance.
greenhouse gases	Carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulfur hexafluoride.
ground vibration	Vibration transmitted through the ground following blasting.
groundwater	All waters occurring below the land surface; the upper surface of the soils saturated by groundwater in any particular area is called the water table.
habitat	The particular local environment occupied by an organism.
hydrology	The study of water, particularly its movement in streams, rivers, or underground.
infrastructure	The supporting installations and services that supply the needs of a project.
introduced	Introduced to a particular environment; exotic.
invertebrates	Commonly, animals without a backbone (jellyfish, worms, molluscs, etc.).
irrigation	The artificial flooding of agricultural land to promote cultivation.
landform	A specific feature of a landscape (such as a hill) or the general shape of the land.
load	The amount of a substance discharged into a body of water (e.g., salt or sediment); usually expressed as mass over a specified time (e.g., tonnes per year).
MBGL	Meters Below Ground Level
model	A mathematical simulation of a natural system (such as the variation of particulate levels within a lake) used to predict how the system will change with time, particularly where external changes have been imposed upon it (such as from mining operations).
monitoring	Systematic sampling and, if appropriate, sample analysis to record changes over time caused by impacts such as mining.
native	Belonging to, or found naturally, in a particular environment.
natural	Existing in, or formed by, nature (generally excludes anything obviously modified by human beings).
neutral	Neither acidic nor basic (e.g., a pH equal to 7.0).
nutrients	Generally refers to nitrogen and phosphorus, which are essential for biological growth.
operations	Mining and ore processing activities.
ORV	Off Road Vehicles.
passive	Performing a function without electrical or mechanical action or movement.
PER	Public environmental review.
pH	Percentage hydrogen; a measure of the degree of acidity or alkalinity of a solution; expressed numerically (logarithmically) on a scale of 1 to 14, on which 1 is most acid, 7 is neutral and 14 is most basic (alkaline).
Prescribed	A premise that falls into the categories prescribed in Schedule 1 of the Environmental

Term	Definition/Expansion
Premise	Protection Regulations 1987.
project area	the total area covered by the project, including pit, processing plant, stockpiles, haul road, rail siding, port facilities etc.
quadrat	A square measuring area used in ecological studies such as the distribution of plants or animals in an area. Quadrats can vary in size depending largely on the focus of the study.
receptor	A designated place at which an impact may occur (e.g., a dwelling).
recharge	The addition of water to an aquifer, directly from the surface, indirectly from the unsaturated zone, or by discharge from overlying or underlying aquifer systems.
rehabilitation	The restoration of a landscape and especially the vegetation following its disturbance.
reptiles	Cold-blooded vertebrates, including lizards, snakes, turtles, and crocodiles.
reserve	The calculated tonnage and grade of ore which can be extracted profitably from a mineral deposit; classified according to the level of confidence that can be placed in the data.
residual impacts	Impacts from an activity (e.g., mining) that remain after mitigation measures.
resource	The calculated amount of material in a mineral deposit, based on exploration drilling information.
richness (of fauna or flora)	A measure of the number of species in a given area or assemblage.
runoff	That portion of precipitation (rain, hail and snow) that flows from a specific area as water.
ore	Siliceous group of particles within the size range 63 microns to 2 millimetres.
silt	Sediment with particles finer than ore and coarser than clay, i.e., 2 to 63 microns.
species	A taxonomic grouping of organisms that is able to interbreed with each other but not with members of other species.
stockpile	A pile used to store material (such as low-grade ore) for future use.
stockpiled	Stored in a stockpile.
stripping	Removal of vegetation and topsoil.
surface water	Water flowing over, or contained on, a landscape (e.g., runoff, streams, lakes, etc.).
taxa	Plural of taxon.
taxon	A group or category, at any level, in a system for classifying plants or animals. Animal or plant group having natural relations.
TEC	Threatened Ecological Community.
topography	Physical relief and contour of a region.
topsoil	Upper layer of soil, usually containing more organic material and nutrients than the subsoil beneath it.
TPS	Town Planning Scheme
variable	Not constant, subject to change.
vibration	Oscillating movement.
WAPC	Western Australian Planning Commission
WAWC Act	WA Wildlife Conservation Act, 1950
water balance	The sum of the inputs and outputs and changes in storage levels of water in a given locality.
water quality	Degree of the lack of contamination of water.
watertable	The surface of the groundwater, below which soil and rock are saturated.
watercourse	Stream or river, running water.
weed	Any plant (in particular an herbaceous one) that survives in an area where it is harmful or troublesome to the desired land use.
wetland	A low-lying area regularly inundated or permanently covered by shallow water.

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16 FIGURES

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Figure No. 1
Location Map

Date: 2/10/2015 Paper: A4 P GDA94, MGA50

Data Source: 4K, 13A, 15I, 17A

File Info: H04_J06_Base_Map_V2

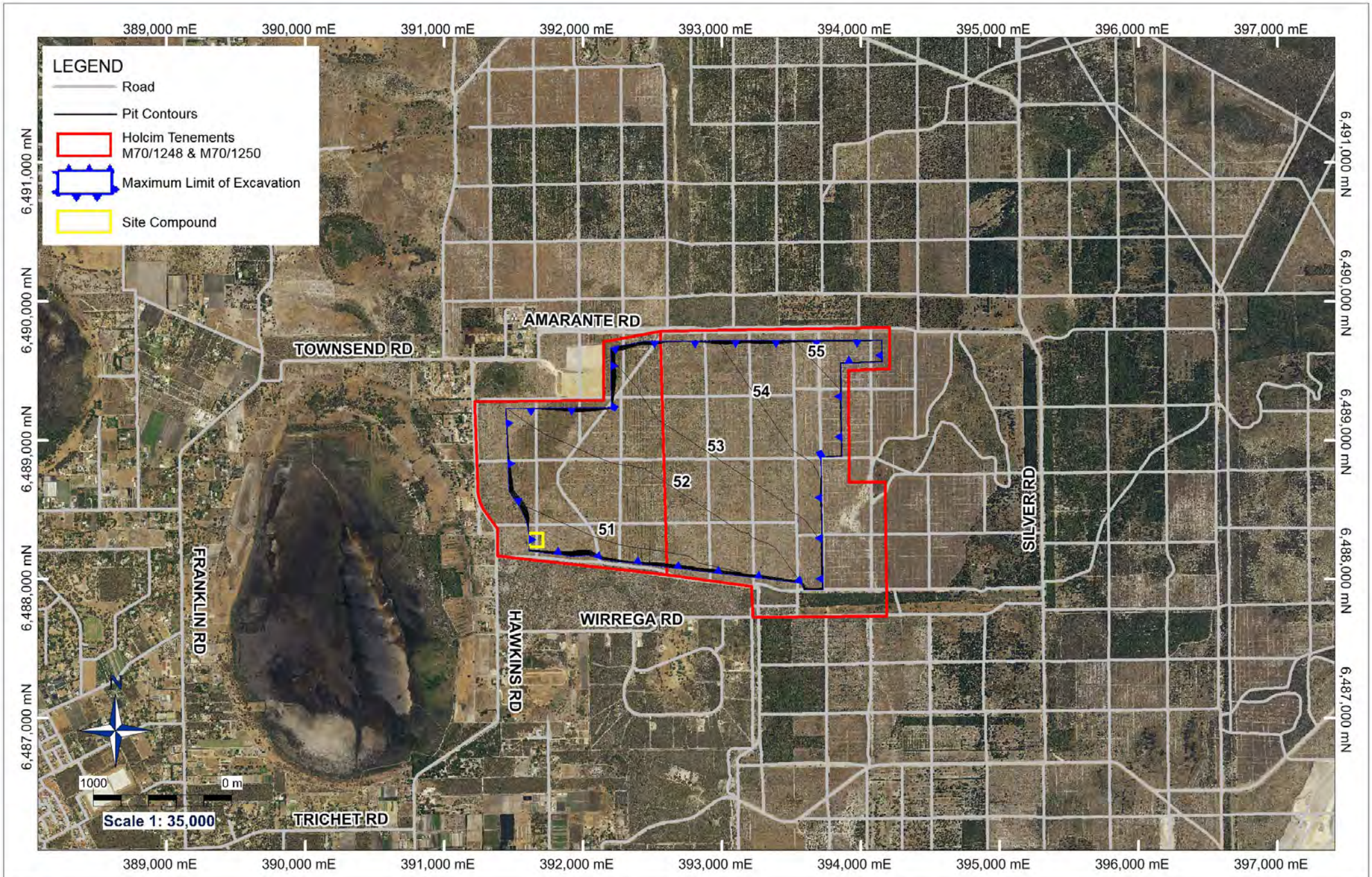

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Fig No. 2
Site Layout

Date: 26/10/2015	Paper: A4 L	GDA94, MGA50
Data Source: 7A, 13A		
File Info: U04_J06_Site_Layout_Area_20.08.2015		

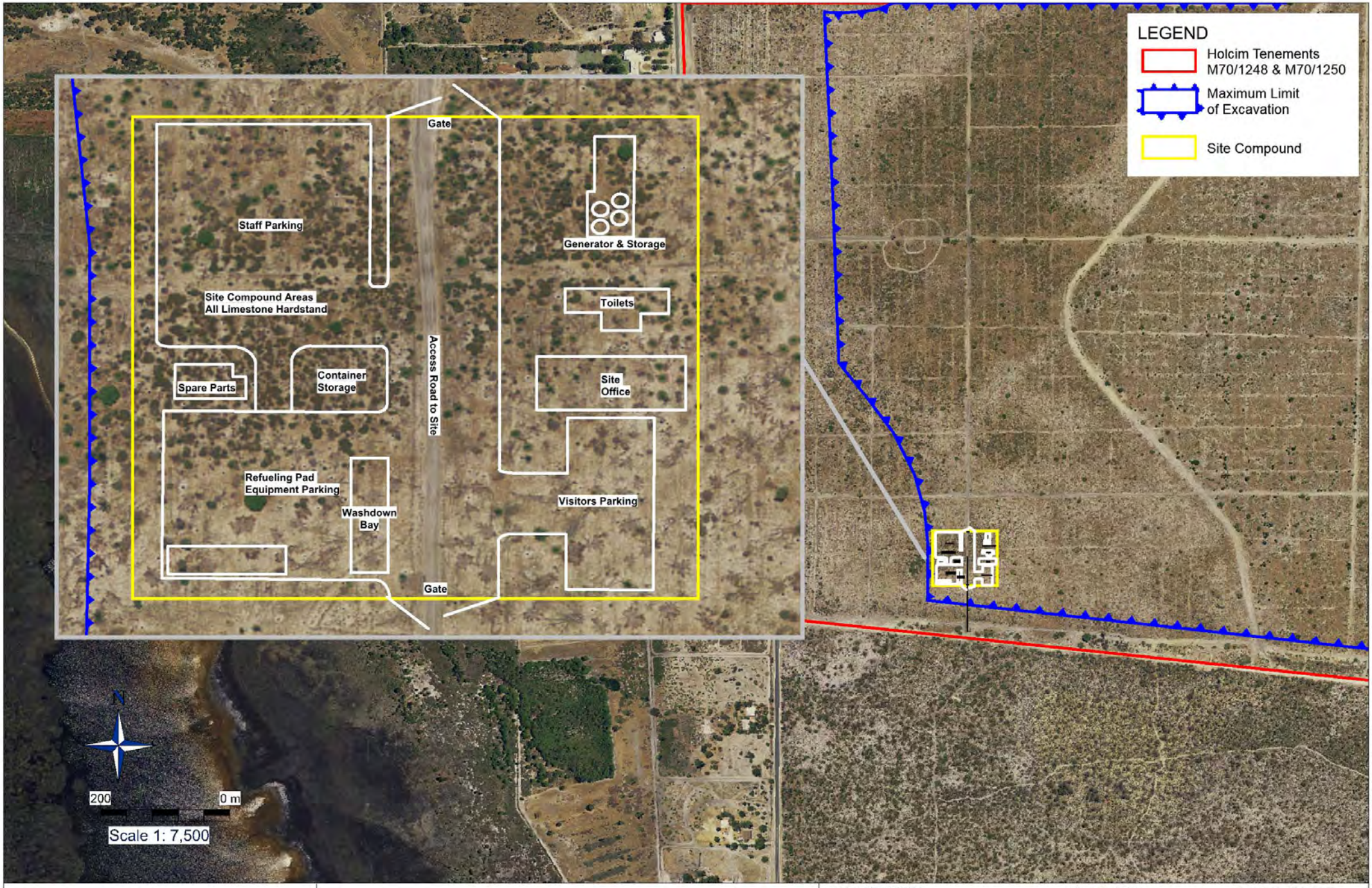

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Figure No. 3
Site Compound Layout

Date: 2/10/2015	Paper: A4 L	GDA94, MGA50
Data Source: 13A, 15I		
File Info: H04_J06_Site_Compound_Layout_20.08.2015		

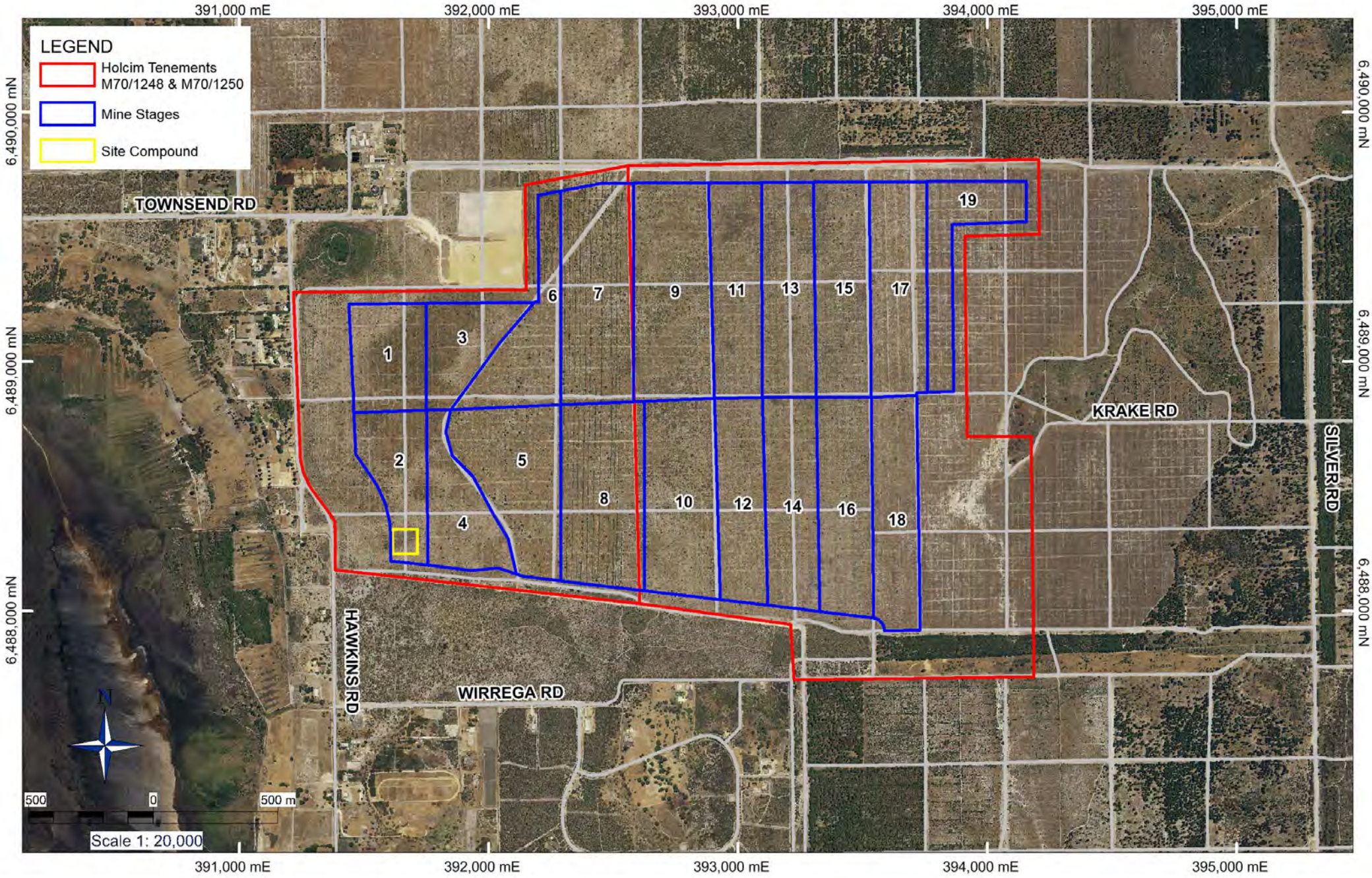

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Figure No. 4
Mining Staging Plan

Date: 26/10/2015	Paper: A4 L	GDA94, MGA50
Data Source: 8A, 13A		
File Info: H04_J06_Mine_Staging_26.08.2015		

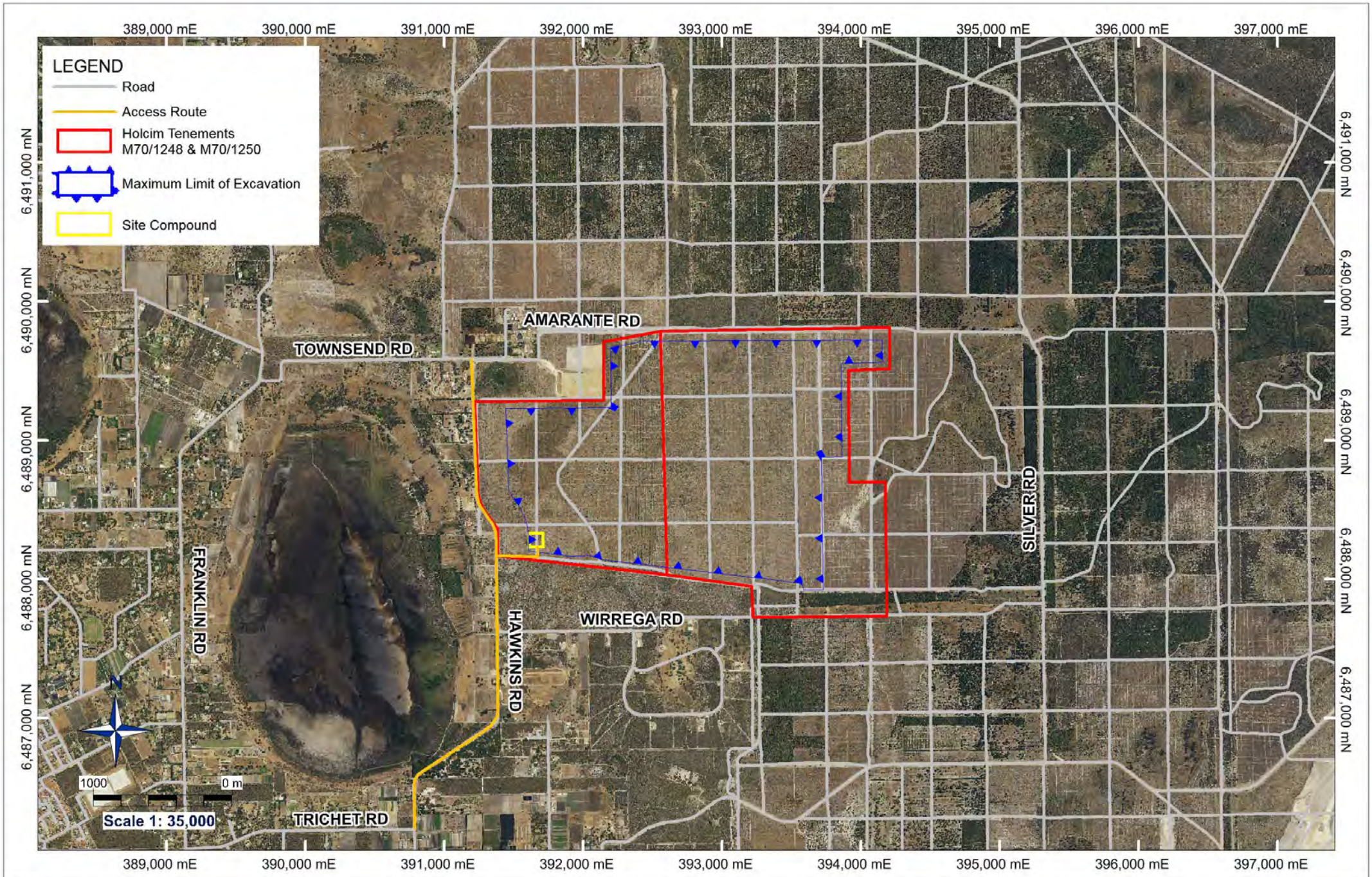

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Fig No. 5
Site Access Routes

Date: 26/10/2015	Paper: A4 L	GDA94, MGA50
Data Source: 7A, 13A		
File Info: H04_J06_Site_Access_Route_20.08.2015		

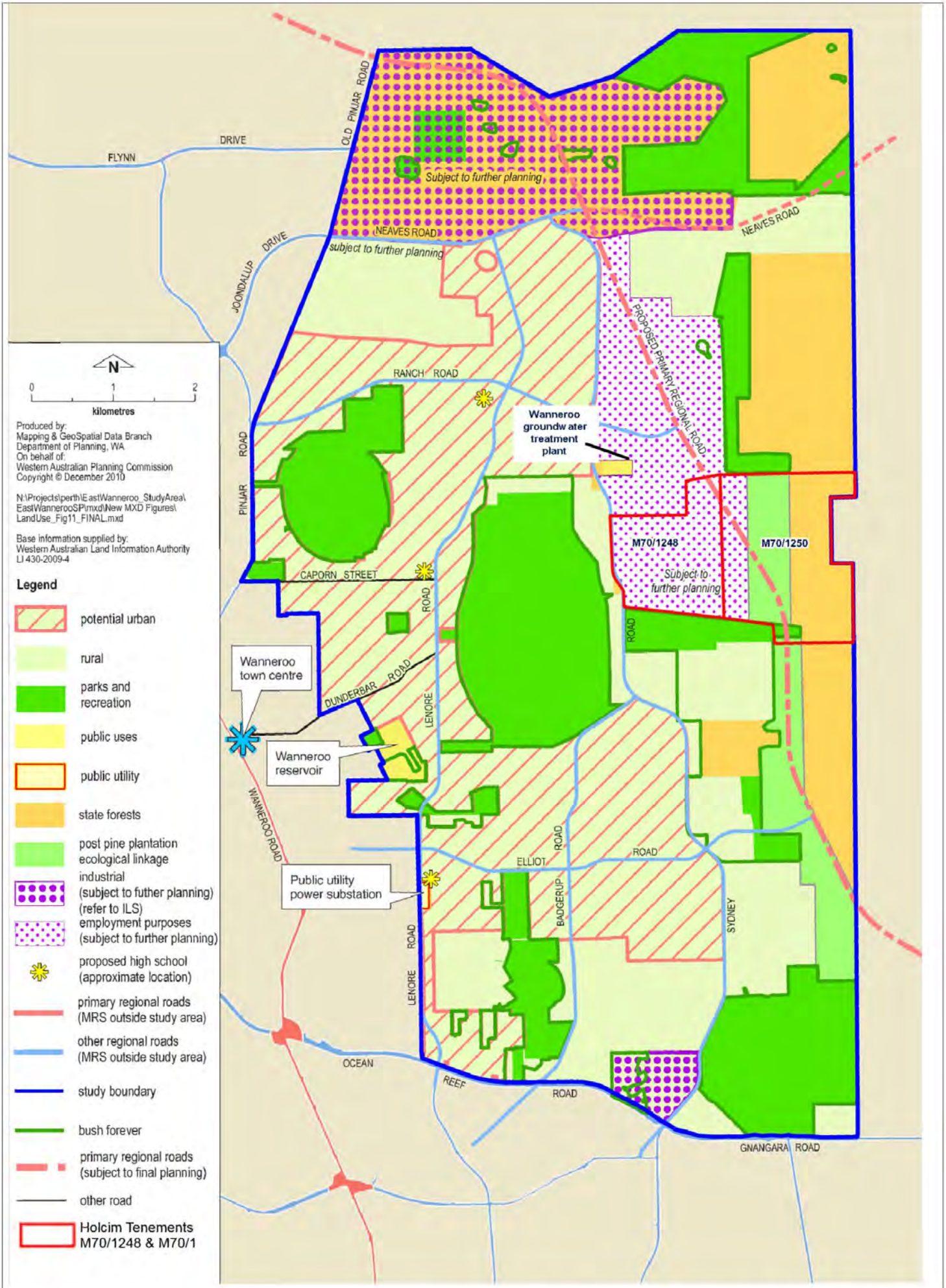

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Figure No. 6
East Wanneroo Structure Plan

Date: 24/08/2015 Paper: A4 P GDA94, MGA50

Data Source: 15l, Western Australian Planning Commission, 2011

File Info: H04_J06_Wanneroo_Structure_Plan_24.08.2015

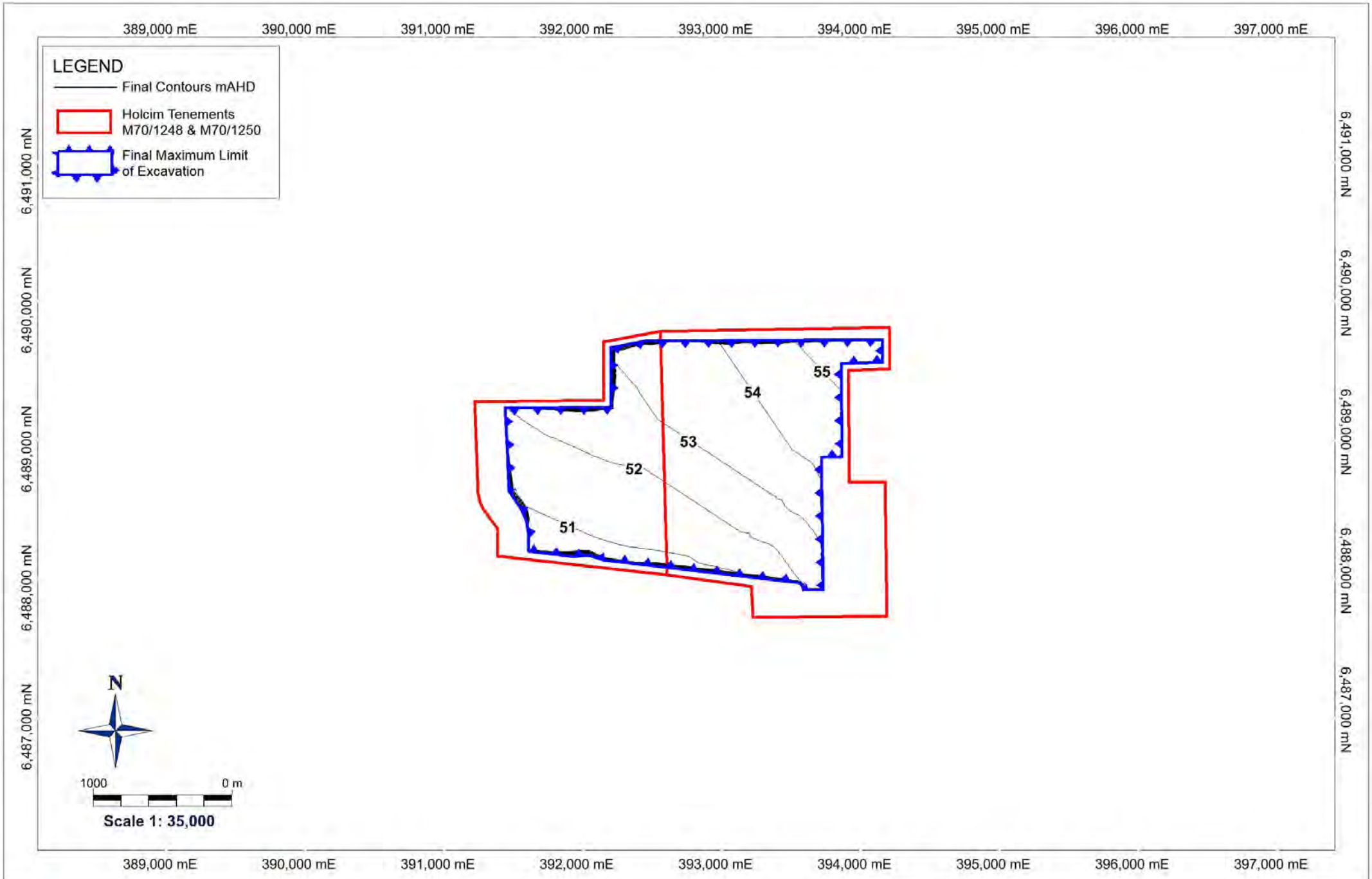

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Figure No. 7
Final Landform

Date: 26/10/2015 | Paper: A4 L | GDA94, MGA50

Data Source: 7A, 13A

File Info: H04_J06_Final_Landform_21.10.2015

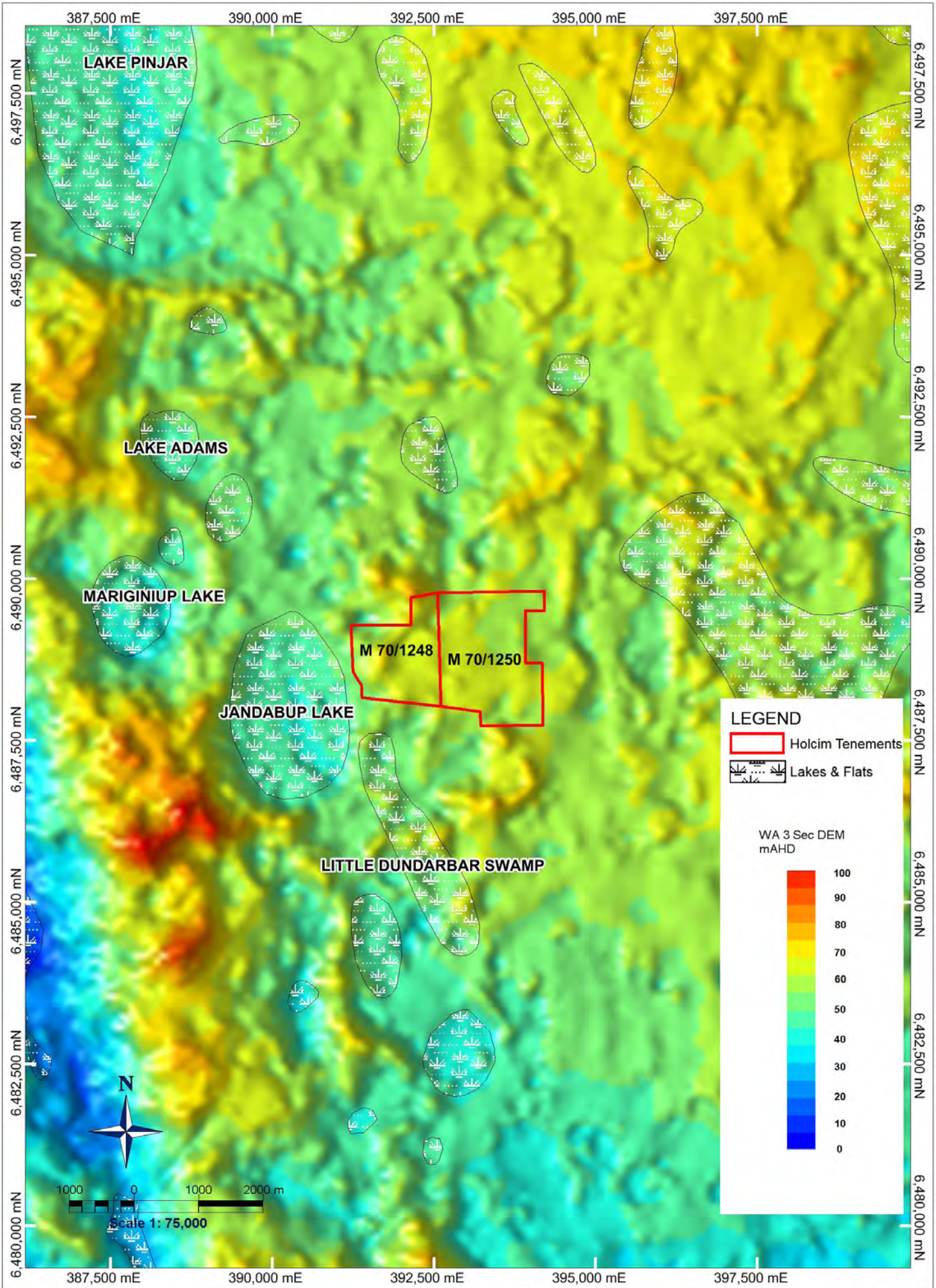

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Figure No. 8
Elevation

Date: 26/08/2015 Paper: A4 P GDA94, MGA50

Data Source: 9A

File Info: H04_J06_Elevation_26.08.2015

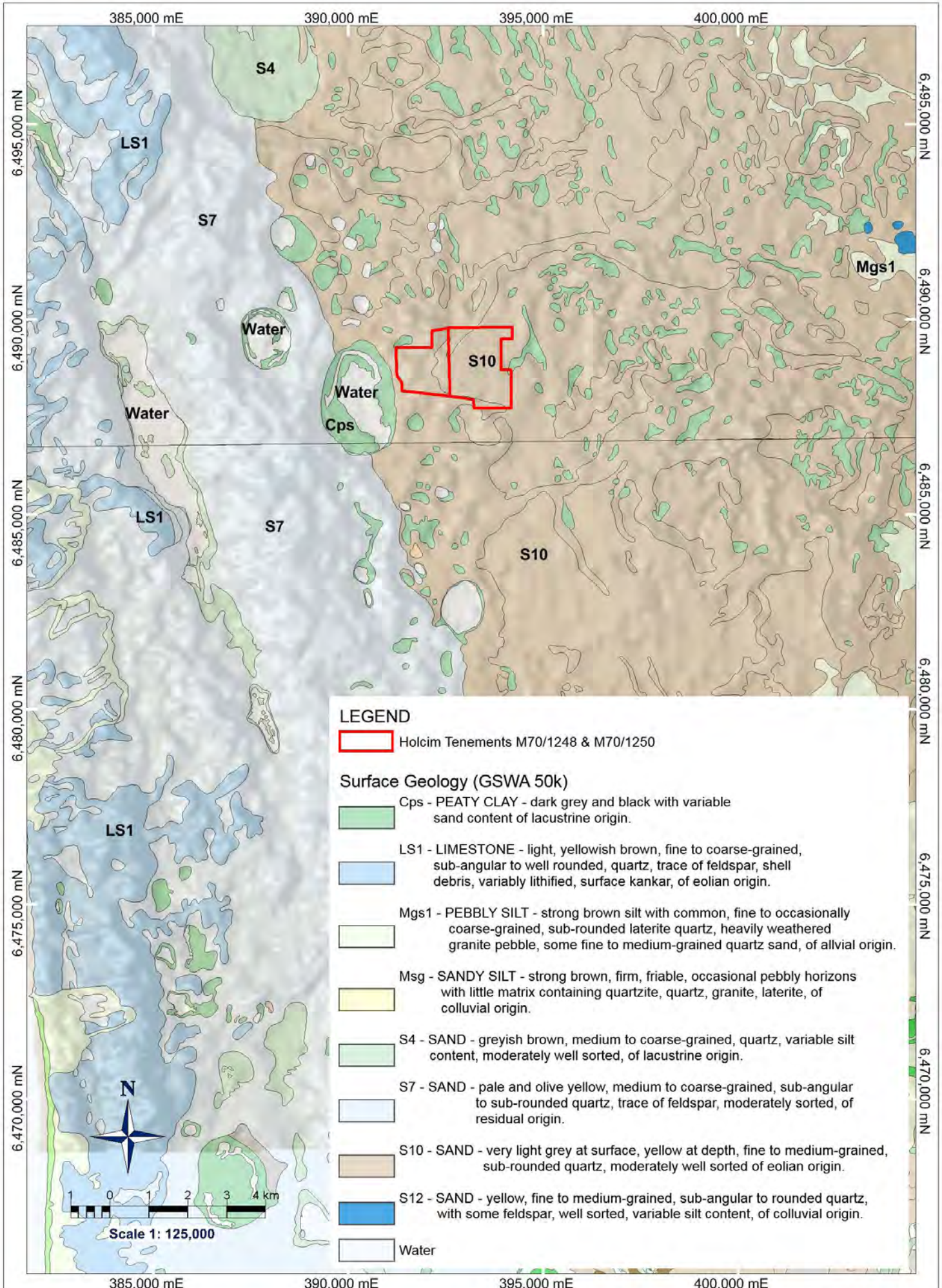

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Figure No. 9
Surface Geology

Date: 20/08/2015 Paper: A4 P GDA94, MGA50

Data Source: 9A, 11B

File Info: U04_J06_Surface_Geology_20.08.2015

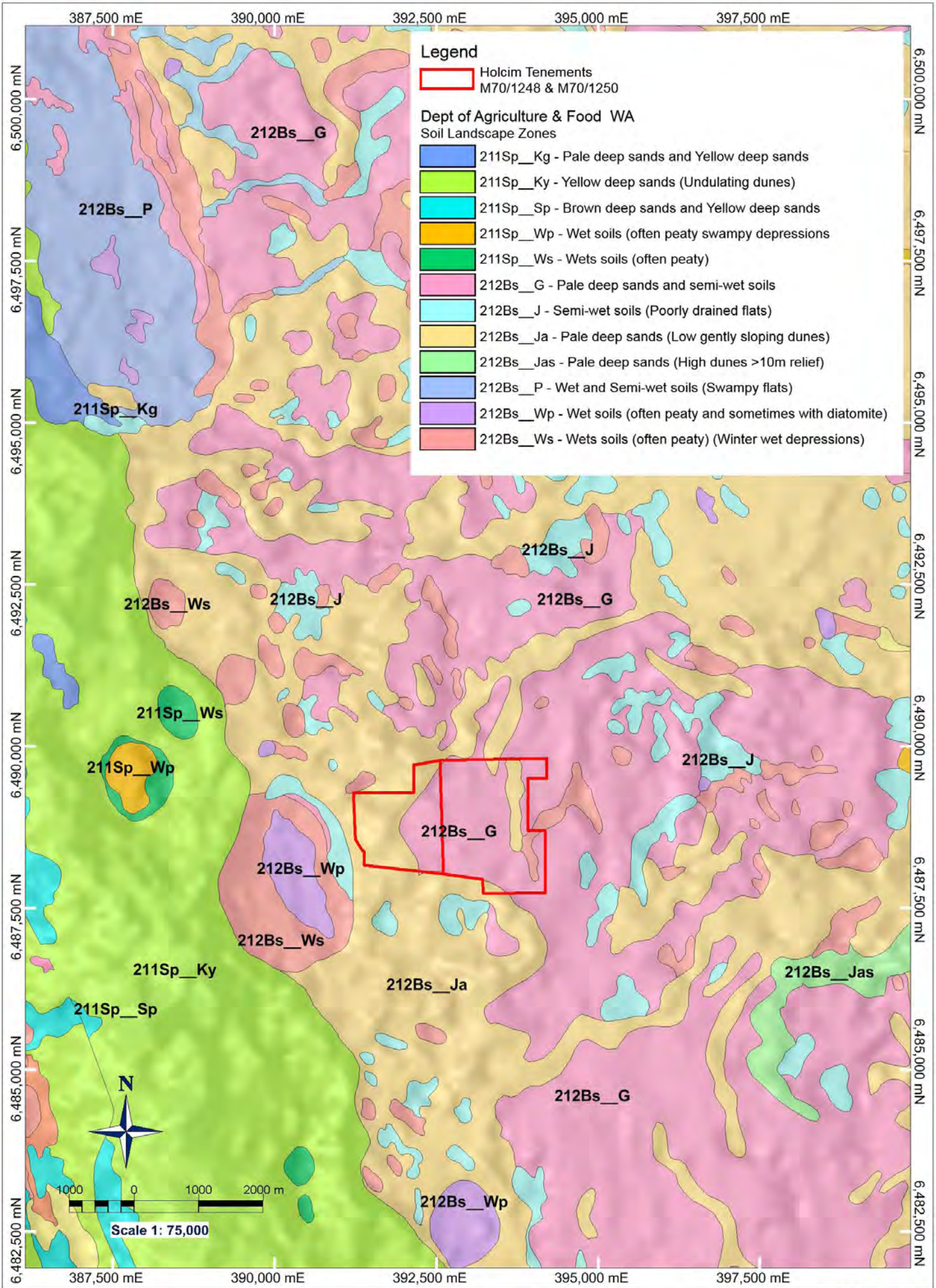

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Figure No. 10
Soil Types

Date: 20/08/2015 Paper: A4 P GDA94, MGA50
Data Source: 9A, 18C
File Info: U04_J06_Soil_Type_20.08.2015

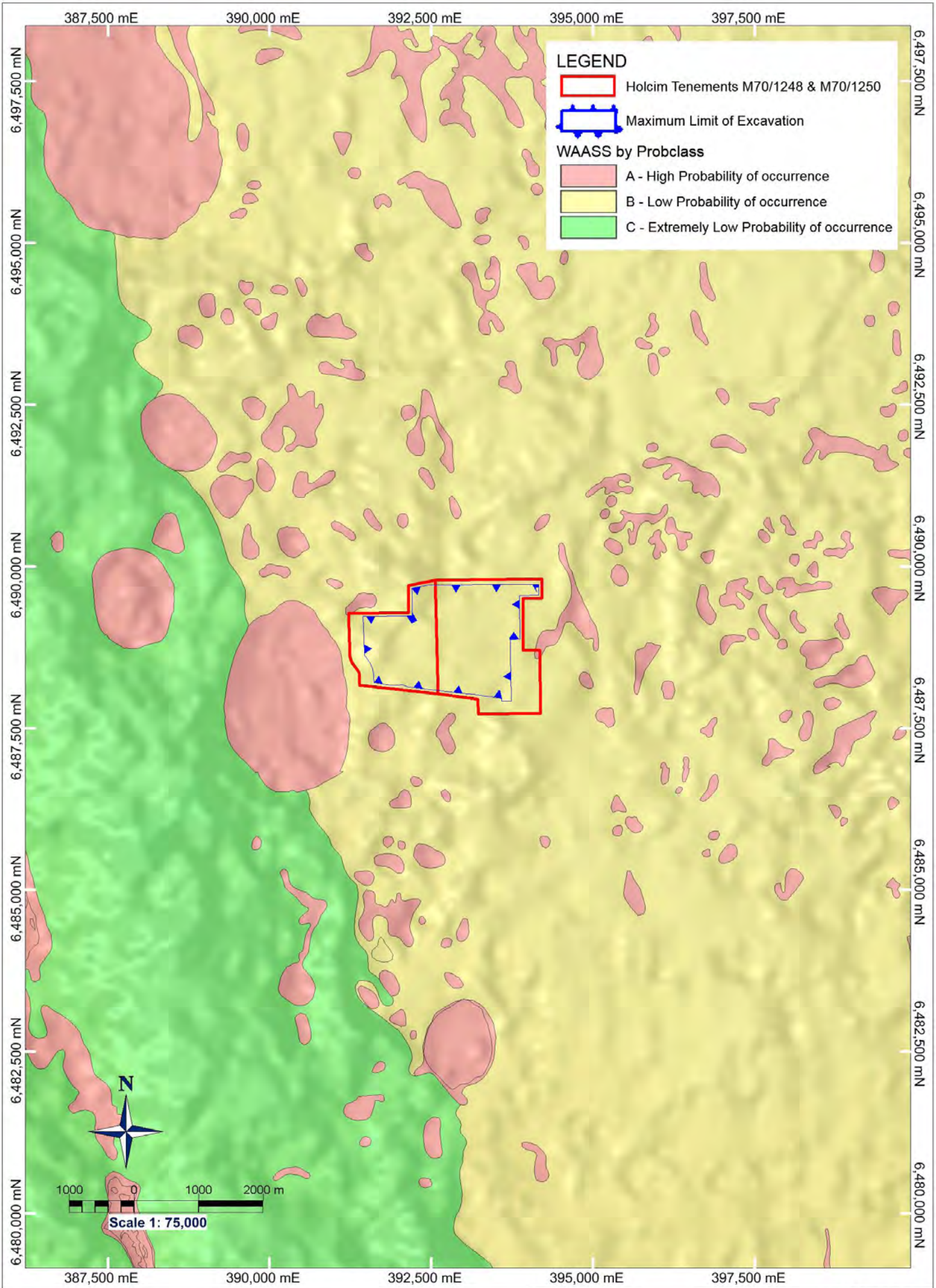

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Figure No. 11
Acid Sulphate Soils

Date: 26/10/2015 Paper: A4 P GDA94, MGA50

Data Source: 9A, 18A

File Info: U04_J06_Acid_Sulphate_20.08.2015

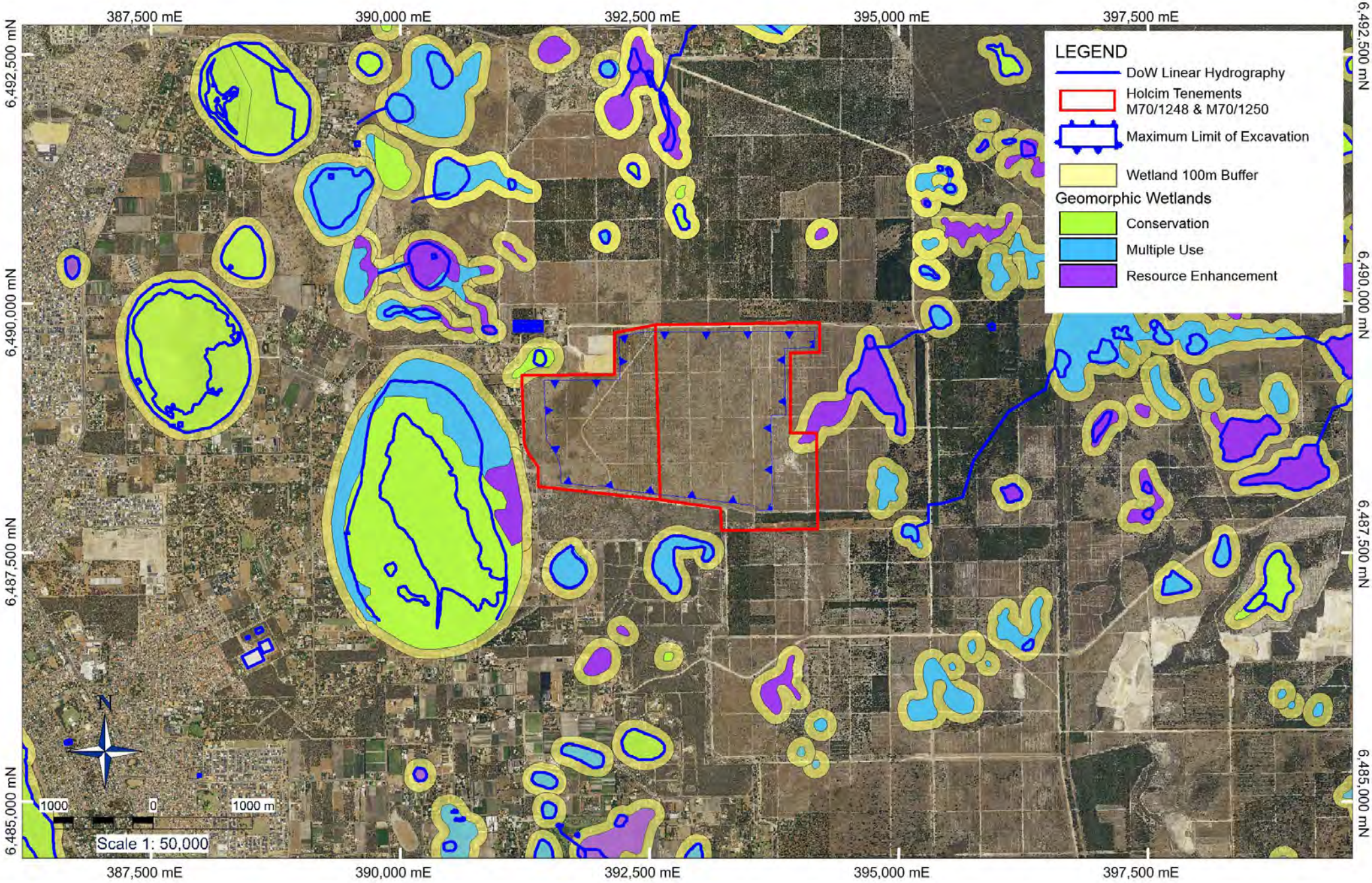

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Figure No. 12
Surface Water

Date: 26/10/2015 | Paper: A4 L | GDA94, MGA50

Data Source: 9A, 21AB, 21AF

File Info: H04_J06_Surface_Water_20.08.2015

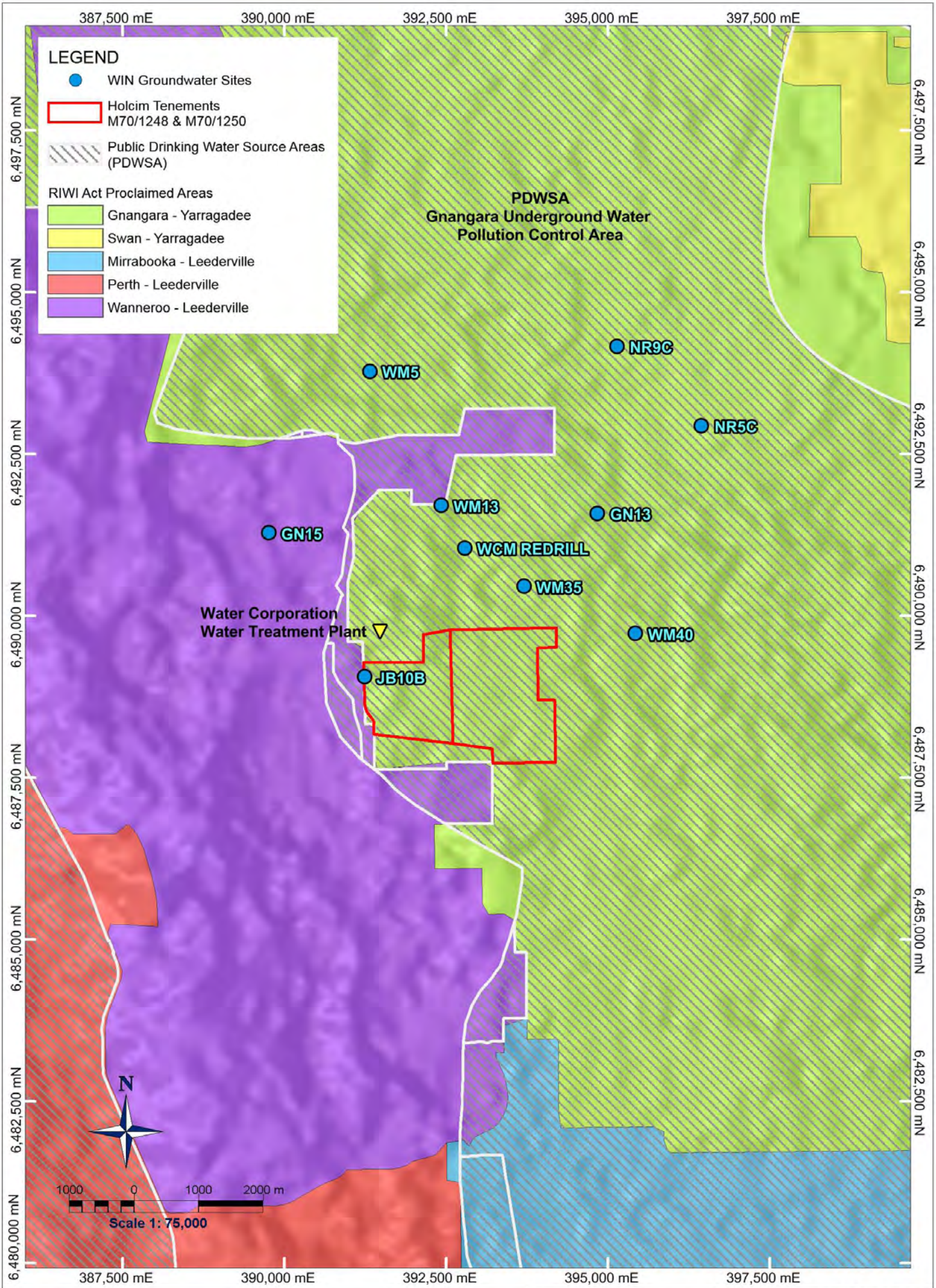

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Figure No. 13
Ground Water

Date: 21/08/2015 Paper: A4 P GDA94, MGA50

Data Source: 9A, 21A, 21B, 21G

File Info: H04_J06_Ground_Water_21.08.2015

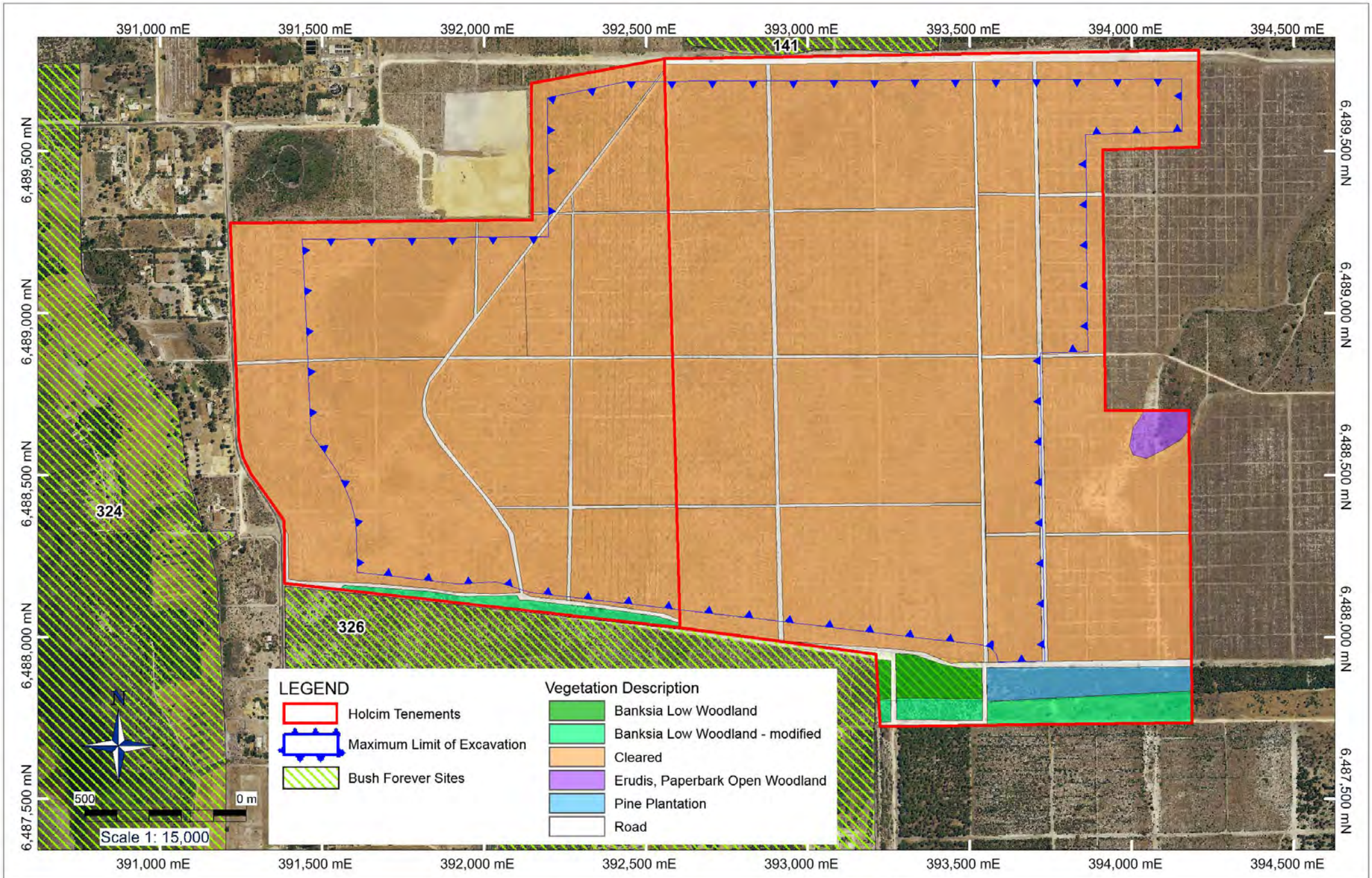

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Figure No. 14
Vegetation

Date: 26/10/2015 | Paper: A4 L | GDA94, MGA50

Data Source: 7A, 13A, 23A

File Info: H04_J06_Vegetation_21.08.2015

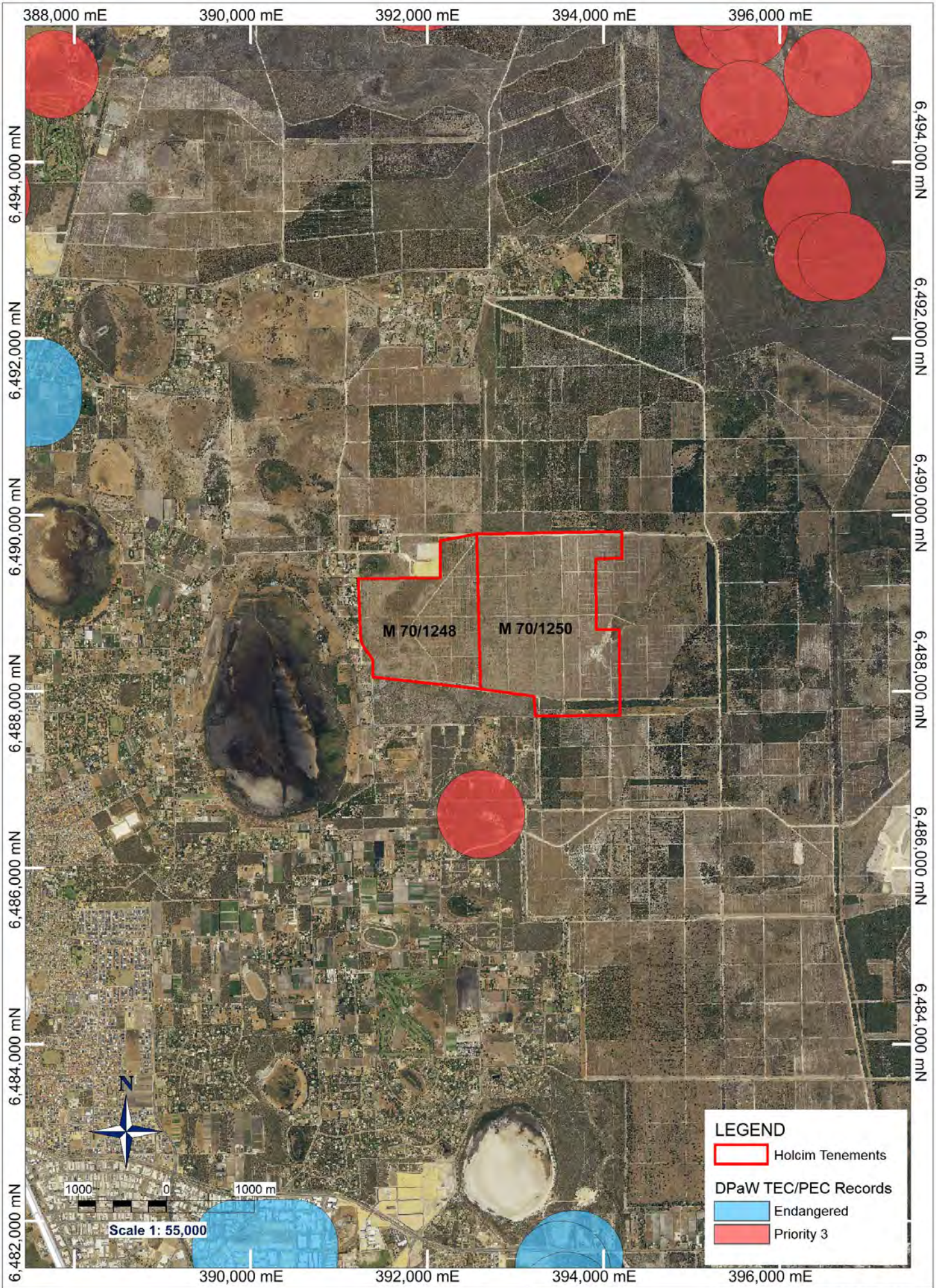

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Figure No. 15
DPaW TEC/PEC Records

Date: 20/08/2015 Paper: A4 P GDA94, MGA50

Data Source: 10H, 10I, 10J, 13A, 15I,

File Info: H04_J06_TECPEC_21.08.2015

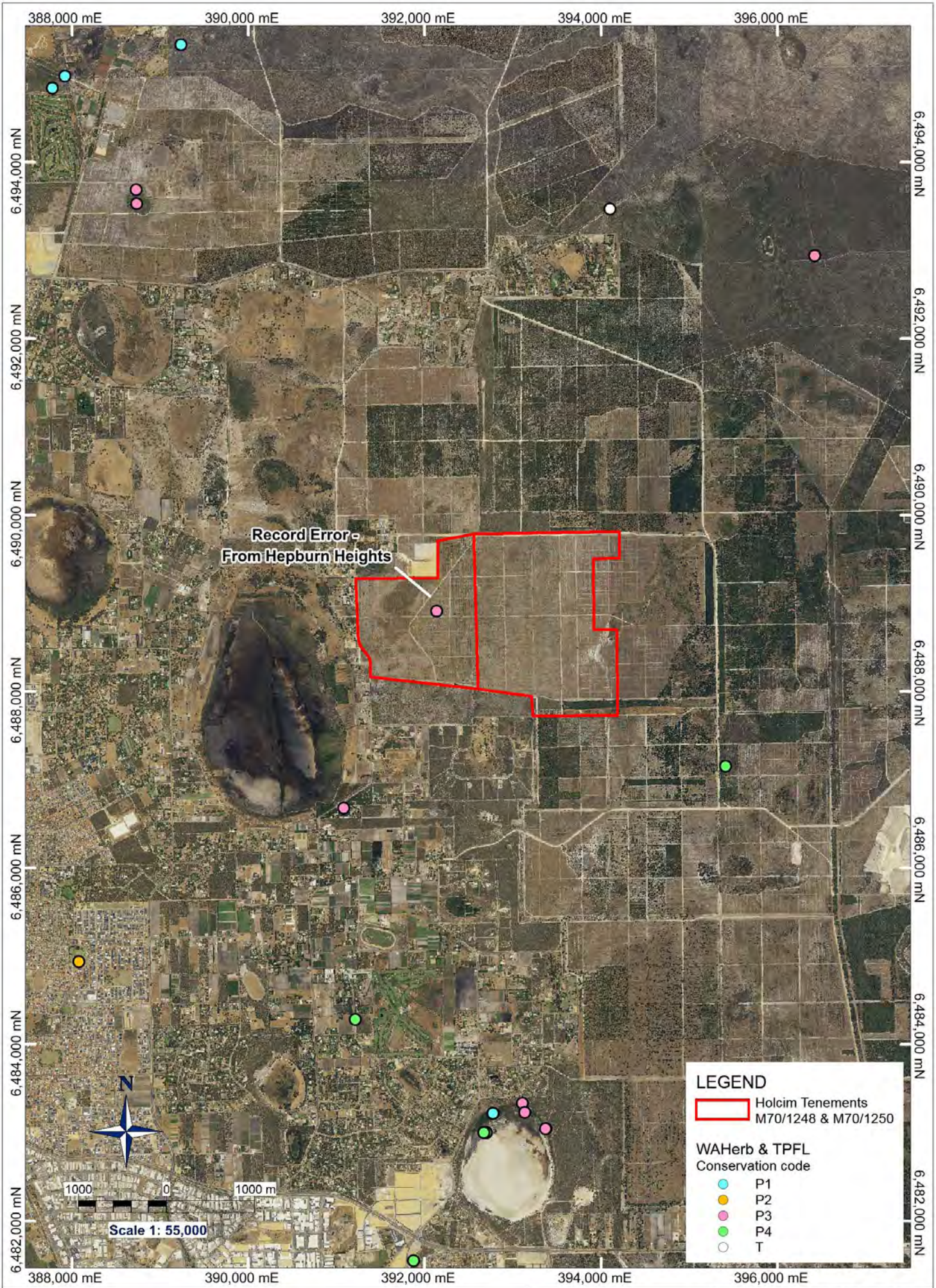

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Figure No. 16
DPaW Significant Flora Records

Date: 21/08/2015 Paper: A4 P GDA94, MGA50

Data Source: 10H, 10I, 10J, 13A, 15I,

File Info: H04_J06_Sig_Flora_21.08.2015

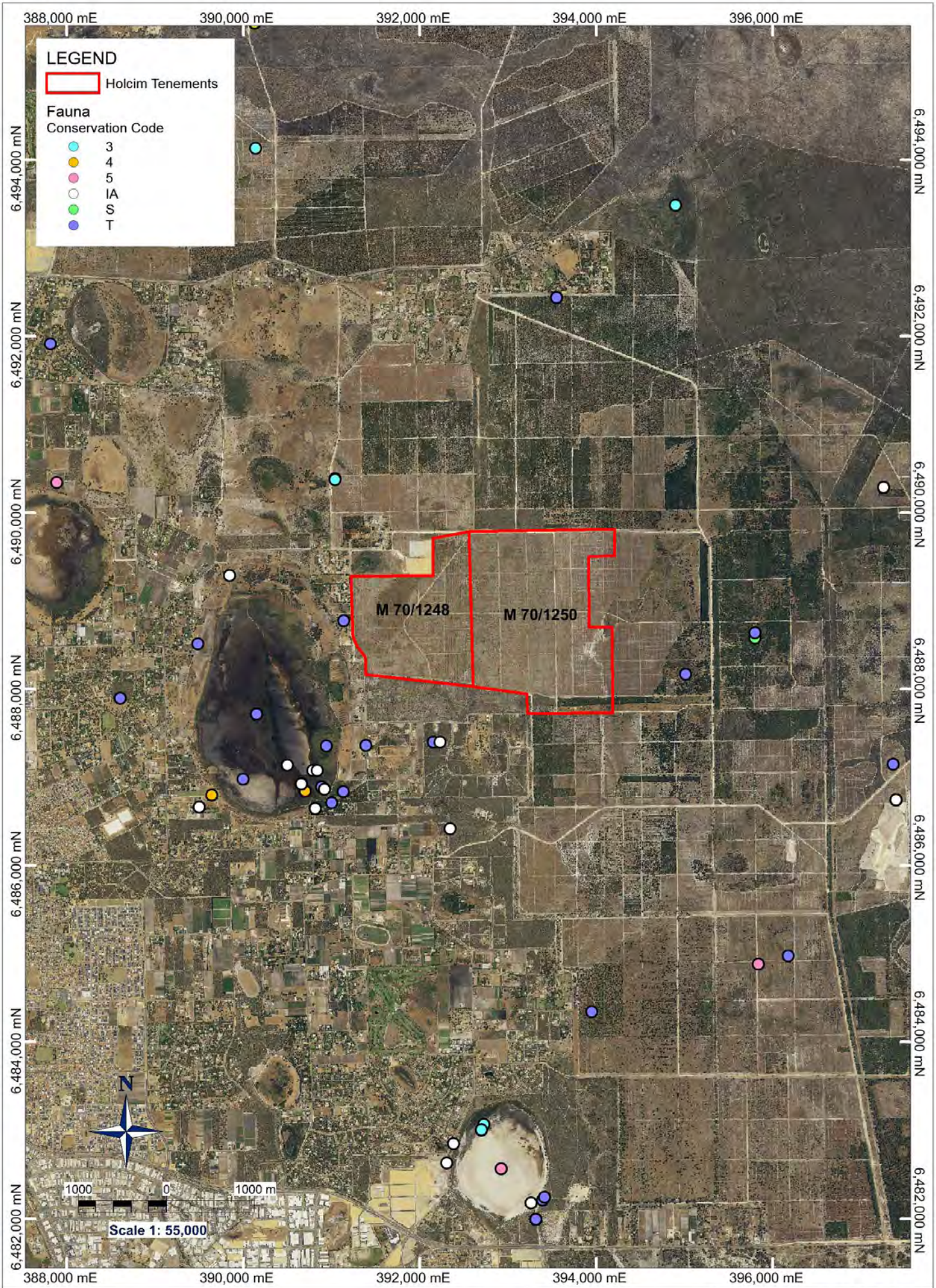

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Figure No. 17
Fauna

Date: 21/08/2015 Paper: A4 P GDA94, MGA50

Data Source: 10H, 10I, 10J, 13A, 15I,

File Info: H04_J06_Fauna_21.08.2015

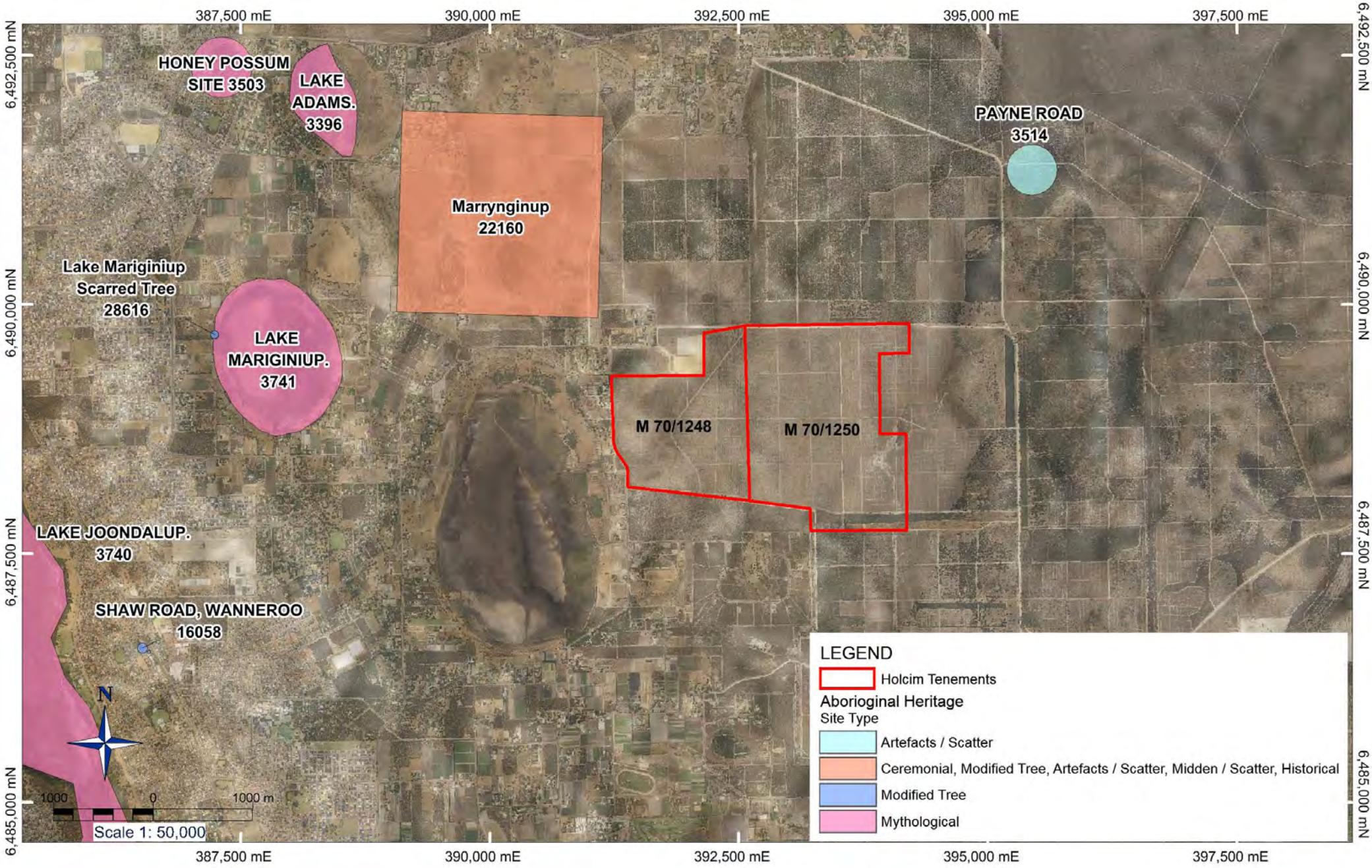

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Figure No. 18
Aboriginal Heritage

Date: 24/08/2015	Paper: A4 L	GDA94, MGA50
Data Source: 2H, 9A, 15I		
File Info: H04_J06_Aboriginal_Heritage_24.08.2015		

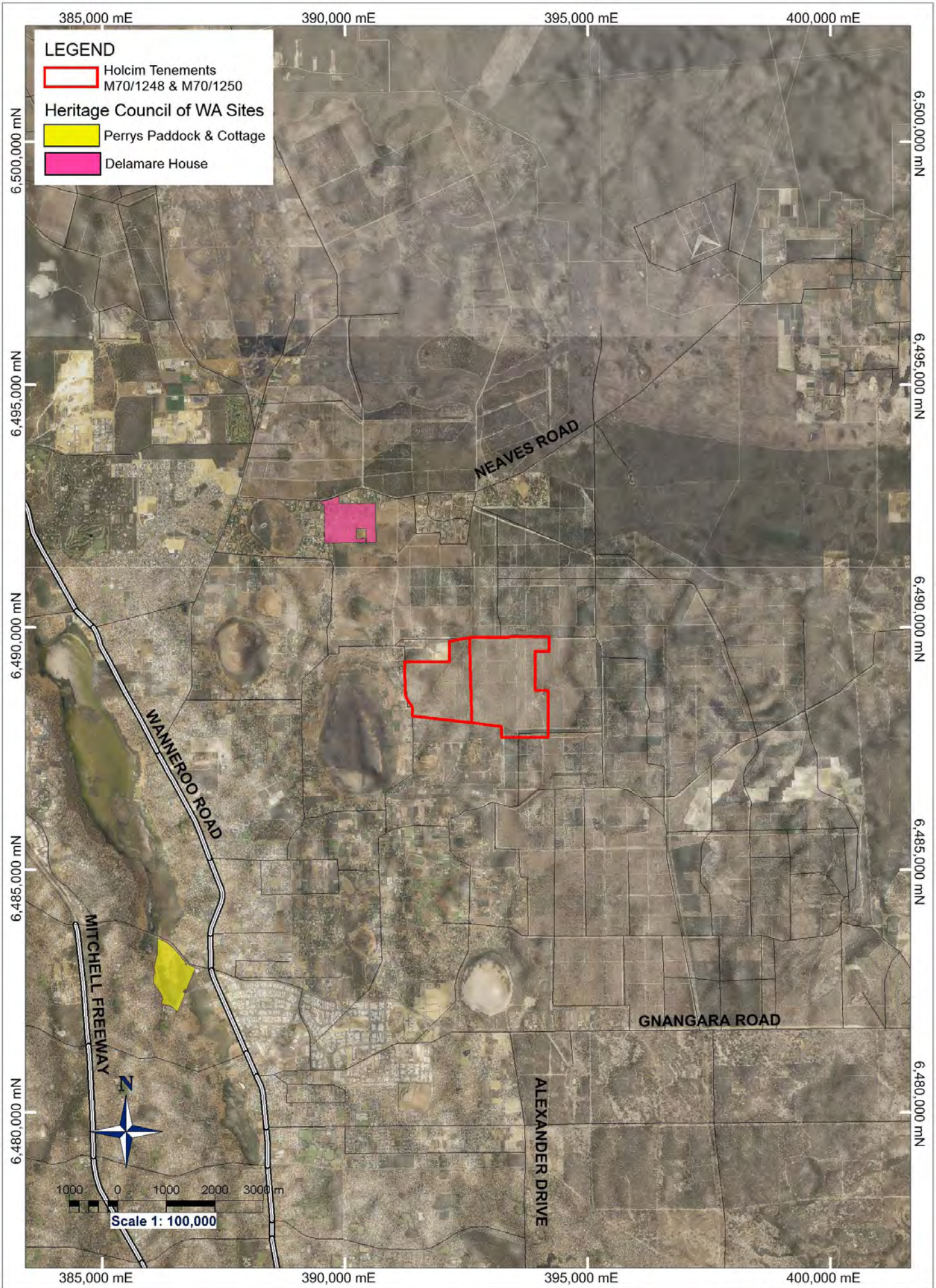

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Figure No. 19
European Heritage

Date: 24/08/2015 Paper: A4 P GDA94, MGA50

Data Source: 9A, 10Q, 12A, 15I

File Info: H04_J06_European_Heritage_24.08.2015

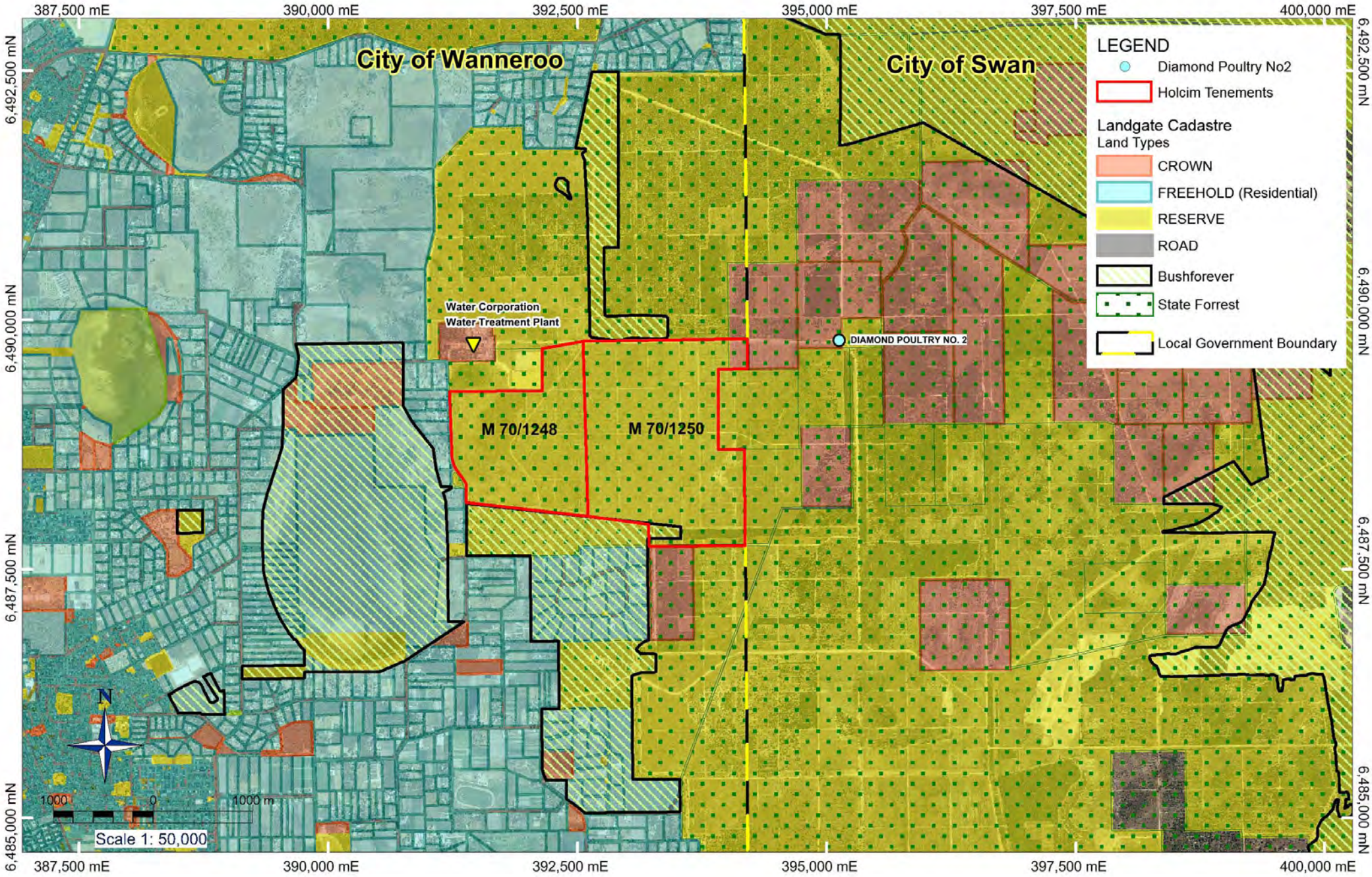

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Figure No. 20
Land Use

Date: 20/08/2015 | Paper: A4 L | GDA94, MGA50

Data Source: 8A, 13A, 15I

File Info: H04_J06_Land_Use_21.08.2015

APPENDIX A. CLOSURE LEGAL OBLIGATIONS REGISTER

Regulatory Instrument	ID	Document Type	Aspect	Description of Condition / Commitment
Mining Tenement M70/1248	Tenement Condition 2	Mining Tenement	Rehabilitation	All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe immediately after completion.
	Tenement Condition 3		Rehabilitation	All disturbances to the surface of the land made as a result of exploration, including costeans, drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Mines and Petroleum (DMP). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DMP.
	Tenement Condition 4		Rehabilitation	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration program.
	Tenement Condition 19		Contamination	All hydrocarbon or other pollutant spillage being reported to the Department of Water. Remediation being carried out to the satisfaction of the Department of Water.
	Tenement Condition 47		Rehabilitation	The licensee to prepare and implement a rehabilitation plan to the the satisfaction of the Director General, Department of Environment and Conservation and areas within the lease being rehabilitated to the standard and condition agreed by the Director General, Department of Environment and Conservation.
Mining Tenement M70/1250	Tenement Condition 2	Mining Tenement	Rehabilitation	All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe immediately after completion.
	Tenement Condition 3		Rehabilitation	All disturbances to the surface of the land made as a result of exploration, including costeans, drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Mines and Petroleum (DMP). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DMP.
	Tenement Condition 4		Rehabilitation	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration program.
	Tenement Condition 19		Contamination	All hydrocarbon or other pollutant spillage being reported to the Department of Water. Remediation being carried out to the satisfaction of the Department of Water.
	Tenement Condition 37		Rehabilitation	The licensee to prepare and implement a rehabilitation plan to the the satisfaction of the Director General, Department of Environment and Conservation and areas within the lease being rehabilitated to the standard and condition agreed by the Director General, Department of Environment and Conservation.
Mining Proposal	Section 9 – Summary of Commitments	Mining Proposal	Access	• Holcim commit to reaching agreement with DPaW on roading access routes on an ongoing basis throughout the project. The process will be primarily managed through formal annual reviews with DPaW. • Holcim also commit to resolving a final roading plan with DPaW upon decommissioning of the site.
			Visual Amenity	• Rehabilitate all disturbed and excavated areas, when work is completed. • Ensure barriers, fences and gates are compatible with the semi-rural style of the area or of a similar colour and texture to the natural landscape. • Locate the screening plant so the quarry pit walls screen it as far as possible. • Locate buildings in areas of low visual impact, and maintain appropriate size. • Operations will be undertaken from 0700–1700 Monday - Saturday (excluding public holidays) only. • Locate product stockpiles to create screening as far as practicable. • Adopt good house-keeping practises, such as orderly storage and removal of disused equipment or waste. • All visual amenity management measures will be incorporated into the Environmental Management Plan.
			Surface Water	• Tree stumps will be retained as long as possible to assist soil stabilization. • A buffer zone of 100 m will be maintained between operations and naturally vegetated geomorphic wetlands.

Regulatory Instrument	ID	Document Type	Aspect	Description of Condition / Commitment
				• Stockpiles of erodible material will be located away from roads and pavements to minimise sediment transport in runoff. • Each stage will be progressively rehabilitated at completion. • Vegetative cover will be established to minimise erosion. • Holcim will provide spill response equipment at the site. • Bunds will be established along the access road to contain stormwater runoff and settle out sediment. • Hydrocarbon and chemical management measures will ensure surface water contamination does not occur. • All surface water management measures will be incorporated into the Environmental and Water Management Plans.
			Groundwater	• Excavation depth is limited to 3m above maximum groundwater level determined by URS (2015a). • Contamination and spills management will be implemented as described below. • Surface water management as described above will ensure that all potentially contaminated surface water runoff will be detained and/or treated before discharge to the environment, minimising the risk of contamination to groundwater via infiltration. • Waste management will ensure that all wastes are disposed of appropriately minimising the risk of groundwater contamination. • All groundwater management measures will be incorporated into the Environmental and Water Management Plans.
			Hydrocarbon, Dangerous Goods and Hazardous Substance Management	• The storage, handling and disposal of hazardous materials will be undertaken in a manner that complies with all relevant legal requirements. • No bulk storage of hazardous substances or dangerous goods will occur on site. • Storage of minor quantities of hazardous substances and dangerous goods will only occur in designated areas, which are appropriately signed, bunded or contained. These areas are to be maintained in a clean and tidy state to minimise potential for spills or littering. • All hydrocarbons (grease, fuel, oils and lubricants) will be contained within bunds according to the requirements of Australian Standard 1940. • Hydrocarbons and other hazardous materials shall not be delivered to on site storage areas without appropriate bunding/containment. • Controlled wastes (including waste oil) will be collected and disposed of in accordance with the *Environmental Protection (Controlled Waste) Regulations 2004* which requires: o A licensed contractor to remove, transport and dispose of controlled wastes o Sufficient information be provided to enable categorisation of the waste and selection of an appropriate disposal site o Waste types and packaging to be suitable for transportation prior to collection. • Soil contaminated by hydrocarbons will be segregated into designated sites for storage, then removed from site. • Hydrocarbons and oily wastes (e.g. fuels, greases, de-greaser, emulsified oils and oily waste water) are to be managed using the following practices: o Minimal generation of waste and associated contaminants o Appropriate storage and handling procedures o Segregation of hydrocarbon waste from stormwater and other water o Clean-up procedures for spills. • Regular housekeeping and inspections of dangerous goods and hazardous substances will occur to ensure that storage and handling is appropriate. • Material Safety Data Sheets (MSDS) will maintained and easily accessible/located on-site for all hazardous substances and dangerous goods stored on site. • The workforce will be trained on handling dangerous goods and hazardous substances in line with associated MSDS.

Regulatory Instrument	ID	Document Type	Aspect	Description of Condition / Commitment
				• A Spill Response Procedure will be implemented by Holcim. • Hydrocarbon/hazardous material spills will be reported in accordance with Holcim Incident Management Procedures. • Appropriate emergency equipment (including spill kits) will be made available on-site and replenished when required. • All spills will be immediately contained and cleaned up. All wastes from clean-up will be appropriately stored and disposed. • All site personnel will receive training on the Spill Response Procedure. • Copies of the Spill Response Procedure will be available with spill kits and in designated storage areas. • The Site Supervisor shall: o Provide advice in a timely nature as required by personnel regarding the management of hydrocarbons. o Ensure changes to management requirements are communicated to the workforce. o Ensure inspections are done on hydrocarbon storage areas. o Ensure training on Hydrocarbon Management is made available for operational personnel. • All hydrocarbon, dangerous goods and hazardous substance management measures will be incorporated into the Environmental and Water Management Plans.
			Flora and Clearing	• Clearing will only occur in previously cleared pine plantation. • 50 m buffers will be maintained to Bush Forever Sites • 100 m buffers will be maintained to naturally vegetated geomorphic wetlands. • Vehicles will be restricted to designated access roads and excavation areas. • Areas will be cleared of tree stumps in stages, as they help stabilise the soil. • All flora management measures will be incorporated into the Environmental Management Plan.
			Dieback	• All vehicles and equipment will be free of soil and plant material before entering the property. • Training programs and inductions will be conducted for site personnel. • All surface water will be contained onsite. Runoff from the quarry pit, stockpiles, cleaning down and haul roads will be contained, and not released into areas of native vegetation. • Light vehicles and machinery will be restricted to access roads, tracks and the excavation area. • All dieback management measures will be incorporated into the Environmental Management Plan.
			Weeds	• All machinery and equipment brought onto site will be clean and free of soil and vegetative material. • Site personnel will be educated on weed risk measures and identification of problem species. • All weed management measures will be incorporated into the Environmental Management Plan.
			Fauna	• All disturbance will occur in previously cleared pine plantation. • 50 m buffers will be maintained to the remnant vegetation in Bush Forever Sites • 100 m buffers will be maintained to naturally vegetated geomorphic wetlands. • Vehicles will be restricted to designated access roads and the excavation area. • All fauna management measures will be incorporated into the Environmental Management Plan.
			Topsoil /ASS	• Holcim will avoid disturbance of high ASS risk areas. Holcim commits to the exclusion of mining from a 100 metre buffer around mapped high to moderate risk ASS soils (including 100 metres around all wetlands whether mapped as high to moderate risk or not). • If mining is proposed within the 100 metre buffer, Holcim commits to the provision of a management plan which will include the results of ASS investigations and will incorporate the results into management strategies to be presented with a new mining proposal to be submitted for approval. • Overburden will be stockpiled and used for rehabilitation. • Excavation will not intersect the water table. Excavation depth is limited to 3m above maximum groundwater level

Regulatory Instrument	ID	Document Type	Aspect	Description of Condition / Commitment
				determined by URS (2015a). • Based on precedents set by other sand mining operations in the pine plantation (including Rocla's adjacent Hawkins Rd Quarry), the topsoil will not be stripped separately, as the native seed bank will be negligible after growing pines since the 1960's. • Overburden and oversize material stockpiles will be used to backfill and rehabilitate the excavation at quarry closure and are thus temporary. • All topsoil and ASS management measures will be incorporated into the Environmental and Water Management Plans.
			Waste	• Hydrocarbons and chemical containers, such as lubricants will be regularly removed from site for disposal at a licensed landfill facility. • Sewage waste will be transported off-site for treatment and disposal by a licensed contractor. No effluent will be released onsite. • Instruction will be provided to site personnel on waste management. • Mobile service vehicles will store any waste oil removed from machinery, and remove it from-site daily. • All waste management measures will be incorporated into the Environmental and Water Management Plans.
			Noise	• The quarry pit face will be used as far as practicable to provide noise suppression between the nearest dwellings. • Operations will occur between 0700 – 1700 Monday – Saturday (excluding public holidays) to minimise the likelihood of noise nuisance. • All mobile equipment will be maintained, with efficient mufflers and noise shielding. • Mobile equipment without audible reversing alarms will be used if possible. • Mobile equipment and the screening plant will only be used when necessary (at other times engines will be turned off). • Avoiding use of the screening plants while empty as this generates up to 5 dB more noise than when screening sand. • Providing ongoing training for staff and signage for visitors to be aware of the closeness to sensitive receivers to keep engine and brake noise to a minimum. • Any complaints received regarding noise disturbance will be recorded and investigated immediately. • All noise management measures will be incorporated into the Environmental Management Plan.
			Dust	• Dust suppression measures, such as water sprays/carts, will be implemented as necessary, in the event that high levels of dust are observed. • Dust will be visually monitored daily during operations and construction to ensure control measures are effective. • Cleared areas will be limited (as many tree stumps will be retained as possible, for as long as possible). • Access roads will be constructed of crushed limestone. • Activities with high dust-causing potential, such as stripping, will not be carried out in sensitive areas during adverse wind conditions. • Material drop heights between loaders and trucks and trucks to stockpiles will kept to the minimum practical height. • Any complaints will be investigated immediately. • All dust management measures will be incorporated into the Environmental Management Plan.
			Local Community	• In the event of a community complaint, Holcim will investigate and take immediate remedial action. • Operations are limited to 0700 – 1700 Monday - Saturday only. No operations will occur on Sundays or public holidays. • A 300 m buffer will be maintained between the proposed quarry and all residents. • Within the 300 metre buffer to residents Holcim will, in consultation with DPaW, revegetate within the tenement with to native vegetation. • An unmined buffer of 40 metres will be maintained adjacent to Boundary Road.

Regulatory Instrument	ID	Document Type	Aspect	Description of Condition / Commitment
				• The noise and dust management measures described above will be used to minimise noise and dust impacts on the community.
			Heritage	• Holcim has already undertaken an Aboriginal Heritage survey. • Any identified heritage material will be protected and reported in accordance with relevant legislation. • Should any evidence of early aboriginal occupation be uncovered during works, all activities will be stopped, pending an assessment by a recognised consultant. • All heritage management measures will be incorporated into the Environmental Management Plan.
			Rehabilitation/ Closure	• All buildings and infrastructure will be removed. • Any hard stand surfaces will be removed and used to backfill the pit. • Overburden and oversize screened material will be used as backfill. • Area will be seeded and vegetated according to the agreed prescriptions. • A Closure Plan which complies with the DMP 2011 Closure Guideline has been included within this Mining Proposal. • All rehabilitation management measures will be incorporated into the Rehabilitation Management Plan.
			Monitoring	• A groundwater monitoring programme will be implemented (refer to Section 8). • Incorporate the following re-vegetation monitoring: o Short-term monitoring (eg 2nd Spring – 15 months) will focus on establishment success and the need for any short term remedial action including weed control. o Long-term vegetation observations will provide data regarding plant mortality, health, and reproduction to enable analysis of system function, dynamics and resilience. o Monitoring management measure will be incorporated into the Water, Rehabilitation and Environmental Management Plans as relevant.

APPENDIX B. CLOSURE COMPLETION CRITERIA

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Monitoring Criteria
1. FINAL LAND USE				
1.1 Final Land Use	Agreed final land use has been determined in consultation with relevant stakeholders.	All	The whole site is to be rehabilitated to natural woodland. In the event that the proposed end use changes, this approach will need to be revised.	Land use and objectives are documented in the Holcim Mine Closure Plan as reviewed and agreed by stakeholder groups.
1.2 State Forest	If the area is to remain State Forest, it is rehabilitated to be compatible with this end land use.	All	On closure, the site is integrated with, compatible with and maintains the values of the surrounding State Forest. Rehabilitated state forest areas must be: • Non-polluting (using Contaminated Sites Act definitions) • Safe and stable relative to similar natural state forest areas • Not cause any environmental or public liability In the event that the proposed end use changes, this approach will need to be revised.	Land use and objectives are documented in the Holcim Mine Closure Plan as reviewed and agreed by stakeholder groups.
2. SAFETY				
2.1 Safety	The site is safe for use by humans and wildlife under the agreed final land use	All	All hazards that could endanger the safety of any person or animal have been identified and eliminated where practical. All residual safety and health hazards have been identified, controlled through appropriate active controls, and appropriate isolations (e.g. fences) and warning signs have been put in place.	Reports on Holcim Rehabilitation Standards and Procedures, landform stability assessment, erosion monitoring, and visual inspection as previously described.
2.2 Landform Safety	Final landforms are safe.	All	Landforms have been constructed as described in criterion 2.1. They conform to DMP guidelines for structural stability, with no significant slumping or failure of constructed slopes or berms. No hazards to humans or wildlife have developed thorough erosion, subsidence, Acid Drainage or otherwise. Inspections of the rehabilitated landforms have been conducted to monitor their stability over time, with monitoring conducted after each significant rainfall season.	Report on landform construction methods, and any additional maintenance works undertaken. Rehabilitation inspections (including those undertaken on maintenance earthworks) confirm earthworks have met final landform designs. Rehabilitation monitoring results (including erosion monitoring) confirm final landforms are safe.

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Monitoring Criteria
				Report on performance in relation to design criteria and DMP Guidelines.
3. LANDFORMS				
3.1 Visual Amenity	Visual amenity of constructed landforms is compatible with that of local landforms.	All except final voids	Within the constraints imposed by aspects such as the physical nature of the materials available, tenement boundaries, and proximity to landforms have been constructed to blend into the surrounding landscape and are similar to the existing regional landforms.	Report on rehabilitation works confirms landform construction undertaken according to Holcim Mine Closure Plan. Rehabilitation inspections confirm earthworks have met final landform designs.
3.2 Waste Characterisation	Materials with poor growth characteristics do not limit rehabilitation.	Anywhere problem materials present	Landform re-contouring occurs to create final landform which blends with existing landform. Overburden and screened material utilized in accordance with the Holcim Mine Closure Plan.	Report on landform construction methods. Rehabilitation inspections confirm earthworks have met final landform designs.
3.3 Landform Stability	Constructed landforms are structurally stable.	All	Post-mining landforms have been constructed according to commitments and procedures outlined in the Holcim Mine Closure Plan. Landform design standards include: ▪ Re-contoured land suitable for final land use.	Report on rehabilitation works at construction confirms all DMP Guidelines have been met and sites constructed according to Holcim Mine Closure Plan. Rehabilitation inspections confirm earthworks have met final landform designs.
3.4 Surface Stability	The constructed soil surface similar to pre-mining surface.	All	The post-mining landform responds to erosive forces in a similar manner to equivalent naturally occurring landforms composed of similar material types. Maintenance works performed to improve performance, where necessary.	Report on landform construction methods, and any additional maintenance works undertaken. Rehabilitation inspections (including undertaken on maintenance earthworks) confirm earthworks have met final landform designs. Visual assessment and monitoring, taking into account slope, available materials and vegetation cover, and relevant research projects on surface stability of comparable rehabilitated landforms.

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Monitoring Criteria
				Rehabilitation monitoring results (including erosion monitoring) indicate gullies and rills are stabilising.
3.5 Landform Surface	Landform surface material promotes water infiltration and reduces erosion and crusting.	All (exc. V)	There has been capping with appropriate materials and if necessary ripping (light or deep) of rehabilitated surfaces as required to maximise water infiltration, compliment natural drainage lines to reduce erosion potential and support establishment of vegetation.	Report on landform construction methods. Rehabilitation inspections confirm earthworks have met final landform designs.
4. SUSTAINABILITY				
4.1 Sustainability	Rehabilitation is sustainable and the land capability and groundwater are suitable for the agreed end land use. The site can be integrated with standard Parks and Wildlife management practices without the input of extraordinary resources.	All where relevant	Monitoring, research data and site inspections indicate that the rehabilitation will be sustainable and will continue to fulfil rehabilitation objectives relating to the agreed final land use in terms of flora, vegetation, fauna, and surface and groundwater hydrology.	Documented in relevant monitoring and research reports; site inspections.
4.2 Resilience	Vegetation is sustainable and resilient to likely impacts such as fire, drought and grazing (where applicable, if managed according to agreed guidelines).	All rehabilitated areas	Monitoring and/or research results have shown that recruitment of native perennial species is occurring or is likely to occur on the site (e.g. evidence of flowering, fruiting, soil seed bank or second generation seedlings). Research trials in rehabilitation representative of the same age and technique have demonstrated plants are likely to tolerate fire or regenerate / reseed; rehabilitation has reached the age where plants are likely to tolerate fire or regenerate/reseed. Monitoring has shown that the rehabilitation can survive one or more	Review of progress and performance of Rehabilitation Development Monitoring results, and related rehabilitation monitoring procedures. Monitoring results reported in Annual Environmental Report. Research findings from trials on representative rehabilitated areas demonstrating post-disturbance recovery

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Monitoring Criteria
			seasons of low rainfall.	of vegetation.
4.3 Soil and/ or Growth Media	A suitable growth medium has been utilised to facilitate plant establishment and growth.	All where revegetation is planned	The depth and characteristics of newly constructed landforms surface soils and subsoils are suitable for plant growth in terms of their structure, water holding capacity, and lack of materials that might affect plant growth or survival (i.e. they are suitable for establishing target vegetation communities and supporting the agreed final land use). Soils should be comparable with analogous systems.	Review audits and inspections reports to assess conformance with the Holcim Mine Closure Plan. Rehabilitation monitoring results provide feedback to determine suitability of growth medium.
4.4 Provenance	Vegetation is locally endemic.	All	Revegetation has established native species recorded in the area prior to mining (comparable with analogous systems). Note: Use of local provenance species will depend on final land use.	Site Rehabilitation Report including native species re-establishment data. Rehabilitation monitoring results demonstrate locally endemic species are establishing.
4.5 Vegetation Development	Vegetation is suited to the agreed final land use.	All with revegetation	Established vegetative cover should be self-sustaining and similar to the surrounding undisturbed vegetation (comparable with analogous systems). Monitoring of rehabilitated areas has been undertaken until it can be demonstrated that the landscape and vegetation is progressing towards a self-sustaining state. Rehabilitation Development stage density or cover target to be developed. If the area is to remain State Forest, key factors of rehabilitated State forest must be comparable to analogous undisturbed State forest.	Monitoring of rehabilitation development vegetation is occurring. Monitoring results reported in Annual Environmental Report (AER). Report on performance in relation to rehabilitation methods, using site inspection and rehabilitation monitoring sites to assess whether criteria have been met.
4.6 Weeds	Potential for rehabilitation to meet the agreed post-mining use is not limited by the presence of weeds.	All with revegetation	No Declared Plants (as defined under the *Agriculture and Related Resources Protection Act 1976*) are present in greater abundance than surrounding areas. Weed abundance does not exceed baseline. No Declared Plants are present; Populations of environmental weeds have been monitored and controlled; All Declared Plants and environmental weeds recorded in the rehabilitation have been effectively managed.	Review weed monitoring and control undertaken. Report on weed monitoring and control records. Measurement of weed abundance compared to representative reference sites, using cover or counts (as appropriate according to the species). Monitoring and visual inspection of vegetation establishment and

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Monitoring Criteria
				representative reference areas.
4.7 Fauna Recolonisation	There is evidence that local native fauna are colonizing the rehabilitation.	All where opportunities exist	Rehabilitation meets agreed standards. Rehabilitation provides representative habitat values for native fauna of the region Note: Encouragement of fauna habitation may not be desirable if the land is to be developed for commercial and residential purposes.	As per monitoring plan and research findings
5. HYDROLOGY				
5.1 Surface Hydrology	Rehabilitation drainage patterns have been established and impacts on natural surface water flows minimised.	All where relevant	There are no significant, physical off-site impacts of surface water drainage. All spills reported and cleaned up appropriately.	Report on landform construction methods. Relevant closure surface water issues reported in the closure section of the AER.
5.2 Groundwater Hydrology	Mining-related impacts on groundwater flows have been minimised.	All where relevant	Excavation limit is complied with, to ensure sub-surface water table is not intersected. All spills reported and cleaned up appropriately.	Relevant closure groundwater issues reported in the closure section of the AER.
6. DECOMMISSIONING				
6.1 Decommissioning	Access roads have been de-commissioned and removed, or handed to another party	Access Roads	Access roads fully decommissioned and rehabilitated or handed to another party.	Site inspection and documentation of road removal and rehabilitation operations, or evidence of legally binding road handover.
6.2 Decommissioning	Site infrastructure has been de-commissioned and removed, or handed to another party	Access Road	Site infrastructure fully decommissioned and rehabilitated or handed to another party.	Site inspection and documentation of road removal and rehabilitation operations, or evidence of legally binding road handover.
6.3 Remaining Infrastructure	Any built infrastructure is	All	Agreements are in place for any infrastructure to remain in areas of state forest, including (but not limited to):	Agreements for infrastructure to remain post-closure are documented in the

Criterion	Criterion Objective	Domain	Criterion standard or milestone	Monitoring Criteria
	removed, unless otherwise agreed by DPaW and so long as the maintenance of the infrastructure is not inconsistent with all of these objectives.		• roads, tracks and firebreaks • fences, barriers and gates • monitoring equipment	Holcim Mine Closure Plan as reviewed and agreed by stakeholder groups.
7. CONTAMINATED SITES				
7.1 Contaminated Sites	Contaminated sites have been documented and addressed	All where relevant	All commitments relating to the identification and management of contaminated sites, as per Contaminated Sites Act (2003) have been fulfilled. All spills reported and cleaned up appropriately.	Report documenting compliance with specific requirements.
8. LAND MANAGEMENT				
8.1 Land Management	Long-term management requirements have been addressed.	All	At the time mine closure is considered complete, site land management requirements will be no greater than those of areas prior to mining (or comparable unmined areas); alternatively, where additional management actions are required, these will be identified in agreement with regulators, and Holcim will make adequate provisions so that this additional management can be undertaken.	Reports into sustainability and long-term management requirements identified in the monitoring and research carried out as per Criterion 4.

APPENDIX C. HOLCIM RISK ASSESSMENT MATRIX DETAILS

Step 1 - Consider the Consequence					
What are the consequences of the most reasonable worst case scenario considering a credible failure of existing controls?					
Consequence	**Disaster**	**Severe**	**Serious**	**Significant**	**Minor**
Environment On Site & Off Site	Major event, unconfined impact, severe permanent damage with low likelihood of recovery.	Significant permanent damage; reversible damage with recovery time of years; high potential for prosecution	Minor permanent damage; temporary damage that is widespread or that has moderate impact	Damage that is near source confined, temporary and minor	No measurable damage to environment
Compliance With Legal and Other Requirements	Blatant or serious breech of legal requirement, leading to operation being suspended or severely reduced. Prosecution expected.	Breach of external requirement (license, legislation, regulation, contract etc) with high potential for prosecution and/or high impact.	Non-compliance with external requirement with moderate potential for impact.	Repeated non-compliance with internal procedure, non-compliance with external requirement with low potential impact	Minor non-compliance with internal procedures.
Community Perception and Reputation	Significant adverse media attention (state or national level), loss of reputation or work nationally or across product groups.	Prosecution, significant impacts on social license to operate, loss of reputation or ability to secure work across product groups.	Local adverse media attention, loss of reputation or ability to secure work in local area, complaints that result in changes to external requirements.	Multiple community complaints or complaints that require changes to internal operating procedures.	Community complaint resolved with no changes to existing operating procedures.
Note: Temporary environmental damage has a duration of up to approximately one week to rectify					

Step 2 - Consider the Likelihood					
What is the likelihood that the proposed consequence will occur with a credible failure of existing controls?					
Likelihood	**Certain**	**Likely**	**Possible**	**Unlikely**	**Rare**
Description	Event that is expected to occur on multiple occasions	Event that is likely to occur at least once	Event that may occur	Event that is unlikely to occur	Event that may occur only in exceptional circumstances
Frequency	Event is likely to occur more than twice a year.	Event is likely to occur once or twice a year.	Event is likely to occur more than once or twice in a 10 year period	Event is likely to occur once or twice in a 10 year period	Event is likely to occur once or twice in a 100 year period

Step 3 - Determine Risk Rating from the Risk Matrix					
Liklihood	Consequence				
	Disaster	Severe	Serious	Significant	Minor
Certain	High	High	High	Medium	Medium
Likely	High	High	Medium	Medium	Low
Possible	High	Medium	Medium	Low	Low
Unlikely	Medium	Medium	Low	Low	Low
Rare	Medium	Low	Low	Low	Low

APPENDIX D. CLOSURE RISK REGISTER

Jandabup Closure Risk Register

Hazard/Aspect	Potential Impact	Current Controls	Risk Rating With Controls		
			Consequence	Likelihood	Risk Rating
Unacceptable end land use	Air emissions due to discharge of airborne dust from open areas	Progressive rehabilitation during operation	Significant	Unlikely	Low
Unacceptable end land use	Visual amenity does not meet community expectations	Progressive rehabilitation during operation	Significant	Unlikely	Low
Unacceptable end land use	Sand pit walls unstable	Pit wall slopes will be graded to 3:1	Significant	Unlikely	Low
Rehabilitation Unsuccessful	Weeds impacting the ability to meet completion criteria	Weed control during operation	Significant	Possible	Low
Rehabilitation Unsuccessful	Insufficient growth of vegetation / inappropriate cover density	• Closure implementation strategies as outlined in Section 9 of the Closure Plan and re-vegetation processes as outlined in Appendix E of the Closure Plan will ensure the success of rehabilitation so that a suitable native vegetative cover is established. • If the end land use changes to require other than native vegetation establishment this objective will be revisited.	Significant	Possible	Low
Rehabilitation Unsuccessful	Low species diversity	As above	Significant	Possible	Low
Rehabilitation Unsuccessful	Unknown expectations/requirements	This plan has been developed in consultation with DPaW therefor expectations are known.	Significant	Unlikely	Low
Spill response	Contamination of land due to poor storage of hydrocarbons	• The storage, handling and disposal of hazardous materials will be undertaken in a manner that complies with all relevant legal requirements. • No bulk storage of hazardous substances or dangerous goods will occur on site. • Storage of minor quantities of hazardous substances and dangerous goods will only occur in designated areas, which are appropriately signed, bunded or contained. These areas are to be maintained in a clean and tidy state to minimise potential for spills or littering. • All hydrocarbons (grease, fuel, oils and lubricants) will be contained within bunds according to the requirements of Australian Standard 1940. • Hydrocarbons and other hazardous materials shall not be delivered to on site storage areas without appropriate bunding/containment. • Controlled wastes (including waste oil) will be collected and disposed of in accordance with the *Environmental Protection (Controlled Waste) Regulations 2004* which requires: o A licensed contractor to remove, transport and dispose of controlled	Significant	Unlikely	Low

Hazard/Aspect	Potential Impact	Current Controls	Risk Rating With Controls		
		wastes o Sufficient information be provided to enable categorisation of the waste and selection of an appropriate disposal site o Waste types and packaging to be suitable for transportation prior to collection. • Soil contaminated by hydrocarbons will be segregated into designated sites for storage, then removed from site. • Hydrocarbons and oily wastes (e.g. fuels, greases, de-greaser, emulsified oils and oily waste water) are to be managed using the following practices: o Minimal generation of waste and associated contaminants o Appropriate storage and handling procedures o Segregation of hydrocarbon waste from stormwater and other water o Clean-up procedures for spills. • Regular housekeeping and inspections of dangerous goods and hazardous substances will occur to ensure that storage and handling is appropriate. • Material Safety Data Sheets (MSDS) will maintained and easily accessible/located on-site for all hazardous substances and dangerous goods stored on site. • The workforce will be trained on handling dangerous goods and hazardous substances in line with associated MSDS. • A Spill Response Procedure will be implemented by Holcim. • Hydrocarbon/hazardous material spills will be reported in accordance with Holcim Incident Management Procedures. • Appropriate emergency equipment (including spill kits) will be made available on-site and replenished when required. • All spills will be immediately contained and cleaned up. All wastes from clean-up will be appropriately stored and disposed. • All site personnel will receive training on the Spill Response Procedure. • Copies of the Spill Response Procedure will be available with spill kits and in designated storage areas. • The Site Supervisor shall: • Provide advice in a timely nature as required by personnel regarding the management of hydrocarbons. • Ensure changes to management requirements are communicated to the workforce. • Ensure inspections are done on hydrocarbon storage areas. • Ensure training on Hydrocarbon Management is made available for operational personnel. All hydrocarbon, dangerous goods and hazardous substance management measures will be incorporated into the Environmental and Water Management Plans.			
Spill response	Contamination of water due to poor storage of hydrocarbons	As above	Significant	Unlikely	Low

Hazard/Aspect	Potential Impact	Current Controls	Risk Rating With Controls		
Generation of acid drainage on closure (due to disturbance of acid sulphate soils during operations)	Contamination of soil or groundwater	• Holcim will avoid disturbance of high ASS risk areas. Holcim commits to the exclusion of mining from a 100 metre buffer around mapped high to moderate risk ASS soils (including 100 metres around all wetlands whether mapped as high to moderate risk or not). • If mining is proposed within the 100 metre buffer, Holcim commits to the provision of a management plan which will include the results of ASS investigations and will incorporate the results into management strategies to be presented with a new mining proposal to be submitted for approval. • Overburden will be stockpiled and used for rehabilitation. • Excavation will not intersect the water table. Excavation depth is limited to 3m above maximum groundwater level determined by URS (2015a). All topsoil / ASS management measures will be incorporated into the Environmental and Water Management Plans.	Significant	Unlikely	Low
Disruption of surface water	Post closure design disrupts natural surface water flows	• Tree stumps will be retained as long as possible to assist soil stabilization. • A buffer zone of 100 m will be maintained between operations and naturally vegetated geomorphic wetlands. • Stockpiles of erodible material will be located away from roads and pavements to minimise sediment transport in runoff. • Each stage will be progressively rehabilitated at completion. • Riffle zones and contour sills will be used downslope of product stockpiles. • Vegetative cover will be established to minimise erosion. • Holcim will provide spill response equipment at the site. • Bunds will be established along the access road to contain stormwater runoff and settle out sediment. • Hydrocarbon and chemical management measures will ensure surface water contamination does not occur. • Annual surface water monitoring will be undertaken when surface water is present. • At closure, any hard stand surfaces will be removed and used to backfill the pit. • All water management measures will be incorporated into the Environmental and Water Management Plans.	Significant	Unlikely	Low
Disruption of groundwater	Post closure design disrupts natural groundwater flows / levels	• Excavation depth is limited to 3m above maximum groundwater level determined by URS (2015a). • Surface water management as described above will ensure that all potentially contaminated surface water runoff will be detained and/or treated before discharge to the environment, minimising the risk of contamination to groundwater via infiltration. • Waste management will ensure that all wastes are disposed of appropriately minimising the risk of groundwater contamination. • Waste management will ensure that all wastes are disposed of appropriately	Significant	Unlikely	Low

Hazard/Aspect	Potential Impact	Current Controls	Risk Rating With Controls		
		minimising the risk of groundwater contamination. • Appropriate groundwater monitoring will be undertaken. • All water management measures will be incorporated into the Environmental and Water Management Plans.			

APPENDIX E. PRELIMINARY REHABILITATION PLAN

HOLCIM JANDABUP QUARRY
PRELIMINARY REHABILITATION PLAN

1 INTRODUCTION

As part of the requirements for a Mining Proposal this Rehabilitation and Revegetation plan has been developed to provide overarching guidance for the project. This plan will be updated periodically in the light of new information and research results.

The subject site is currently State forest consisting of cleared pine planation. The State Government is currently undertaking various planning processes in order to determine an end land use for the area. However a final end land use decision has not yet been formally endorsed by State Government.

In the absence of a clear end use decision it has been determined in consultation with the land manager Department of Parks and Wildlife (DPaW) that the whole site is to be rehabilitated to natural woodland. In the event that a commercial/residential end use for the site is approved by State Government, this approach will need to be revised.

The following plan is designed to minimize open areas and rehabilitate the site in a progressive manner with a view to establishing permanent vegetation cover that is representative of the pre-existing flora at the site.

2 REHABILITATION PROGRAM

2.1 RESEARCH AND DEVELOPMENT PROGRAM

The rehabilitation program will be driven by a comprehensive research and development program funded by Holcim, to develop practical and efficient methods of returning the cleared pine plantation to Banksia woodland. The research program will:

- Involve recognized and competent research organization/s to carry out the research program.
- Include engagement of a post doctorate researcher to coordinate the program and/or conduct specific research project/s.

- Include opportunities for undergraduate research project/s in conjunction with academic institutions.
- Use Holcim's internal and/or contractor capabilities to carry out rehabilitation trials.
- Involve collaboration with other sand mining companies working in the area which are also rehabilitating cleared pine plantation to Banksia woodland.
- Incorporate findings and recommendations from the work by Kellie Maher (commissioned by DPaW -*Restoration of Banksia woodland after the removal of pines at Gnangara: seed species requirements and prescriptions for restoration.* May 2009*)* and other relevant existing research where available.
- Commence research activities following successful project approvals.
- Include a documented initial rehabilitation process and methodology to guide the early stages of rehabilitation and also to incorporate relevant trials.

2.2 REHABILITATION TRIALS

Trials for this rehabilitation program will focus on:

- Managing the weed bank in the existing topsoil.
- Establishing plants in the sand strata without topsoil (where topsoil is deemed unsuitable), with a view to examining methods to treat and improve the medium to make it more receptive to the growth of plants.
- Management of the topsoil if removed.
- Importation of topsoil from land that is being cleared in the proximity of the sites.
- Selection of the best species to suit the rehabilitation being requested including a preference for species that would be useful for the Carnaby Cockatoo.
- Appropriate performance targets and criteria.

2.3 PROGRESSIVE REHABILITATION PROGRAM

2.3.1 PURPOSE

The purpose of the rehabilitation program will be to restore post-sand extracted sites with an ecosystem resembling the pre-mined natural species composition of surrounding *Banksia* woodland, within the constraints of a post pine plantation landscape. A key focus will be to incorporate species capable of providing a food source for Carnaby's Cockatoo to replace that food source lost by pine removal.

2.3.2 OBJECTIVE

The broad objective is to: *establish a diverse, effective and permanent vegetation cover capable of plant succession and regeneration to suit currently designated land uses including wildlife habitat (focus on Carnaby's Cockatoo feeding resources) and water protection / production*. Note that this objective will be modified in the event of changes to final land use.

2.3.3 PROCESS

Subject to further trials and research outcomes the initial rehabilitation will incorporate:

- reconstructing soil profiles with physical parameters that provide for the successful and sustainable growth of plant species;
- correct handling of the topsoil seedbank where it occurs (potentially an important source of seeds);
- development of a seed mix to take into consideration the following attributes: ability to propagate from seed; seed availability; suitability for Carnaby's Cockatoo food sources;
- seeding of species at a rate that takes into account the viability and germinability of seeds and the subsequent mortality of plants;
- dependent on direct seeding success the planting of tubestock (eg canopy species *Banksia attenuata*, *B. menziesii* and *Eucalyptus todtiana, E marginate)*; and
- brushing with larger logs (remaining following vegetation clearing) on the perimeter of rehabilitation sites to decrease the potential for erosion and vehicle movement.

2.4 MONITORING

The rehabilitation monitoring program will be largely driven by the requirements of the related research trials. Subject to the design and requirements of research trials the monitoring program should constitute the following elements:

- Short-term monitoring (eg 2nd Spring – 15 months) will focus on establishment success and the need for any short term remedial action including weed control.
- Long-term vegetation observations will provide data regarding plant mortality, health, and reproduction to enable analysis of system function, dynamics and resilience. Long-term observations will include:

- Native seedling recruitment (derived from the topsoil, from seed broadcasting, and tubestock) following each Spring for years 3 & 5, following rehabilitation operations;
- Plant reproductive and regenerative capability over time;
- Recruitment and persistence of weeds with subsequent management, which may include spraying for removal if necessary; and
- The need for supplementary planting of tubestock.

2.5 COMPLETION CRITERIA

The following rehabilitation performance criteria are proposed:

- There will be adequate cover, richness and density of plants to suit the final land use. Holcim commits to the development and agreement of interim target metrics for rehabilitation establishment following initial investigations by Holcim's selected research organisation/s into the performance of current best practice rehabilitation methodologies and consultation with other companies operating in the area also in the process of committing to such targets (to ensure a consistent approach to rehabilitation in the area).
- All surfaces will be stable with vegetation cover and no erosion.
- There will be no increase of weeds above baseline and weeds will be of such a density that they do not adversely compromise rehabilitation success.
- Long-term observations of the vegetation will provide data for plant mortality, health and reproduction and will enable analysis of system function, dynamics and resilience.

2.6 REPORTING

Holcim will provide the following regulatory reporting on rehabilitation efforts:

- Yearly: Annual Environmental Report (AER) – Briefly report rehabilitation performance, additional treatments, outcomes and proposed changes.
- Years 3 & 5:
    - Provide a detailed performance review in conjunction with monitoring of comprehensive parameters.
    - Refine the Research Program in consultation with DPaW, to address identified gaps based on monitoring. E.g. diversity, sustainability, soil attributes.

APPENDIX H. HYDROCARBON MANAGEMENT PLAN (HOLCIM, 2015)

JSQ Guideline 1.1
Hydrocarbon Management

Objectives

To ensure minimal release of hydrocarbons to the environment, either as a result of storage or handling incidents at the Jandabup Sand Quarry (JSQ) (Mining Lease M70/1248 and M70/1250).

Background

The JSQ is situated within a Priority 1 Drinking Water Source Protection Area (P1 DWSPA) that is managed by the Department of Water (DoW) to ensure the resource utilised for drinking water by the Water Corporation, is secure. In addition to this, there are three existing water bores and associated infrastructure present along the southern and western perimeters of the JSQ quarrying tenements. As they are located within a P1 DWSPA, each is surrounded by a well head protection zone (WHPZ) of 500m radius. Although the DoW supports extraction of sand in the WHPZ, no storage of hydrocarbons or refuelling is permitted within this area.

As the site is within a P1 DWSPA running repairs will occur on site, however major servicing of machines and equipment will occur off site. A running repairs maintenance area, equipment storage area and fuelling facility will be located within a fenced compound. An equipment storage area for the storage of heavy equipment will be located within a fenced compound. This running repairs maintenance area (RRMA) will contain one bay with a containment apron.

Oils will be stored in the RRMA for equipment maintenance and will be segregated and bunded in accordance with Australian Standard (AS) 1940 and DMP and DER requirements. Elevated chemical storage tank systems are prohibited in WHPZs. Elevated chemical tank systems (including fuels) within UWPCA should have a maximum capacity of 5,000L, unless approved by the Department of Water.

Diesel will be stored onsite in one self-bunded 20,000L or four 5,000L capacity storage tanks. The risk of diesel storage failure is considered low, as the fuel will be stored in a self-bunded, double skinned tank.

The fuel storage and refilling facility will be managed in accordance with Holcim's Hydrocarbon and Water Management Plans, AS 1940, DMP and DER requirements, with appropriate surface water drainage and collection.

A sump will operate at the site to collect waste water from the washdown bay and maintenance areas that will be covered to minimise the collection of runoff and risks associated with overflow. Water collected in the sump will be regularly removed by a licensed operator and disposed of at an approved waste facility.

Waste hydrocarbons may be derived from mobile equipment and maintenance activities. Sources may include: waste oils, hoses, filters and used rags. All hydrocarbon wastes will be collected at or near their source, contained and disposed off-site at an appropriate hydrocarbon disposal facility. Inappropriate disposal or failure to contain hydrocarbon spills can result in contamination of soils, surface water and groundwater and pose a safety risk to personnel onsite. Regular site inspection will be undertaken to determine that storage onsite is maintained to the standards of this plan.

The Department of Mines and Petroleum (DMP), and Department of Environment Regulation (DER) require all petroleum hydrocarbons to appropriately contained using bunded retention compounds in accordance with Australian Standard (AS) 1940 – *The storage and handling of flammable and combustible liquids*.

Further information for the management of hydrocarbon discharge in stormwater can be found in the *Stormwater Management Manual for Western Australia* available through the Department of Water website at:

- *http://portal.water.wa.gov.au/portal/page/portal/WaterManagement/Stormwater/StormwaterMgtManual*

Scope

This procedure applies to all outdoor activities and all personnel, contractors and visitors at JSQ.

Related Documents

The following documents relate to hydrocarbon management at JSQ and should be consulted where applicable. This list is not exhaustive. Other SHE Guideline Documents and legislative requirements may also apply.

- JSQ Guideline 1.5: Waste Management;
- SHE Guideline 3.1: Risk Management;
- SHE Guideline 3.20: Hazardous Substances – Handling and Storage;
- SHE Guideline 3.21: Dangerous Goods;
- SHE Guideline 4.1: Permits, Licences and Approvals;
    - 4.1A: Guide to Environmental Planning Permits & Approvals for Holcim Operations
    - 4.1E: Environmental Compliance Planner - Aggregates
- SHE Guideline 4.2: Hazard Identification;
    - 4.2A: Aspects and Impacts Register for Aggregates Sites
- SHE Guideline 4.18: Spill Response and Reporting:
    - 4.18B: Spill Response Procedure
- *Agriculture and Related Resources Protection Act* 1976;
- Western Australian *Environmental Protection Act* 1986;
- *Poisons Act* 1964;
- Poisons Regulations 1965;
- *Mines Safety and Inspection Act* 1994;
- *Mines Safety and Inspection Regulations* 1995;
- *Dangerous Goods Safety Act* 2004;
- Dangerous Goods Safety Regulations 2007; and
- AS 1940 – The storage and handling of flammable and combustible liquids.

Planning and Approvals

Planning

- A waste compound will be installed at the site and will function as a collection and storage point for domestic, industrial and hydrocarbon waste prior to disposal offsite. (See Waste Disposal Plan for details)
- Spill kits will be stored in the RRMA, site office and centrally located within the workfront to be accessible by all operating equipment to contain any potential spills.
- Oil and fuel storage areas will be segregated and bunded in accordance with AS 1940 and DMP and DER requirements.
- All mobile equipment will be fuelled in the maintenance compound.
- Remote fuelling procedures will be adopted for fuelling of any immobile equipment on site.

Approvals

- Obtain consent of the Site Manager or authorised representative prior to engaging in maintenance activities and to ensure correct disposal of oil and maintenance fuel wastes.

Management Strategy

Unplanned Discharges

Unplanned discharges may occur for a number of reasons including leaks or unmanaged spill. Leaks or spills could potentially arise from refuelling of on-site excavators or from the on-site ablutions. Haulage trucks will be refuelled outside of the WHPZs and on-site machinery will be serviced off-site, thereby minimising the risk of releases of oils and lubricants. Releases of hydrocarbons (hydraulic oils and lubricants) are still possible due to unexpected failure of hoses or lubricant delivery systems on board the excavator or trucks. To support this plan, a hydrocarbon risk assessment has been undertaken that is presented in Appendix A.

To minimise the occurrence of an unplanned discharge, hydrocarbons on site will be managed according to the JSQ Guideline 1.1 “Hydrocarbon Management” as follows:

- Diesel will be stored onsite in one self-bunded 20,000L or four 5,000L capacity storage tanks. The risk of diesel storage failure is considered low, as the fuel will be stored in a self-bunded, double skinned tank. A risk assessment has been undertaken for the onsite plant & vehicle maintenance, fuel storage & refuelling activities.
- During operations at the Jandabup Sand Quarry (JSQ), the principles of reduce, reuse and recycle will be employed to minimise the amount of waste produced.
- All hydrocarbon wastes including waste oils, absorbent material and materials contaminated with hydrocarbons will be collected and stored in the fenced waste compound in the north east of the project site, prior to being disposed offsite by a licensed contractor.
- All hydrocarbon substance storage containers and areas will be clearly identified with appropriate signage and labelling.
- The purchase, storage and transport of fuel will be carried out in accordance with:
    - Poisons Act 1964;

  - Poisons Regulations 1965;
  - Mines Safety and Inspection Act 1994;
  - Mines Safety and Inspection Regulations 1995; and
  - Dangerous Goods Safety Act 2004.

- Dangerous Goods Safety Regulations 2007; Raise the awareness of the workforce about the hydrocarbon management plan. All employees will undergo site specific awareness training during inductions. The hydrocarbon component of the training will include:
- Hydrocarbon purchase, storage and use at Jandabup Sand Quarry.
- Issues relating to the management of hydrocarbons on the site and staff responsibilities (correct fuelling, storage and disposal).
- The adverse impact of hydrocarbon spills to soils, surface water, groundwater and safety risk to personnel onsite.
- The measures to prevent hydrocarbon spills and procedures for clean-up of hydrocarbon spills.
- How staff report hydrocarbon spills.
- Equipment and vehicle maintenance will only take place in the designated maintenance compound so that any spills and runoff can be collected in the sump.
- Accidental oil spills will be mopped up with absorbent material (using spill kits) and waste will be segregated for removal and disposal offsite by a licensed contractor (see Waste Management Plan). All spills are to be reported to the site manager and SHE Coordinator (Perth Region) for Incident Investigation.
- The oil/water separator in the maintenance area will be checked regularly and the waste removed and disposed offsite by a licensed contractor.
- Remote fuelling will be conducted by a fuel truck or light vehicle with a fuel trailer. Remote fuelling will only be carried out for immobile equipment on site such as; generator sets, bore pump and screening plant.
- Spill kits will be stored in the fuel truck or fuel trailer used on site for remote fuelling and be employed in the event of a spill during remote fuelling.
- In the event of a spill while remote fuelling, any affected sand material which cannot be immediately treated, will be excavated and transported to a hardstand area for storage prior to disposal in a licensed facility.
- The storage, handling and disposal of hazardous materials will be undertaken in a manner that complies with all relevant legal requirements.
- Storage of minor quantities of hazardous substances and dangerous goods will only occur in designated areas, which are appropriately signed, bunded or contained. These areas are to be maintained in a clean and tidy state to minimise potential for spills or littering.
- All hydrocarbons (grease, fuel, oils and lubricants) stored on site will be stored in segregated, bunded areas according to Australian Standard (AS) 1940 and DMP and DER requirements.
- Hydrocarbons and other hazardous materials shall not be delivered to on site storage areas without appropriate bunding/containment.
- Controlled wastes (including waste oil) will be collected and disposed of in accordance with the Environmental Protection (Controlled Waste) Regulations 2004 which requires:
- A licensed contractor to remove, transport and dispose of controlled wastes

- Sufficient information be provided to enable categorisation of the waste and selection of an appropriate disposal site
- Waste types and packaging to be suitable for transportation prior to collection.
- Soil contaminated by hydrocarbons will be segregated into designated sites for storage, then removed from site.
- Hydrocarbons and oily wastes (e.g. fuels, greases, de-greaser, emulsified oils and oily waste water) are to be managed using the following practices:
    - Minimal generation of waste and associated contaminants
    - Appropriate storage and handling procedures
    - Segregation of hydrocarbon waste from stormwater and other water
    - Clean-up procedures for spills
    - Should an unplanned spill event occur, the nominated clean-up procedures listed below will be adopted.

Clean-up Procedure for Spills

- Regular housekeeping and inspections of dangerous goods and hazardous substances will occur to ensure that storage and handling is appropriate.
- Material Safety Data Sheets (MSDS) will maintained and easily accessible/located on-site for all hazardous substances and dangerous goods stored on site.
- The workforce will be trained on handling dangerous goods and hazardous substances in line with associated MSDS.
- A Spill Response Procedure will be implemented by Holcim.
- Hydrocarbon/hazardous material spills will be reported in accordance with Holcim Incident Management Procedures.
- Appropriate emergency equipment (including spill kits) will be made available on-site and replenished when required.
- All spills will be immediately contained and cleaned up. All wastes from clean-up will be appropriately stored and disposed.
- All site personnel will receive training on the Spill Response Procedure.
- Copies of the Spill Response Procedure will be available with spill kits and in designated storage areas.
- The Site Supervisor shall:
- Provide advice in a timely nature as required by personnel regarding the management of hydrocarbons.
- Ensure changes to management requirements are communicated to the workforce.
- Ensure inspections are done on hydrocarbon storage areas.
- Ensure training on Hydrocarbon Management is made available for operational personnel.

Remote Fuelling

- Remote fuelling will be conducted by a fuel truck or light vehicle with a fuel trailer. Remote fuelling will only be carried out for immobile equipment on site such as; generator sets, bore pump and screening plant.
- Spill kits will be stored in the fuel truck or fuel trailer used on site for remote fuelling and be employed in the event of a spill during remote fuelling.
- In the event of a spill while remote fuelling, any affected sand material which cannot be immediately treated, will be excavated and transported to a hardstand area for storage prior to disposal in a licensed facility.

Monitoring and Performance Indicators

Monitoring

- Undertake regular scheduled inspection of the oil/water separator and ensure all hydrocarbon waste is removed and collected for offsite disposal.
- Spills that occur are recorded as a non conformance.
- Retain all Controlled Waste Tracking Forms from offsite disposal of hydrocarbon waste.

Performance Indicators

- Hydrocarbon use, storage and disposal must be carried out in a manner so that no environmental damage is caused.
- No spillage of hydrocarbons in areas beyond containment areas in the maintenance compound, and no subsequent discharge of hydrocarbon to the soil, surface water or groundwater. Spills that do occur in the containment area are to be recorded as a non conformance.
- Copies of Controlled Waste Tracking Forms are to be kept as evidence of appropriate disposal.

Accountabilities

Role	Accountability
Site Manager	• Ensure that all personnel who report to you are aware of and conform to this procedure. • Ensure the process for awarding and varying contract requires environmental approval (where the contract has an environmental aspect). • Ensure the site conditions of contract include hydrocarbon management requirements. • Ensure all spills are contained and clean-up appropriately and recorded. • Ensure hydrocarbons are used, stored and disposed of correctly and in accordance with AS 1940. Ensure offsite disposal is carried out by a licensed contractor. • Ensure the oil/water separator is inspected daily and any sediment of hydrocarbon collected is removed and disposed of. • Review and, if necessary, update this plan every two years or earlier if hydrocarbon monitoring indicates that changes to hydrocarbon management are required. • Record and file copies of Controlled Waste Tracking Forms from offsite disposal of hydrocarbon waste.
All Persons	• Conform to this procedure at all times. • Ensure hydrocarbons are stored and disposed of correctly and the correct fuelling procedures are carried out. • Report any non-conformances or spills to the site manager.

Document Management

Rev No.	Date	Revision Description	By	Check	Approved
0	24 March 2015	Final	J.Russell (HAUS)	C O'Neill (HAUS)	K.Reece (HAUS)

References

Department of Water (2004). Stormwater Management Manual for Western Australia. Available online: http://portal.water.wa.gov.au/portal/page/portal/WaterManagement/Stormwater/StormwaterMgtManual. Accessed February 2008.

Department of Environment and Conservation (DEC) Controlled Waste Tracking System. Available online: http://portal.environment.wa.gov.au/pls/portal/url/page/land/**controlled_waste**/publications/guidelines

Appendix A

Attachment 4.2A - Environmental Aspects & Impacts Register for Aggregate Sites

Site:	Jandabup
Completed by:	Joanna Russell
Date Completed:	13/10/2015

Hazard / Aspect	Potential Impact	Current Controls	Risk Rating With Current Controls		
			Consequence	Likelihood	Risk Rating
Plant & Vehicle Maintenance					
Vehicle & Plant Maintenance	Contamination of land or water due to fluid release during maintenance tasks.	Fluids released during machinery maintenance operations are collected and removed to an approved disposal site or are recycled.	Minor	Unlikely	**Low**
Vehicle & Plant Maintenance	Contamination of land or water due to fluid release during maintenance tasks.	Good housekeeping ensures that there is no spillage of oils or lubricants onto unsealed areas.	Minor	Possible	**Low**
Vehicle & Plant Maintenance	Air emissions due to excessive vehicle exhaust.	Mobile haulage equipment is maintained to OEM requirements to maintain emission standards. 10 second rule used as a trigger for the scheduling of repairs or maintenance.	Minor	Possible	**Low**
Vehicle & Plant Maintenance	Creation of noise emissions through maintenance activities	Maintenance activities that occur outside normal operating hours need to ensure that noise impacts on neighbours are minimised.	Minor	Unlikely	**Low**
Storage & Handling of liquid fuels and chemicals					
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facilities.	All liquid fuels and chemicals are stored in a bunded area in accordance with the Holcim Bunding Guidelines.	Minor	Unlikely	**Low**
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facility maintenance.	Bunded areas must be regularly maintained. This includes checking and inspecting the integrity of bund and actively minimising ponding of stormwater by regular inspection and clean out of the bund after significant rain events.	Minor	Unlikely	**Low**
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facility maintenance.	Maintenance of refuelling equipment is incorporated into the site maintenance schedule.	Minor	Unlikely	**Low**
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facility site selection.	Storage areas are located away from waterways and areas prone to flooding.	Minor	Unlikely	**Low**
Storage & Handling of liquid fuels and chemicals	Contamination of land or water due to release of fuel or chemicals due to poor storage facility site selection.	Spill response equipment is available and maintained to allow ready use in the event of a fuel spill. All appropriate personnel have been trained in its use.	Minor	Unlikely	**Low**
Storage of bulk hydrocarbons					
Storage of bulk hydrocarbons (fuel)	Contamination of land or water due to release of fuel due to poor storage facilities.	All liquid fuels are stored in a self bunded, double skinned tank	Minor	Unlikely	**Low**
Storage of bulk hydrocarbons (fuel)	Contamination of land or water due to release of fuel due to unattended transfer.	Operators remain with their vehicle at all times during the delivery of fuel and chemicals to permit immediate response in the event of any spill or leakage.	Minor	Unlikely	**Low**
Storage of bulk hydrocarbons (fuel)	Contamination of land or water due to release of fuel due to poor storage facility maintenance.	Bunded areas must be regularly maintained. This includes checking and inspecting the integrity of bund and actively minimising ponding of stormwater by regular inspection and clean out of the bund after significant rain events.	Minor	Unlikely	**Low**
Refuelling of mobile equipment					
Refuelling of mobile equipment	Degradation of land or stored water due to fuel spillages.	Fuel delivery lines on mobile fuel carts are fitted with a breakaway coupling to avoid fuel losses in the event of a drive away incident.	Minor	Unlikely	**Low**

Refuelling of mobile equipment	Degradation of land or stored water due to fuel spillages.	Spill response equipment is available and maintained to allow ready use in the event of a fuel spill. All appropriate personnel have been trained in its use.	Minor	Unlikely	**Low**
Refuelling of mobile equipment	Degradation of land or stored water due to fuel spillages.	All spills are cleaned up promptly, reported and investigated with the generation of corrective actions as required.	Minor	Unlikely	**Low**
Spill Response					
Spill response	Contamination of land or water due to poor emergency response.	Spill response equipment is available and readily accessible in high-risk areas	Minor	Unlikely	**Low**
Spill response	Contamination of land or water due to poor emergency response.	A documented spill response procedure is in place and employees have been trained in its use.	Minor	Unlikely	**Low**
Spill response	Contamination of land or water due to poor emergency response equipment availability.	Spill response equipment is regularly maintained including replacement of used equipment.	Minor	Unlikely	**Low**
Vehicle Washdown					
Vehicle Washdown	Degradation of land due to poor washdown practices	Washing of vechiles will only occur on hard stand areas.	Minor	Unlikely	**Low**
Vehicle Washdown	Degradation of land due to wash down water leaving hard stand area	Hard stand area will drain to a containment sump.	Minor	Unlikely	**Low**
Vehicle Washdown	Degradation of land due to over flow of containment sump	Maintenance areas that will be covered to minimise the collection of runoff and risks associated with overflow. Water collected in the sump will be regularly removed by a licensed operator and disposed of at an approved waste facility.	Minor	Unlikely	**Low**
Waste Management					
Waste Management	Generation of wastes due to cross contamination of waste types	Wastes are appropriately segregated (e.g.. oils separated from general refuse)	Minor	Unlikely	**Low**
Waste Management	Non-compliance with state based legislative waste requirements.	Wastes including waste oil, batteries, filters, coolant, tyres and scrap steel are suitably stored, labelled and disposed of or recycled at appropriately licensed facilities.	Minor	Unlikely	**Low**
Waste Management	Non-compliance with state based legislative waste requirements.	All transport and disposal practices meet State regulations including waste tracking where required.	Minor	Unlikely	**Low**
Waste Management	Generation of wastes due to poor housekeeping processes	All rubbish, equipment, structures and waste material is removed on a progressive basis from the premises and recycled wherever possible or disposed of at an approved disposal site.	Minor	Unlikely	**Low**
Waste Management	Generation of wastes due to poor housekeeping processes	Waste is stored in an area that will not contaminate any watercourse, waterway, groundwater, wetland or lake and soil.	Minor	Unlikely	**Low**
Waste Management	Generation of wastes due to poor housekeeping processes	Empty drums are stored in a designated hardstand area until collected for recycling.	Minor	Unlikely	**Low**
Waste Management	Generation of wastes due to poor housekeeping processes	Any leakage from empty drums is contained and not permitted to enter waterways or come into contact with soil.	Minor	Possible	**Low**
Closure					
Spill response	Contamination of land due to poor storage of hydrocarbons	Hydrocarbon Management Plan Spill response kits and procedures Phase 1 Assessment prior to decommission Sealed maintenance pad and self bunded fuel bund	Significant	Unlikely	**Low**
Spill response	Contamination of water due to poor storage of hydrocarbons	Hydrocarbon Management Plan Spill response kits and procedures Phase 1 Assessment prior to decommission Sealed maintenance pad and self bunded fuel bund Groundwater monitoring during approvals, operations and closure phases	Significant	Unlikely	**Low**

Attachment 4.2G - Environmental Risk Matrix

Step 1 - Consider the Consequence

What are the consequences of the most reasonable worst case scenario considering a credible failure of existing controls?

Consequence	Disaster	Severe	Serious	Significant	Minor
Environment On Site & Off Site	Major event, unconfined impact, severe permanent damage with low likelihood of recovery.	Significant permanent damage; reversible damage with recovery time of years; high potential for prosecution	Minor permanent damage; temporary damage that is widespread or that has moderate impact	Damage that is near source confined, temporary and minor	No measurable damage to environment
Compliance With Legal and Other Requirements	Blatant or serious breech of legal requirement, leading to operation being suspended or severely reduced. Prosecution expected.	Breach of external requirement (license, legislation, regulation, contract etc) with high potential for prosecution and/or high impact.	Non-compliance with external requirement with moderate potential for impact.	Repeated non-compliance with internal procedure, non-compliance with external requirement with low potential impact	Minor non-compliance with internal procedures.
Community Perception and Reputation	Significant adverse media attention (state or national level), loss of reputation or work nationally or across product groups.	Prosecution, significant impacts on social license to operate, loss of reputation or ability to secure work across product groups.	Local adverse media attention, loss of reputation or ability to secure work in local area, complaints that result in changes to external requirements.	Multiple community complaints or complaints that require changes to internal operating procedures.	Community complaint resolved with no changes to existing operating procedures.

Note: Temporary environmental damage has a duration of up to approximately one week to rectify

Step 2 - Consider the Likelihood

What is the likelihood that the proposed consequence will occur with a credible failure of existing controls?

Likelihood	Certain	Likely	Possible	Unlikely	Rare
Description	Event that is expected to occur on multiple occasions	Event that is likely to occur at least once	Event that may occur	Event that is unlikely to occur	Event that may occur only in exceptional circumstances
Frequency	Event is likely to occur more than twice a year.	Event is likely to occur once or twice a year.	Event is likely to occur more than once or twice in a 10 year period	Event is likely to occur once or twice in a 10 year period	Event is likely to occur once or twice in a 100 year period

Step 3 - Determine Risk Rating from the Risk Matrix

Liklihood	Consequence				
	Disaster	Severe	Serious	Significant	Minor
Certain	High	High	High	Medium	Medium
Likely	High	High	Medium	Medium	Low
Possible	High	Medium	Medium	Low	Low
Unlikely	Medium	Medium	Low	Low	Low
Rare	Medium	Low	Low	Low	Low