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PLANNING DESIGN ENVIRONMENT

DEVELOPMENT APPROVAL RENEWAL

EXTRACTIVE INDUSTRY LICENCE RENEWAL

CLAY EXTRACTION MANAGEMENT PLAN

LOT 6 WANDENA ROAD, MUCHEA

PREPARED FOR MIDLAND BRICK

JUNE 2022

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Document History:

Date	Document Name	Document Manager	Summary of Document Revision	Client Delivered
Mar-22	1084 – Muchea 6 DA and EIL	SR	Initial Draft	Mar-22
Apr-22	1084 – Muchea 6 DA and EIL	SR	Updated Draft	Apr-22
Jun-22	1084 – Muchea 6 DA and EIL	SR	Final for submission	Jun-22

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Executive summary

Land Insights act for Midland Brick (the applicant) and Lower Chittering and Muchea Pty Ltd (the owner) and lodge this application on their behalf. The purpose of the application is to seek a renewal of the Development Approval and Extractive Industry Licence for an existing clay quarry located at Lot 6 Wandena Road, Muchea ("the site") known as the "Muchea 6" quarry.

Existing approvals were issued by the Shire on the 11th September 2018, expiring on the 30th June 2022. Excavation within the quarry has been ongoing since October 2008 and there are considerable resources remaining on the site.

This report addresses the requirements of both the Development Approval under the Shire's Local Planning Scheme, and the Extractive Industry Licence application under the Shire's Extractive Industry Local Law.

A summary of the proposal is outlined in the table below.

SUBJECT	DESCRIPTION
Operating times	The hours of operation will be from 07:00 to 18:00 hours from Monday to Saturday. No operation will occur on Sundays or Public Holidays.
Life of project	Over 10 years.
Volume extracted	Approximately 150,000 tonnes annually.

SUBJECT	DESCRIPTION
Site preparation	Limited site preparation is required as the site is already established for clay extraction. Some clearing of native vegetation (parkland cleared vegetation and regrowth) will be required. Screening vegetation will continue to be planted and the new areas of excavation will be screened with overburden bunds. Drainage systems are already in place. New drainage management will be established as the excavation progresses or moves into new areas. Road access, signage and fencing has already been established.
Operation Area	The existing Active Pit Area is approximately 3.5 hectares. The proposed excavation areas (expansion areas) are approximately 8.6 hectares at the northern end of the site and 6.1 hectares at the southern end. Note that the water detention basins, access roads and overburden and topsoil stockpiles are separate to these areas. It should also be noted that the proposed extent of excavation has been significantly reduced from the current approved plan, and existing operational areas have instead been used where possible.
Excavation process	Excavation will continue within the existing active pit area located at the eastern side of the site. Previously identified areas for excavation at the southern and northern extents of the site will also be excavated.
Depth	The depth of topsoil is approximately 200mm. The depth of overburden varies across the site but is approximately 3 metres. Clay resource is approximately 10 metres below this. The total depth of excavation is approximately 5 to 15 metres across the site and varies depending on site topography and the quality of the resource.

SUBJECT	DESCRIPTION
Excavation process	Excavation of clay takes place in a sequence of steps which can be broadly broken down into; the Excavation Campaign (i.e. removal of topsoil and overburden, excavation of clay to stockpile) and Carting Campaign (transport of clay from stockpiles to the factories) and Rehabilitation. In general, the steps will involve the following: • Overburden and topsoil will be removed from excavation area. It will be stockpiled in bunds around the perimeter of the pit to be used as part of land recontouring during rehabilitation. • Excavation involves moving clay with an excavator and dump trucks and placing into stockpiles located on the site. • Excavation will generally progress west to east across the site. • Stockpiles will be located at the southern end of the property. • Previously excavated areas will be utilised as water detention basins for drainage management, to access other parts of the quarry and to be used as stockpile areas. Recontouring will take place where possible. • Clay will be transported off-site during a carting campaign.
Stockpiling	Currently, clay is stockpiled within the previous excavation area located at the southern end of the property. The stockpile area will be expanded and rearranged as indicated on the attached plans but will remain at the southern side of the site.
Access	Access to the site will continue to be from the existing access off Wandena Road.
Workforce	2-6 people on site during the excavation and carting campaigns.
Vehicle movements	It is expected that there will be approximately 90 truck loads per day when carting is occurring. Carting will take place for approximately 4 days each month throughout the year. This equates to approximately 2,160 truck loads each year. Truck numbers may vary slightly from this depending on demand. A Traffic Impact Statement is attached to this report.
Refuelling	The operation will use mobile refuelling for excavation equipment only (not cartage trucks). There will be no storage of fuel on site. A Refuelling Management Plan is provided.

SUBJECT	DESCRIPTION
Environmental management	The proposed excavation operation has been subject to a rigorous environmental assessment (this is presented in Chapter 5) which has considered ways to avoid, reduce and mitigate environmental impact. As such, the clay extraction operation will comply with a range of management procedures as presented in the following management plans included with this report: • Acid Sulphate Soil Investigation and Management Plan • Dust Management Plan • Noise Management Plan • Water and Drainage Management Plan • Refuelling Management Plan • Visual and Amenity Management Plan • Waste Management Plan • Dieback Management Plan • Weed Management Plan • Rehabilitation and Decommissioning Management.
Water Management	All rainwater is retained within the operation area and is collected in the drainage basin and at the base of the pit. A Water and Drainage Management Plan and an Acid Sulphate Soil Investigation and Management Plan is provided.
Structures	A temporary lunchroom/office and portable toilet will be used when the site is operational.
Decommissioning	The pit will be recontoured to a safe and stable condition and the site will be returned to pasture surrounding a dam created by the void. A Rehabilitation Management Plan is provided.

1 Introduction

1.1 Background

Land Insights act for Midland Brick (the applicant) and Lower Chittering & Muchea Pty Ltd (the owner) and lodge this application on their behalf. The purpose of the application is to seek a renewal of the Development Approval and Extractive Industry Licence for a clay quarry located at Lot 6 Wandena Road, Muchea ("the site") known as the "Muchea 6" quarry.

Existing approvals were issued by the Shire on the 11th September 2018, expiring on the 30th June 2022. Excavation within the quarry has been ongoing since 2008 and there are considerable resources remaining on the site. This report addresses the requirements of both the Development Approval under the Shire's Local Planning Scheme, and the Extractive Industry Licence application under the Shire's Extractive Industry Local Law.

The proposed excavation operation has been subject to a rigorous environmental assessment (this is presented in Chapter 5) which has considered ways to avoid, reduce and mitigate environmental impact. As a result, the proposed extent of excavation has been significantly reduced from the current approved plan, and existing operational areas have instead been used where possible to reduce the overall disturbance area.

It should be noted that while the annual tonnages to be carted has been increased in this application this does not mean an increase in the intensity of the operation from day-to-day (i.e. not an increase in machinery on site, trucks visiting each hour etc.), it just means that operation will be spread out over more days per year. Despite this, it is important to note that the operator is not on the site every day. For large stretches of time and for a majority of the year there will be no activity on the site (i.e. it will be dormant). Excavation, carting and rehabilitation only take place over a certain period of time or at scattered times throughout the year.

1.2 Importance of the resource

Clay is an essential basic raw material used in the manufacture of roof tiles, bricks and paving blocks. As such, the extraction of clay is an important process in the supply of bricks and other construction materials for the community.

The Perth housing industry is almost entirely reliant on the supply of economic and quality bricks and Midland Brick has provided the bricks for over 60% of all homes in Perth. This resource is a critical part of the production of these bricks and therefore homes for Western Australians.

The site is located in close proximity to the Perth Metropolitan Area and comprises important clay resources which will supply the Midland Brick factories. Clay has been excavated from the Muchea area for many years and for the last 15 years from this site. The clay resource found on Lot 6 is of particular importance to Midland Brick so it can be blended with other clays to enable them to produce a full range of the desired brick products. (Landform Research, 2017).

More specifically, the resource on site is a white to cream kaolinite clay of sedimentary origin. With local changes geology, different clay resources are present in different locations, hence why quarries can be found on a number of sites. In addition, the horizontal variations in clay quality means that useable clay is intermittent in outcrop and restricted by the depth of overburden. Variations in clay quality relate to composition, the plasticity and the behaviour when fired. The clays from the pits in the Muchea area are normally blended to increase the use of the resource and provide a wide range of clay products (Landform Research, 2017).

The types of clay found on the site can also vary, hence the need to keep a number of different areas open for excavation at one time. This allows for various clay types to be worked separately and efficiently mixed.

The importance of clay to the community is reflected in *State Planning Policy 2.4: Basic Raw Materials* (WAPC, 2021). This site is mapped as a "Significant Geological Supply" in State Planning Policy 2.4.

1.3 Location

Lot 6 is located in the suburb of Muchea, north of Perth. It is approximately 3 kilometres to the east of the Muchea townsite. The property is approximately 50 hectares in size. The operational areas (existing and proposed) occupy a majority of the site (apart from the areas of vegetation to be retained in the centre and western sections of the site).

1.4 Ownership

Ownership details are in Table 1.1 below.

Table 1.1 – Ownership Details

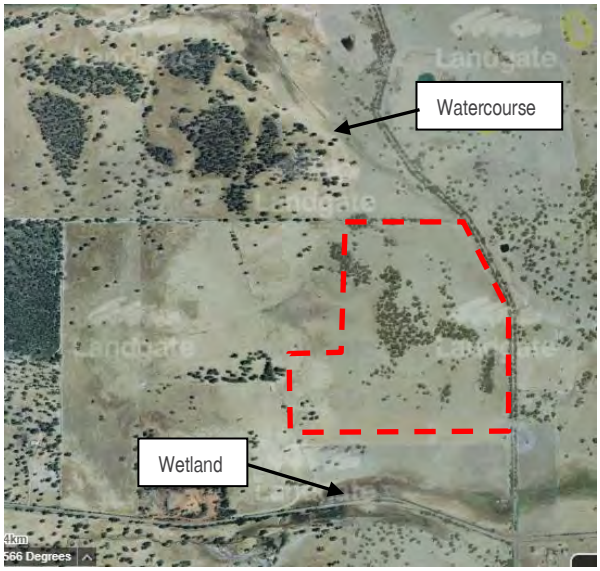
LOT #	DIAGRAM	VOLUME	FOLIO	OWNER
6	DP49665	2631	794	Lower Chittering & Muchea Pty Ltd

1.5 Community benefits

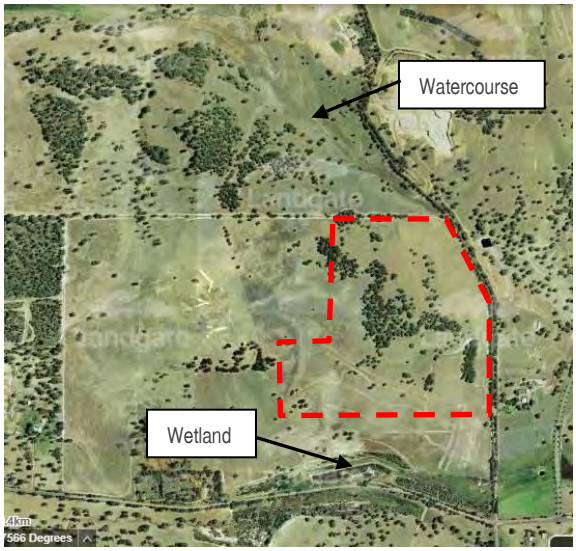
Midland Brick have been extracting clay resource from the Muchea area for the past 30 years and at this particular quarry, for the last 15 years.

Over this time, they have undertaken extensive landcare projects in the local area and have provided many community benefits. Since the year 2000, Midland Brick have worked with the local landcare group to undertake extensive revegetation on the watercourse to the north of the site, which stretches across the north of Lot 51, as well as the watercourse and wetland to the south. Both watercourses were completely cleared of native vegetation from prior land use (agriculture) before this revegetation took place. Historic aerial photos of the site are provided below to demonstrate the revegetation efforts undertaken over the last 20 years.

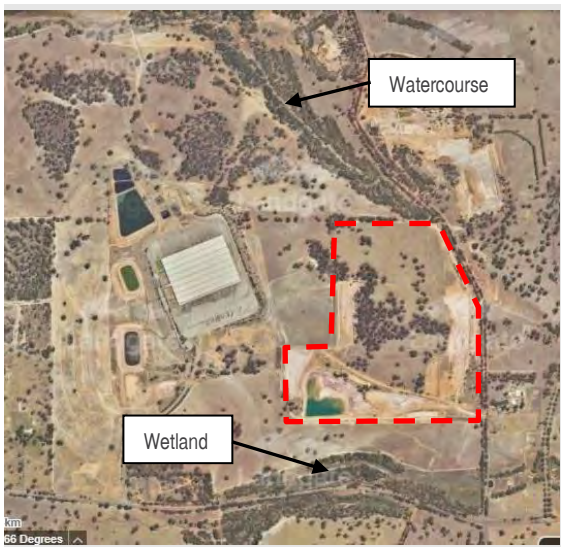
Aerial Photo – 1989



Aerial Photo – 2000

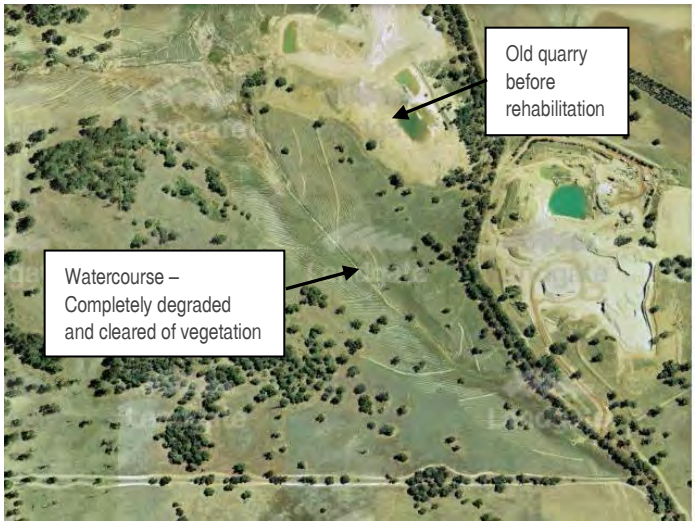


Aerial Photo – 2021

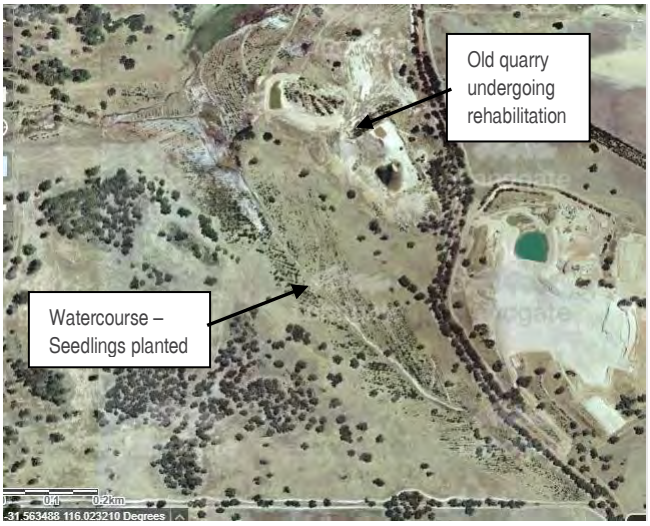


Revegetation is evident when comparing the aerial photos between 1989 and 2000 (prior to planting) and 2021.

Aerial Photo – 2000

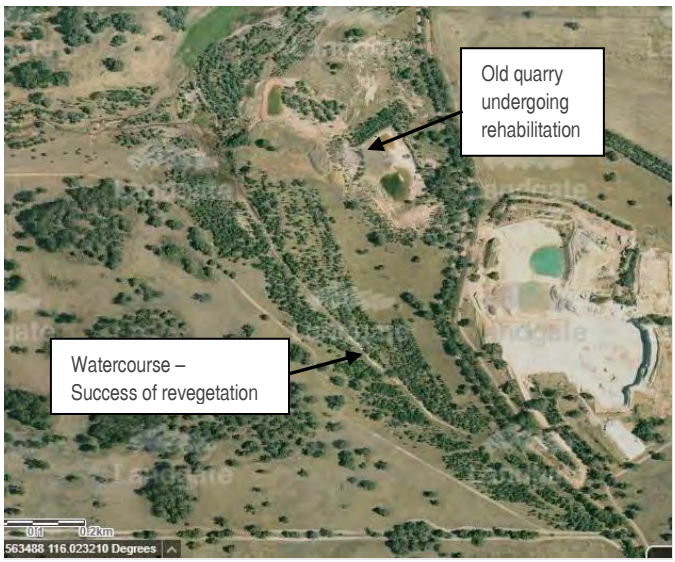


Aerial Photo – 2002

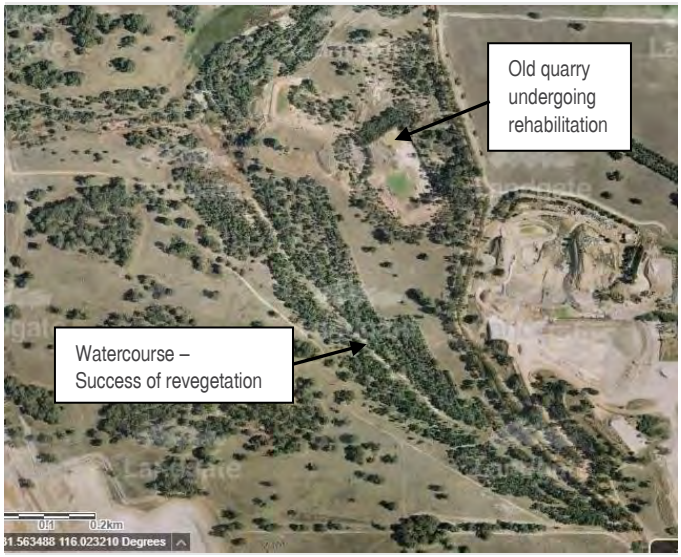


Close-up of the watercourse to the north of the site showing the condition prior to revegetation by Midland Brick in the year 2000 and the seedlings planted by the year 2002.

Aerial Photo – 2004



Aerial Photo – 2008



The success of the Midland Brick revegetation efforts can be seen in the aerial photos from 2004 and 2008.

The existence of the Midland Brick quarries in the area has many community benefits such as the following:

- Water supply in the event of a fire
- Local fire brigade has access to the site to set up communication vehicles
- Restoration and revegetation project on the site will improve local vegetation and habitat for wildlife
- Ongoing work with the Chittering Landcare Centre.

Midland Brick have recently been in contact with the Lower Chittering Fire Brigade to discuss their needs and to identify whether the company can assist with resources and space. They are also in regular contact with the local fire brigade to discuss their needs and any assistance which can be provided. For example, the fire brigade has access to the site to obtain water supplies from the detention basins in the event of a fire. They can also set up their communication vehicles within the operational area, there is adequate space for this purpose. Water from the on-site basins is also used by the Shire of Chittering for road maintenance and construction.

2 Works and excavation program

2.1 Excavation procedure

Excavation of clay takes place in a sequence of steps which can be broadly broken down into the following:

- Earthworks Campaign (i.e., removal of topsoil and overburden, excavation of clay to stockpile)
- Carting Campaign (transport of clay from the pit or stockpiles to the factories)
- Rehabilitation.

Further information on the excavation process is below.

No processing, crushing, screening or blasting will occur on site. This operational procedure has been determined to help minimise disturbance to the neighbouring residents and other locals.

The proposed excavation operation has been subject to a rigorous environmental assessment (this is presented in Chapter 5) which has considered ways to avoid, reduce and mitigate environmental impact. As a result, the proposed extent of excavation has been significantly reduced from the current approved plan, and existing operational areas have instead been used where possible to reduce the overall disturbance area.

It should be noted that while the annual tonnages to be carted has been increased in this application this does not mean an increase in the intensity of the operation from day-to-day (i.e. not an increase in machinery on site, trucks visiting each hour etc.), it just means that operation will be spread out over more days per year. Despite this, it is important to note that the operator is not on the site every day undertaking the activities listed above. For large stretches of time and for a majority of the year there will be no activity on the site (i.e. it will be dormant). Excavation, carting and rehabilitation only take place over a certain period of time or at scattered times throughout the year (as described further below).

Earthworks campaigns

The "Earthworks Campaign" refers to the excavation and stockpiling of material. During the earthworks campaign, topsoil and overburden is removed and clay is excavated and placed into stockpiles located within the Operation Area.

An earthworks campaign will take place for the equivalence of 3 to 4 months each year. During these times, excavation will generally take place for six days a week during the approved operation times. It should be noted that for much of the year (8 to 9 months) there will be no extraction taking place.

Approximately 150,000 tonnes of clay will be excavated each year and placed onto stockpile. This will be the maximum annual volume.

The excavation process is undertaken as an "inside out" operation. For example, excavation of the first part of the active pit becomes the water detention pond so that drainage management can commence straight away. Vehicles work on the floor of the excavation and work towards the edges of the excavation. As the resource comprises of several grades (i.e. types) of clay, benches are used to enable the various clays to be separated. Each grade of clay is then stored in separate stockpiles in the Stockpile Area.

As there are different grades/types of clays located around the property, there will be a need to have more than one Active Pit Area open for excavation at one time. Therefore, the areas identified for excavation on the attached plans could be open for excavation concurrently. The extent and exact location of excavation will vary depending on the demand for different types and colours of clay.

As vehicles usually operate from the pit floor, the walls of the pit also act as a noise and dust barrier for most of the excavation process. There will be a relatively short period where vehicles are located at the ground level (when clearing vegetation and stripping topsoil and overburden), however the existing overburden bunds around the property boundary will provide a further noise and dust barrier. In addition, a Dust Management Plan and Noise Management Plan will be in place for the operation.

Machinery and vehicles used for the excavation campaign includes:

- Excavator
- Dozer
- Loader
- Haul trucks (one haul turck within the clay pit and one haul truck between the pit and the stockpiling area).

No processing (crushing, screening etc) will occur on the site. No blasting will be required to facilitate excavation.

Cartage campaigns

The "Cartage Campaign" refers to the removal or transport of clay from the site where it is taken to the brickmaking factories located in the Perth Metropolitan area. Loading and carting from the site will occur throughout the year for approximately 4 days each month (the equivalent of approximately 48 days each year). For most of the year there will be no carting/truck movements in and out of the site.

It is estimated that approximately 150,000 tonnes of clay will be carted from the site annually. Carting from the site depends on the market demand for bricks, as well as the types of clay and colour of clay. Therefore, there may be some variation from the truck numbers and the number of days that carting will be required each month (i.e. some months will have more carting days than other months). Further detail regarding truck numbers is provided below. A Traffic Impact Statement prepared by Shawmac Consulting Engineers is also at Appendix F. It should be noted that while the annual tonnages to be carted has been increased in this application this does not mean an increase in the intensity of the operation from day-to-day (i.e. not an increase in machinery on site, trucks visiting each hour etc.), it just means that operation will be spread out over more days per year.

The Stockpile Area will be located at the southern end of the site, near the site access. This allows for ease of access and to reduce the distance trucks need to travel along internal access roads. This is a management technique used to help mitigate potential dust and noise impacts.

The stockpile area will also be used to blend clays. Blending and loading of clay in the stockpile area will use a one front end loader.

Rehabilitation

Rehabilitation of the quarry will involve recontouring the slopes to a safe and stable condition and returning the site to pasture and dams created from the lowest parts of the landscape.

Progressive rehabilitation will generally take place from west to east across the site. Rehabilitation will take place when an area is no longer required for operations (i.e. for clay excavation, for water management and drainage, for stockpiling and for access).

It is expected that rehabilitation will take a few years to complete following decommissioning (to allow for monitoring of pasture and erosion control). It should also be noted that the rehabilitation and closure of the quarry will also be reviewed by the Department of Mines, Industry Regulation and Safety in accordance with the *Mines Safety and Inspection Act 1994*. Further details relating to rehabilitation is provided in the Rehabilitation Management Plan.

2.2 Hours of operation

The hours of operation will be from 07:00 to18:00 hours from Monday to Saturday. A six-day working week is required to maintain efficiency which in turn reduces the brick manufacturing cost. No operation will occur on Sundays or Public Holidays. Further information on the length of time required annually for excavation and carting is provided above.

2.3 Extent of excavation

The operation comprises of different areas which serve a different purpose as follows:

- Active Pit Area
- Stockpiling Area
- Drainage Basins
- Access Roads
- Overburden Bunds
- Topsoil Stockpiles
- Areas undergoing rehabilitation and recontouring.

These areas are marked on the plans at Appendix B and can be seen on the aerial photography of the site.

Existing operation description

The existing operation occupies much of the southern extent of Lot 6, with the current Active Pit Area on the eastern side of the property. A drainage basin is located at the south-western corner of the operation, and another is located on the southern boundary. The Stockpile Area is currently located at the southern portion of the lot.

Proposed operation description

The proposed excavation operation has been subject to a rigorous environmental assessment (this is presented in Chapter 5) which has considered ways to avoid, reduce and mitigate environmental impact. As a result, the proposed extent of excavation has been significantly reduced from the current approved plan, and existing operational areas have instead been used where possible to reduce the overall disturbance area.

The excavation within the current Active Pit Area (located at the eastern side of the site) will continue in the short term. This area will be excavated within the current footprint (i.e., the area already stripped of overburden and topsoil) and slightly to the west, shown on the attached plans. Excavation will resume in

this area after a period of time (possibly 10 years) once other parts of the site have been excavated. As a result, the current Active Pit Area will not be rehabilitated until the resource in the eastern part of the site has been undertaken. This area is also required to stay open to allow internal access through the site to link the northern excavation area to the stockpiling area at the southern part of the site.

Excavation across the site will generally occur from west to east across the site. Excavation over the next 10 years has been identified at the northern end of the site and the southern portion of the site. As there are different grades/types of clays located around the property, there will be a need to have more than one Active Pit Area open for excavation at one time. Therefore, the areas identified for excavation on the attached plans could be open for excavation concurrently. The extent and exact location of excavation will vary depending on the demand for different types and colours of clay.

The clay resources on site are extensive and it is anticipated that it will take upwards of 20 years to completely excavate. The proposed extent of excavation for the next 10 years is shown on the plans at Appendix B. It is important to note that despite the careful planning and onsite investigations which help determine the location of the resource, the areas to be excavated in the next 10 years can vary slightly from those depicted on the plans. Some flexibility for the size/area and specific location of the pit area is required to allow for the most efficient use of the site.

The Stockpiling Area will remain at the southern end of the site and will be slightly rearranged to provide a larger area for stockpiling and truck movement. The proposed stockpiling area is shown on the plans at Attachment B. A portion of this area will be excavated of clay resource prior to it being used for a stockpile area. The stockpile area will extend north as the clay is excavated.

The existing Overburden Bund located at the western side of the site will be retained and additional bunding will be formed as excavation progresses. The noise bund on the eastern side of the site will be added to to improve noise management and to account for the new areas being excavated. Topsoil Stockpiles will also be created when required. Existing Access Roads will continue to be utilised and new

roads formed as excavation progresses. The existing Drainage Basin will continue to be used and new basins established as required.

2.4 Depth of excavation

The current pit has been excavated to a depth of approximately 14 metres. The ultimate depth of the pit areas is expected to vary from between 5 metres to 15 metres. The depth of excavation varies across the site depending on the topography, the depth of overburden and the depth of the resource.

It is important to note that despite the careful planning and onsite investigations which help determine the location of the resource, the depth can vary slightly from the areas depicted on the plans.

2.5 Topsoil and overburden

Topsoil and overburden, consisting of gravel, sand with lateritic clays is removed prior to excavation commencing in new areas. The depth of overburden is approximately 2 to 5 metres across the site, depending on the location.

Topsoil is scraped from the top of the area to be excavated to a depth of approximately 0.5 metres. It is either transferred directly to an area being rehabilitated or pushed to form low stockpiles of approximately 1 to 2 metres in height for later use in rehabilitation.

Overburden is scraped from the surface and used to create bunds along the perimeter of the excavation/pit area. The overburden is used to create screening bunds just inside the lot boundary and the noise bunds on the south-eastern side of the site. This practice will continue as the excavation progresses. Overburden bunds also assist with drainage management and help with noise reduction. It is generally placed around the perimeter of the excavation area, so it is ready to be pushed back into the excavation area for future recontouring.

As excavation progresses, existing topsoil and overburden bunds will be used for recontouring and rehabilitation and new bunds will be established around new pit areas.

2.6 Site preparation

Minimal, additional site preparation will be required as the site is already used for extractive industry. Signage, fencing, gates, security, screening vegetation, site access, bunding, crossover, internal access roads, stockpiling area and drainage management is already in place.

Some clearing of native vegetation is likely to be required, comprising of parkland cleared vegetation within the paddock areas and regrowth within the current operation area. A Clearing Permit will be applied for from the Department of Water and Environmental Regulation.

Drainage management, bunding, internal access roads and stockpiling areas will be established and rearranged across the site as excavation progresses.

2.7 Access arrangements

Access to the site will continue to be from Wandena Road. The internal access is sealed for 100 metres at the entrance. The remainder of the access tracks are unsealed. The purpose of the sealed entrance is to help reduce the amount of dirt tracked onto Wandena Road from trucks and vehicles exiting the site.

Unauthorised access to the site is restricted by a locked gate at the entrance to the property and the site is fenced around the boundary.

2.8 Truck movements

Trucks are used to cart clay from the site to the factories. All trucks turn right from the site and travel south down Wandena Road to access Great Northern Highway. They travel south towards the Perth metropolitan area where the factories are located.

Carting will be undertaken for approximately four days each month throughout the year. It is anticipated that there will be approximately 45 truck loads per day (90 movements) during each day of carting. Annually there will be approximately 2,160 truck loads spread out over the course of a year. An approximate number is provided because there may be some variation in truck numbers due to the cyclic

demand for clay building products. The number of trucks will also vary depending on the weather and demand for a particular type of clay. It should be noted that while the annual tonnages to be carted has been increased in this application this does not mean an increase in the intensity of the operation from day-to-day (i.e. not an increase in machinery on site, trucks visiting each hour etc.), it just means that operation will be spread out over more days per year.

Trucks used for the extraction are RAV 2 truck and dog combination with a payload of 42 tonnes.

A Traffic Impact Statement has been prepared by Shawmac Consulting Engineers and is provided at Appendix F. The assessment concluded the following:

- "The estimated traffic generation for the proposed haulage activity can be accommodated within the capacity of the existing road network.
- The additional traffic generated by the site is not considered to increase the likelihood of crashes.
- The available Safe Intersection Sight Distance and Entering Sight Distance at the site access location is deemed acceptable for the assumed design approach speeds, however they can be affected by overgrown vegetation towards both sides of the access. Therefore, it is recommended to implement a monitoring and maintenance program for vegetation growth and scheduled vegetation trimming to ensure sightline is not affected.
- The existing BAR/BAL configuration of the site access is considered appropriate to cater for the proposed additional traffic.
- The swept path assessment for the designated RAV vehicle movements indicates that the designated non-lane-correct movements can be completed satisfactorily, and this is considered to be acceptable considering the low volume nature of Wandena Road and the achieved sight distances."

2.9 Plant and on-site equipment

No permanent structures associated with the clay pit will be situated on the site. A temporary structure to be used as an office and lunchroom will be located on the site during operational times. It will be moved around the site as required. A portable toilet will also be located with the office.

The equipment required for excavation will be brought in on an as-required basis and will include a dozer, excavator, water truck, haul trucks, and loader. This equipment is removed at the end of each "earthworks campaign".

No bulk storage of fuel and oil is required on site and no chemicals are stored on site. A Refuelling Management Plan is at Chapter 9.

All supplies will be delivered. Rubbish bins will be provided for site workers to use. A Waste Management Plan is provided at Chapter 11.

2.10 Controls

Excavation activities on site will be conducted in accordance with the *Mines Safety and Inspection Act 1994* and the *Mines and Safety and Inspection Act Regulations 1995.* Operation inspections are regularly carried out by the Department of Mines, Industry Regulation and Safety (DMIRS) who inspect safety, operational procedures and workplace health such as dust and noise.

Operations are managed by a licenced Quarry Manager and inspections occur on a daily basis during the excavation and cartage campaigns. Midland Brick has procedures in place to manage safety, health, environmental impact, site completion and rehabilitation.

In terms of occupational health and safety, Midland Brick requires full personal protection be required for all persons on site at all times. All workers are required to wear full protective safety and high visibility gear when on site. There is a site entry "call up" procedure in place. The site is within mobile phone contact and all vehicles are equipped with two-way radios.

Site closure and decommissioning will also be regulated by the Department of Mines, Industry Regulation and Safety. DMIRS will also require Midland Brick to prepare a Mine Closure Plan once they have

completed site rehabilitation and they will inspect the site to ensure it is safe and stable (as required by the *Mines Safety and Inspection Act 1994*).

Fences, gates and warning signs required by DMIRS, and the Shire of Chittering will be maintained.

2.11 Public Safety

Public access to the site is restricted and appropriate warning signs are located at the entrance regarding quarrying and restricted entrance. The site has locked gates when it is not being worked.

Work on site (excavation and cartage) will be discontinuous and there will be periods of time throughout the year when no activity will take place on site. This reduces the risk to public safety from machinery and truck movements. When the site is not operational, the Quarry Manager periodically checks to ensure the site is secure and safe.

2.12 Workforce

Workers associated with the excavation will be on site primarily during the earthworks campaign. At such times the workforce will vary from 1-6 workers in addition to the truck drivers who enter and leave the site.

2.13 Bushfire

The entire property is located within a *Bushfire Prone Area* as mapped by the DPLH. A review of bushfire risk and a description of current operational management is provided below. It should be noted that a Bushfire Management Plan and Bushfire Attack Level Assessment is not required for extractive industry as stated in Clause 2.6 of the Guidelines for Planning in Bushfire Prone Areas (Version 1.4) (WAPC, 2021) prepared under State Planning Policy 3.7 (WAPC, 2015). This Clause states that there is an exemption from the requirements of SPP 3.7 where there is no intensification of land use such as "a development application for an extractive industry where the extraction is undertaken in an open cleared area (for example, quarries and open cut mining) and no habitable buildings are proposed."

The greatest risk of starting a fire from operations on site are during clearing of vegetation and stripping of topsoil, particularly during hot and windy conditions. This type of work in summer can generate sparks which when combined with dry grasses and leaves may lead to fire. Clearing and stripping of topsoil is only conducted in campaigns of once every 2-5 years.

Standard Operating Practices.

There are a range of activities documented (known as "Standard Operating Practices" – SOP) within Midland Brick to assist staff in carrying out work in a safe and efficient manner.

Many SOP's linked with mobile equipment have actions for operators to check around and under the machine for sources of fuel that could be a problem. All staff are trained to carry out daily pre-start checks on their machinery. One of the checks is for hydrocarbon leaks. Staff are trained on how to contain a hydrocarbon leak.

Each year in spring, the company uses a grader to cut fire breaks around all properties used for mining or buffers. Fire breaks will be inspected during the summer to ensure the 3m x 4m rule and mineral earth rule are in place.

Machine maintenance and refuelling is carried out in areas free from fuel burdens. The mobile mining equipment is nearly always in the mine area, hence well away from dry grass and leaves.

Pre-Start Meetings

The Quarry Managers in control of Midland Brick mining and transport teams hold briefing sessions for their work crews every morning. The points of discussion will always cover:

- Safety – issues from yesterday and anything likely to be aware of today, including hazards, incidents/near misses
- Production – what we are doing, where and quality. Allocation of water trucks to sites will be discussed at this time.

- Issues for today – weather conditions and warnings, possible visitors to the site, maintenance of any plant etc.

To prepare for the next day's quarrying activities, the Quarry Manager will review forecasts from Bureau of Metreorology daily to check for temp and wind plus check warnings from DFES during extremely hot windy days. All staff are briefed at the morning pre-start meeting about likely fire dangers and the possibility of lightning developing and compliance with Lightning Procedures. Comply with warnings prepared by DFES.

Fuel load reduction

Midland Brick encourages the owners of land used for clay mining to graze the paddocks to reduce the fuel loads from winter annual grasses. It should be noted that Midland Brick does not own any of the land where they mine clay.

Fire response

The Midland Brick team have developed an Emergency Management Plan and have trained their staff in what to do in all types of emergencies. Should there be a small fire associated with any quarrying equipment it will be treated immediately.

All mobile plant carries at least one portable fire extinguisher. Operators are trained in the correct use of various types of handheld fire extinguishers.

Large quantities of stormwater are retained within the operation area in a dam for internal use. This source of water is normally in large quantities and is suitable for large tankers in case of fire. Midland Brick have been in communication with the Local Bush Fire Brigade who are aware of the quarry location, access gates and water storage.

The Muchea 6 quarry has mobile phone coverage for Emergency Procedures. The Midland Brick staff/team are briefed on what they should do in case of Fire Emergency.

3 Site description

3.1 Topography and landform

The site is slightly undulating with a high point in the middle of the site at approximately 155 metres Australian Height Datum (AHD). The land slopes gently down in all directions to approximately 110-125 metres AHD around the site perimeters.

The landform is relatively simple, with a vegetated high point in the centre of the site and the natural land sloping down to the south, west and north. The natural land has been excavated and altered to the east and south of the hill, altering the landform in these areas. The landform will continue to change as excavation continues, and again once rehabilitation has taken place.

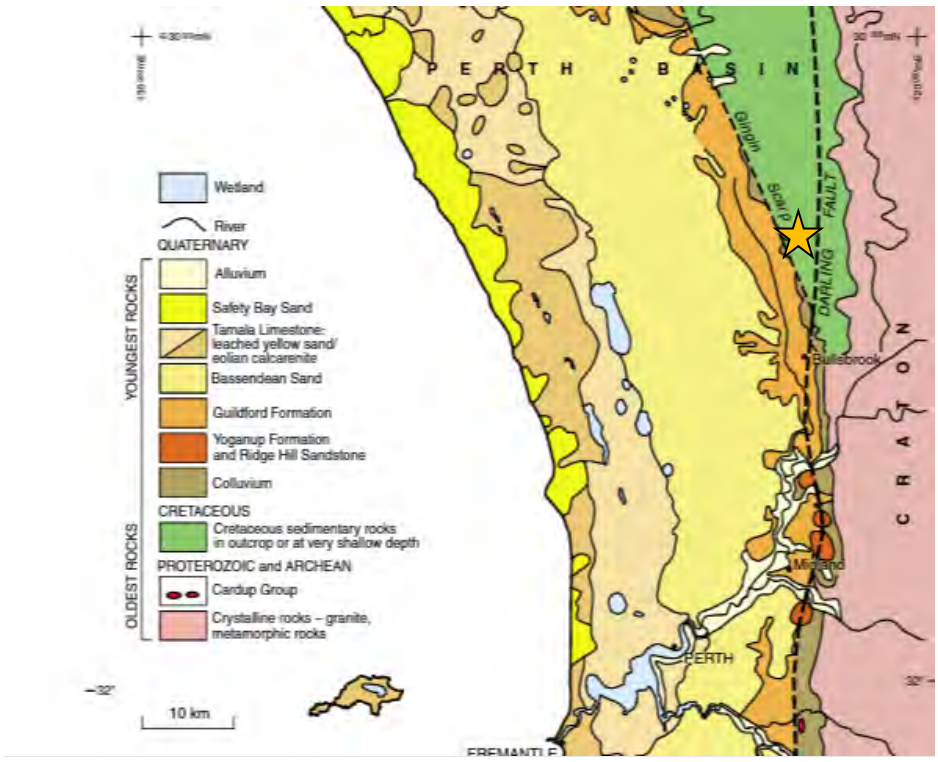
3.2 Geology

The site is located on the eastern edge of the Perth Basin and along the Gingin Scarp. The surface geology of the site is of Cretaceous age and composed of sedimentary rocks in outcrop or at very shallow depth (see figures below) (Gozzard, 2007).

Figure 3.1 – Landforms of the Perth Region

Source: *Geology and Landforms of the Perth Region* (Gozzard, 2007). Site - ★

Figure 3.2 – Geology of the Perth Region



Source: *Geology and Landforms of the Perth Region* (Gozzard, 2007). Site - ★

The 1:500 000 State interpreted bedrock geology is mapped as “Coolyena Group”. The surface geology mapped by the Regolith Map of WA (DMIRS, 2021) describes the site as “residual or relict material, including ferruginous, siliceous and calcareous duricrust”.

The Coolyena Group comprises the Osborne Formation, Molecap Greensand, Gingin Chalk and Poison Hill Greensand. Landform Research (2017) identified the clay resource as part of the Osborne Formation. The lithology of the Osborne Formation is described as “interbedded sandstone (in part calcareous), siltstone, shale and claystone”. The formation is exposed at numerous locations along the Scarp near Bullsbrook, along Ellen Brook (Upper Swan) and along the Moore River (Playford, etc al., 1976). The sediments are horizontally bedded, shallow marine shales that are white when oxidised. Below the excavation the sediments can be dark grey, organic and slightly pyritic at depth below the water table (Landform Research, 2017).

The entire site and surrounds are mapped as “regionally significant basic raw materials” for clay resources by DMIRS. This is reflected in State Planning Policy 2.4 – Basic Raw Materials which maps the site as a “Significant Geological Supply”.

3.3 Soils

Soils have been mapped by the Department of Primary Industries and Regional Development (DPIRD). The site has two soil-landscape units mapped across it. They are listed in Table 2.1 below and shown in Figure 1 below. Soil qualities are described in Table 2.2 below.

Table 2.1 – Soil-landscape Units

CODE	NAME	DESCRIPTION	LOCATION
222Re_1g	Reagan 1g Phase	Gentle slopes of gravelly deep pale sands often over clay or duricrust.	Central part of the site.
222Re_1x	Reagan 1x Phase	Gentle slopes of loose brown or pale sands with a sandy fabric	Northern, southern and eastern extents.

Source: DPIRD, 2021

Table 2.2 – Soil qualities

NAME	WIND EROSION	WATER EROSION	FLOOD	LAND INSTABILITY
Reagan 1g Phase	High risk	Low risk	Low risk	Low risk
Reagan 1x Phase	High risk	Low risk	Low risk	Low risk

Source: DPIRD, 2021

Figure 3.3 – Soil-Landscape Units

Source: SLIP, 2021

Bore logs were included in the Acid Sulphate Soil Investigation and Management Plan (Parsons Brinckerhoff, 2006). The generalised soil profile is as follows:

- 0.0 – 2.0 metres bgl – Sand (fine, loamy, brown, some gravels)
- 2.0 – 2.75 metres bgl – Silty Sand (brown, with some grey clay)
- 2.75 – 3.75 metres bgl – Clay (light grey, crumbly)
- 3.75 – 5.0 metres bgl – Clay (light grey, with orange and red mottles)
- 6.5 – 16 metres bgl – Clay (grey with red mottles)
- 16 – 20 metres bgl – Clay (dark brown/black).

The sand, gravels and silty sand are considered overburden for this operation.

Acid Sulphate Soils

The clay resource being excavated comprises clay and silt which are horizontally bedded and white in colour. Below the excavation level it changes onto grey carbonaceous claystones and siltstones. Above the carbonaceous beds the sediments consist of oxidised clays and silts (Landform Research, 2017).

Due to the occurrence of the grey carbonaceous shales below the excavation and as a precaution, Midland Brick commissioned Parsons Brinckerhoff to prepare an Acid Sulphate Soil Investigation and Management Plan in 2006, prior to excavation commencing. The report concluded that "both laboratory and field results indicated actual acid sulphate soil and potential acid sulphate soil occurs at the site". The potential acid sulphate soil was only encountered within the underlying wet silty clays (around 15 metres bgl) and some acid sulphate soil in the overlying clays, however they found that "this has largely leached from the soil profile by rainfall infiltration". With regards to the specific pH levels, the investigation concluded the following:

- Soil pH indicated that the overlying gravelly sand is slightly acidic at around 5-6
- There is a sharp decrease in the pH in the clay layer (around 1-6 metres bgl)
- Potential acidity was only encountered beneath the water table.

The risk assessment by Parsons Brinckerhoff in 2006 determined the following (note that these points were subsequently addressed in the Management Plan):

- "There was a risk of adverse impact to surface water by soil or water with high levels of acidity leaving the operation area and flowing into the surrounding environment"
- "There was low risk of adverse impacts on the beneficial use of groundwater from acidity due to the low permeability of the underlying clays and that clay excavation is not anticipated to extract to the areas containing potential acid sulphate soils."

This risk of impact to surface water was addressed in the Acid Sulphate Soil Management Plan prepared by Parsons Brinckerhoff in 2006. The objectives of the Management Plan are to:

- "Minimise mobilisation of acidity from disturbed areas
- Retain stormwater runoff from disturbed areas in detention basins and excavation voids and treat as required with lime dosing to neutralise acidity prior to any release or re-use
- Facilitate the re-establishment of a vegetative cover to prevent erosion as part of the longer-term management of the site."

The Management Plan recommends the continued monitoring of surface and groundwater quality, as well as appropriate drainage management and rehabilitation of exposed soils. A copy of the Acid Sulphate Soil Investigation and Management Plan is at Appendix D.

Monitoring of both soils and water quality has occurred since operations commenced in 2008. The results of surface and groundwater quality monitoring are included in the annual reporting to the Shire.

The soil program consists of routine sampling of the stockpiles held onsite, as well as samples typical of undisturbed areas pre mining. Stockpile monitoring is part of the routine grade control for clay quality.

The water program consists of samples of both surface and below ground water. The surface water monitoring is undertaken by Midland Brick. Samples are taken at least annually from the two detention

dams onsite to test for pH and salinity. The groundwater monitoring program is undertaken by an external consultant. Three groundwater bores are located on the property and water is tested for a full suite of parameters including metals, dissolved metals, acid sulphate soil parameters, cations, and nutrients by an accredited laboratory. Parameters tested in the field include pH, electrical conductivity, redox and dissolved oxygen. The most recent groundwater results reported by RPS (2020) states that water quality is generally within the historical ranges for the quarry based on previous studies.

The review of the Acid Sulphate Soil Investigation and Management Plan by Talis in 2015 noted that the operation was largely compliant, although a few minor areas for improvement were noted. One recommendation was to test and lime surface water used for dust suppression (note that the water contained within the eastern water basin is already treated with lime) to ensure that all water used for dust suppression is of a higher pH than the general area. However, it is considered that the intent of the original action from the ASSIMP was to test the pH of water that is used off site, as the use on site for dust suppression will be within the existing operation area. It should be noted that the review also stated that "it is therefore considered that the use of untreated/unlimed water on site is not considered to pose a significant risk to Human Health or the Environment."

3.4 Vegetation

On-site vegetation description

The site has been historically cleared for rural use. The remaining vegetation is located in the centre of the site, with some vegetation located at the north-west corner and scattered throughout the remainder of the site. The vegetation is best described as "Parkland Cleared".

A Flora and Vegetation Assessment was undertaken by Mattiske Consulting Pty Ltd in Spring of 2021. A copy of the report is provided at Appendix E. The vegetation was described as being dominated by "open woodlands of Wandoo (*Eucalyptus wandoo*) with the occasional Marri (*Corymbia calophylla*) over mainly introduced grasses and herbs".

The vegetation condition was identified in the Flora and Vegetation Assessment by Mattiske Consulting Pty Ltd as “Degraded” and “Completely Degraded”.

The Flora Report states that “The range of flora on the site is very limited due to the previous grazing activities and as such only 4 native and 9 introduced species were recorded” and concludes that the area is not considered to contain levels of high biodiversity. This low species diversity reflects the degree of past disturbances from earlier agricultural activities.

Pre-European vegetation mapping

The Pre-European vegetation in the local area is mapped by DPIRD as the “Gingin_1020”. It is described as “mainly jarrah and marri”.

The vegetation complex mapped by the Department of Biodiversity, Conservation and Attractions (DBCA) is “Reagan Complex” across the southern part of the site and “Mogumber Complex – South” across the northern part of the site. They are described as follows:

- Mogumber South – Open Woodland of *Corymbia calophylla* with some mixtures of *Eucalyptus marginata* subsp. *thalassica* and a second storey of *Eucalyptus todtiana-Banksia attenuata-Banksia menziesii-Banksia ilicifolia* on sandy-gravels on the uplands in arid and per-arid zones.
- Reagan – Mixture of low open woodland of *Banksia* species – *Eucalyptus todtiana* to closed heath of Myrtaceae – Proteaceae species depending on depth of soils on escarpment in arid and per-arid zones.

According to the data in the Shire of Chittering Local Planning Strategy (Shire of Chittering, 2010), the percentage of the Reagan Complex remaining regionally is 38% and the percentage of Mogumber Complex – South” remaining regionally is 40%. Neither of these vegetation complexes are identified as being “locally significant” in the Biodiversity Strategy.

It should be noted however, that the Flora and Vegetation Assessment by Mattiske (2022) states that "the vegetation as defined in Mogumber and Reagan do not reflect the local dominance of the *Eucalyptus wandoo,* which reflects the dominance of clays in the local soils."

The amount of clearing required to support the operation has been avoided and minimised where possible. Some clearing of parkland cleared vegetation is proposed.

Threatened species

There are no records of threatened or priority flora, fauna or ecological communities on the site. The closest TEC adjoins the south-west of the site. The Flora and Vegetation Assessment was undertaken by Mattiske Consulting Pty Ltd (2021) states that "No threatened or priority ecological communities listed at the State or Federal levels pursuant to the *Wildlife Conservation Act 1950* or the *Environment Protection Biodiversity and Conservation Act 1999* were recorded in the BGC Muchea project area". It also states that "no naturally occurring threatened or priority flora species were present in the assessment area".

Therefore, it is not considered that the continuation of extractive activities on the site will impact on threatened species or communities.

Environmentally sensitive areas

There are no Environmentally Sensitive Areas mapped by DWER on the site.

Clearing instruments

Some parkland cleared vegetation was previously cleared to facilitate extraction within the current pit area. A Clearing Permit was obtained from the Department of Water and Environmental Regulation in accordance with the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* to facilitate clearing of this vegetation (CPS 2928/1). While some areas were cleared to facilitate the extraction on the eastern side of the site, much of the approved area was not cleared at the time and the permit has now expired. This demonstrates the minimisation and avoidance strategies used by Midland Brick to reduce the level of clearing where possible.

As this Permit has now expired a new application will be submitted to facilitate clearing of some parkland cleared vegetation and regrowth.

No other clearing instruments (applications or proposals) and no offsets are mapped on the site.

Conservation areas

The nearest conservation areas are Bullsbrook Nature Reserve (approximately 5 kilometres to the south), Moondyne Nature Reserve (approximately 9 kilometres to the east), Gnangara-Moore River State Forest (approximately 11 kilometres to the west) and Chandula Nature Reserve (approximately 9 kilometres to the north).

3.5 Water resources

Mapping

The site is located within the following management/catchment areas as mapped by DWER:

- Surface water catchment area – Proclaimed, *Swan River System*
- Surface water subarea – *Ellen Brook*
- RIWA Act Groundwater Area – Proclaimed, *Gingin Groundwater Area*
- RIWA Act Groundwater Subarea – *Chandala Confined, Cowalla Confined, Eclipse Hill* and *Southern Scarp Semi-confined*
- Hydrographic Catchment (Basin) – *Swan Coastal*
- Hydrographic Catchments (Catchments) – *Swan Avon_Lower Swan*
- Hydrographic Catchments (Subcatchment) – *Ellen Brook*
- Surface Water Management Area – *Swan River and Tributaries*
- Surface Water Management Subarea – *Ellen Brook*

Surface water

The site is located within the Swan River System which is a "Proclaimed Area" under the *Rights in Water and Irrigation Act 1914*. The purpose of this designation is to allow DWER to control how much and when water is taken from surface water areas (such as watercourses).

The surface water sub-catchment area for the site is Ellen Brook. The Ellen Brook sub-catchment area covers an area of 715km^2 and expands to the north and south of the site (Water and Rivers Commission, 2002).

No wetlands or watercourses are mapped by DWER on the site. No Public Drinking Water Source Areas are mapped on the site. The site is not located within mapped flood fringe, flood way or Floodplain Development Control Area.

In addition, the site does not have any "Sensitive Water Resource Areas" as set out under draft *State Planning Policy 2.9 – Planning for Water* (WAPC, 2021).

A minor watercourse commences at the northern boundary of Lot 6 and flows to the north-west. The excavation area will be at least 40 metres from this watercourse. It is a tributary of the Ellen Brook. The watercourse flows north-west and joins with a minor watercourse running east-west (Wandena Creek). It then flows into Chandala Brook (which is approximately 2.5 kilometeres to the west of the site) which flows into the Ellen Brook a short distance to the south. The Ellen Brook keeps flowing south and eventually joins up with the Swan River. The baseline review of the surface and ground water undertaken by Coffey Environment in 2006 (prior to the clay extraction operations) notes the existence of watercourse to the north of Lot 6. It states that this watercourse is "restricted to basal flow during low flow periods". They also note that it is the less dominant channel in comparison to the channel located to the north-east which also flows into Wandena Creek.

Prior to excavations commencing in 2008 the watercourse adjoining the north was fenced and extensively revegetated as part of a landcare project to improve water quality and environmental values of the watercourse. Historic aerial photos of the revegetation are provided in Chapter 1.5 above.

Another minor watercourse runs east-west approximately 160 metres to the south of the site. This area is also mapped on the Geomorphic Wetlands of the Swan Coastal Plan Dataset by the DBCA is a Multiple Use category wetland (ID 12 251). Midland Brick was also involved in the extensive rehabilitation of this watercourse in association with the local landcare centre prior to operations commencing on the site. This watercourse also flows east to west into the Ellen Brook.

Outside of the excavation area, surface water drains from the high points to low parts of the landscape and is diverted around the outside of the operation area. Some minor drainage lines channel water down the hill.

Figure 3.4 below shows the wetlands and watercourses in proximity to the site.

Appropriate caution is undertaken to ensure that the surrounding surface water features are not detrimentally impacted by the excavation operation. All water runoff from the extraction site is detained in constructed basin areas to ensure it does not flow into the watercourse and surrounding area. The water from the basins can be used in the summer months for dust suppression.

Two water detention basins are currently located within the operation area. Water Basin 1 was created in the south-west corner of the site. No ground water was intersected during the excavation. Water Basin 2 was constructed adjacent to the southern boundary as a water treatment dam. This dam was lined with limestone to assist with pH control of surface water.

Further detail on water management is provided in the Water and Drainage Management Plan. Actions relating to surface water monitoring and drainage control from the perspective of managing acid sulphate

soils is provided in the Acid Sulphate Soil Investigation and Management Plan by Parsons Brinckerhoff (2006) (Appendix D).

Figure 3.4 – Watercourses and Wetlands

Groundwater

The site is located within the Gingin Groundwater Area which is a "Proclaimed Area" under the *Rights in Water and Irrigation Act 1914*. The purpose of this designation is to allow DWER to control how much and when water is taken from groundwater.

The site lies within the Dandaragan Plateau hydrological zone. It is described as "gently undulating plateau with areas of sandplain and some laterite, on Cretaceous sediments" by DPIRD.

Groundwater aquifers in the area are Perth-Yarragadee North (from the Chandala Confined groundwater subarea), Perth-Leederville-Parmelia (from the Cowalla Confined groundwater subarea) and Perth – Surficial (Eclipse Hill groundwater subarea).

The Perth Groundwater Map (DWER, 2022) indicates that the minimum groundwater levels are between 55 metres and 60 metres AHD. Maximum groundwater contours are not available for the site. Regionally, groundwater flows in a southwest direction (Water and Rivers Commission, 2002).

The Acid Sulphate Soil Investigation and Management Plan (Parsons Brinckerhoff, 2006) states that within the Stage 1 area investigated as part of the report (which is the existing operation area at the southern end of the property) groundwater was encountered within silty clays approximately 15-17 metres bgl at the south-west corner and greater than 21 metres bgl at the northern extent of the stage. The groundwater was encountered within the silty clays which form a semi-confined aquifer. The unsaturated clays most likely act as an aquitard with the underlying more permeable sediments forming a semi-confined aquifer (Parsons Brinckerhoff, 2006).

Groundwater has not been encountered in the excavations. Excavations will be above the water table and groundwater will not be intercepted, with a separation of more than 2 metres being maintained between excavations and the groundwater table.

As stated above, there is a comprehensive groundwater monitoring program already in place at the site in accordance with the Acid Sulphate Soil Investigation and Management Plan. The results of monitoring are provided to the Shire in the Annual Reports.

3.6 Surrounding land use

Most of the surrounding properties are used for rural industry, agriculture and extractive industries. Adjoining the site to the west is the Muchea Livestock Centre (WAMIA). Other clay extraction operations are located directly to the east and south of the site. A rural residential estate is located approximately 750 metres to the north-east and east of the site. The remainder of the surrounding land uses are primarily used for agriculture.

The quarry is approximately 2.5 kilometres to the east of the Muchea townsite.

A Site Context plan showing surrounding land uses is provided at Appendix B.

3.7 Contaminated sites

There are no mapped contaminated sites on the property including the following categories: “contaminated – remediation required”, “contaminated – restricted use” and “remediated for restricted use”. There have not been any known “potentially contaminating activities” on the property as listed by the Department of Water and Environmental Regulation, and no memorial has been placed on the certificate of title relating to contaminated sites.

3.8 Heritage

A search of the Aboriginal Heritage Inquiry System (managed by the DPLH) shows one mapped “Registered Heritage Site” across the site. The heritage site is “Ellenbrook: Upper Swan” (ID 3525) which is described as a mythological site. It is mapped across the border area. There are no “Other Heritage Sites” mapped across the site and the surrounding area.

An Aboriginal Heritage Study was undertaken on the property by Tom O'Reilly, Michael Gallagher and Joe Mattner in 2005 during the preliminary planning for the quarry. The archaeological survey was undertaken by Tom O'Reilly in December 2005 which found no archaeological sites or materials on the site. An ethnographic survey was undertaken by Michael Gallagher in December 2005 with Aboriginal spokespersons. No sites of cultural or historical significance were reported by the Aboriginal spokespersons, however, two wandoo trees with scars were identified as Aboriginal scarred trees by the consultants. These trees are located at the north-western corner of the property. The trees were inspected by archaeologist Tom O'Reilly who determined that the scarring was natural rather than cultural based on a scientific assessment which considered shape, termination, regrowth and scarring on other Wandoo trees. While it was concluded that there are no Aboriginal heritage sites on the property, it was recommended that the scarred trees identified by the Aboriginal spokesperson be retained.

No heritage sites listed by the Heritage Council of WA, or the Shire of Chittering are located on the site.

4 Statutory framework

4.1 State Planning Policy 1 – State Planning Framework

The *State Planning Framework* was prepared by the WAPC in 2017. It sets out the key principles relating to environment, community, economy, infrastructure, regional development and governance to guide the way in which future planning decisions are made. More specifically, the Framework identifies relevant policies and strategies used by the Commission in making decisions.

State Planning Policy 2.4 – Planning for Basic Raw Materials is recognised under the Framework. This is discussed below.

4.2 State Planning Policy 2.0 – Environment and Natural Resources Policy

State Planning Policy 2.0 was prepared by the WAPC in 2003. It aims to integrate environment and natural resource management with broader land use planning and to protect, conserve and enhance the natural environment.

Basic Raw Materials is included within Policy Measure 5.7 which states that "mineral resources, petroleum resources and basic raw materials are important natural resource assets and are a vital part of the economy". The importance of basic raw materials located in close proximity to the metropolitan area is also recognised in the Policy. It states that "A ready supply of basic raw materials close to developing areas is required in order to keep down the cost of land development and the price of housing."

The Policy sets out a list of principles which should be considered by decision-makers including the following relating to basic raw materials. The principles from the Policy are below:

- "The identification and protection of important and economic mineral resources to enable mineral exploration and mining in accordance with acceptable environmental standards
- The identification and protection of important basic raw material resources and provide for their extraction and use

- Support sequencing of uses where appropriate to maximise options and resultant benefits to community and the environment
- Support, where possible, improved efficiencies in the production and consumption of mineral and basic raw material resources to ensure their availability for future environmental and human uses."

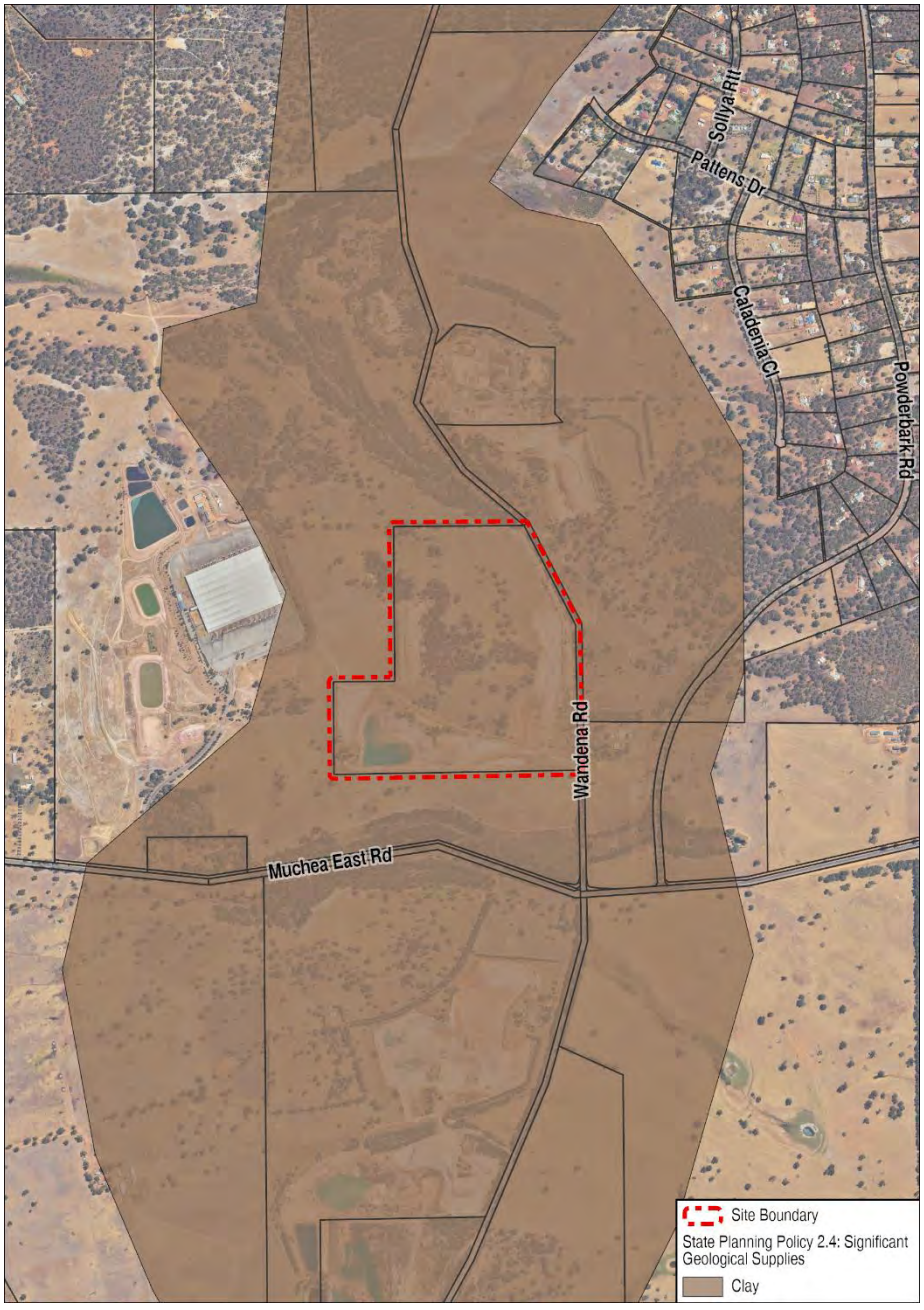
SPP 2 supports the identification, protection and extraction of basic raw materials. The identification of clay resources has already been undertaken, and the site is identified in *State Planning Policy 2.4 – Basic Raw Materials*. Protection of basic raw materials is also provided in SPP 2.4. The extraction of basic raw materials is the basis of this application.

4.3 State Planning Policy 2.4 – Planning for Basic Raw Materials

State Planning Policy 2.4 – Planning for Basic Raw Materials was finalised and gazetted in July 2021. It "enables the responsible extraction of BRM, while ensuring the protection of people and the environment*".* The Policy provides guidance to operators and decision makers regarding applications for BRM extraction, as well as other types of planning applications that can potentially impact on extraction sites or significant geological supplies. The associated *Planning for Basic Raw Materials Guidelines* (WAPC, 2021) provide further information on the specific requirements that need to be met for extractive industry (including operational and environmental protection requirements).

The associated mapping identifies "Extraction Sites" and areas of "Significant Geological Supplies". The mapping indicates that "Significant Geological Supplies" are located on the site. The figure below shows the location of "Significant Geological Supplies" on the property. The clay operation is located within this recognised area. The location of Significant geological Supplies is shown in Figure 4.1 below.

Figure 4.1 – State Planning Policy 2.4



Source: DPLH (2022)

The location of the "Significant Geological Supplies" is also recognised in the Shire's Local Planning Scheme No. 6 which shows the site is located within the "Basic Raw Materials Special Control Area

(SCA)". The purpose of the SCA is "to secure known basic raw materials resources and protect future resources".

This application for extractive industry is consistent with the principles and objectives of the Policy as discussed in Table 4.1 below.

Table 4.1 – Objectives of SPP 2.4

POLICY OBJECTIVES	COMMENT
Ensure BRM and its regional importance is considered at the earliest stages of the planning process.	The Local Planning Scheme recognises the BRM's on the site and includes it within the "Basic Raw Materials Special Control Area".
Protect BRM in SGS areas and ES by avoiding encroachment from incompatible land uses.	This application complies with this objective by proposing excavation of resources prior to encroachment of incompatible land uses.
Ensure BRM resources are used efficiently in land use planning and development.	This application complies with this objective by proposing excavation of resources prior to encroachment of incompatible land uses.
Identify BRM extraction opportunities through sequential land use without compromising the final intended land use.	The final landform will be recontoured and rehabilitated and does not compromise the final intended land uses.
Ensure the extraction of BRM avoids, minimises or mitigates any adverse impacts on the community, water resources and biodiversity values.	This application complies with this objective by providing a number of detailed management plans.

The *SPP 2.4 Planning for Basic Raw Materials Guidelines* (WAPC, 2021) provide support for decision-making authorities, proponents and referral agencies to implement SPP 2.4. Section 4 of the Guidelines provides advice on the assessment of proposals for extractive industries. Of particular note, they state that

the “assessment of proposals should prioritise proposals within SGS areas” and “if the resource is identified as a SGS area”.

The Guidelines suggest the type and content of information to be submitted with an application for extractive industry including operational information, separation distances, environmental management, surface and groundwater, noise, dust, landscaping, access and rehabilitation. The information recommended by the Guidelines is included in this application.

4.4 State Planning Policy 2.9 – Water Resources

State Planning Policy 2.9 – Water Resources was prepared by the WAPC in 2006. The objectives of the Policy are to protect, conserve and enhance water resources, assist in ensuring the availability of suitable water resources and promote the sustainable use of water resources. It provides a range of policy measures to guide and assist decision-makers in the consideration of water resources in decision-making. Policy Measures are provided for surface water, groundwater, wetlands, waterways, estuaries and total water cycle management.

Policy Measures of relevance to this application include those related to surface water and groundwater. Further information on the water resources on the site are provided in Chapter 2 of this report and a Water and Drainage Management Plan and Acid Sulphate Soil Investigation and Management Plan are also provided.

4.5 Draft State Planning Policy 2.9 – Planning for Water

The *draft State Planning Policy 2.9 – Planning for Water* was prepared by the WAPC in 2021. The intent of the Policy is “ensure that planning and development considers water resource management and includes appropriate water management measures to achieve optimal water resource outcomes”. It provides guidance for the consideration of water resources for planning applications and decision-makers. The Policy Measures include consideration of environmental values, social and cultural values, riverine flooding, infrastructure and supply.

The associated SPP 2.9 Guidelines provide further detail as to how the Policy Measures can be considered and the information to be provided in an application. It should be noted that no "important environments" (including "Sensitive Water Resource Areas") are mapped on the site under the draft Policy.

4.6 State Planning Policy 3.7 – Planning in Bushfire Prone Areas

State Planning Policy 3.7 – Planning in Bushfire Prone Areas was prepared by the WAPC in 2015. It provides the foundation for land use planning to address bushfire risk management in Western Australia and to inform and guide decision-makers, referral agencies and landowners to help achieve acceptable bushfire protection outcomes. It applies to development in designated bushfire prone areas.

The latest DPLH mapping (2019) identifies *Bushfire Prone Areas* across the entire site.

A bushfire risk assessment and management actions are provided in Chapter 2.13 above.

4.7 State Planning Policy 4.1 – State Industrial Buffer Policy

State Planning Policy 4.1 – State Industrial Buffer Policy was gazetted by the WAPC in 1997. Its purpose is to provide a consistent Statewide approach for the protection and long-term security of industrial zones, transport terminals (including ports) other utilities and special uses, as well as providing for the safety and amenity of surrounding land uses. The policy applies to a range of industrial uses, including extractive industries.

In relation to extractive industries, the Policy recommends that off-site buffers are appropriate. It also states that "extractive industry is a special case, as it can be a temporary use or a long term use. In the case of basic raw materials, or materials used in the development of urban areas for buildings, roads and infrastructure, its cost effectiveness often requires proximity to the urban areas. Each case will need to be considered separately, with hard rock quarries being of a long-term nature perhaps needing different treatment to the limestone and sand extraction areas."

The Policy also refers to the environmental criteria which should be applied when determining an appropriate buffer distance (such as noise, dust, odour, air emissions etc) and recommends that various environmental policies are referred to. Since the Policy was gazetted, the EPA Guidance Statement No. 3 has been prepared which provides more specific information on buffers/separation distances. As such, the Guidance Statement is referred to for advice on separation distances for this operation (discussed below).

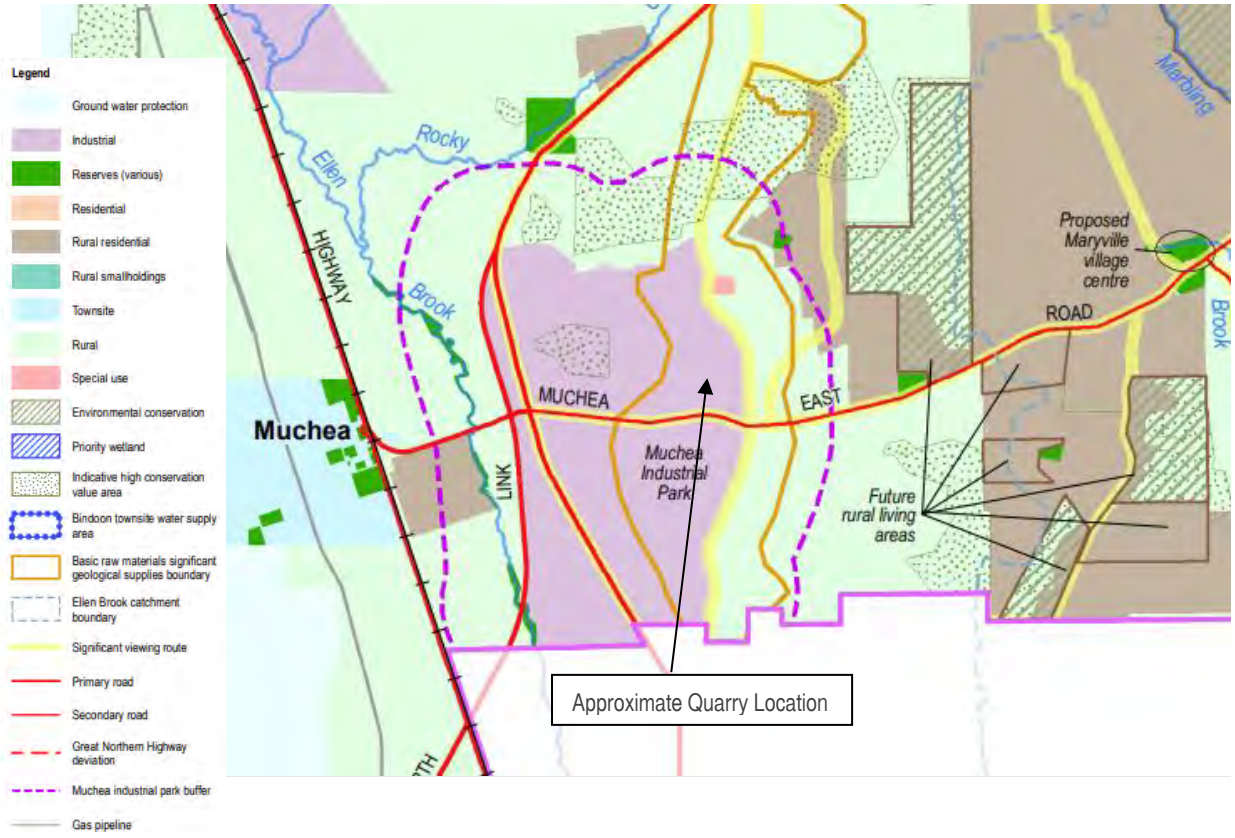
4.8 Shire of Chittering Local Planning Strategy

The *Shire of Chittering Local Planning Strategy* was endorsed by the WAPC in October 2019. It sets out the long-term planning directions for the Shire.

The Strategy maps indicate that the site is identified as *Industrial* and within the "Muchea Industrial Park". It also shows the site is located within the *Basic Raw Materials Significant Geological Supplies* area. This mapping is reflective of the Significant Geological Supplies mapping in SPP 2.4. It should be noted that no *Environmental Conservation, Indicative High Conservation Value Areas, Priority Waterways* and *Priority Wetlands* are identified on or adjoining the site. An image from the Strategy is included below.

The site is also located within the "Muchea Employment Node" Planning Precinct.

Figure 4.2 – Local Planning Strategy



Source: DPLH

Section 3.3.6 of the Strategy discusses basic raw materials in the Shire. The objective is to "secure the extraction of basic raw materials, including *significant geological supplies*". One of the actions relating to basic raw materials is to "protect significant geological supplies areas identified". This application is consistent with these objectives from the Strategy.

The Strategy also states that it provides for proposals for extraction to be considered in relation to "likely impacts on natural areas, residential amenity, compatibility with existing land uses and impacts on landscape character". These considerations are addressed in this application and the attached management plans.

Figure 6 of the Strategy indicates that the property is visible from the Great Northern Highway within 6.5 kilometres. However, it should be noted that the quarry should not have a significant visual impact as seen from the highway due to the vegetation screening, topography and development located between the site and the highway.

Figure 7 of the Strategy maps the biodiversity and conservation values in the Shire. It does not show any locally significant or poorly represented vegetation complexes on the site. It shows that Banksia Woodlands of the Swan Coastal Plain are "likely to occur", however it has been confirmed through the Flora Survey (Mattiske, 2022) that Banksia Woodlands do not occur on the site. It is also located within the buffer area (12km) for a confirmed Carnaby's Black Cockatoo breeding area. A tree hollow survey was also included in the report by Mattiske (2022) to assess the breeding and foraging value of the vegetation.

Considering the site is already identified in the Strategy for basic raw materials and is not identified for development, the application for a renewal of extractive industry approvals is not in conflict with the future planning for the area.

4.9 Shire of Chittering Local Biodiversity Planning Strategy

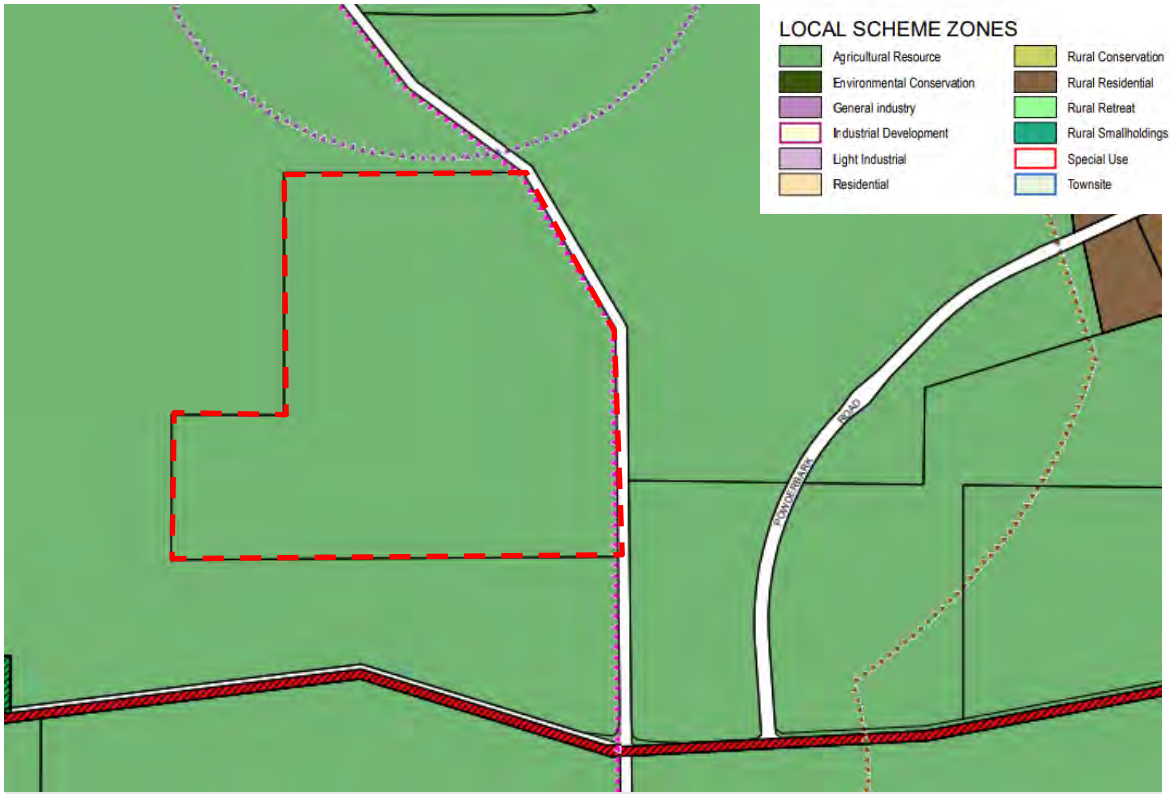
The *Shire of Chittering Local Biodiversity Planning Strategy* was adopted by Council in April 2010. It provides a strategic approach to planning for conservation of local natural areas.

No "indicative high conservation value areas" are identified on or adjoining the property. No "local ecological linkages" are identified on the site. Therefore, it can reasonably be concluded that the application for continued extraction is not in conflict with the Biodiversity Strategy.

4.10 Shire of Chittering Local Planning Scheme No. 6

The *Shire of Chittering Local Planning Scheme (LPS) No. 6* was gazetted on the 30th November 2004. The site is zoned "Agricultural Resource" in Scheme. The objectives of this zone are discussed in Table 4.2 below.

Figure 4.3 – Shire of Chittering Local Planning Scheme



Source: DPLH

Table 4.2 – Objectives of the Agricultural Resource Zone

OBJECTIVE	COMMENT
Preserve productive land suitable for grazing, cropping and intensive horticulture and other compatible productive rural uses in a sustainable manner.	It is considered that this objective does not apply to this site as it is also located within the Basic Raw Materials SCA and is also identified in State Planning Policy 2.4 as a Significant Geological Resource.
Protect the landform and landscape values of the district against despoliation and land degradation.	Potential land degradation is managed on site by controlling erosion and ensuring that water runoff is retained on site. The Rehabilitation Management Plan prepared for the site proposes that the final landform will be recontoured to a safe and stable slope. This same rehabilitation has been undertaken successfully by Midland Brick for other quarries they have operated.

OBJECTIVE	COMMENT
Encourage intensive agriculture and associated tourist facilities, where appropriate.	Intensive agriculture and tourist land use is not proposed for the site as part of this application. However, the extractive industry does not preclude the site having potential for this land use following rehabilitation.
Allow for the extraction of basic raw materials where it is environmentally and socially acceptable.	This application is consistent with this objective. A range of management plans are included in the application.

The land use *Industry – Extractive* is an "A" use in the Agricultural Resource zone which "means that the use is not permitted unless the local government has exercised its discretion by granting Development approval after giving special notice in accordance with clause 64 of the deemed provisions."

The site is also within the Special Control Area (SCA) for the "Muchea Employment Node" and "Basic Raw Materials". These are discussed further below.

Muchea Employment Node

The purpose of the Muchea Employment Node SCA is to provide a basis for the zoning and development of the area for an industrial estate in accordance with the Muchea Employment Node Structure Plan. The Structure Plan is discussed further below.

Basic Raw Materials

The purpose of the Basic Raw Materials SCA is "to secure known basic raw materials resources, and protect future resources".

The planning requirements of this SCA include the requirement for development approval to extend a building and that no new dwelling shall be approved within the buffer area. Any development proposal in the SCA should consider how it will affect future extractive industry.

4.11 Shire of Chittering Extractive Industries Local Law 2014

The *Shire of Chittering Extractive Industries Local Law* was prepared by the Shire in 2014. It sets out the licensing requirements for extraction of basic raw materials in the Shire and to provide for the regulation, control and management of extractive industry. This application has been prepared in accordance with the requirements of this Local Law by providing detailed information on the operation and management.

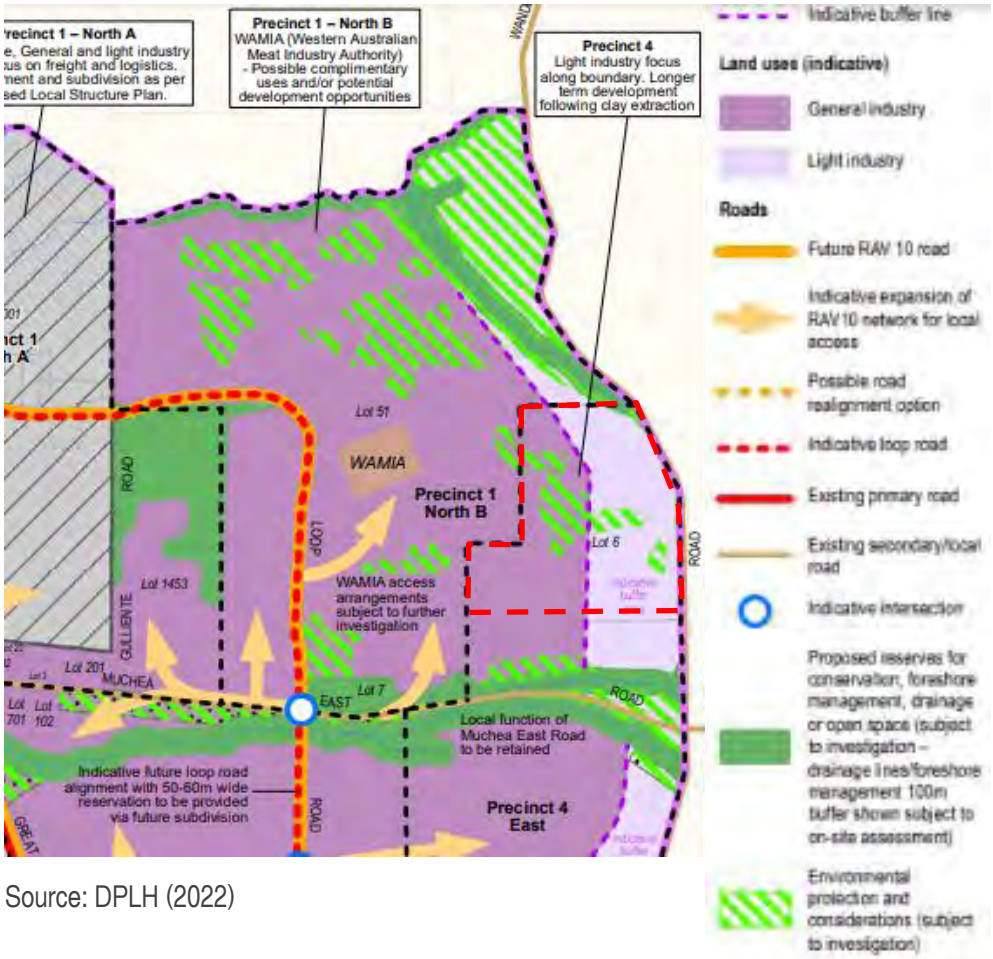
4.12 Muchea Industrial Park Structure Plan

The *Muchea Industrial Park Structure Plan* was prepared in April 2022 by the DPLH. It is an update to the 2011 Muchea Employment Node Structure Plan (referred to in the Shire's Local Planning Strategy).

The Structure Plan identifies the site as being in "Precinct 4" and proposes it is for light industry and long-term development following clay extraction. The Plan also identifies the vegetation in the centre of the site for "Environmental Protection and Considerations (subject to investigations)". A Flora and Vegetation survey has been undertaken by Mattiske (2022) to support any proposed clearing applications.

The location of the site as shown in the Muchea Industrial Park Structure Plan is provided in Figure 4.4 below.

Figure 4.4 – Muchea Industrial Park Structuire Plan



Source: DPLH (2022)

4.13 EPA Guidance Statement 3 – Separation Distances between Industrial and Sensitive Land Uses

The EPA's *Guidance Statement No. 3* (GS3) provides a guideline on the separation distances and buffers for a range of industrial land uses to sensitive land uses (such as residential dwellings). It should be noted that the distances in GS3 assume the land use is not managed and, should best practice environmental management take place, these distances can be reduced.

The operations on site fit into the category "clay extraction or processing". The potential impacts are listed as "noise" and "dust". The separation distance is "500-1000 metres, depending on size and processing", however this can be less with appropriate environmental management. It should be noted that in the

EPA's *Draft Environmental Assessment Guideline for Separation Distances between Industrial and Sensitive Land Uses* the separation distance is 300-500 metres.

The nearest dwellings to the site are as follows:

- Rural dwelling approximately 820 metres south of the lot boundary
- Rural dwelling approximately 975 metres to the west of the lot boundary
- Rural dwelling approximately 60 metres to the east of the lot boundary (although it should also be noted that this dwelling is also approximately 400 metres from the existing active pit area and approximately 300 metres from the stockpile/loading area)
- Rural dwelling approximately 815 metres to the east of the lot boundary
- Rural residential area approximately 785 metres to the east of the lot boundary (the closest dwelling is 875 metres to the east of the lot boundary).
- Rural residential dwellings approximately 990 metres to the north of the lot boundary.

Site management, including dust and noise management and protection of visual amenity, is addressed in the management plans contained in this report. The quarry has been in operation for 15 years and has received only one complaint relating to dust (which could not be verified as the wind was found to be blowing in the opposite direction) and no complaints relating to noise and visual amenity indicating that the existing management is adequate to address potential dust, noise and amenity impacts on neighbours.

As can be seen from the above, the 500 metre separation distance can be met for all sensitive land uses, except for the dwelling located on the adjacent lot to the east. A detailed environmental risk assessment and a suite of Environmental Management Plans are provided in this report which consider potential impacts to amenity such as noise, dust and visual amenity.

5 Environmental risk assessment

5.1 Introduction

Environmental management is achieved through implementation of a variety of management plans throughout the duration of the operation. Compliance with these environmental management commitments can also be monitored by Local Government through the Planning Approval and Licence.

The primary aim of the management plans is to ensure the clay extraction activities have minimal environmental impacts and to help return the land to an appropriate end use. The following management plans are included in this report:

- Dust Management Plan
- Noise Management Plan
- Water and Drainage Management Plan
- Visual and Amenity Management Plan
- Refuelling Management Plan
- Waste Management Plan
- Dieback Management Plan
- Weed Management Plan
- Rehabilitation and Decommissioning Management Plan.

5.2 Risk Matrix

The risk assessment for the Muchea 6 quarry is summarised in the risk matrix below (Table 5.1). It lists the feature being considered, the risk if the operation is not managed and the residual risk once avoidance, mitigation and management is considered. The assessment is based on the criteria in the Department of Water and Environmental Regulation's *Guidance Statement: Risk Assessments* (2017) with integration of relevant components from the relevant policies and guidelines.

The risk rating is determined by considering the likelihood and consequence of environmental and amenity impact. The likelihood and consequence criteria are defined in Tables 5.2 and 5.3. The risk matrix criteria is set out in Table 5.4. It should be noted that Tables 5.2 – 5.4 are sourced from *Guidance Statement: Risk Assessments* (DWER, 2017).

The "inherent" risk rating is determined in the first part of Table 5.1. It considers the likelihood and consequence of impact if the operation was unmanaged. That is, if there was no avoidance of impact, mitigation or reduction of impact, complaints procedures and training. The "residual" risk rating in the second part of the table is determined by considering the likelihood and consequence of impact if the operation is managed in accordance with the various management plans which apply to the operation.

The purpose of the risk assessment is to demonstrate that inherent risk identified as "medium", "high" or "extreme" can be effectively managed. Management of the operation has the potential to reduce the likelihood of an impact occurring (i.e., the frequency) as well as the consequence of what this impact will be.

In general, given the operation is located on rural land there is minimal impact on the natural environment. The greatest risk associated with the operation is with regards to the potential impact on amenity. As a result, this is the focus of the Management Plans. Several management plans are in place to address potential impacts such as dust, noise, water and waste. It should be noted that more detailed risk assessments are provided in the respective management plans for dust, noise, water, refuelling etc.

Table 5.1 – Risk Assessment

FEATURE	ENVIRONMENTAL OR AMENITY FACTOR	INHERENT RISK			MANAGEMENT	RESIDUAL RISK		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Native Vegetation	Native vegetation may be impacted.	Possible	Minor	Med	Vegetation values have been determined through the Flora Survey by Mattiske (2022). This application avoids clearing the area of remnant vegetation located in the centre of the site. Only parkland cleared vegetation and some regrowth will be required to be cleared.	Possible	Slight	Low
	Threatened and Priority Communities may be impacted if present on site.	N/A			The Flora Survey (Mattiske, 2022) confirmed that there are no Threatened or Priority Communities on the site. Vegetation requiring clearing has been reduced significantly to avoid large areas.	N/A		
	Threatened and Priority Species may be impacted if present on site.	N/A			The Flora Survey (Mattiske, 2022) confirmed that there are no Threatened or Priority Species on the site. Vegetation requiring clearing has been reduced significantly to avoid large areas.	N/A		
	Weeds may be introduced to areas of native vegetation.	Possible	Slight	Low	Refer to the Weed Management Plan.	Rare	Slight	Low
	Dieback may be introduced and impact on native vegetation.				Refer to the risk assessment in the Dieback Management Plan.			

FEATURE	ENVIRONMENTAL OR AMENITY FACTOR	INHERENT RISK			MANAGEMENT	RESIDUAL RISK		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
	Fragmentation to vegetation and impact to ecological linkages.	Possible	Minor	Med	This application avoids clearing the area of remnant vegetation located in the centre of the site. Only parkland cleared vegetation and some regrowth will be required to be cleared.	Rare	Slight	Low
Native fauna	Native fauna (individuals and communities) significantly impacted by the operation through land clearing, introduction of weeds and disease and activities on site.	Possible	Minor	Med	Only parkland cleared vegetation and some regrowth will be required to be cleared. A Weed Management Plana and Dieback Management Plan is in place.	Rare	Slight	Low
	Threatened and Priority Fauna disturbed and impacted by the operation (predominantly through clearing).	Possible	Minor	Med	Only parkland cleared vegetation and some regrowth will be required to be cleared. A few large trees will likely be cleared.	Unlikely	Slight	Low
Water	Impact to hydrological regimes such as groundwater level changes, flooding, modification of watercourses etc.	Unlikely	Minor	Med	There are no surface water features on the site. All stormwater within the operation area will be retained on site and not permitted to drain into surrounding areas. The excavation will not intercept groundwater. Refer to the Water and Drainage Management Plan.	Rare	Slight	Low

FEATURE	ENVIRONMENTAL OR AMENITY FACTOR	INHERENT RISK			MANAGEMENT	RESIDUAL RISK		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
	Intersection with the groundwater table which could potentially lead to dewatering requirements and contamination.	Unlikely	Minor	Med	The operation lies above the groundwater table and does not intersect or impact on groundwater. There will be no pumping, dewatering, changes to recharge or alterations to flow as a result of the operation. Refer to the Water and Drainage Management Plan.	Rare	Slight	Low
	Impact to surface water quality due to erosion and transport of sediment to watercourses and wetlands. Sedimentation can result in higher turbidity levels and suspended solids.	Possible	Minor	Med	The operation will be setback from the nearest watercourse. All stormwater within the operation area will be retained on site and not permitted to drain into surrounding areas. Refer to the Water and Drainage Management Plan.	Rare	Slight	Low
	Impact to surface water and groundwater from hydrocarbons (fuel and oil) and chemicals as a result of spills and leaks from equipment and machinery used.	Unlikely	Moderate	Med	Refer to the Refuelling Management Plan for the operation. No chemicals are used in the operation.	Rare	Slight	Low
	Risk to surface water and groundwater from acid sulphate soils.				Refer to the risk assessment in the Acid Sulphate Soil Investigation and Management Plan.			
	Pathogens from staff amenities posing a risk to water quality and public health.	Unlikely	Minor	Med	A portable toilet will be located on the site and will be cleared as required.	Rare	Slight	N/A

FEATURE	ENVIRONMENTAL OR AMENITY FACTOR	INHERENT RISK			MANAGEMENT	RESIDUAL RISK		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Land and soils	Soils subject to significant water and wind erosion.	Unlikely	Minor	Med	Soils within the operation area have been mapped by DPIRD as having a high wind erosion risk and low water erosion risk. Wind erosion can be managed through the Dust Management Plan. Water erosion is managed through the Water Management Plan.	Unlikely	Slight	Low
	Local landform not being recontoured to be compatible with the surrounding landscape.	Possible	Moderate	Med	Excavation is only to a depth of up to 15 metres and the pit area will be recontoured to a safe and stable slope at the decommissioning stage.	Rare	Slight	Low
Heritage	Impact to Aboriginal Heritage Sites.	Rare	Minor	Low	The Registered Heritage Site mapped across the site is the Ellen Brook mythological site. The excavation is not expected to have any adverse impact on this site (i.e. the Ellen Brook). The proposed excavation will also completely avoid the trees located at the north-west corner of the site (referred to in the Aboriginal Heritage Study (O'Reilly et. al., 2006)).	Rare	Slight	Low
	Impact to sites of European heritage.	Rare	Slight	Low	No European heritage sites are located on site.	Rare	Slight	Low

FEATURE	ENVIRONMENTAL OR AMENITY FACTOR	INHERENT RISK			MANAGEMENT	RESIDUAL RISK		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Off-site impacts	Noise levels exceed the assigned noise levels as prescribed by the Noise Regulations to noise sensitive premises.				Refer to the risk assessment in the Noise Management Plan.			
	Dust emissions cause impact to sensitive land uses (such as residential properties).				Refer to the risk assessment in the Dust Management Plan.			
	Buffers and separation distances are not adequate enough to reduce impact on sensitive land uses.	Rare	Slight	Low	Only one residence is located within 500 metres from the operation (the house to the east). All other sensitive land uses are well over 500 metres from the site. Environmental management plans will reduce impact to nearby sensitive land uses.	Rare	Slight	Low
	Impact of truck use on local and regional roads and traffic.	Rare	Slight	Low	The only local road to be used is Wandena Road. A Traffic Impact Statement has been prepared for the operation.	Rare	Slight	Low
	Impact of the operation on visual amenity and that the pit area can be seen from the public realm.	Possible	Minor	Med	The site will be rehabilitated back to pasture surrounding a dam. The operation is currently screened from the road and from surrounding areas with mature vegetation and overburden bunds. Refer to the Visual and Amenity Management Plan.	Rare	Slight	Low

The criteria used to determine the likelihood and consequence are shown in Tables 5.2 and 5.3 respectively. The risk matrix is defined in Table 5.4 below.

The tables are based on the criteria in the Department of Water and Environmental Regulation's *Guidance Statement: Risk Assessments (2017).*

Table 5.2 – Likelihood Criteria

Almost certain	Likely	Possible	Unlikely	Rare
The risk event is expected to occur in most circumstances.	The risk event will probably occur in most circumstances.	The risk event could occur at some time.	The risk event will probably not occur in most circumstances.	The risk event may only occur in exceptional circumstances.

Table 5.3 – Consequence Criteria

	Slight	Minor	Moderate	Major	Severe
Environment	• On-site impact: minimal (No discernible adverse impact).	• On-site impacts: low level (discernible effect on the environment but no adverse impact) • Off-site impacts local scale: minimal • Off-site impacts wider scale: not detectable • Minor number of individuals of species may be affected locally.	• On-site impacts: mid level (Minor adverse affect to the environment) • Off-site impacts local scale: low level • Off-site impacts wider scale: minimal • Moderate loss of individuals of species locally.	• On-site impacts: high level (moderate impact to the environment) • Off-site impacts local scale: mid level • Off-site impacts wider scale: low level • Short term impact to an area of high conservation value or special significance^ • Moderate damage to ecosystem function and major loss of individuals of species locally.	• On-site impacts: catastrophic (significant impact to the environment) • Off-site impacts local scale: high level or above • Off-site impacts wider scale: mid level or above • Mid to long term or permanent impact to an area of high conservation value or special significance^ • Significant long-term damage/loss of ecosystem function and loss of individuals of species locally.

	Slight	Minor	Moderate	Major	Severe
Public Health and Amenity	• Local scale: minimal to amenity.	• Local scale impacts: low level impact to amenity.	• Adverse health effects: low level or occasional medical treatment • Local scale impacts: mid level impact to amenity.	• Adverse health effects: mid level or frequent medical treatment • Local scale impacts: high level impact to amenity.	• Loss of life • Adverse health effects: high level or ongoing medical treatment • Local scale impacts: permanent loss of amenity.

^ Determination of areas of high conservation value or special significance should be informed by the Guidance Statement: Environmental Siting.

*'onsite' means within the Lot boundary.

Table 5.4 – Risk Matrix Criteria

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

6 Dust management plan

6.1 Introduction

This chapter presents the Dust Management Plan for the "Muchea 6" quarry operated by Midland Brick located at Lot 6 Wandena Road, Muchea.

Dust is particulate matter (PM) comprising very small solid particles that may become airborne by natural forces (such as wind) or mechanical forces (earth-moving, stockpiling, haulage) (DWER, 2021). Dust particles are generally referred to as either "fine" or "coarse". According to the *Draft Dust Guidelines* (DWER, 2021), fine dust particles (PM10 and PM2.5) that are readily inhaled are associated with a range of chronic health effects and fine and coarse dust particles can cause acute health effects (such as eye irritation or breathing issues).

This Dust Management Plan outlines the appropriate procedures implemented by Midland Brick to manage any potential for dust generation and to reduce the creation and effect of dust. It has been prepared in accordance with the *Guidelines for Managing the Impacts of Dust and Associated Contaminants from land Development Sites, Contaminated Sites, Remediation and Other Related Activities* (Department of Environment and Conservation, 2011) with consideration of the *Draft Dust Guidelines* (DWER, 2021) where appropriate.

6.2 Objectives

The objectives of the Dust Management Plan are:

- To manage the potential for dust generation
- To minimise the likelihood of any dust created dispersing past the lot boundaries.

6.3 Screening analysis

Appendix B of the *Draft Dust Guidelines* (DWER, 2021) provides a questionnaire to help determine if additional and more detailed information is required for a proposed development. The outcome of the questionnaire is provided below.

Question 1 – Description of dust emissions

A description of the activities, potential dust sources and proposed controls are provided in Table 6.2 below.

Question 2 – Identification of current dust impacts

No dust impacts have occurred as a result of the current operational configuration. Although one complaint was received approximately 8 years ago relating to dust, it was unverified as the wind direction was in the opposite direction at the time of the complaint. This complaint is not considered to have an implication on this screening analysis.

Question 3 – Changes to emissions

There are no proposed changes to the existing premises that are likely to increase the dust emissions or change the configuration of any dust source.

Question 4 – Separation Distances

The separation distances to sensitive land uses are listed below:

- Rural dwelling approximately 820 metres south of the lot boundary
- Rural dwelling approximately 975 metres to the west of the lot boundary
- Rural dwelling approximately 60 metres to the east of the lot boundary (although it should also be noted that this dwelling is also approximately 400 metres from the active pit area and approximately 300 metres from the stockpile/loading area)
- Rural dwelling approximately 815 metres to the east of the lot boundary
- Rural residential area approximately 785 metres to the east of the lot boundary (the closest dwelling is 875 metres to the east of the lot boundary).

- Rural residential dwellings approximately 990 metres to the north of the lot boundary.

Only one sensitive residence is located within 500 metres of the excavation area and stockpiling area. Therefore, it is considered that separation distances are adequate, and this question is satisfactory.

Question 5 – Special case factors

The draft Guidelines lists the "special case factors" to be considered for new and existing sites. Most of the special case factors do not apply. The only possible factor to consider is the "dust impacts from other nearby sources" as there are other clay extraction quarries neighbouring the site, the Shire landfill and the Muchea Livestock Centre.

However, as these surrounding land uses are intermittent and as the site is located within the Muchea Industrial Structure Plan Area, adequate separation distances/buffers have already been applied to the area to protect cumulative impacts on sensitive land uses. Therefore, it is not considered that a detailed assessment is required.

Conclusion

The result of the above questionnaire is that a detailed dust assessment is not required for the proposed development. Therefore, an operational dust analysis and an assessment of the existing dust levels and dust characteristics has not been undertaken.

6.4 Risk Assessment

Introduction

The risk assessment for the Muchea 6 Quarry has considered in detail the activities associated with the operation, the risk factors and the proposed controls.

There are three different components to the below risk assessment which provide a thorough consideration of the potential issues and risks.

The assessment commences with a review of the "factors" from Chapter 7 of the *Draft Guidelines: Dust Emissions* (DWER, 2021). This provides an overarching look of the factors that are considered in a dust emission assessment and helps lead into the site classification and the overall risk assessment.

The "site classification" has been determined using the current guideline for dust management – *Guidelines for Managing the Impacts of Dust and Associated Contaminants from land Development Sites, Contaminated Sites, Remediation and Other Related Activities* (Department of Environment and Conservation, 2011). It should be noted that the recommendations from this document are not specific to extractive industries and therefore a more detailed management plan is provided in this document.

Following this is a more detailed risk assessment of the specific activities that take place for the operation. The assessment has been prepared based on the consequence, likelihood and risk definitions provided in *Guidance Statement: Risk Assessments* (Department of Environment Regulation, 2017).

Draft Guideline: Dust Emissions

The *Draft Guideline: Dust Emissions* (DWER, 2021) provides information on the "factors" to be considered in a dust emission assessment. Each of the factors listed in Chapter 7 of the Guidelines is provided in Table 6.1 below. Commentary on the operation against these factors is also provided in the table below.

Table 6.1 – Dust emission assessment

FACTOR	COMMENT	CONCLUSION
Location and proximity to sensitive receptors	The site is located approximately 2.5km to the east of the Muchea townsite in a primarily rural area. All rural dwellings are located over 500 metres from the site boundary. The only exception is the rural dwelling at the south-eastern side of the property. It is approximately 60 metres to the east of the lot boundary but is approximately 400 metres from the active pit area and approximately 300 metres from the stockpile/loading area.	It is considered that there is a low risk that dust will impact on sensitive receptors.
Management of dust sources and activities.	Management of dust sources and activities (proposed controls) are set out in Table 6.3 below.	It is considered that there is a low risk of dust affecting nearby sensitive receptors when the Dust Management Plan is implemented.

FACTOR	COMMENT	CONCLUSION
Characteristics of the dust.	As is explained above, the Screening Analysis for the proposed operation concluded that a detailed analysis of the dust is not required. Therefore, an analysis of the dust has not been undertaken. Despite this, some conclusions on the characteristics of the dust can eb drawn through consideration of the geology and soil composition. As this is a clay extraction operation, it can be assumed that there is the potential for fine dust particles to be produced. However, as the site is clean and there have been no known contamination activities, there is not expected to be any toxic or harmful components such as metals and asbestos in the dust. Dust has the potential to be generated primarily when the clay soil is disturbed when dry. When the pit area is inactive the clay layer on the surface forms a "crust" and is not considered to have a high potential for dust generation.	Although there is the potential for fine dust particles to be produced, there is not expected to be any contamination.
Potential dust impacts from other nearby sources.	The only other potential dust source is from the adjoining clay extraction operations to the south and east, the Shire landfill to the north-east and the Muchea Livestock Centre to the west. However, these sites also operate intermittingly, it is not expected that there will be a cumulative dust impact. For example, all nearby clay quarries are also operated by Midland Brick and these sites are also appropriately managed for dust.	All nearby operations are expected to be managed in accordance with their approvals and Dust Management Plans, therefore the potential risk from other sources is considered to be low.

FACTOR	COMMENT	CONCLUSION
Topography and complexity of terrain.	The topography of the operation area is undulating, with a hill rising in the centre of the property. The lowest point on the site is at the southern side. The operation is currently located along the southern and eastern sides of the site and is expected to move along the northern part of the site as well. Mature vegetation is located along Wandena Road along the eastern boundary. This will provide additional dust protection.	The clay extraction operation is well screened from nearby sensitive receptors by the topography and vegetation. Additional tree planting will also occur.
Size and/or complexity of the facility.	The clay extraction operation occurs for a few months each year with extraction taking place for 3-4 months annually and carting taking place for 4 days each month. Therefore, the site is not operational full-time year-round and will only operate intermittingly.	The scale of the operation is considered to have a low risk on nearby sensitive receptors.
Whether the proposal is in a Strategic Industrial Area.	The site is not located within a Strategic Industrial Area.	This factor is not relevant.
Whether the proposal is in an area that has an established risk-based approach and regulatory context.	The proposal is not within an area with an established risk-based approach and regulatory context.	This factor is not relevant.
Compliance history of existing premises.	The site has historically been used for extractive industry for 15 years only one unsubstantiated complaint has been received over this time relating to dust.	The compliance history for the site is good and therefore is not a concern.

FACTOR	COMMENT	CONCLUSION
Other considerations	The local area experiences a Mediterranean climate which experiences cool, wet winters and hot dry summer. Most of the rain occurs in the Winter months (May-August) and summer months can be typically dry. The prevailing winds throughout most of the year are predominantly from the east (morning) and the south-west (afternoon) (Bureau of Meteorology, 2021).	The closest sensitive land uses (rural dwellings) is located at the south-east of the site. Therefore, it is considered unlikely that there will be dust impact from the prevailing wind on nearby sensitive residences.

Site classification

The site classification has been prepared for the site in accordance with DWER's Guidelines (2011) and has been classified as "medium risk". This is due to the fact that there is a large area exposed or open at one time, the activities largely involve earthworks, and there is one residence located within 500m from the site. The classification is provided in the table below. The table below is reproduced from Appendix 1 of the Guidelines. The total score is 504 which fits into "Classification 3 – score between 400 and 799 – Medium Risk". This risk classification is reflected in the detailed risk assessment in the section below which identifies the "inherent risk" as "medium" for most activities. The "residual risk" of the operation after implementation of management should be noted.

Table 4.2 – Site classification assessment

ITEM	SCORE	COMMENT
PART A – Nature of site		
Nuisance potential of soil, when disturbed	Medium – 4	The activities on site that will likely "disturb" the soil are excavation activities, loading trucks with clay, recontouring and vehicles moving across the site. For the remainder of the time (when the site is not operational) the soil will not be disturbed.

ITEM	SCORE	COMMENT
Topography and protection provided by undisturbed vegetation	Medium – 6	The site has mature screening vegetation to the east and mature vegetation in the centre of the site.
Area of site disturbed by the works	More than 10ha – 9	Although the current disturbed area is less than 10ha, the anticipated area of disturbed land open at one time is over 10 ha.
Type of work being done	Bulk earthworks – 9	Extraction activities.
PART B – Proximity of site to other land uses		
Distance of other land uses from site	Between 100m and 500m – 12	Although most sensitive receptors are over 500 m from the site, one receptor is located between 100m and 500m from the operation.
Effect of prevailing wind direction on other land uses	Isolated land uses affected by one wind direction – 6	Residents to the west – affected by easterly winds and residents to the north-east affected by south-westerly winds. Sensitive land uses located within 500m to 1000m of the site are not dense land uses. Dense land uses (such as the Muchea townsite) are at least 2km from the site. It is not considered that these receptors will be affected by prevailing winds.

Source: *Guidelines for Managing the Impacts of Dust and Associated Contaminants from land Development Sites, Contaminated Sites, Remediation and Other Related Activities* (Department of Environment and Conservation, 2011)

Risk Assessment

The overall dust risk assessment in Table 6.3 below is based on the criteria defined in *Guidance Statement: Risk Assessments* (DWER, 2017). The risk assessment below lists the activity(s) which have the potential to cause dust impact, the inherent risk (i.e. with no controls) and the residual risk (with controls in place). It uses the outcomes of the "Dust Emission Assessment" from the draft *Guidelines: Dust Emissions* in above and the "Site Classification Assessment" from the 2011 Guidelines as a base. The

"likelihood" and "consequence" determined in the below risk assessment can be supported by both of the assessments above. .

The "risk" is determined by considering the likelihood and consequence of the environmental impact. The likelihood and consequence criteria are defined in the Guidance Statement. A copy of the criteria have been provided in Tables 5.2 and 5.3 above. The matrix used to determine the risk rating is also based on the matrix used in the Guidance Statement and a copy of this table is provided in Table 5.4 above.

The purpose of the risk assessment is to demonstrate that risk identified as "medium", "high" or "extreme" can be effectively managed. In accordance with the DWER Guidance Statement on risk assessments, a "low risk" is considered acceptable and generally not controlled through regulation.

Table 6.3 – Muchea 6 Quarry Dust Risk Assessment

ACTIVITY/DUST SOURCE	POTENTIAL IMPACT	INHERENT RISK			EXISTING CONTROLS	RESIDUAL RISK		
		L	C	Risk		L	C	Risk
Clearing Vegetation	Nuisance dust generated from activities. Neighbours and road traffic affected. Potential operator exposure to silica dust.	Possible	Major	High	This activity is conducted every 2-5 years. Plan to conduct activity during late winter and spring when the soil is moist. Use water truck to wet access roads. Stop work immediately if visible dust is generated. Operators in air-conditioned cabins.	Unlikely	Slight	Low
Stripping topsoil and overburden	Nuisance dust generated from activities. Neighbours and road traffic affected. Potential operator exposure to silica dust.	Possible	Major	High	This activity conducted every 2-5 years. Plan to conduct activity during late winter and spring when the soil is moist. Use water truck to wet access roads. Stop work immediately if visible dust is generated. Operators in air-conditioned cabins.	Unlikely	Slight	Low

ACTIVITY/DUST SOURCE	POTENTIAL IMPACT	INHERENT RISK			EXISTING CONTROLS	RESIDUAL RISK		
		L	C	Risk		L	C	Risk
Machinery and vehicle movements throughout the site.	Dust can be generated by machinery and vehicles driving along unsealed access tracks. Dust particles in the air could move off-site (i.e. outside of the property boundary). Neighbours and road traffic affected. Mud and dust can be tracked onto Wandena Road. Potential operator exposure to silica dust.	Possible	Major	High	Daily pre-start meeting - discuss likely weather impacts during day. QM's use the latest weather technology Apps. Mining team have authority to stop work if they see visible dust issues, especially if wind conditions deteriorate. Water truck to wet all roads. Train and discuss the impacts of vehicle speeds on dust generation - Frictional heat dries the surface. Some sites now have a bitumen seal on the first part of entrance road (including this site). All trucks have tarps to cover their load.	Unlikely	Slight	Low

ACTIVITY/DUST SOURCE	POTENTIAL IMPACT	INHERENT RISK			EXISTING CONTROLS	RESIDUAL RISK		
		L	C	Risk		L	C	Risk
Excavation of clay and loading onto trucks	Nuisance dust generated from activities. Neighbours and road traffic affected. Potential operator exposure to silica dust.	Possible	Major	High	Daily pre-start meeting - discuss likely weather impacts during day. QM's use the latest weather technology Apps. Clay freshly mined is normally damp. Mining team have authority to stop work if they see visible dust issues, especially if wind conditions deteriorate. Train mining team how to reduce dust via sensible placement of loads into trucks. Water truck to wet all roads. Train and discuss the impacts of vehicle speeds on dust generation – Frictional heat dries the surface. Mining clay behind barriers like trees and surface bunds (where possible). Mining below surface (where possible).	Unlikely	Slight	Low

ACTIVITY/DUST SOURCE	POTENTIAL IMPACT	INHERENT RISK			EXISTING CONTROLS	RESIDUAL RISK		
		L	C	Risk		L	C	Risk
Tipping clay onto stockpile	Wind blowing dry clay dust from stockpiles causing nuisance to neighbours and road traffic.	Possible	Major	High	Wet down all internal roads with water truck. Minimise vehicle speeds on internal roads. Slow down as vehicle approaches dump zone. Freshly mined clay is generally damp and shouldn't provide a dust issue. Consider wind direction when tipping.	Unlikely	Moderate	Med
Drilling	Localised fine dust generated. Potential long term health affects to operators.	Possible	Major	High	All drill rig operators to wear dust masks during drilling activity. Consider slow driving speeds in paddocks. All operators monitored for silica dust exposure as per HHMP & SRS. No drilling in hot weather	Unlikely	Moderate	Med

ACTIVITY/DUST SOURCE	POTENTIAL IMPACT	INHERENT RISK			EXISTING CONTROLS	RESIDUAL RISK		
		L	C	Risk		L	C	Risk
Stockpiles and windrows	Wind blowing dry clay dust from stockpiles causing nuisance to neighbours and road traffic.	Possible	Major	High	Allow a 'skin' to form over the stockpile surface. Limit stockpile disturbance by only loading from one face. Plant ground cover shrubs on windrows. Use the cannon on water truck to wet down any stockpiles that are causing dust, hence forming a skin.	Unlikely	Slight	Low
Loading clay onto road trucks during carting campaign.	Dust can be generated by moving raw material (clay) from the stockpile onto trucks. Dust particles in the air could potentially move off-site (i.e. outside of the property boundary).	Possible	Major	High	Daily pre-start meeting - discuss likely weather impacts during day. QM's use the latest weather technology Apps. Mining team have authority to stop work if they see visible dust issues, especially if wind conditions deteriorate. Cover trucks with a tarp. Operators tip clay slowly onto trucks.	Unlikely	Slight	Low
Rehabilitation of the operation area.	Dust can be generated by earthworks (moving overburden to batter slopes) and machinery/vehicles driving along access tracks.	Possible	Major	High	Daily pre-start meeting - discuss likely weather impacts during day. QM's use the latest weather technology Apps. Mining team have authority to stop work if they see visible dust issues, especially if wind conditions deteriorate. Water truck to wet all roads.	Unlikely	Slight	Low

6.5 Dust Control Actions

Introduction

The Dust Management Plan aims to describe the measures that will be used by Midland Brick to reduce the creation and effect of dust. It includes actions relating to dust control measures, corrective procedures and complaints protocol. These actions are described further below.

The plan has been prepared in accordance with the *Guidelines for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites, Remediation and Other Related Activities* (Department of Environment and Conservation, 2011) and the *Draft Guideline: Dust Emissions* (DWER, 2021) and best practice in mine/quarry management and experience.

Site layout/design

The excavation activities commenced at the southern end of the site and have progressed along the eastern boundary. It is expected that excavation will continue at the existing active pit area and will also commence at the south-west and north-west corners of the site and progress in an easterly direction. The stockpiling area is currently located in the previously excavated southern end of the site and is expected to remain in this general area. The existing site entrance and internal access tracks will continue to be utilised.

The site layout, including the decision to keep the stockpiling area at the southern end of the site, close to the access means that internal truck movements are reduced. The retention of the mature trees along the site boundary and the vegetation on the hill in the centre of the site will provide physical barriers to surrounding areas from the impacts of dust.

Complaints procedure

The complaints procedure is described below. It is also important that all complaints are recorded. The following activities will be conducted:

- Complaints made to the operator will be documented and dealt with expeditiously.
- Complaints received either directly from the complainant or via the Shire of Chittering will be reviewed by the Quarry Manager and interested parties to assess:
    (i) the legitimacy of the complaint;
    (ii) the aspects of the operation that triggered the complaint;
    (iii) management actions required to address the issues raised to bring operations into line with conditions imposed on the extractive operation by the Shire of Chittering under the Extractive Industries Licence.
- Actions deemed necessary to bring operations into line with relevant legislation, regulation and license conditions will be undertaken immediately and before works are recommenced.
- Summaries of complaints and actions taken to address each specific issue will be recorded in the Complaints Register (See Appendix G).

Complainants and the Shire of Chittering will be notified in writing of the date, time and nature of the complaint received, results of the investigation, remedial actions undertaken and date and time of recommencement of works. If any complaints are received, necessary action will take place to help rectify the issue.

The complaints response is applicable at all times (i.e., not just during site operation) and there will always be a prompt response from Midland Brick whether onsite or not. Complaints are generally sent to the Shire of Chittering. The Shire will then contact Midland Brick as required should a complaint be received by them.

It should be noted that this complaints procedure has worked very well for Midland Brick at numerous other sites in the past, including those within the Shire of Chittering.

Monitoring weather conditions

All Midland Brick mining crews have a prestart morning meeting with the Quarry Manager. One of the topics will be the Bureau of Meteorology forecasts and the likely effect of weather (wind and temp) on dust generation. Guidance will be given on likely issues and scenarios.

During the course of the day, the Quarry Manager will check weather conditions. If weather conditions are adverse (i.e., particularly strong winds are making dust management difficult), then operations will stop until the weather improves. All operators have delegated authority to stop work immediately when dust is visible around the site.

Visual inspections

The Quarry Manager visits the site each day that the site is operational (i.e., excavating or carting). When the site is not being worked it is attended every quarter for inspection by the Quarry Manager. The visual monitoring is undertaken when required. It is in the interest of Midland Brick to make sure that dust management is adequate, and they are committed to this.

Dust suppression

Dust suppression is generally achieved through the use of a “dust suppression agent”, most commonly water. The application of water over areas prone to the generation of dust helps to reduce the likelihood that small dust particles which will be picked up by the wind. Water will be used as a dust supressing agent on days where excavation and carting take place. Biodegradable chemical dust suppressants (such as Dustex) can also be used on unsealed tracks if they are planned to be unused for extended periods.

Water will be available from the detention basin located at the base of the pit area. Watering will be undertaken as required utilising a water cart. The water cart will have a capacity of 12,000 litres. The frequency and amount of water applied will be dependent upon local conditions and observable dust generation. The quantity of water to be used will vary as conditions will change from day to day. Should the pond run dry, water may be obtained from other nearby pits managed by Midland Brick, although this is unlikely to occur.

Description of activities and dust control

Clearing of vegetation and stripping topsoil

The activity of clearing vegetation and topsoil from a clay mine is an activity only performed once every 2-5 years depending on the depth of the clay deposit. In most cases a bulldozer on tracks will be used for this task as it has the necessary power and traction to handle the trees being removed. Often, the dozer is assisted by a rubber tyre front end loader and a truck to move the vegetation and topsoil to another position. All of these mining vehicles have the potential to generate dust. On a hot windy day in summer, this dust might be clearly visible. However, with proper management procedures in place, the potential for dust to move off-site is minimised.

At Midland Brick, the Quarry Manager plans his mining sequence well in advance. The clearing and stripping activities are conducted during late winter and spring when there is sufficient moisture in the soil to prevent any dust generation.

Regardless of timing and weather, operators on site have delegated authority to stop work immediately if visible dust is generated.

Excavation of clay and loading onto trucks

Clay is mined and stockpiled or is loaded direct into trucks for transport to the brick making factories in the Midland area. When stockpiled at the mine site, damp clay is mined via an excavator or bulldozer. Dump trucks then take the clay to prepared stockpile areas for later loading into road trucks.

Mostly, freshly mined clay is damp and has no dust however, when loading road trucks from a stockpile, the clay has dried slightly and can generate dust if the loader operator drops the load into the truck without any care. At Midland Brick, our operators are trained to carefully place each load into the truck body by keeping the bucket low and tipping slowly. When loaded, the truck drivers can then close their tarps.

Tipping clay onto stockpiles

On all Midland Brick clay mines, stockpiles are created so that road trucks can be loaded throughout the year. To create the stockpiles, off highway dump trucks are loaded by an excavator. The clay is generally damp however the movement of the dump trucks can create dust.

The disciplines of a water truck wetting the roads being used by the dump trucks and also dump truck drivers being cautious of their speeds will alleviate most of the issues with dust generation.

Dust management during non-operational periods

Excavation is expected to occur for approximately 3-4 months annually and carting will be over 4 days each month of the year. For the rest of the year the site will be non-operational.

During non-operational times Midland Brick will adhere to the following procedures:

- Continue to respond to complaints as described above
- Visually inspect the site each month by the Quarry Manager.

During non-operational times wind erosion of an undisturbed clay pit is unlikely to present a significant risk as the clay soil is particularly prone to soil crusting and the development of a “skin” which means that the wind erosion is likely to be negligible. Therefore, no additional dust management is required during non-operational times except for those listed above.

Stockpiles and bunding

Clay stockpiles and perimeter bunding have the potential to be a source of dust generation in dry windy conditions.

As above, experience has shown that after a heavy rain event, a “skin” is formed on the surface of the stockpile/bund which protects fine dust from escaping, providing there is no mechanical disturbance. Also,

most perimeter bunds are now covered with weeds or shrubs which also helps protect fine dust escaping. When loading from a stockpile into road trucks, operators are encouraged to load from one end only.

Drilling

All extractive industry starts with the exploration drilling activity. Drills are used to explore and for quality control purposes. The activity of the air core drill provides a <3mm clay sample. The potential for this material to become airbourne is low due to the small quantity however, the operators do have some exposure to possible silica dust.

The drilling Standard Operating Procedure (SOP) requires all drill operators to use dust masks whilst drilling. This is also a requirement in our Health and Hygiene Management Plan.

Vehicle movements

There are several different mobile pieces of mining equipment moving around a clay mine at any one time. These can vary from slow moving dozers and excavators to all types of trucks. Internal roads are often constructed from natural laterite however, sometimes overburden sandy clay is used. When vehicles drive over a unsealed surface, they break it down into smaller particles which eventually is fine enough to become airbourne dust. Small particles that are wet don't become a dust issue, but when trafficked, the truck wheels generate friction, and this dries the fine particles. Truck wheels moving over loose dry particles tend to generate dust clouds when large areas of road are not maintained.

The normally accepted practice is to have a water truck spraying water on the internal road throughout the day during the dry summer months when trucks are active on a site. Truck speed also makes a difference in reducing dust from a trafficked road. Vehicle speeds vary slightly from clay mine to clay mine and are well sign posted.

On some Midland Brick clay mines, the entrance statement and the first section of the internal road are sealed. As needed, these sections are washed down with water as clay can be deposited from the truck tyres.

The stockpile area has been located at the southern end of the pit and closest to the site entrance to reduce the amount of truck movement through the site. The speed limit for trucks and vehicles is reduced throughout the site.

All trucks will be covered by Enviro-tarp if they need to leave the site to control dust generation during transport.

6.6 Dust Management Plan

The actions for dust control are set out in Table 6.4 below. It provides a detailed outline of the specific dust management to be implemented for each activity previously identified in the risk assessment (Chapter 6.5 above) as having the potential for dust impact.

Table 6.4 – Dust Management Plan

ACTIVITY	MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
Clearing vegetation	Plan to conduct activity during late winter and spring when the soil is moist.	Raw Materials Manager, Quarry Manager, Team	Late winter and spring
	Use water truck to wet access roads.	Quarry Manager, Team	As required
	Stop work immediately if visible dust is generated.	Quarry Manager, Team	Ongoing
	Operators in air-conditioned cabins.	Quarry Manager, Team	Ongoing
	Check conditions of door seals to cabins.	Quarry Manager, Team	Prior to operations.
Stripping topsoil and overburden	Plan to conduct activity during late winter and spring when the soil is moist.	Raw Materials Manager, Quarry Manager, Team	Late winter and spring

ACTIVITY	MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
	Use water truck to wet access roads.	Quarry Manager, Team	As required
	Stop work immediately if visible dust is generated.	Quarry Manager, Team	Ongoing
	Operators in air-conditioned cabins.	Quarry Manager, Team	Ongoing
	Check conditions of door seals to cabins.	Quarry Manager, Team	Prior to operations commencing.
Excavation of clay and loading onto trucks	Daily pre-start meeting – discuss likely weather impacts during day. Quarry Manager to use the latest weather technology apps to review weather conditions, particularly wind.	Quarry Manager, Team	Daily when excavating
	Freshly excavated clay is normally damp. This can be checked by the Quarry Manager.	Quarry Manager, Team	Ongoing
	Mining team have authority to stop work if they see visible dust issues, especially if wind conditions deteriorate.	Quarry Manager, Team	Ongoing
	Train mining team how to reduce dust via sensible placement of loads into trucks.	Raw Materials Manager, Quarry Manager, Team	Prior to operations commencing
	Watercarts will be utilised to wet down access tracks to prevent dust generation. Water for the carts should be obtained from the pond onsite.	Quarry Manager, Team	When excavating
	Train and discuss the impacts of vehicle speeds on dust generation - Frictional heat dries the surface.	Raw Materials Manager, Quarry Manager, Team	Prior to operations commencing.
	Excavate clay behind barriers like trees and surface bunds (where possible). Excavate below ground level surface (where possible).	Quarry Manager, Team	Ongoing
	Quarry Manager to inspect the excavation area to review dust management.	Quarry Manager	Ongoing – during excavation.
	Maintain all equipment in good condition.	Raw Materials Manager, Quarry Manager, team	Ongoing
Machinery and vehicle movements on internal access tracks throughout the site.	Daily pre-start meeting - discuss likely weather impacts during day. QM's use the latest weather technology Apps to review weather conditions, particularly wind.	Quarry Manager, Team	Daily when operational.
	Mining team have authority to stop work if they see visible dust issues, especially if wind conditions deteriorate.	Quarry Manager, Team	Ongoing

ACTIVITY	MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
	Train mining team how to reduce dust via sensible placement of loads into trucks.	Raw Materials Manager, Quarry Manager, Team	Prior to operations commencing.
	Watercarts will be utilised to wet down access tracks to prevent dust generation. Water for the carts should be obtained from the pond onsite.	Quarry Manager, Team	When excavating.
	Train and discuss the impacts of vehicle speeds on dust generation – Frictional heat dries the surface.	Raw Materials Manager, Quarry Manager, Team	Prior to operations commencing.
	Keep vehicle speed limits low throughout the site.	Quarry Manager, team	Ongoing
	Maintain sealed bitumen at the site entrance.	Raw Materials Manager, Quarry Manager	Ongoing
	Chemical dust suppressants (such as Dustex) can be used on unsealed areas if they are planned to be unused for extended periods.	Quarry Manager, team	If required.
	Quarry Manager to inspect the site on excavation and carting days to review dust management.	Quarry Manager	Ongoing – on carting days.
Tipping clay onto stockpile.	Watercarts will be utilised to wet down access tracks to prevent dust generation. Water for the carts should be obtained from the pond onsite.	Quarry Manager, Team	When excavating.
	Keep vehicle speed limits low throughout the site.	Quarry Manager, team	Ongoing
	Ensure vehicles slow down as they approach the dump zone.	Quarry Manager, Team	Ongoing
	Freshly excavated clay is normally damp. This can be checked by the Quarry Manager.	Quarry Manager, Team	Ongoing
	Consider wind direction when tipping and make adjustments if necessary.	Quarry Manager, Team	Ongoing
Loading clay onto road trucks during carting campaign.	Daily pre-start meeting - discuss likely weather impacts during day. Quarry Manager to use the latest weather technology apps to review weather conditions, particularly wind.	Quarry Manager, Team	Daily when carting.
	Watercarts will be utilised during dry weather conditions to wet down access tracks to prevent dust generation. Water for the carts should be obtained from the pond onsite.	Quarry Manager, team	Ongoing – during carting.
	Ensure operators place each load into the truck carefully by keeping the bucket low and tipping slowly in order to reduce the potential for dust generation from loading trucks.	Quarry Manager, team	Ongoing – during loading.
	Quarry Manager to inspect the stockpiling area on carting days to review dust management.	Quarry Manager	Ongoing – during carting.

ACTIVITY	MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
	Mining team have authority to stop work if they see visible dust issues, especially if wind conditions deteriorate.	Quarry Manager, Team	Ongoing
	Maintain all equipment in good condition.	Quarry Manager, Team	Ongoing
Stockpiles and bunds.	Allow a 'skin'/crusting to form over the stockpile surface.	Quarry Manager, Team	Ongoing
	Limit stockpile disturbance by only loading from one face.	Quarry Manager, Team	Ongoing
	Use the cannon on water truck to wet down any stockpiles that are causing dust, hence forming a skin.	Quarry Manager, Team	Ongoing
Rehabilitation of the operation area.	Daily pre-start meeting - discuss likely weather impacts during day. Quarry Manager to use the latest weather technology apps to review weather conditions, particularly wind.	Quarry Manager, Team	Daily when rehabilitating.
	Watercarts will be utilised during dry weather conditions to wet down access tracks to prevent dust generation. Water for the carts should be obtained from the pond onsite.	Quarry Manager, team	Ongoing – during rehabilitation
	Maintain all equipment in good condition.	Quarry Manager	Ongoing
	Quarry Manager to inspect the operation area to review dust management.	Quarry Manager	Ongoing – during rehabilitation.
	Mining team have authority to stop work if they see visible dust issues, especially if wind conditions deteriorate.	Quarry Manager, Team	Ongoing
Drilling	All drill rig operators to wear dust masks during drilling activity.	Quarry Manager, Team	When drilling.
	Ensure vehicles are driven slowly through paddocks.	Quarry Manager, Team	When drilling.
	All operators monitored for silica dust exposure as per HHMP & SRS.	Quarry Manager, Team	When drilling.
	Ensure drilling does not occur during hot weather.	Quarry Manager, Team	When drilling.
General	Continue training programmes on dust control requirements to all workers and contractors.	Raw Materials Manager, Quarry Manager	Ongoing
	All non-conformances and dust related complaints immediately reported to the Quarry Manager.	Quarry Manager, Team	Ongoing
	Comply with the “Complaints Procedure” at all times.	Raw Materials Manager, Quarry Manager, Team	Ongoing
	Following complaints, the source of any excessive dust will be identified and work practices will be modified or re-scheduled to reduce or eliminate the risk of future events.	Raw Materials Manager, Quarry Manager, Team	Ongoing

ACTIVITY	MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
	A notice should be placed on site with contact details of the Quarry Manager.	Quarry Manager	Ongoing

7 Noise management plan

7.1 Introduction

This chapter presents the Noise Management Plan for the "Muchea 6" quarry operated by Midland Brick located at Lot 6 Wandena Road, Muchea.

In this report, noise-generating activities are considered in the context of its potential impact on noise sensitive premises, such as residential dwellings. The potential for noise generation can be managed through the implementation of appropriate noise management procedures adopted as part of a Noise Management Plan.

As part of the detailed risk assessment for this Management Plan, an Environmental Noise Assessment has been undertaken by Lloyd George Acoustics for the operation. A copy of the report is provided in Appendix G. A summary of the results and the resultant noise management is provided in this report.

This Noise Management Plan outlines the appropriate procedures implemented by Midland Brick to manage any potential for noise generation and to reduce the creation and effect of noise. It has been prepared in accordance with the *Environmental Protection (Noise) Regulations 1997* and the *Draft Assessment of Environmental Noise Emissions Guideline* (DWER, 2021) where appropriate and based on the recommendations of the Environmental Noise Assessment (Lloyd George Acoustics, 2022).

7.2 Objectives

The objectives of the Noise Management Plan are:

- To manage the potential for noise generation to ensure compliance with the *Environmental Protection (Noise) Regulations 1997*
- To reduce the potential for noise to impact on noise sensitive premises
- To provide a process in the event of a noise-related complaint.

7.3 Legislation and Guidelines

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 7 of the Regulations defines the prescribed standard for noise emissions as follows:

> *7. (1) Noise emitted from any premises or public place when received at other premises –*
>
> *(a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and*
>
> *(b) Must be free of –*
>
> *i. tonality;*
>
> *ii. impulsiveness; and*
>
> *iii. modulation,*
>
> *when assessed under Regulation 9.*

Regulation 7(2) states that a "noise emission is taken to significantly contribute to a level of noise if the noise emission…exceeds a value which is 5 dB below the assigned level".

"Noise sensitive premises" are set out in Schedule 1, Part C of the Regulations. They include, but are not limited to, premises occupied solely or mainly for residential or accommodation purposes and rural premises. Furthermore, a "highly sensitive area" is defined in the Regulations as an area of noise sensitive premises comprising a building used for a noise sensitive purpose (such as a residential or accommodation building). Therefore, the assigned noise levels applicable to this site are those set out in Regulation 8 (3) Table 1 of the Regulations for "noise sensitive premises: highly sensitive area".

A range of facts sheets have been prepared by DWER to assist with the interpretation of the Regulations. The *Draft Assessment of Environmental Noise Emissions Guideline* (DWER, 2021) was prepared to provide further guidance.

The other guideline regularly used to determine impact on sensitive land uses is the Environmental Protection Authority's *Guidance Statement No. 3 Separation Distances Between Industrial and Sensitive Landuses* (EPA, 2005). It states that "land uses considered to be potentially sensitive to emissions from industry and infrastructure include residential developments, hospitals, hotels, motels, hostels, caravan parks, schools, nursing homes, child care facilities, shopping centres, playgrounds, and some public buildings".

The separation distance for "clay extraction" is 500-1,000 metres. These distances are guidelines only depending on size and scale of a proposal. This Noise Management Plan provides management actions to address potential noise impacts.

7.4 Screening analysis

The *Draft Assessment of Environmental Noise Emissions Guideline* (DWER, 2021) includes a "screening analysis" which is used to help determine if detailed noise assessments are required for a proposed development. All separation distances to the nearest sensitive premises exceeds the minimum distance set out in Guidance Statement No. 3 except for the residence at the south-east of the site. This premise is approximately 60 metres to the east of the lot boundary, however approximately 400 metres from the active pit area and approximately 300 metres from the stockpile/loading area. Nevertheless, as the separation distances from the excavation and stockpiling areas are less than the minimum recommended distance in Guidance Statement No. 3 a detailed Environmental Noise Assessment (Lloyd George Acoustics, 2022) has been undertaken (Appendix G).

7.5 Environmental Noise Assessment

Introduction

The Environmental Noise Assessment was undertaken by Lloyd George Acoustics. A copy is provided at Appendix G and the results and recommendations are provided below.

The Assessment considered the potential noise generation from a range of operations undertaken on the site such as:

- Construction of the main bund (located along the eastern boundary) and future removal of the bund ("Construction Noise")
- Topsoil removal ("Construction Noise")
- Overburden removal at the eastern and northern extraction areas (this is the "worst case scenario" for noise associated with overburden removal to the closest residence located to the south-east) ("Operational Noise")
- Extraction of clay at 5 metres below ground level and movement of clay between the pit and stockpiling area (including consideration of the different locations around the property) ("Operational Noise")
- Loading and carting of clay ("Operational Noise").

It is important to note that the assessments undertaken for the above scenarios were of the worst-case scenario. For example, the noise assessment for excavation was undertaken at the point closest to the house to the south-east (as this is the premise of most concern, being located the closest to the site) and located behind the pit face.

It should also be noted that as the haul truck is the dominant noise source, being on natural surface, on-site measurements were undertaken of a Bell B400 travelling at 25 km/h on a similar path to that proposed for the "Muchea 6" site in relation to the noise sensitive premise. This provided Lloyd George Acoustics with more accurate information of the noise provided by the haul truck. These results were used in the assessment.

Results and recommendations

The assessment determined that the "adjusted level" (i.e., the level adjusted by +5dB for tonality) complies with the Regulations for the Operational Noise (i.e., for removal of overburden, excavation and carting/loading).

Noise associated with construction activities (such as construction of the main bund and topsoil removal) does not need to comply with the assigned levels. However, apart from receiver R1 located at the south-east of the site, the noise impact during these activitiesis minimal and below the assigned levels for all other nearby sensitive receptors. The highest impact at receiver R1 would occur during the construction of the bund. This is to be expected as the bund will be constructed close to this receiver to provide noise mitigation for the life of the operation. It should be noted that the material used for the construction of the main bund along the eastern boundary will be overburden sourced from the eastern and northern excavation. The overburden removal in these areas is assessed under Regulations 7 and 8 and will comply with the Regulations.

The recommended noise mitigation measures from the Assessment include:

- Construction of the main noise bund along the eastern perimeter
- Construction of noise bunds on the southern boundaries of the eastern and northern excavation areas using topsoil
- Construction of noise bunds on the eastern boundaries of the southern excavation using topsoil
- Construction of a noise bund on the eastern boundary of the stockpiling area
- The use of broad-band reversing alarms.

The main recommendation from the assessment is that a bund is constructed on the south-eastern side of the site ranging from 3 to 5 metres in height to provide a noise buffer to the south-east. While a bund is already in place in this location, it will be increased in size as recommended. The assessment also recommends that during clay loading the loader will need to be working behind a stockpile of at least 4 metres in height. It is also recommended that the loader works on the western side of the stockpile to further protect the noise sensitive premise to the east.

The conclusion from the assessment is:

> *The results of this assessment have shown that with construction of noise bunds, the proposed clay pit operations of "Muchea 6" on Wandena Road, Lower Chittering, would comply with the*

requirements of the Environmental Protection (Noise) Regulations 1997, between the hours 7.00 a.m. to 7.00 p.m. Monday to Saturday.

7.6 Risk assessment

Introduction

The risk assessment for this Noise Management Plan has been undertaken using the risk matrix from *Guidance Statement: Risk Assessments* (Department of Environment Regulation, 2017). The likelihood and consequence for the activities/operations on the site can be determined using the results of the Environmental Noise Assessment (Lloyd George Acoustics, 2022). It should be noted that the risk assessment is based on the impact on the nearest noise sensitive residence (located at the south-east of the site). The risk of impact to residences located further away will be less.

Further information has also been provided in accordance with the *Draft Guideline: Assessment of Environmental Noise Emissions* (DWER, 2021).

Draft Guideline: Assessment of Environmental Noise Emissions

The *Draft Guideline: Assessment of Environmental Noise Emissions* (DWER, 2021) provide information on the factors to be considered in a noise emission assessment. This includes the following:

- The context of the noise emissions
- The nature of the noise emissions
- The control and management of noise emissions
- Known or demonstrated compliance.

A review of the above factors is provided in Table 7.1 below. It should be noted that the below is based on the excavation and carting operations (as the construction noise from removal of topsoil and construction of noise bunds does not need to comply with Regulation 7/operational noise).

Table 7.1 – Noise emission assessment

FACTOR	COMMENT	CONCLUSION
The context of the noise emissions: • Background noise • Time of day and activity of the receiver • Distance, topography and meteorological conditions between the emitter and receivers • The types of receptors, including current and potential • Contributing and cumulative noise sources.	All noise sensitive premises are at least 500 metres from the site except for the house to the south-east which is approximately 60 metres to the east of the lot boundary, however approximately 400 metres from the active pit area and approximately 300 metres from the stockpile/loading area. The site rises to a hill in the centre of the property. A bund will also be established at the south-east of the property. Vegetation is located between the operation and the Highway and large areas of native vegetation are located to the west of the operation. Operation of the quarry will be between daylight hours of between 7am and 6pm Monday to Saturday. There are no plans to increase the number of sensitive receptors within 1km of the site. Potential background noise and cumulative noise is from the other nearby extraction sites, the livestock yard and the landfill. It should be noted that the site is located in a future industrial area.	It is considered that there is a low risk that noise will impact on noise sensitive premises. This is confirmed from the Environmental Noise Assessment. Other uses surrounding the site will be managed in accordance with their approvals.

FACTOR	COMMENT	CONCLUSION
The nature of the noise emissions • The characteristics of the noise emission • Received noise/vibration levels • How the noise emission is perceived by receivers.	The Environmental Noise Assessment by Lloyd George Acoustics (2022) has determined that the the "adjusted noise level" (i.e., the level adjusted by +5dB for tonality) complies with the Regulations for operational noise associated with overburden removal, excavation and carting/loading. There will be some exceedance in levels received at the house to the south-east during construction of the main bund, however this is construction noise and is not required to comply with the assigned levels. Noise mitigation and management as set out in this Management Plan will help to manage and reduce noise impacts where possible.	It is considered that risk of impact on nearby sensitive receptors is low.
The control and management of noise emissions • whether the noise management measures set out in a detailed noise emission assessment are acceptable, reasonable and practical • whether the noise management measures are likely to be effective in reducing noise levels to meet the Noise Regulations or other standards and noise values outlined in the guideline.	Management of noise sources and activities (proposed controls) are set out in Table 7.3 below. These management actions are based on the recommendations from the Environmental Noise Assessment by Lloyd George Acoustics (2022).	It is considered that there is a low risk of noise affecting nearby sensitive receptors when the Noise Management Plan is implemented.

FACTOR	COMMENT	CONCLUSION
Known or demonstrated compliance: • by the occupier and premises with the provisions of the EP Act • with the Noise Regulations or other standards and noise values outlined in the guideline • with the screening and detailed noise emission assessment process set out in the guideline.	The site has historically been used for extractive industry for 15 years and no noise complaints have been received.	The compliance history for the site is good and therefore is not a concern.

Risk assessment for proposed activities

The risk assessment for the noise generating activities on the site is provided in Table 7.2 below. The assessment criteria is based on that set out in *Guidance Statement: Risk Assessments* (DWER, 2017). It lists the activity(s) which have the potential to cause noise impact and the residual risk. It should be noted that the risk assessment is based on the impact on the nearest noise sensitive residence (located at the south-east of the site). The risk of impact to residences located further away will be less.

The "risk" is determined by considering the likelihood and consequence of the environmental impact. The likelihood and consequence criteria are defined in Tables 5.2 and 5.3 above. The likelihood, consequence and the residual risk for the activities/operations on the site was determined using the results of the Environmental Noise Assessment (Lloyd George Acoustics, 2022).

Table 7.2 – Noise risk assessment

ACTIVITY	POTENTIAL IMPACT	INHERENT RISK			PROPOSED CONTROL	RESIDUAL RISK		
		L	C	Risk		L	C	Risk
Stripping topsoil and the construction of bunds.	Noise from machinery could impact on the nearest noise sensitive premises, particularly the premise to the south-east of the site.	Likely	Moderate	High	Refer to Table 7.3 – Noise Management Plan. It should be noted that the noise from this activity is considered "construction noise" under Regulation 13.	Possible	Moderate	Med
Overburden removal	Noise from machinery could impact on the nearest noise sensitive premises, particularly the premise to the south-east of the site.	Likely	Moderate	High	Refer to Table 7.3 – Noise Management Plan.	Rare	Minor	Low
Excavation of clay and stockpiling within the stockpile area.	Noise from machinery could impact on the nearest noise sensitive premises, particularly the premise to the south-east of the site.	Likely	Moderate	High	Refer to Table 7.3 – Noise Management Plan.	Rare	Minor	Low
Loading and carting clay.	Noise from machinery could impact on the nearest noise sensitive premises, particularly the premise to the south-east of the site.	Likely	Moderate	High	Refer to Table 7.3 – Noise Management Plan.	Rare	Minor	Low

7.7 Noise control actions

Introduction

The Noise Management Plan aims to describe the measures that will be used by Midland Brick to reduce the creation and effect of noise. It includes actions relating to noise control measures, corrective procedures and complaints protocol. These actions are described further below.

Site layout/design

A bund has already been constructed on the eastern side of the site. This will be increased in height and length to improve the buffering capabilities to the height recommended in the Environmental Noise Assessment (Lloyd George Acoustics, 2022).

The location of the stockpile area has also been carefully considered. It is located to the western side of the site to increase the distance to the closest noise sensitive premise. The loading of clay onto trucks can occur to the western side of the clay stockpile, essentially utilising the stockpile as an additional noise bund.

In addition, topsoil stripped from each excavation area will be placed into low stockpiles to provide an additional noise bund. The topsoil for the northern and eastern excavation areas will be placed on the southern side of the excavation and the topsoil for the southern excavation will be placed to the east of the excavation.

Complaints Procedure

The complaints procedure is described below. It is also important that all complaints are recorded. The following activities will be conducted:

- Complaints made to the operator (Midland Brick) will be documented and dealt with expeditiously
- Complaints will be dealt with by the Quarry Manager and the WA Environmental Manager.

- Complaints received either directly from the complainant or via the Shire of Chittering will be reviewed by Midland Brick and interested parties to assess:
    (i) the legitimacy of the complaint;
    (ii) the aspects of the operation that triggered the complaint;
    (iii) management actions required to address the issues raised to bring operations into line with conditions imposed on the extractive operation by the Shire of Chittering under the Extractive Industries Licence.
- Actions deemed necessary to bring operations into line with relevant legislation, regulation and license conditions will be undertaken immediately and before works are recommenced.
- Summaries of complaints and actions taken to address each specific issue will be recorded in the Complaints Register (See Appendix G).

Complainants and the Shire of Chittering will be notified in writing of the date, time and nature of the complaint received, results of the investigation, remedial actions undertaken and date and time of recommencement of works. If any substantiated complaints are received, necessary action will take place to help rectify the issue.

The complaints response is applicable at all times (i.e., not just during site operation) and there will always be a prompt response from Midland Brick whether onsite or not. Complaints are generally sent to the Shire and the Shire will then contact Midland Brick as required should a complaint be received by them.

It should be noted that this complaints procedure has worked very well for Midland Brick at numerous other sites in the past, including those within the Shire.

Operational controls

Midland Brick are aware of their responsibilities to reduce potential impact from noise and already undertake the following:

- There will be no blasting or processing on site.

- All equipment used for excavation is relatively new and well maintained which aims to minimise noise generation.
- All vehicles use broadband reversing beepers to reduce noise emissions.
- Operations will only take place during the approved hours of operation which are within the hours stipulated by the Regulations.
- Comply with the complaints procedure as described above.

Noise management plan

Noise management actions are set out in Table 7.3 below. It incorporates the recommendations from the Environmental Noise Assessment (Lloyd George Acoustics, 2022) and outlines the usual operational controls utilised on the site.

Table 7.3 – Noise Management Plan

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
1. Construct the main noise bund as recommended in the Environmental Noise Assessment (Lloyd George Acotsics, 2022).	Quarry Manager, Team	Ongoing
2. Ensure that loading of clay onto trucks occurs on the western side of the stockpile.	Quarry Manager, Team	Ongoing
3. Place topsoil into low stockpiles on the southern side of the excavation for the northern and eastern excavation areas and on the eastern side of the southern excavation area.	Quarry Manager, Team	Ongoing
4. Adhering to the "daylight hours" as set out in the Regulations, with work conducted in the hours identified in the application or on the approval.	Quarry Manager, Team	Ongoing
5. All machinery and vehicles being fitted with appropriate noise suppression equipment to reduce noise levels so far as is practicable, with machines the quietest reasonably available.	Quarry Manager, Environmental Manager	Ongoing
6. Maintain all equipment in good condition.	Quarry Manager	Ongoing
7. All noise and vibration related complaints immediately reported to the Quarry Manager.	Quarry Manager, Environmental Manager, Team	Ongoing

	MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
8.	Following substantiated complaints, the source of any excessive noise or vibration will be identified and work practices will be modified or re-scheduled to reduce or eliminate the risk of future events.	Quarry Manager, Environmental Manager	Ongoing
9.	Continue training programmes on noise control requirements to all workers and contractors, including any new methods as proposed by this plan.	Raw Materials Manager, Quarry Manager, Environmental Manager	Ongoing

8 Water and Drainage Management Plan

8.1 Introduction

This chapter presents the Water and Drainage Management Plan for the "Muchea 6" quarry operated by Midland Brick located at Lot 6 Wandena Road, Muchea. It sets out the drainage management procedures during normal operation and the guidelines in the event of a storm or emergency.

The Water and Drainage Management Plan has been prepared in accordance with *Water Quality Protection Note (WQPN) No. 15 – Basic Raw Materials Extraction* (DWER, 2019). The WQPN provides guidance for operators on how to limit the impacts of their operations to the environment and water resources. It applies to new proposals and the expansion of existing operations. Relevant recommendations are included in this management plan.

It should be noted that the Muchea 6 quarry also operates in accordance with an existing Acid Sulphate Soil Investigation and Management Plan (ASSIMP) prepared by Parsons Brinckerhoff in 2006. The ASSIMP was prepared prior to operations commencing and in accordance with the first approval issued in 2008. It provides actions relating to surface water and groundwater protection and management. The ASSIMP can be referred to for management actions specifically related to acid sulphate soils. A copy is provided at Appendix D.

8.2 Objectives

The objectives of the Water and Drainage Management Plan are to:

- Ensure that extractive industry activities do not have an adverse impact on water resources
- Provide for management of water within the operation area.

8.3 Risk assessment

A risk assessment for the clay extraction operation has been undertaken using the water management considerations from WQPN No. 15 (DWER, 2019) and based on the likelihood, consequence and risk

criteria provided in *Guidance Statement: Risk Assessments* (DWER, 2017). The results of the risk assessment are presented in Table 8.1 below.

The purpose of the risk assessment is to provide a clear link between the WQPN Policy considerations and the management controls. It also demonstrates the effectiveness of the management controls by providing an assessment of risks using the DWER Guidance Statement. It should be noted that some considerations from the WQPN (such as dust, site rehabilitation, refuelling, waste management etc.) are addressed in their own separate management plans. The considerations that are identified as being relevant to the site (such as management of surface water, stormwater runoff etc.) are considered further in the management section.

A detailed description of water resources is contained in Chapter 2.5.

Table 8.1 – Water Management Plan Risk Assessment

WQPN 15 CONSIDERATIONS	WQPN 15 POLICY RECOMMENDATION	POTENTIAL IMPACT	PROPOSED CONTROL	RESIDUAL RISK		
				L	C	Risk
Public drinking water source areas.	The Policy makes recommendations if an operation is proposed within a public drinking water source area.	Not applicable – The site is not located within a public drinking water source area.	N/A	N/A		
Clearing control catchments (Country Areas Water Supply Act 1947).	BRM activities within clearing control catchments need to be assessed for potential salinity impacts.	Proposed clearing is limited to parkland cleared trees and regrowth.	N/A	Unlikely	Slight	Low

WQPN 15 CONSIDERATIONS	WQPN 15 POLICY RECOMMENDATION	POTENTIAL IMPACT	PROPOSED CONTROL	RESIDUAL RISK		
				L	C	Risk
Near waterways.	The Policy states that extraction should be above the 1 in 100 flood level, outside of areas subject to waterlogging or flooding and to have adequate buffers to waterways.	The operation area is located outside of areas prone to waterlogging and flooding. The operation area is approximately 40 to 50 metres from the nearest watercourse located to the north of the operation and approximately 160 metres from the southern wetland. This is in accordance with SPP 2.9 which recommends a separation distance of at least 30 metres. All stormwater will be retained on site and not permitted to drain into surrounding areas. An ASSIMP is in place to further protect surface water features from site operations.	N/A	Rare	Slight	Low
BRM extraction within waterways (in-stream mining).	The Policy provides recommendations for BRM operations which extract from riverbeds or from pits in floodplains.	Not applicable – in-stream mining or extraction in waterways is not proposed.	N/A	N/A		
Wetlands.	The Policy recommends contacting DBCA to discuss wetlands.	There are no wetlands located on the site.	N/A	N/A		

WQPN 15 CONSIDERATIONS	WQPN 15 POLICY RECOMMENDATION	POTENTIAL IMPACT	PROPOSED CONTROL	RESIDUAL RISK		
				L	C	Risk
Groundwater.	Assessment of groundwater requires consideration of acid sulphate soils and the maintenance of a vertical separation to the groundwater table.	Extraction will be least 2m above the watertable at all times. No dewatering of groundwater will be required. An ASSIMP is in place to protect groundwater. The ASSIMP determined that the risk of adverse impacts to groundwater from acidity is low.	Actions 1, 4 and 5	Unlikely	Slight	Low
Landscape.	The Policy recommends that land selected should be gently sloping (between 1 in 20 and 1 in 50) so runoff and wastes can be more easily managed, but erosion is avoided. It also recommends that rocky and steep slopes, and land prone to erosion should be avoided.	The operation area is mostly located on gently sloping land. Wind erosion risk will be low for the pit area as the clay soils form a crust when dry and stick together when wet. The final landform will be recontoured to safe and stable slopes which will be planted with pasture.	Action 13 – Refer to Rehabilitation Management Plan	Unlikely	Slight	Low
Other land uses.	This aspect relates to separation distances to sensitive land uses and the avoidance of infrastructure.	No permanent infrastructure is located on site. Separation distances and off-site impacts are addressed in other management plans.	N/A	N/A		

WQPN 15 CONSIDERATIONS	WQPN 15 POLICY RECOMMENDATION	POTENTIAL IMPACT	PROPOSED CONTROL	RESIDUAL RISK		
				L	C	Risk
Construction.	The Policy recommends that existing tracks and roads should be used where possible, that any waterway crossings are constructed appropriately and that access should be designed to have the least impact on surface water features and vegetation.	No waterway crossings are proposed.	N/A	N/A		
Solid waste.	The Policy makes reference to the requirements of the *Environmental Protection (Unauthorised Discharges) Regulations 2004*.	Midland Brick stores and appropriately disposes of wastes from the site in accordance with the Waste Management Plan.	Action 8 – Refer to Waste Management Plan	Rare	Slight	Low
Water supply.	The Policy refers to the need for a licence under the *Rights in Water and Irrigation Act 1914* to construct a bore, and abstract groundwater or surface water in a Proclaimed Surface or Groundwater Area. It also makes recommendations regarding water supply.	While the site is located in a Proclaimed Groundwater Area and a Proclaimed Surface Water Area, there is no need for abstraction of surface or groundwater for the operation. Water to be used for the operation is captured within the onsite dams. And ASSIMP is in place to protect surface and groundwater features from acidity.	N/A	N/A		
Wastewater.	The Policy makes recommendations relating to wastewater treatment and management.	Portable toilets will be managed in accordance with the manufacture's specifications. There will be no discharge to the environment.	Action 8 – Refer to Waste Management Plan	Rare	Slight	Low

WQPN 15 CONSIDERATIONS	WQPN 15 POLICY RECOMMENDATION	POTENTIAL IMPACT	PROPOSED CONTROL	RESIDUAL RISK		
				L	C	Risk
Stormwater.	This aspect of the Policy aims to ensure that stormwater from the operational areas is retained on site. It also recommends that ponds are used to manage turbidity (i.e. settling ponds) and that they are designed to handle up to a 2 hour, 1 in 10 (10 per cent) annual exceedance probability event.	All stormwater is retained onsite and is diverted to the detention basins. The basin areas are large enough to accommodate a 1 in 10 annual exceedance probability event. Recommendations relating to drainage management are also provided in the ASSIMP.	Actions 1, 2, 3 and 6	Rare	Slight	Low
Dust	The Policy refers to the obligations of a proponent under the EP Act 1984 and mentions the DWER *A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities* (2011).	Dust is managed on site in accordance with the Dust Management Plan.	N/A – Refer to Dust Management Plan.	Rare	Slight	Low
Toxic and hazardous substances.	The Policy makes recommendations for the storage and handling of chemicals, pesticides and fuel.	Refuelling is managed in accordance with the Refuelling Management Plan.	Action 7 – Refer to Refuelling Management Plan.	Rare	Slight	Low
Vehicles.	This aspect relates to the cleaning and maintenance of vehicles.	Cleaning and maintenance of vehicles is in accordance with the Refuelling Management Plan.	Action 7 – Refer to Refuelling Management Plan.	Rare	Slight	Low

WQPN 15 CONSIDERATIONS	WQPN 15 POLICY RECOMMENDATION	POTENTIAL IMPACT	PROPOSED CONTROL	RESIDUAL RISK		
				L	C	Risk
Accidents and emergency response.	The Policy makes recommendations about spills and the need for a contingency plan.	No chemicals are used in the clay extraction operation and Midland Brick operates within a Refuelling Management Plan for the site which includes procedures for spills.	Action 7 – Refer to Refuelling Management Plan.	Rare	Slight	Low
Monitoring.	The Policy recommends that monitoring occurs as appropriate for the site (i.e. monitoring of surface water if required etc.)	The ASSIMP includes actions relating to monitoring of surface and groundwater features. Regular groundwater monitoring takes place on the site and the pH and salinity from the water basins on site are tested annually.	Action 2.	N/A		
Closure, rehabilitation and subsequent land uses.	This section of the Policy makes recommendations with regards to mine closure plans and the consideration of the end use of a site.	Closure, decommissioning and site rehabilitation is provided in the Rehabilitation Management Plan.	Action 13 – Refer to Rehabilitation Management Plan.	Rare	Slight	Low

8.4 Water management actions

Introduction

This chapter provides a description of the various drainage control and water management actions implemented at the Muchea 6 quarry. Further information is provided in Chapter 3 above.

Site location and separation distances

A drainage line is located at the southern end of the site, to the north of the current stockpile area. The drainage lines direct water from the hill located in the centre of the site to the lower parts of the landscape.

A minor watercourse runs east-west approximately 160 metres to the south of the site. This area is also mapped on the Geomorphic Wetlands of the Swan Coastal Plan Dataset by the DBCA is a Multiple Use category wetland (ID 12 251).

A minor watercourse commences at the northern boundary of the site and flows to the north-west. It is a tributary of the Ellen Brook. The watercourse flows north and then turns east to flow into Chandala Brook, which in turn flows into Ellen Brook. The excavation area will be at least 40 metres from the watercourse.

Schedule 2 of the SPP 2.9 provides guidance for the determination of appropriate waterway buffers. It states that existing mechanisms for identifying foreshore management and protection areas is generally based on a setback of 30 metres for waterways.

Surface water runoff

All stormwater drainage will be contained within the operation area and is not permitted to flow into surrounding vegetation or the watercourse. Rainwater which falls into the operation will be directed into existing pit areas and drainage basins. This method is consistent with the recommendations from *Water Quality Protection Note No. 15.*

Two water detention basins already exist within the pit area to capture water runoff. These are created from previously extracted areas. As extraction progresses the old pit areas are used as water detention basins before they are recontoured and rehabilitated.

Overburden excavated from the pit is used to create bunds around the pit area. These serve to prevent runoff from leaving the excavation area. Bund walls are located between the excavation area and the watercourse will be maintained throughout the life of the operation. Water which lands within the excavation area flows down the batter slopes and is directed to the detention ponds at the lowest part of the pit. This ensures that rainwater which falls within the operation area is not permitted to flow into surrounding vegetation and the surrounding watercourse.

Actions recommended by the ASSIMP are also implemented on site such as the following:

- Prior to commencing earthworks stormwater diversion drains will be constructed at the up-gradient boundary to minimise stormwater migration across worked areas.
- Stormwater runoff from worked areas shall be retained in stormwater detention ponds e.g. pit voids.
- Water levels within detention ponds shall be monitored to prevent overtopping
- Any stormwater released from the site shall be monitored and treated as required (note that this has not been required)
- Roadside drainage system designed for proper discharge of runoff to avoid erosion of soil.
- Stockpiles, including overburden, topsoil and clay stored on site should be managed in a manner that will retain any leachate by stormwater runoff and prevent erosion.

Water monitoring

A monitoring program is included in the ASSIMP. It recommends the monitoring of groundwater from bores located on site and testing of the water in the basins located in the pit area. The results of water monitoring are provided in the Annual Reports provided to the Shire of Chittering.

Refuelling

The operation operates in accordance with a Refuelling Management Plan provided in Chapter 9. The objective of the plan is to minimise risk to surface water and groundwater from fuel spills and leaks.

Management of waste

The operation operates in accordance with a Waste Management Plan provided in Chapter 11.

Water management

Water and drainage management procedures for the Muchea 6 quarry are set out in Table 8.2 below.

Table 8.2 – Water management plan

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
1. Ensure continued compliance with the ASSIMP (Parsons Brinckerhoff, 2006) and train site workers in the requirements of the plan.	Quarry Manager/Environmental Manager	Ongoing
2. Continue to undertake monitoring of surface and groundwater as required by the ASSIMP.	Quarry Manager/Environmental Manager	Ongoing
3. Ensure run-off from operational areas is contained on site through the placement of bunds and diversion drains.	Quarry Manager/Environmental Manager	Ongoing
4. Ensure groundwater table is not intercepted throughout excavation.	Quarry Manager/Environmental Manager	Ongoing
5. Maintain the excavation surface at least 2 metres above the groundwater table.	Quarry Manager	Ongoing
6. Ensure that there is capacity in the detention basins for high rainfall events.	Quarry Manager/Environmental Manager	Ongoing
7. Comply with the Refuelling Management Plan.	Quarry Manager/Environmental Manager	Ongoing
8. Comply with the Waste Management Plan.	Quarry Manager/Environmental Manager	Ongoing
9. Provide an appropriately serviced portable toilet for on-site workers and clean as specified by the manufacturer.	Quarry Manager/Environmental Manager	If required.
10. Continue training programmes on water management requirements to all workers and contractors.	Quarry Manager/Environmental Manager	Ongoing
11. Any significant adverse water management issues to be recorded, investigated and remediated internally.	Quarry Manager/Environmental Manger	Ongoing

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
12. Water retained on site can be used for dust suppression if required.	Quarry Manager	Ongoing
13. Rehabilitate the site in accordance with the Rehabilitation and Decommissioning Management Plan.	Quarry Manager/Environmental Manger	When required.

9 Refuelling management plan

9.1 Introduction

This chapter presents the Refuelling Management Plan for clay excavation quarries operated by Midland Brick. It outlines the procedures to follow in order to reduce the risk of spills and leaks and the response in the event of a hydrocarbon spill.

Hydrocarbon leaks and spills have the potential to adversely impact on the environment and human health. Spills and leaks can pollute groundwater and surface water, ultimately impacting native flora and fauna and other users of water resources. In addition, spills and leaks can result in the site being classified as a contaminated site and higher closure/remediation costs. Hydrocarbons are also combustible, and spills can increase the risk of a fire occurring. It is therefore in the best interests of everyone that hydrocarbon spills and leaks are cleaned and treated appropriately and in a timely way.

While no fuel, chemicals or lubricants are stored on site, machinery and vehicles used for the operation are refuelled on site using a mobile fuel truck. Servicing of vehicles and machinery are also undertaken on site. This management plan provides a list of actions should any spills or leaks occur during refuelling and servicing.

9.2 Objectives

The objectives of the Refuelling Management Plan are:

- To reduce the potential for a fuel spill or leak
- To protect soil and water resources from fuels
- To provide a procedure to clean any fuel spills and leaks.

9.3 Trained Operators

Midland Brick provides Standard Operating Procedure training to any person in operating a mobile fuel truck. The training covers aspects of how to carry out the task in a safe and environmentally friendly manner but also what to do in case of an accidental spill. At the conclusion of the training each operator is

to satisfactorily pass a practical and written test. In addition to the Standard Operating Procedure, each fuel truck operator is given training in how to use a Spill Kit. Additionally, operators are trained in all aspects of this management plan as well as the other management plans applicable to this operation.

Mines and safety legislation ensures an employer provides a safe working environment in which employees are not exposed to hazards in the workplace. Environmental legislation makes it an offence to cause harm or pollution to the environment. The *Environmental Protection (Unauthorised Discharges) Regulations 2004* specifically lists "petrol, diesel or other hydrocarbon" as "materials that must not be discharged into the environment".

9.4 Refuelling and servicing procedures

Refuelling

Machinery and vehicles used for the operation will be refuelled on site from mobile tankers when required. As no fuel, chemicals or lubricants are stored on site, this considerably reduces the risk of spills and leaks occurring. The use of mobile fuel tanks to refuel machinery and vehicles presents a much lower risk to the environment than storing fuel on site.

Refuelling will be undertaken in the operation area to allow for containment if a spill does occur. It will not be undertaken upstream of any surface water features and will occur in the operation area as the drainage in this area is controlled and does not flow into the surrounding area. Refuelling will also not occur within any area with dry grass.

The main risk of associated with refuelling is the minor drips that occur during removal of the hoses etc. The actions required to address all spills (minor and large) is provided below.

Servicing

Servicing of machinery and vehicles is completed on site. Servicing mainly relates to oil and filter changes. A major service entails a more thorough inspection of the machinery and vehicles including diffs, gearbox/transmission, wheel hubs and engine. Some major repairs are undertaken off site.

The mobile fuel truck is well set up for evacuation of all waste fluids into containers on the truck. Any spills will be cleaned following the procedures outlined below.

Machinery is checked at the pre-start inspection each morning by the operator. Leaks in the hydrocarbon systems are part of the inspection.

Environmental risks

The risk of environmental impact from refuelling and servicing of machinery and vehicles is considered to be low when following best practice procedures and the appropriate legislation and policies. Further information on management is provided below.

9.5 Refuelling Management Plan

Table 9.1 below provides the actions to be followed in the event of a hydrocarbon spill or leak. It includes actions for the following:

- General actions to maintain machinery and vehicles
- Servicing of machinery
- Actions for when a spill is identified
- Actions to manage a minor spill or leak
- Actions to manage a large spill or leak
- Reporting requirements.

Table 9.1 – Refuelling Management Plan

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
General		
1. No fuels, lubricants or chemicals will be stored on site. They are brought to the site as required.	Quarry Manager	Ongoing
2. Inspect all machinery for hydrocarbon leaks at the pre-start meeting.	Quarry Manager	Ongoing (at the pre-start meeting)
3. Some major repairs of machinery are done off site.	Quarry Manager	Ongoing
4. Ensure refuelling and lubricating occurs in designated areas within the pit area and free from vegetation and dry grass.	Quarry Manager	Ongoing
5. Ensure that equipment for the containment and clean-up of spills is provided on site.	Quarry Manager	Ongoing
6. Maintain the site in a tidy manner.	Quarry Manager	Ongoing
7. Ensure that refuelling activities are not located upstream of watercourses and take place within the drainage-controlled operation area.	Quarry Manager	Ongoing
8. Ensure a spill kit is kept with the mobile fuel truck.	Quarry Manager	Ongoing
9. Train fuel truck operators and other site workers in Standard Operating Procedures, in the proper use of the spill kits and any other procedures from this Refuelling Management Plan.	Quarry Manager	Ongoing
Servicing and repairs		
10. Service all machinery and equipment in accordance with the maintenance schedule prescribed.	Quarry Manager	Ongoing
11. Ensure that all waste fluids are evacuated into the containers located on the mobile fuel truck.	Quarry Manager	Ongoing
12. Inspect for fuel, oil and hydraulic leaks on machinery during the start of shift pre-start inspection.	Quarry Manager	Ongoing
When a Spill is identified		
13. Isolate the spill area and identify the spilt substance.	All workers and contractors.	As soon as a spill or leak is identified.
14. Ensure the source of the spill is restricted or stopped.	All workers and contractors.	As soon as a spill or leak is identified.
15. The spill or leak should be contained by placing soil and clay resource around it.	All workers and contractors.	As soon as a spill or leak is identified.
16. Contact the Quarry Manager to advise them that a spill has occurred.	All workers and contractors.	Once the spill is contained.

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
Minor spills		
17. Minor spills should be scooped up with the clay resource.	Quarry Manager	In the event of a minor spill.
18. The clay resource containing the spill should be sent to the brickworks site and burnt with the clay during the firing process.	Quarry Manager	In the event of a minor spill.
Large spills		
19. Large spills can be absorbed using polypropylene pads and scooped up with the clay resource.	Quarry Manager	In the event of a large spill.
20. Depending on advice from DWER, soils containing large spills can be removed from the site and disposed of at an appropriate location/facility.	Quarry Manager	In the event of a large spill.
Reporting		
21. All spills and leaks incidents are to be reported to the Quarry Manager and followed up with an incident form.	Quarry Manager	In the event of a spill or leak.
22. The incident form is to be followed up and investigated to determine the cause of the spill and to assist with prevention of future incidents.	Quarry Manager	In the event of a spill or leak.
23. The Quarry Manager is to report large spills to DWER and follow up any additional reporting or remediation requirements.	Quarry Manager	In the event of a large spill or leak.

10 Visual amenity management plan

10.1 Introduction

This chapter presents the Visual Amenity Management Plan for the "Muchea 6" quarry operated by Midland Brick located at Lot 6 Wandena Road, Muchea. The purpose of the Visual Amenity Management Plan is to provide actions to reduce impact of the operation from the road (public realm) and from neighboring properties and surrounding residents.

Extractive industries involve bulk earthworks and usually the creation of pit areas of various depths below the natural ground level and stockpiling of clay, either in the pit area or on the natural ground level. It can also involve the removal and planting of vegetation which can change the views into and out of a site. In addition, the end use usually results in a change in land contours once the operation is decommissioned.

10.2 Objective

The objective of the Visual and Amenity Management Plan is:

- To reduce the impact of the operation on the visual amenity from neighbouring properties and the public realm.

10.3 Context

While the visual amenity of a location can be subjective, it is generally the aim for extractive industry to have minimal visual impact from the public realm (including roads and public places) and on surrounding residents and private landholdings where possible. If the operation cannot be successfully hidden using the natural topography, this is usually achieved through a "visual screen" such as bund walls and screening vegetation.

Visual amenity impact is generally guided by two key documents prepared by the State Government – *Visual Landscape Planning in Western Australia: A Manual for Evaluation, Assessment, Siting and Design* (DPLH, 2007) and *Guidance Statement No.3: Separation Distances Between Industrial and Sensitive Land Uses* (EPA, 2005).

The Visual Landscape Planning Manual provides advice on techniques for incorporating visual landscape planning into the planning system. As a general rule, the Manual states that "mining and extractive uses should avoid sites that are prominent in important views, especially where they are located at the focal point of views." It also states that the "visibility of mines, quarries and industry should be assessed from the property boundaries, from near and distant residences and from neighbourhood vantage points such as public roads". This guidance was used during the pre-planning for the quarry operation to ensure that it was well-screened from the road and surrounding areas. The Manual will continue to be used to minimise visual amenity impact from future operations on the site.

In terms of reducing visual impact and amenity, the Manual recommends the following for quarries and mines:

- Use natural topography and existing vegetation for screening purposes
- Plant additional vegetation to enhance screening
- The working faces of mines or quarries may be oriented to minimise their public visibility.
- Access roads should be aligned to avoid providing a direct view of operations from nearby public view locations such as roads, lookouts or recreation sites.

Guidance Statement No. 3 provides guidance on the separation distances and buffers for a range of industrial land uses to sensitive land uses. The operations on site fit into the category "Clay extraction or processing". The separation distance is given as "500-1000 metres, depending on size and processing", however this can be less with appropriate environmental management. The potential impacts listed in the Guidance Statement are noise and dust. These are managed through the Noise Management Plan and Dust Management Plan.

10.4 Visual assessment

As is discussed in Guidance Statement No. 3, separation distances and buffers serve the function of providing distance to sensitive land uses (such as residential dwellings). Impact on views and amenity are outlined in the Visual Landscape Planning Manual. Views into and out of the site/operation area should be

considered in a visual assessment as the topography and vegetation can usually provide adequate screening.

Separation distances

The nearest dwellings to the operation are as follows:

- Rural dwelling approximately 820 metres south of the lot boundary
- Rural dwelling approximately 975 metres to the west of the lot boundary
- Rural dwelling approximately 60 metres to the east of the lot boundary (although it should also be noted that this dwelling is also approximately 400 metres from the active pit area and approximately 300 metres from the stockpile/loading area)
- Rural dwelling approximately 815 metres to the east of the lot boundary
- Rural residential area approximately 785 metres to the east of the lot boundary (the closest dwelling is 875 metres to the east of the lot boundary).
- Rural residential dwellings approximately 990 metres to the north of the lot boundary.

Site features

Along the eastern boundary of the property, the operation is screened from Wandena Road as mature screening vegetation is established along the road reserve. In addition, a bund is located along the eastern boundary of the site. Views into the site from Muchea East Road are shielded by the vegetation associated with the wetland to the north of the road.

The land slopes down to the south and west and there are no residential dwellings within 500 metres in these directions. The vegetation associated with the wetland to the south protects views into the site from the south and from Muchea East Road. The Muchea Livestock Centre (WAMIA) is located on the adjoining property to the west and Great Northern Highway is almost 2 kilometres to the west. Overburden will be used to construct bunds on the western boundary of the site to protect views to the west.

Compliance history

It should be noted that no valid complaints have been received in the past 15 years of operation regarding dust, noise or visual amenity impacts (although it should be noted that one complaint was received approximately 8 years ago relating to dust, however it was unverified as the wind direction was in the opposite direction at the time of the complaint).

Conclusions

It is considered that the impact of the clay extraction operation on visual amenity from the public realm and neighbours is low.

10.5 Visual amenity management actions

The visual amenity management plan is provided in Table 10.1 below.

Table 10.1 – Visual amenity management plan

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
1. Maintain existing screening bunds around the property and excavation areas.	Quarry Manager	Ongoing
2. Establish new screening bunds again using overburden when moving into a new excavation area.	Quarry Manager	Prior to moving into a new excavation area.
3. Excavations for most of the time will be below ground level. The walls of the pit will help screen it from surrounding properties.	Quarry Manager	Ongoing
4. Comply with the Dust Management Plan for the operation.	Quarry Manager and Environmental Manager	Ongoing
5. Comply with the Noise Management Plan for the operation.	Quarry Manager and Environmental Manager	Ongoing
6. Rehabilitate the site in accordance with the Rehabilitation and Decommissioning Management Plan at the end of the operation.	Quarry Manager and Environmental Manager	Ongoing

11 Waste management plan

11.1 Introduction

This chapter presents the Waste Management Plan for the "Muchea 6" quarry operated by Midland Brick located at Lot 6 Wandena Road, Muchea. The purpose of the Waste Management Plan is to set out the actions to manage waste and rubbish.

Extraction of clay is a low waste operation. As a result, there will be minimal waste produced on site and it will largely be limited to some rubbish by site workers. Waste can also occur when trespassers access the site, and this will also be managed accordingly. It should be noted that wastes from servicing of machinery is addressed in the Refuelling Management Plan.

11.2 Objectives

The objectives of the Waste Management Plan are:

- To ensure that the operation is kept clean and tidy
- To ensure that waste and rubbish generated by the operation and trespassers is disposed of appropriately.

11.3 Context

Unauthorised access dumping of rubbish

The potential for dumping of rubbish occurs from trespassers entering the site illegally. Although site security is in place, the risk of trespassers entering the site is always a possibility at extractive industry operations. The site will be fenced, and the gates locked. Signs will be located on the site perimeter to warn the public that the site is an open pit to deter trespassers from entering the site.

Any illegally dumped material will be removed promptly and removed to an approved landfill site.

Solid domestic waste and light industrial waste

The site will only be operational intermittingly throughout the year so the potential for creating waste is small. A rubbish bin will be provided with the temporary office/lunchroom whilst the site is operational. Any domestic waste will be placed into the rubbish bins provided and removed from the site frequently to an approved landfill site.

Wastewater disposal

There will be a portable toilet located on site for workers to use. Wastewater from the portable toilet will be disposed of appropriately in accordance with the manufacturer's instructions.

11.4 Waste management actions

Procedures to minimise and control waste are outlined in Table 11.1 below.

Table 11.1 – Waste Management Plan

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
1. Keep the site tidy and remove rubbish from the site to an approved waste disposal facility as required.	Quarry Manager, Environmental Manager, Team	Ongoing
2. Recycle waste where possible.	Quarry Manager, Environmental Manager, Team	Ongoing
3. Gates will be locked at all times when the site is not being operated on to reduce the potential for trespassers.	Quarry Manager, team	Ongoing
4. Maintain signage to warn the public that there is an extractive industry operation on the site.	Quarry Manager	Ongoing
5. Maintain fences around the site perimeter to discourage trespassers entering the site.	Quarry Manager	Ongoing
6. Clean portaloos as required and in accordance with the manufacturers instructions.	Quarry Manager, Environmental Manager	Ongoing

12 Dieback management plan

12.1 Introduction

This chapter presents the Dieback Management Plan for the "Muchea 6" quarry operated by Midland Brick located at Lot 6 Wandena Road, Muchea. The purpose of the Dieback Management Plan is to set out the hygiene management procedures for the site.

The Plan has been prepared in accordance with the following guidelines:

- Department of Conservation and Land Management (DBCA), (2003), *Phytophthora cinnamon and disease caused by it – Volume 1 Management Guidelines*
- Department of Conservation and Land Management (DBCA), (2004) *Draft Best Practice Guidelines for the Management of Phytophthora cinnamomic.*

12.2 Objectives

The objective of the Dieback Management Plan is to:

- Provide hygiene practices to reduce the potential for Dieback introduction to the site
- Prevent the introduction and spread of Dieback into the site.

12.3 Context

"Dieback" is the common name for the pathogen *Phytophthora cinnamomi*, however there are also other pathogens that can cause dieback such as *Armillaria.* It is a soil-borne pathogen that kills a wide range of plant species in the south-west of Western Australia by attacking their root system. Dieback is caused when a pathogen infests a plant and causes it to lose health, eventually killing it. Areas with an average annual rainfall of more than 400 millimetres and suitable soil composition is considered vulnerable to dieback. The pathogen can be spread through the movement of soil and water from place to place (DBCA, 2003).

12.4 Dieback risk

The risk of the spread of dieback onto the site and surrounding vegetation is considered in this chapter. The risk assessment considers the activities on site, the occurrence of native vegetation, water and drainage management and the likelihood of dieback being brought onto the site. It is important to also consider the risk to the native vegetation elsewhere on the property.

Access

The site is currently used as an operational clay extraction quarry. There is one access in and out of the site and internal access tracks provide access to the various components of the operation such as the drainage basins, active pit areas, overburden dumps and stockpile areas. The remainder of the site is managed as a rural property.

Once a new area is cleared, stripped and drainage put into place, the machinery and vehicles will only access current cleared and operational areas. Therefore, the risk of vehicles and machinery bringing dieback to the site is low. A slightly higher risk comes from the machinery used for clearing, stripping and maintaining firebreaks.

Clearing of native vegetation

Some limited clearing of native vegetation is required to facilitate the operation. These areas have been identified as revegetation and some scattered parkland cleared areas adjoining the existing operation. The other areas of remnant vegetation (i.e., those areas not approved to clear) will not be accessed for the proposed clearing activities.

Drainage

The quarry operates in accordance with the Water and Drainage Management Plan which ensures that water runoff is kept within the operation area. This reduces the risk of spread of dieback to the surrounding areas. No drainage from the operation ends up in the wetland located to the south of the site and the watercourse to the north. The remnant vegetation is largely located on the hill at the centre of the site. As

this area is at a higher elevation than the remainder of the operation, there will be no risk of drainage from the operation to the remnant vegetation.

Security

The site is secured to discourage public access with the use of fencing, locked gates and signage. Obviously, any trespassers who enter the site are not likely to follow dieback management protocols and there is a risk that dieback is introduced if trespassers enter the site. Midland Brick commits to keeping the site locked and secured when not in operation.

Conclusion

The occurrence of dieback on the site has not been determined through soil or plant testing. However, as the risk of dieback already occurring on site and the potential for spread is low it is not considered necessary to undertake testing.

Overall risk of dieback spread is considered to be low when following best practice procedures and the appropriate policies. Further information on management is provided below.

12.5 Dieback management

Management of dieback involves hygiene management to reduce the spread of the pathogen from infested areas to uninfested areas. If the occurrence of dieback has not been confirmed, the operation is managed to reduce the risk of introducing dieback to the site and removing dieback from the site.

Dieback can spread through the movement of infected material, including soil, plant material and water, and as such, the actions that will allow these to occur are the focus areas for management. As dieback can infect vegetation if soil or plant material is brought onto the site from vehicles and footwear. This can be managed by ensuring that vehicles and machinery arrive to the site clean and free of soil and plant material and that staff do not walk-through areas of native vegetation.

The entrance to the operation is a "clean on entry" (COE) point for machinery used to clear vegetation and strip topsoil and overburden and for maintaining firebreaks. Note that this is not recommended for other machinery and vehicles used on site as they will keep to existing cleared/operational areas (refer to the risk assessment above). This means that the vehicle should not be carrying any clods/slurry of soil or plant material. It should be noted that a thin, dry film of grime/dust is not considered to present a risk and does not need to be removed.

As good practice, trucks and vehicles should also be cleaned before leaving the site. This serves to reduce the spread of dieback to other locations and helps to reduce dust on the roads.

Firebreak maintenance should be done when the soil is dry and avoid wet weather. As is mentioned above, machinery should be clean-on-entry and cleaned ofcods of soil and plant material before entering the property.

The dry brush-down method of cleaning is the preferred method for machinery. The wash-down method increases soil moisture levels in the immediate area, creating more favourable conditions for dieback.

The operation is managed in accordance with the Water and Drainage Management Plan which ensures that water is retained within the operation area by use of bunding and is not permitting to flow into the adjoining vegetation.

Dieback management procedures are summarised in Table 12.2 below.

Table 12.2 – Dieback Management Plan

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
1. Inspect machinery used for clearing, stripping and grading firebreaks when arriving at the site to ensure they are clean from clods of soil and free of plant material. The entrance to the site should be a "clean on entry" point.	Quarry Manager, Enmvironmental Manager, Team	Ongoing

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
2. Inspect the machinery used to maintain firebreaks on arrival to the site to check it is cleaned of clods of soil and free of plant material prior to entering the property.	Quarry Manager	When maintaining firebreaks
3. Maintain firebreaks when the soil is dry and avoid wet weather.	Quarry Manager	Ongoing
4. Ensure that site workers and contractors do not walk-through areas of native vegetation located outside of the operation area.	Quarry Manager, Team	Ongoing
5. Ensure that vehicles, trucks and machinery keep to existing access tracks and operational areas and are not permitted to enter areas of native vegetation.	Quarry Manager, Team	Ongoing
6. Inspect all vehicles, trucks and machinery before exiting the site to ensure they are clean from clods of soil and plant material.	Quarry Manager, Team	Ongoing
7. Ensure access roads are well-maintained and that water is drained towards the basins within the operation area.	Quarry Manager	Ongoing
8. Comply with the Water and Drainage Management Plan for the site to ensure that no water drainage from the operation area to the surrounding area.	Quarry Manager, Environmental Manager	Ongoing
9. Ensure that the site is secured from public access at all times with fences, locked gates and signage to discourage trespassers. Quarry Manager inspect the site regularly to ensure it is secure.	Quarry Manager	Ongoing
10. Ensure that any plants brought onto the site (i.e. seedlings) are obtained by nurseries free of dieback.	Quarry Manager, Environmental Manager	Ongoing
11. Keep the site tidy and remove any rubbish to an approved waste disposal facility as required.	Quarry Manager, Team	Ongoing
12. Provide training (including vehicle cleaning) during site inductions to all relevant personnel working on the site.	Quarry Manager, Environmental Manager	Prior to working on the site and ongoing.
13. Should an area be identified as being infested with dieback (through testing etc) procedures will be followed in accordance with the DWER guidelines.	Quarry Manager, Environmental Manager	If required

13 Weed management plan

13.1 Introduction

This chapter presents the Weed Management Plan for the "Muchea 6" quarry operated by Midland Brick located at Lot 6 Wandena Road, Muchea. The purpose of the Weed Management Plan is to set out the procedures in which weeds will be managed within the operation area.

While some agricultural and common weeds are likely to be located within the operation area, no Declared Plants or Weeds of National Significance are known to occur. This Weed Management Plan has been prepared in accordance with the advice in the *Australian Weeds Strategy 2017 to 2027* (Invasive Plants and Animals Committee, 2016).

13.2 Objectives

The objectives of the Weed Management Plan are to:

- Reduce the risk of introduction and spread of weeds within the quarry operational area.
- Eliminate *Declared Plant* species as listed under the *Biosecurity and Agriculture Management Act 2007* and *Weeds of National Significance* as listed by the Commonwealth Department of Agriculture, Water and the Environment located within the operation area.

13.3 Context

A "weed" is defined in the *Australian Weeds Strategy 2017 to 2027* (Invasive Plants and Animals Committee, 2016) as "a plant that requires some form of action to reduce its negative effects on the economy, the environment as well as human health and amenity". They are generally considered as plants that are not native to an area and are not desirable.

"Environmental weeds" are plants that establish themselves in natural ecosystems and can lead to a modification of natural processes and a decline of native communities and species.

Some weed species are included on a list of "Declared Pests" or as "Weeds of National Significance". These are described further below.

- "Declared Plants" are controlled under the *Biosecurity and Agriculture Management Act 2007*. The list is regulated by the Department of Primary Industries and Regional Development (DPIRD). Weeds listed as a Declared Plant are required to be controlled as they pose a significant risk to the WA economy. It should be noted however that some weed species are not listed under this Act as they have an agricultural role. A list of Declared Plants is at the following link https://www.agric.wa.gov.au/declared-plants/declared-plant-control-table
- "Pest Plants" are identified by local government under the *Biosecurity and Agriculture Management Act 2007* in addition to weeds already listed as a Declared Plant. They will be listed under a local law prepared by the respective local government authority.
- "Weeds of National Significance" (WoNS) are listed by the Commonwealth Department of Agriculture, Water and the Environment. A list of the WoNS is provided in Appendix A and a list is available at https://weeds.org.au/weeds-profiles/ Nomination as a WoNS recognises a species as "a priority current and future weed threat to Australia, requiring coordinated and strategic management along with shared stakeholder investment to develop and implement best practice to prevent, eradicate, contain and/or minimise its impacts in different parts of the nation" (Invasive Plants and Animals Committee, 2016). All WoNS have individual national strategic management plans which can be referred to if any are identified on Midland Brick properties.

13.4 Management options

The Commonwealth Department of Agriculture, Water and the Environment recommends in the *Australian Weeds Strategy 2017 to 2027* that there are four weed management options depending on the stage of invasion.

1. Prevention -
2. Eradication
3. Containment
4. Asset protection.

While the Australian Weeds Strategy is aimed at addressing weeds at a national level, the principles can also apply at a regional or local level.

Prevention of weed spread is largely addressed at a national and state/territory level through border controls and biosecurity. However, at a local-level, Midland Brick have this management plan to reduce the potential for disease and weeds to enter or exit their clay operations. Prevention is recommended where there is minimal weed invasion.

Eradication of weeds is possible if weed populations are small or if the weed has only recently been introduced to the country, state or region. As is stated in the Australian Weeds Strategy (Invasive Plants and Animals Committee, 2016), "eradication at the local level tends to be less feasible, since on-going invasion tends to occur from adjacent areas, where the weed is not subject to the same high level of control". This needs to be taken into consideration as, although one aim of weed management is to eradicate certain from the property (such as Declared Pests and Weeds of National Significance), there is the risk that they will return or that they will not be entirely eradicated as invasion can occur from adjoining areas.

Containment of weeds aims to completely prevent further spread of a weed species beyond the boundary of existing infestations or to slow the spread. It may include reduction of the density or area of the infestation. Containment is recommended when there is a rapid increase in weed distribution and abundance.

Asset protection is generally applied to weed species that are widespread and abundant. Most likely they have existed in Australia for many decades and, over this time, have spread across large portions of their potential range. Eradication or containment of these species is considered to be impractical (Invasive Plants and Animals Committee, 2016). Instead, the goal becomes effectively managing weed threats to protect certain high-value assets. This form of weed management is a cost/benefit approach in which the

feasibility and cost-effectiveness of controlling the weed needs to be considered. This is largely the case on properties which have a high number of agricultural weeds. These weeds exist on agricultural properties which have been previously cleared and used for rural purposes. Therefore, control and elimination of these weeds is not considered practical.

Weed management at the Muchea 6 quarry will focus on the prevention of weed introduction through biosecurity measures and eradication and containment of Declared Pests and Weeds of National Significance and asset protection where agricultural weeds are present within the operational area.

13.5 Weed control

Introduction

Weed control methods are of three main types:

- Physical – the removal of the weed by physical or mechanical means, such as cutting, hand pulling, digging, mowing, tilling or burning. Hand pulling or digging can be useful for small infestations, particularly in highly sensitive areas or for herbicide-resistant weeds. Cutting and removal of woody weeds is often used in combination with chemical control (herbicide treatment of the cut stump).
- Chemical – involves the use of herbicides. Chemical weed control is generally considered to be an effective and practical form of weed control. Herbicides can be selective (targeting a particular group of plants, such as grasses or broadleafs) or nonselective, and can either destroy or reduce the growth of treated weeds.
- Biological – the introduction of a weed's natural enemies, such as insects, pests, fungi or diseases to reduce weed spread or growth. Biological control can reduce the impact and spread of a weed, but not eliminate it.

In the context of the Muchea 6 Quarry, the most effective means of weed control will be chemical control.

Declared Plants – Weed Control

Actions for controlled Declared Plants as listed by the DPIRD are listed on their website at https://www.agric.wa.gov.au/declared-plants/declared-plant-control-table This resource provides a detailed description of the Declared Plant, the control methods and timing.

Weeds of National Significance – Weed Control

There are currently 32 Weeds of National Significance which are listed on the Weeds Australia website at https://weeds.org.au/weeds-profiles/ This resource provides a detailed description of the weed, the control methods and timing.

13.6 Weed management actions

Weed management actions are summarised Table 13.1 below.

Table 13.1 – Weed Management Actions

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
1. Ensure no weed contaminated or suspect soil or plant particles is brought on site	Quarry Manager, Environmental Manager	Ongoing
2. Ensure the site is kept secure with perimeter fencing, signs and locked gates to avoid rubbish dumping from trespassers.	Quarry Manager	Ongoing
3. Keep vehicles to tracks and operational areas to reduce the risk of spreading weeds around the property.	Quarry Manager, Team	Ongoing
4. Remove all rubbish promptly from the operational area.	Quarry Manager, Team	Ongoing
5. Weed affected soils are not used for rehabilitation.	Quarry Manager, Environmental Manager	Ongoing
6. The site will be inspected annually for the presence of any Declared Plants and Weeds of National Significance. The inspection will be undertaken by the Quarry Manager or Environmental Manager.	Quarry Manager, Environmental Manager	Annually.
7. Declared Plants and Weeds of National Significance will be removed as appropriate (according to the control methods listed by DPIRD and Weeds Australia).	Quarry Manager, Environmental Manager	As required.

14 Rehabilitation and decommissioning management plan

14.1 Introduction

This chapter presents the Rehabilitation and Decommissioning Management Plan for the "Muchea 6" quarry operated by Midland Brick located at Lot 6 Wandena Road, Muchea. The purpose of the Rehabilitation and Decommissioning Management Plan is to set out the rehabilitation actions which are to take place during the life of the quarry and during decommissioning.

The historic use of the site has been for agriculture and the site is identified in the Draft Muchea Industrial Park Structure Plan for future industrial use. As a result, it is anticipated that once clay extraction has been completed the land will be recontoured to a safe and stable condition, pasture planted as a groundcover and dams will remain at the lowest points in the landscape. Slopes greater than 1:2.5 will be planted with vegetation to assist with erosion control. Should a future use other than agriculture (i.e. industrial) be contemplated for the land then this will be subject a new application with appropriate environmental and planning work would be submitted to seek support for a revised rehabilitation approach.

A Concept Plan is provided at Appendix B which provides an indicative illustration of how the site could look following closure of the operation. Note that contours are indicative only as the exact depths and slopes can vary once the site has been excavated and rehabilitated. Proposed planting shown on the plan is also indicative.

14.2 Rehabilitation objectives and completion criteria

The objectives of the Rehabilitation Management Plan are listed in Table 14.1 below. It also describes the completion criteria which relate to each objective. The completion criteria can be used for future monitoring of the site following decommissioning and rehabilitation.

Table 14.1 – Rehabilitation Objectives and Completion Criteria

OBJECTIVE	COMPLETION CRITERIA
Recontour the land surface to a safe and stable condition.	All recontoured slopes are safe and stable in compliance with the DMIRS Mine Closure Guidelines.
Recontour the lowest part of the landscape to a farm dam with batter perimeter slopes in a safe and stable condition.	A farm dam is created from the lowest part of the landscape and slopes are safe and stable in compliance with the DMIRS Mine Closure Guidelines.
The rehabilitated quarry surfaces are planted with pasture.	The recontoured surfaces (excluding the dams) are largely covered in established pasture.
Slopes greater than 1:2.5 are planted with native vegetation as described in this Plan.	Native plants on slopes greater than 1:2.5 should have a density of one plant per 5 square metres.

14.3 Previous Rehabilitation

Midland Brick have undertaken rehabilitation and mine closure at a number of decommissioned quarries. One example is located on Lot 51 located approximately 500 metres to the north of the site. This was a clay quarry previously operated and rehabilitated by Midland Brick. Aerial photos of the rehabilitated quarry are provided below which shows the progression of rehabilitation from 2000 to 2021. These photos demonstrate how the quarry is recontoured to safe and stable slopes with dams left in the lowest points of the landscape. Rehabilitation to pasture is also an option. A second example of previous rehabilitation to pasture for a quarry located in the Shire of Toodyay is also provided below. The below examples also demonstrate Midland Brick's commitment to rehabilitation and mine closure.

Previous rehabilitation on Lot 51

Rehabilitation was previously undertaken by Midland Brick on the adjoining lot to the north (Lot 51). The photos below demonstrate the progression and success of the rehabilitation program.

Aerial Photo – 2000

Aerial Photo – 2002

The photo from 2000 shows the quarry on Lot 51 after recontouring. The first stages of revegetation/planting is shown in the 2002 photo.

Aerial Photo – 2006

Aerial Photo – 2010

The photos from 2006 and 2010 show the progression of revegetation and plant growth on the decommissioned quarry. This rehabilitation process had a significant increase in the amount of vegetation in the local area (compared to the pre-development state).

Aerial Photo – 2015

Aerial Photo – 2021

The most recent aerial photo from 2021 is provided above which shows the amount of vegetation cover and the dams remaining.

Previous rehabilitation in the Shire of Toodyay

Additional photos are also provided below to show the progression and outcomes of previous rehabilitation undertaken by Midland Brick on a rural property in Toodyay. This series of photos show how the site can be recontoured and planted for pasture.

Aerial Photo – 2006

Aerial Photo – 2008

The photo above from 2006 shows the quarry during operation and the photo from 2008 shows the quarry after recontouring.

Aerial Photo – 2015

Aerial Photo – 2022

The above photos from 2015 and 2022 show the slopes created from the recontouring and the establishment of pasture throughout.

14.4 Recontouring

Recontouring starts with bulk earthworks. Generally, a large bulldozer will be used to form the basic new slope angle by removing the mine bench structure. This is done by pushing from the top bench. Survey markers are placed at set positions back from the face to indicate where the dozer is to work to. The dozer operator cuts the face down slice by slice until he has worked back to the markers. Each bench is tackled in the same manner. Once the clay benches have been reshaped, the overburden (and or topsoil) is spread over the entire face.

Recontouring can sometimes take place during the quarry operation as excavation progresses. This depends on the size of the quarry, the type of clay located within the pit, water management and the amount of overburden available. For example, if different types of clay are located within the same pit area this will require the need to keep a larger area open at one time to allow access to both types of clay. Different types of clay across the property might also require the need to have multiple active pit areas open at one time and old pit areas might not be able to be completely rehabilitated before new areas are

opened. For example, previous excavated areas sometimes need to be kept open to allow a basin for water drainage.

Progressive rehabilitation will take place where possible (i.e., the areas are not required to remain open for continued excavation, drainage or access). In general, progressive rehabilitation will take place from west to east across the site, however the specifics will be worked out as operations continue. Final recontouring will take place at site decommissioning.

Water management will continue throughout recontouring and rehabilitation with water directed from disturbed areas into the basins located within the pit areas.
Following site decommissioning, Midland Brick will complete a Mine Closure Plan as required by the Department of Mines, Industry Regulation and Safety (DMIRS). The Department requires that slopes are recontoured to a safe and stable condition prior to leaving the site.

Indicative final contours are shown on the Concept Plan at Appendix B. It should be noted that the final contours, slopes and location of water basins is likely to vary depending on the eventual depth and the extent of the areas excavated.

14.5 Pasture

Pasture will be cultivated across the recontoured areas to establish groundcover across the site. This will essentially return the land back to the pre-development state. Pasture will also assist in erosion control.

The species of pasture to be planted may vary depending on the preference of the landowner however, is likely to include the usual varieties planted in the local area including grasses and legumes.

14.6 Planting

Native plants recommended for the slopes greater than 1:2.5 are listed in Table 14.2 below. It is recommended that on these lopes native plants should have a density of one plant per 5m^2.

Table 14.2 – Plant Species for Rehabilitation

SPECIES NAME	COMMON NAME	TYPE
Eucalyptus wandoo	Wandoo	Tree
E. accedens	Powderbark Wandoo	
Corymbia calophylla	Marri	
Acacia acuminata	Jam Wattle	Shrub
Acacia microbotrya	Manna Wattle	

It is anticipated that revegetation will occur by planting of seedlings. It is not anticipated that irrigation will be required to re-establish vegetation, however water should be available from the water retained on site if required. Planting would occur during late autumn/early winter, with a review and further planting being undertaken as required 12 months later (see Table 14.3 above).

Pasture will be planted on the remainder of the recontoured area as discussed above.

14.7 Monitoring and completion

The completion criteria for the rehabilitation management plan are as follows:

- All recontoured slopes are safe and stable in compliance with the DMIRS Mine Closure Guidelines.
- Farm dams are created from the lowest part of the landscape and slopes are safe and stable in compliance with the DMIRS Mine Closure Guidelines.
- The recontoured surfaces (excluding the dams) are largely covered in established pasture.
- Native plants on slopes greater than 1:2.5 should have a density of one plant per 5m^2.

The progress and success of rehabilitation will be monitored for two years following site decommissioning.

Monitoring of the site will be achieved through site inspection (to observe the survival of plants, weed occurrence and erosion). While it is expected that some weeds will be present on the site, monitoring will

target Declared Weeds and Weeds of National Significance and, should any be observed, these will be removed (in accordance with the Weed Management Plan).

Reports can be provided to the Shire of Chittering annually to advise of the progress of rehabilitation.

14.8 Timing

As is discussed above, progressive rehabilitation will take place where possible and final rehabilitation over the entire operation will occur once extraction activities have been completed. The timing for progressive rehabilitation has not been determined as there are many variables which can influence this. However, as the rehabilitation will generally occur from west to east across the site it is expected that some progressive rehabilitation will occur every 10 years of operation.

At the end of excavation, it is likely that some clay stockpiles will remain for a short period. This will allow for recontouring to take place as the final stages of carting occur. After all resource is moved off the site this area will be rehabilitated also.

Further details on timing are provided in Table 14.2 below. It gives a proposed timeframe for the final stages of rehabilitation before site decommissioning/closure.

Table 14.2 – Rehabilitation Timing

ACTION	TIMING
Recontouring of pit area	Some progressive recontouring will occur when possible. Final recontouring will take place once excavation is complete.
Order seedlings from nursery	During summer in preparation for planting during the wetter months
Weed management (most likely spraying)	Autumn, a few weeks before planting
Planting native vegetation (on slopes greater than 1:2.5 only).	Autumn/winter following the first winter rains.
Establish pasture	Autumn/winter following the first winter rains.

ACTION	TIMING
Monitoring success of pasture growth	The summer following planting
Monitor for significant erosion or drainage issues	First winter following recontouring
Undertake erosion management and earthworks (if required)	Spring months following erosion monitoring
Additional pasture established and planting (if required)	Autumn/winter, approximately 12 months after initial planting

14.9 Final site clean up

All wastes on site will be appropriately managed during and after operation of the site in accordance with the Waste Management Plan. They will either be recycled or taken to an approved waste disposal site. Rubbish will be stored in bins, which will be emptied at an appropriate rubbish tip. Clay excavation activities do not require the use of chemicals apart from lubrication materials and fuel.

After clay extraction activities have ceased, all equipment will be removed from the site and the final stages of rehabilitation will occur.

14.10 Rehabilitation Actions

Rehabilitation actions are set out in Table 14.4 below which lists the action, responsibility and timing.

Table 14.4 – Rehabilitation Management Plan

MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
1. Undertake bulk mining/dozing of benches to create new landform using overburden.	Quarry Manager	When possible.
2. Maintain water drainage throughout the site – direct water from the disturbed areas into the dam located within the pit area.	Quarry Manager	Ongoing
3. Undertake weed control (such as spraying) in autumn prior to planting. Ensure that no Declared Weeds and Weeds of National Significance are located on the site. Comply with the Weed Management Plan for the site.	Quarry Manager, Environmental Manager	Prior to pasture cultivation and seedling planting.

	MANAGEMENT/ACTION	RESPONSIBILITY	TIMING
4.	Order seedlings from nursery.	Quarry Manager, Environmental Manager	Summer, following recontouring
5.	Establish pasture across the recontoured parts of the site.	Quarry Manager, Environmental Manager	Following site recontouring.
6.	Undertake planting of native vegetation during late autumn/early winter to allow seedlings to benefit from natural rainfall.	Quarry Manager, Environmental Manager	Late autumn/early winter.
7.	Ensure vehicles and machinery used for rehabilitation keep to access tracks and the operational areas to avoid spread of weeds and disease. Comply with the Dieback Management Plan and Weed Management Plan for the site.	Quarry Manager, Team	Ongoing
8.	No weed contaminated or suspect soil or plant particles will be brought on site for rehabilitation.	Quarry Manager, Environmental Manager	Ongoing
9.	Keep the site secure with perimeter fencing, signs and locked gates to avoid rubbish dumping from trespassers.	Quarry Manager	Ongoing
10.	Monitor the rehabilitated areas for a period of two years to ensure the completion criteria are met.	Quarry Manager, Environmental Manager	Annually after rehabilitation for a period of two years.

15 References

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APPENDIX A

Application Forms

Shire of Chittering
6177 Great Northern Highway
PO Box 70 Bindoon WA 6502
(08) 9576 4600
chatter@chittering.wa.gov.au
www.chittering.wa.gov.au

APPLICATION FOR DEVELOPMENT APPROVAL

Applications can take up to 60 days without advertising, 90 days with advertising.

Owner Details

Name	Lower Chittering and Muchea Pty Ltd			
Address	Level 3 338 Barker Rd, Subiaco WA 6008			
ABN (if applicable)	68 635 664 667			
Contact Details	Home Phone		Work Phone	08 9381 8301
	Mobile Phone	0418 950 180	Other	
Contact person for correspondence	Brett Chivers			
Email address for contact person	brett@hesperia.com.au			
Signature			Date	15/06/22
Signature			Date	15/06/22

The signature of the owner(s) is required on all applications. This application will not proceed without that signature. For the purposes of signing this application an owner includes the persons referred to in the *Planning and Development (Local Planning Schemes) Regulations 2015 Schedule 2 clause 62(2).*

Applicant Details (if different from owner)

Name	BGC (Australia) Pty Ltd (T/A Midland Brick)			
Address	260 Kalamunda Rd, South Guildford, WA 6055			
Contact Details	Home Phone		Work Phone	08 6313 1022
	Mobile Phone	0427 421 683	Other	
Contact person for correspondence	Nathan Blackwell			
Email address for contact person	nathan.blackwell@midlandbrick.com.au			
The information and plans provided with this application may be made available by the Shire of Chittering for public viewing in connection with the application			☒ Yes ☐ No (explained on page 2)	
Signature			Date	15/6/2022

Property Details

Lot Number	6			Street Number			
Street Name	Wandena Rd			Locality			
Nearest street intersection	Muchea East Road						
Location No.		Diagram or Plan No.	49665	Certificate of Title Vol. No.	2631	Folio	794
Title encumbrances (e.g. easements, restrictive covenants)							

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APPLICATION FOR DEVELOPMENT APPROVAL

Proposed Development			
Description of proposed works and/or land use	Extractive Industry - clay (existing)		
Please specify what type of materials the development is made of	N/A		
Nature of development	☐ Works	■ Use	☐ Works & Use
Approximate cost of proposed development	N/A - The clay excavation operation is already established		
Nature of existing buildings and/or land use	Extractive Industry - clay extraction operations		
Estimated time of completion			
Is an exemption from development claimed for part of the development?		☐ Yes	■ No
If yes, is the exemption for	☐ Works		☐ Use
Description of exemption claimed (if relevant)	N/A		

- Applications for Development Approval with associated plans and documentation should be submitted to chatter@chittering.wa.gov.au. We have a limit of 50MB for inbound emails.
- A checklist is available here: https://www.chittering.wa.gov.au/how-to-apply-for-da.aspx
- 'Public viewing' refers to advertising to select parties who are potentially adversely affected. Advertising may not be required for all applications. If permission is not given it can prevent the application from progressing.

CREDIT CARD PAYMENTS

Name as shown on the card		☐ MasterCard ☐ VISA	
Card Number	- - -		
Expiry Date	/	Card Security Number	
Signature:		Fee payable Schedule of Fees on page 3	

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APPLICATION FOR DEVELOPMENT APPROVAL

SCHEDULE OF FEES

Description	Fee
Determining a development application (other than for an extractive industry) where the development has not commenced or been carried out and the estimated cost of the development is	
(a) not more than $50 000	$147.00
(b) more than $50 000 but not more than $500 000	0.32% of the estimated cost of development
(c) more than $500 000 but not more than $2.5 million	$1,700.00 + 0.257% for every $1 in excess of $500,000.00
(d) more than $2.5 million but not more than $5 million	$7,161.00 + 0.206% for every $1 in excess of $2.5 million
(e) more than $5 million but not more than $21.5 million	$12,633.00 + 0.123% for every $1 in excess of $5 million
(f) more than $21.5 million	$34,196.00
Determining a development application (other than for an extractive industry) where the development has commenced or been carried out	The fee in item 1 plus, by way of penalty, twice that fee
Determining a development application for an extractive industry where the development has not commenced or been carried out	$739.00
Determining a development application for an extractive industry where the development has commenced or been carried out	The fee in item 3 plus, by way of penalty, twice that fee
Determining an application to amend or cancel development approval	$295.00
Providing a subdivision clearance for —	
(a) not more than 5 lots	$73.00 per lot
(b) more than 5 lots but not more than 195 lots	$73.00 per lot for the first 5 lots and then $35.00 per lot
(c) more than 195 lots	$7,393.00
Determining an initial application for approval of a home business where the home business has not commenced	$222.00
Determining an initial application for approval of a home business where the home business has commenced	The fee in item 6 plus, by way of penalty, twice that fee
Determining an application for a change of use or for an alteration or extension or change of a non-conforming use to which item 1 does not apply, where the change or the alteration, extension or change has not commenced or been carried out	$295.00
Determining an application for a change of use or for an alteration or extension or change of a non-conforming use to which item 2 does not apply, where the change or the alteration, extension or change has commenced or been carried out	The fee in item 10 plus, by way of penalty, twice that fee
Providing a zoning certificate	$73.00
Replying to a property settlement questionnaire	$73.00
Providing written planning advice	$73.00
Building Envelope relocation/variation	$113.50

EXTRACTIVE INDUSTRY LICENCE APPLICATION

6177 Great Northern Highway
PO Box 70
BINDOON WA 6502

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chatter@chittering.wa.gov.au
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Shire of Chittering
Office Hours
8:30am – 4:30pm
Monday to Friday

OWNER(S) DETAILS			
Name of owner (1)	Lower Chittering and Muchea Pty Ltd		
Name of owner (2)			
Residential Address	Level 3 338 Barker Rd, Subiaco WA 6008		
Postal Address	PO Box 782 Subiaco WA 6904		
Email	brett@hesperia.com.au		
Telephone	08 9381 8301	Mobile	0418 950 180

APPLICANT DETAILS			
Name/Company	BCG (Australia) Pty Ltd (T/A Midland Brick)		
Residential Address	260 Kalamunda Rd, South Guildford, WA 6055		
Postal Address	PO Box 2440 High Wycombe WA 6057		
Email	nathan.blackwell@midlandbrick.com.au		
Telephone	08 6313 1022	Mobile	0427 421 683

PROPOSED EXCAVATION SITE					
Lot	6	Location		Plan or Diagram No	49665
Certificate of Title Volume	2631	Folio	794		
Street and Locality	Lot 6 Wandena Road, Muchea				
Materials to be excavated	Clay				

If the application covers land that is the subject of an existing licence:			
Date of issue of that licence	11 September 2018	Date of expiration of that licence	30 June 2022
Term of licence sought	10 years		

The applicant applies for a licence in respect of the proposed excavation site in accordance with and subject to the Shire of Chittering Extractive Industries Local Law 2014.

The applicant has provided a form of payment to pay the prescribed fee, submitted all documentation in accordance with Part 2.2 of the Shire of Chittering Extractive Industries Local Law 2014 (outlined on page 2 and 3) and will meet all relevant conditions of any Development Approval issued.

Signature of owner (1)		Date	15/06/2022
Signature of owner (2)		Date	15/06/2022
Signature of applicant		Date	15/6/2022
Signature of existing licensee (if applicable)		Date	

CREDIT CARD DETAILS			
Cardholder Name		Visa ☐	Mastercard ☐
Credit Card Number		Expiry	
Signature		CCV	
Extractive Industry Licence Fee		$2,200.00	

EXTRACTIVE INDUSTRY LICENCE APPLICATION

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2.2 APPLICATION FOR LICENCE

(1) A person seeking the issue of a licence in respect of any land must apply in the form determined by the local government from time to time and must forward the application duly completed and signed by each of the applicants, the owner of the land and any occupier of the land to the CEO together with—

(a) 3 copies of a plan of the excavation site to a scale of between 1:500 and 1:2000 showing—

(i) the existing and proposed land contours based on the Australian Height Datum and plotted at 1 metre contour intervals;
(ii) the land on which the excavation site is to be located;
(iii) the external surface dimensions of the land;
(iv) the location and depth of the existing and proposed excavation of the land;
(v) the location of existing and proposed thoroughfares or other means of vehicle access to and egress from the land and to public thoroughfares in the vicinity of the land;
(vi) the location of buildings, treatment plant, tanks and other improvements and developments existing on, approved for or proposed in respect of the land;
(vii) the location of existing power lines, telephone cables and any associated poles or pylons, sewers, pipelines, reserves, bridges, railway lines and registered grants of easement or other encumbrances over, on, under or adjacent to or in the vicinity of the land;
(viii) the location of all existing dams, watercourses, drains or sumps on or adjacent to the land;
(ix) the location and description of existing and proposed fences, gates and warning signs around the land; and
(x) the location of the areas proposed to be used for stockpiling excavated material, treated material, overburden and soil storage on the land and elsewhere;

(b) 3 copies of a works and excavation programme containing—

(i) the nature and estimated duration of the proposed excavation for which the licence is applied;
(ii) the stages and the timing of the stages in which it is proposed to carry out the excavation;
(iii) details of the methods to be employed in the proposed excavation and a description of any on-site processing works;
(iv) details of the depth and extent of the existing and proposed excavation of the site;
(v) an estimate of the depth of and description of the nature and quantity of the overburden to be removed;
(vi) a description of the methods by which existing vegetation is to be cleared and topsoil and overburden removed or stockpiled;
(vii) a description of the means of access to the excavation site and the types of thoroughfares to be constructed;
(viii) details of the proposed number and size of trucks entering and leaving the site each day and the route or routes to be taken by those vehicles;
(ix) a description of any proposed buildings, water supply, treatment plant, tanks and other improvements;
(x) details of drainage conditions applicable to the land and methods by which the excavation site is to be kept drained;
(xi) a description of the measures to be taken to minimise sand drift, dust nuisance, erosion, watercourse siltation and dangers to the general public;
(xii) a description of the measures to be taken to comply with the Environmental Protection (Noise) Regulations 1997; 4146 GOVERNMENT GAZETTE, WA 24 October 2014
(xiii) a description of the existing site environment and a report on the anticipated effect that the proposed excavation will have on the environment in the vicinity of the land to be prepared by a suitably qualified industry consultant;
(xiv) a description of the measures to be taken to minimise the destruction of existing vegetation; and
(xv) a description of the measures to be taken in screening the excavation site, or otherwise minimising adverse visual impacts, from nearby thoroughfares or other areas;

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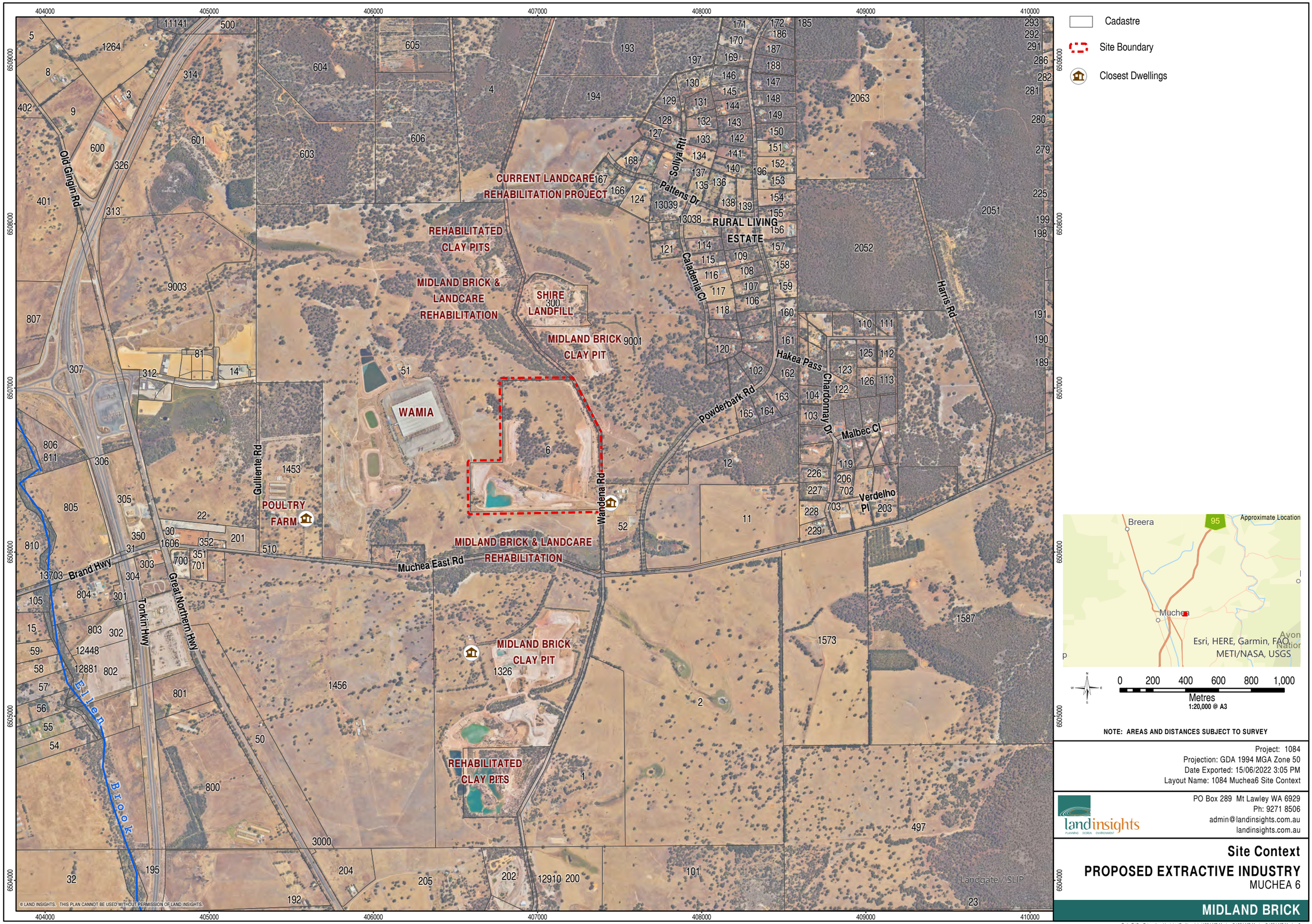
(c) 3 copies of a rehabilitation and decommissioning programme indicating— (i) the objectives of the programme, having due regard to the nature of the surrounding area and the proposed end-use of the excavation site; (ii) whether restoration and reinstatement of the excavation site is to be undertaken progressively or upon completion of excavation operations; (iii) the method by which topsoil is to be replaced and revegetated; (iv) the numbers and types of trees and shrubs to be planted and other landscaping features to be developed; (v) how rehabilitated areas are to be maintained; (vi) the programme for the removal of buildings, plant, waste and final site clean-up; and (vii) how any face is to be made safe and batters sloped;
(d) evidence that a datum peg has been established on the land related to a point approved by the local government on the surface of a constructed public thoroughfare or such other land in the vicinity;
(e) a certificate from a licensed surveyor certifying— (i) the extent of any existing excavation on the proposed excavation site; and (ii) the correctness of the plan referred to in paragraph (a) and the datum peg and related point referred to in paragraph (d);
(f) copies of all land use planning approvals required under any planning legislation;
(g) the consent in writing to the application from the owner of the excavation site;
(h) any other information that the local government may reasonably require;
(i) the licence application fee specified by the local government from time to time;
(j) copies of any environmental approval required under any environmental legislation; and
(k) copies of any geotechnical information relating to the excavation site.

(2) All survey data supplied by an applicant for the purpose of subclause (1) must comply with Australian Height Datum and Australian Map Grid standards.

APPENDIX B

Plans



NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1084
Projection: GDA 1994 MGA Zone 50
Date Exported: 15/06/2022 3:05 PM
Layout Name: 1084 Muchea6 Site Context

land insights
PLANNING DESIGN ENVIRONMENT
PO Box 289 Mt Lawley WA 6929
Ph: 9271 8506
admin@landinsights.com.au
landinsights.com.au

Site Context

PROPOSED EXTRACTIVE INDUSTRY

MUCHEA 6

MIDLAND BRICK

Path: E:\OneDrive - Land Insights\Drafting Jobs\1084 MB Muchea6\1084 MB Muchea6\1084 MB Muchea6.aprx

406500 406750 407000 407250 407500

6507000 6506750 6506500 6506250

Excavation 2022-2032

Wandena Rd

OVERBURDEN BUNDS

9001

51

OVERBURDEN STOCKPILE

6

Current Excavation Area

To be expanded to West as shown

OVERBURDEN BUNDS

Excavation 2022-2032

Note: Stockpile will be created within hatched area. Stockpile will be moved as required to cater for on-site activities.

Future Excavation Post 2032

BASIN 1

BASIN 2

SITE ACCESS

52

Powderbark Rd

12

Landgate / SLIP

- Cadastre
- Site Boundary
- House Point
- Active Pit Area
- Excavation Area
- Internal Haul Roads
- Direction Excavation
- Drainage Basin
- Total Stockpile Area

N W E S

0 40 80 120 160 200

Metres

1:4,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1084
Projection: GDA 1994 MGA Zone 50
Date Exported: 15/06/2022 3:04 PM
Layout Name: 1084 Muchea6 Extraction Plan

land insights
PLANNING DESIGN ENVIRONMENT

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Extraction Plan

PROPOSED EXTRACTIVE INDUSTRY

MUCHEA 6

MIDLAND BRICK

Path: E:\OneDrive - Land Insights\Drafting Jobs\1084 MB Muchea6\1084 MB Muchea6\1084 MB Muchea6.aprx

406500 406750 407000 407250 407500

6507000 6506750 6506500 6506250

NOTES:

The plan assumes a uniform pit depth of 14m (15m depth and 1m overburden replacement) from natural ground level within each of the excavation areas. The ground level in the base of the rehabilitated pits is not uniform but will be a continuous 14m below the NGL.

The side batters are calculated at 1:2.5. Vegetation planting is proposed on batters.

Rehabilitation is a concept only.

14m below NGL

14m below NGL

9001

51

6

52

Wandena Rd

- Cadastre
- Site Boundary
- Top of rehabilitated pit
- Base of rehabilitated pit
- Proposed Pasture
- Dam
- Tree Planting

0 40 80 120 160 200

Metres

1:4,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1084
Projection: GDA 1994 MGA Zone 50
Date Exported: 13/04/2022 10:43 AM
Layout Name: 1084 Muchea6 Rehabilitation Plan

PO Box 289 Mt Lawley WA 6929
Ph: 9271 8506
admin@landinsights.com.au
landinsights.com.au

Indicative Rehabilitation Plan

PROPOSED EXTRACTIVE INDUSTRY

MUCHEA 6

MIDLAND BRICK

Path: E:\OneDrive - Land Insights\Drafting Jobs\1084 MB Muchea6\1084 MB Muchea6\1084 MB Muchea6.aprx

COMPILED BY: SURVEY GRAPHICS JULY 2018
DATE OF PHOTOGRAPHY: 2nd JUNE 2018
HORIZONTAL DATUM: GDA94 MGA 50
CONTOUR INTERVAL: 1m

SURVEY GRAPHICS
MAPPING CONSULTANTS

BORAL Midland Brick

MUCHEA NORTH

0 75 150 300 450 m

1 : 10,000 @ A4

APPENDIX C

Certificate of Title

WESTERN AUSTRALIA

REGISTER NUMBER	
6/DP49665	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	4/10/2006

VOLUME 2631 FOLIO 794

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 6 ON DEPOSITED PLAN 49665

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

LOWER CHITTERING & MUCHEA PTY LTD OF LEVEL 3 338 BARKER RD, SUBIACO WA 6008
(T O499263) REGISTERED 16/9/2020

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. EXCEPT AND RESERVING METALS, MINERALS, GEMS AND MINERAL OIL SPECIFIED IN TRANSFER 4186/1933. SEE DEPOSITED PLAN 49665
2. *O499264 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 16/9/2020.
3. *O699101 CAVEAT BY BGC (AUSTRALIA) PTY LTD LODGED 12/4/2021.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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

SKETCH OF LAND: DP49665
PREVIOUS TITLE: 1655-799
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY: SHIRE OF CHITTERING

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING O499264

APPENDIX D

Acid Sulphate Soil Investigation and Management Plan

Acid Sulphate Soil Investigation & Management Plan Lot 6 Wandena Road Muchea WA

December, 2006

Midland Brick Company

PARSONS BRINCKERHOFF

Parsons Brinckerhoff Australia Pty Limited ABN 80 078 004 798

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Email perth@pb.com.au

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List of acronyms

Acronym	Definition
AHD	Australian Height Datum
AMG	Australian Map Grid
ANZECC	Australian & New Zealand Environment & Conservation Council
AOIG	Australian Oil Industry Guidelines
ASS	A soil or soil horizon which contains sulphides or an acid soil horizon affected by oxidation of sulphides.
AASS	Soils containing highly acidic soil horizons or layers resulting from the aeration of soil materials that are rich in iron sulphides, primarily sulphide.
COC	Constituent of Concern; Chain of Custody
EC	Electrical Conductivity
EPA	Environment Protection Authority; Environmental Protection Agency
ERA	Environmental Risk Assessment
ESA	Environmental Site Assessment
HRA	Health Risk Assessment
mAGL	Metres Above Ground Level
mBGS	Metres Below Ground Surface
mBTOC	Metres Below Top of Casing
NAPL	Non-Aqueous Phase Liquid
NATA	National Association of Testing Authorities
ND	Not Detected (<PQL)
NEHF	National Environmental Health Forum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
OH&S	Occupational Health and Safety
PASS	Soils which contain iron sulphides or sulphidic material which have not been exposed to air or oxidised.
$pH_{(FOX)}$	Field pH. (pH of soil and hydrogen peroxide)
$pH_{(F)}$	Field pH. (pH of soil and deionised water)
PID	Photo-ionisation Detector
ppmV	Parts-per-million by Volume
PQL	Practical Quantitation Limit
PSH	Phase Separated Hydrocarbons
QA / QC	Quality Assurance / Quality Control
RBCA	Risk-Based Corrective Action
RBSL	Risk-Based Screening Level
RPD	Relative Percent Difference
SSTL	Site Specific Target Level
SVOC	Semi-volatile Organic Compounds
SWL	Standing Water Level; Static Water Level
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
uPVC	Un-plasticised Polyvinyl Chloride
VOC	Volatile Organic Compounds

Executive summary

Parsons Brinckerhoff (PB) was commissioned by Midland Brick Company Pty Ltd (MBC) to investigate the presence of acid sulphate soil and prepare an acid sulphate soil management plan (ASSMP) for proposed clay excavations at Lot 6 Wandena Road, Muchea Western Australia.

MBC intends to develop the clay resource in three stages commencing at the southern end of Lot 6 with Stage 1. Stages 2 & 3 are not expected to be commenced before 2015. Therefore the focus of this investigation was on Stage 1. Subject to acid sulphate soil (ASS) being confirmed within Stages 2 & 3 the recommended ASSMP is likely to also be applicable across the balance of the site.

In summary the investigation concluded:

- Within Stage 1 weathered grey/brown mottled clay of a marine origin which is suitable for brick manufacture occurs from a depth of approximately 2 meters below ground surface (m BGS) and appears to form an aquitard overlying more permeable horizons of organic rich silty clays.
- PB encountered groundwater between 12 m and 17 m BGS at the south-western corner of Stage 1. Further upslope groundwater was not encountered within 21 m BGS (maximum extent of drilling) by Midland Brick. The groundwater encountered occurred within silty clays which appear to form a semi confined aquifer. The likely flow was south-west.
- Both laboratory and field results indicated actual acid sulphate soil (AASS) and potential acid sulphate soil (PASS) occurs at the site.
- PASS was only encountered within the underlying wet silty clays (e.g. within borehole J_300 at around 15 m BGS), probably as a result of persistent anoxic conditions. The overlying clays, which MBC intend to extract, contain some AASS, however, this has been largely leached from the soil profile by rainfall infiltration.
- A qualitative risk assessment was undertaken with the following findings:
  - The risk of adverse impact to surface water bodies (streams) by soil or water containing high levels of acidity migrating from the site via overland flow is high in the event stormwater from the site is released to the wider environment.
  - The risk of adverse impacts on the beneficial use of groundwater from acidity is low due to the low permeability and strong chemical attenuation properties of the underlying clays and as the anticipated depth of clay excavations are not likely to result in oxidation of the underlying PASS.

The proposed ASSMP has been recommended to address potential risks to identified receptors. The overall objectives of the ASSMP are to:

- minimise mobilisation of acidity from disturbed areas;
- retain stormwater runoff from disturbed areas in detention basins and excavation voids and treat as required with lime dosing to neutralise acidity prior to any release or re-use; and
- facilitate the re-establishment of a vegetative cover to prevent erosion as part of the longer term management of the site.

1. Introduction

Parsons Brinckerhoff (PB) was commissioned by Midland Brick Company Pty Ltd (MBC) to investigate the presence of acid sulphate soil and prepare an acid sulphate soil management plan (ASSMP) for proposed clay excavations at Lot 6 Wandena Road, Muchea, Western Australia.

The requirement for the ASSMP is established under Condition 4 in the Shire of Chittering planning conditions for the proposed extractive industry (Appendix A).

MBC intends to develop the resource in three stages commencing at the southern end of Lot 6 with Stage 1. Stages 2 & 3 are not expected to be commenced before 2015.

The Shire advised that, in relation to Condition 4, an ASSMP should be completed for each stage of the development and submitted to the DoE for assessment and approval prior to any disturbance of soil. A Department of Environment (DoE) Acid Sulphate Soils Site Summary Form is included in Appendix B.

The focus of this investigation is Stage 1 only. Subject to acid sulphate soil being confirmed within Stages 2 & 3 the recommended ASSMP is likely to also be applicable across the balance of the site.

1.1 Background

Commercially viable clay deposits occur in the general area surrounding the site and have been extracted within the Muchea area for many years. The Western Australian Planning Commission (State Planning Policy No. 2.4 Basic Raw Materials, July 2000) identified the area as "Priority Resource Location" (http://www.wapc.wa.gov.au/Publications/137.aspx viewed 22/1/2006).

1.2 Objectives

The objectives of the work undertaken included:

- investigate the presence of acid sulphate soils at the site;
- undertake a qualitative assessment of the risk to sensitive receptors posed by disturbance of any acid sulphate soils; and
- provide an ASSMP for the management of any risk.

1.3 Scope of work

The scope of work for the ASSMP encompassing the acid sulphate soil investigation and management plan included the following tasks:

- Desktop review of available information including:
  - Preliminary Site Assessment for Acid Sulphate Soils, Stage 1 – Lot 6 Wandena Road Muchea (BBG, 2006);
  - Publicly available datasets including regional geological maps, acid sulphate soil risk maps and local groundwater bore records;

- Excavation – Rehabilitation Management Plan, Lot 6 Wandena Road, Muchea (Stephens, 2005);
- MBC clay exploration drilling results transects 250-1100 have been used to build a geological model of the site. The exploration log data provided by Midland Brick appears consistent with drilling results obtained by PB; and
- Muchea Pits water quality data (SGS laboratory report No. 93475 of 13 January 2006) and accompanying site plan showing sample locations.
- Coffey (13 November 2006) Baseline Water Assessment Report, Proposed Livestock Facility Muchea East, WA. Prepared for WA Meat Industry Association.

- Intrusive soil investigations including:
  - drilling two targeted soil bores to a depth equivalent to approximately 2 m below the base of proposed excavations. Results from two soil bores drilled within the adjoining Lot 5 to investigate acid sulphate soils beneath the neighbouring proposed WA Meat Industry Association's livestock saleyard have been incorporated in this investigation.
  - Field testing of soils at 0.25 m intervals from all bores to 3 m and every 1 m thereafter for field pH (pH_F) and field pH after oxidation (pH_{FOX}) (at PB, Pinjarra Laboratory);
  - Laboratory analysis at 0.5 m intervals to 2 m below ground surface (BGS) and each meter thereafter for all soil bores via Chromium Reducible Sulphur Suite (SCR) (ALS Environmental method EA033 for actual and potential acidity and acid based accounting); and
  - Laboratory analysis at 0.5 m intervals to 2 m BGS and each meter thereafter for all soil bores via LECO for total sulphur (ALS Environmental method ED042T: Total sulphur by LECO).
- Provision of a report which summarises the findings of the ASS investigation and presents a management plan for the management of any disturbance to acid sulphate soils.

2. Project description

It is understood the proposed excavation methods will be the same as those used at existing MBC operations in the Muchea area. The gravel and clay resource is extracted in a sequence starting with the separate removal of topsoil and overburden followed by the underlying clay. Following removal of the clay resource the area will be rehabilitated as described in the Excavation Rehabilitation Management Plan (Landform Research, May 2005).

The clay resource within Lot 6 will be excavated in three stages (Figure 2). Stage 1, located at the southern side of Lot 6, and which is the subject of this investigation, is expected to be developed over a ten year period. Excavations will progress initially in a northern then north-easterly direction, up slope, with the construction of a dam at the south to contain any stormwater runoff.

MBC advised an average of 5.4m of overburden, comprising sand and some gravel, will be removed followed by clay with an average thickness of 8.5m. The excavations will extend to 2m of the encountered water table down slope and in excess of 6m up slope.

The total area of disturbance within Stage 1 is not expected to exceed 13 ha in surface area.

MBC indicated following removal of the overburden an average 8.5 m thick band of clay will be excavated to within 1-2 m of the watertable. It does not intend to target the underlying saturated clays which appear to be organic and slightly pyritic.

3. Site description

The development area is at Lot 6 Muchea East Road between Gulliente Road and Wandena Road, Muchea. The site falls in Priority Resource Location for basic raw materials (WAPC, July 2000).

3.1 Surrounding land use

The site is surrounded to the north, west and south by the proposed WAMIA saleyard. The eastern boundary is Wandena Road.

The predominant land use is agricultural with lot sizes ranging from 100 to 200 ha. Clay extraction has been undertaken in the general area with the nearest pits occurring within 100 m of the northern site boundary and within 500 m of the southern site boundary. In summary surrounding land use includes:

North: beef farming and MBC clay mining

South: beef farming, Muchea East Rd, creek and MBC clay mining

East: beef farming, to the north east of the site there is a Shire of Chittering landfill.

West: proposed WAMIA livestock saleyards, intensive agriculture (poultry).

3.2 Sensitive receptor survey

A sensitive receptor survey was conducted at the site with the following findings.

3.2.1 Tributaries of Ellen Brook

The site is situated across the sub-catchments of two small tributaries of Ellen Brook which is located approximately 2 km to the west. These include Wandena Creek to the north of the site and a small un-named creek adjacent to Muchea-East Road directly south of the site. The southern creek is perennial being recharged by groundwater springs.

The results of laboratory analysis of a water sample collected from within the southern creek (SW3) are included in Appendix C (Amdel Laboratory results) and reported:

- The EC of 710 µS/cm and pH 6.5;
- Metal concentrations generally below analytical detection limits with the exception of copper (0.002 mg/L-Cu) and zinc (0.011 mg/L-Zn); and
- The concentration of sulphate and chloride were 150 mg/L-SO4 and 840 mg/L-Cl respectively.

Potential impacts from acidified waters or sediments include increase metal loading and potential toxicity effects, precipitation of iron oxides [jarosite] and staining of creek beds, increase chemical oxygen demand, and stream bank erosion.

3.2.2 Beneficial use of groundwater

Groundwater in the general area surrounding the site is used mainly for irrigation and stock drinking water. Down hydraulic gradient from the site groundwater is abstracted for municipal water supplies within the Gnangara Mound.

Within the neighbouring Lot12 (soil bores E5_950 and E5_750), perched groundwater was encountered at 7.5 - 8.25 m BGS within clay overlying rock (siltstone). At the south-eastern side of the site, groundwater is at 15 m BGS (soil bores J_300 and M5_400) and 18.25 m BGS. The groundwater is generally fresh (EC 1,500 to 2,000 µS/cm) with pH 6.5, slightly on the acidic side.

Results of laboratory analysis (refer to Amdel Laboratory Report in Appendix C) of a water sample collected from a fresh water spring observed off the southern boundary (SW2 – Figure 6) include:

- the EC of 1,200 µS/cm and pH 6.6;
- metal concentrations generally below analytical detection limits with the exception of copper (0.002 mg/L-Cu) and zinc (0.015 mg/L-Zn); and
- the sulphate was 8.1 mg/L-SO4 and chloride was 280 mg/L-Cl.

3.2.3 Vegetation

When soil pH falls below 5.0, some nutrients may become less available (e.g. phosphorus, potassium, calcium, magnesium, molybdenum, copper) while other elements can reach toxic levels (e.g. aluminium, manganese). Microbial processes that facilitate nutrient recycling can be reduced and the ability of plants to use subsoil moisture limited resulting in stunted root growth. As soil becomes more acidic, the activity of soil fauna such as earthworms is also inhibited.

4. Environmental setting

4.1 Climate

The climate of the area is Mediterranean with hot dry summers and mild wet winters. Climatic data from the Bullsbrook weather station, 9km south of the site reported:

- Precipitation is 688 mm per year, of which 90% falls in the months April to October; and
- At the Swan research station evaporation exceeds rainfall in all but the four wettest months.

4.2 Geomorphology

The site is situated at a height of approximately 70 to 150 metres above Australian Height Datum (AHD) (McDowall Affleck: Drawing No.10320-01) within the uplands of the Dandaragan Plateau at the foothills of the Darling Scarp. The Dandaragan Plateau comprises sand, clay and lateritic cap, and is dissected by several perennial streams flowing west into Ellen Brook.

The site slopes gently south, with a grade of approximately 18%. A topographic high occurs north-east of the site and several topographic lows occur near the northern and southern boundaries. A digital elevation model (DEM) of the site and surrounds is presented as Figure 5.

4.3 Geology

Surficial geology at the site comprises unconsolidated Quaternary aged Colluvial Sands and, in places, Tertiary aged Laterite rock that conformably overlies the Kardinya Shale Member and in turn conformably overlies the Leederville Formation (Geological Survey of Western Australia – Muchea Map Series 20841, Scale 1:50,000).

The soil profile encountered during the sampling programme consisted of grey/brown, fine grained loamy sand, with some gravel underlain by light grey, oxidised, clays to a depth of at least 20 m BGS at the south-eastern side. Where groundwater was encountered the clays tended to be organic and slightly pyritic.

A summary of the generalised site specific geological profile is presented in Table 4.1. Soil bore logs are presented in Appendix C and geological cross sections, utilising exploration drilling results provided by MBC, are presented as Figure 3(a-d).

Table 4.1: Generalised Site Specific Geology (Location J_300)

Depth (m BGS)	Lithology
0.0 – 2.0	SAND: fine, loamy, brown, some gravels
2.0 – 2.75	SILTY SAND: brown, with some grey clay
2.75 – 3.75	CLAY: light grey, crumbly
3.75 – 5.0	CLAY: light grey, with orange and red mottles
6.5 – 16	CLAY: grey with red mottles
16-20	CLAY: dark brown/black (e.o.h at 20 m BGS)

4.4 Hydrogeology

The DoE Groundwater Bore Records suggests that the regional water table is approximately 8-24 m BGS and the regional groundwater flow direction is to the west. Coffey (Nov 2006) reported groundwater beneath the site likely flows in a south-westerly direction.

Locally groundwater discharges to several creeks including Wandena Creek and an unnamed creek along Muchea east Road which are tributaries of Ellen Brook located approximately 2 km to the west.

Within Stage 1 the unsaturated clays probably act as an aquitard. The underlying more permeable sediments appear to form a semi confined aquifer within which groundwater was encountered and within which it is likely to be under pressure.

Groundwater was not encountered across the northern half of Stage 1 to a maximum depth of 21m BGS. It was encountered at the south-western corner at 15 m BGS (PB borehole J300) and across the central southern portion of Stage 1 at approximately 17 m BGS (MBC borehole L5-400) and 12 m BGS (MBC borehole L-400).

It appears that a subsurface channel running in a north-south direction along Midland Brick's "L" transect through the central south of Stage 1 from a depth of between 10-17m at the 400 line and 8-9m at the 300 line occurs.

Geological cross sections of the site showing approximate depths to groundwater are presented as Figure 3.

A summary of the site specific hydrogeology encountered is presented in Table 4.2.

Table 4.2: Generalised Site Specific Hydrogeology

Item	Description
Depth to groundwater	Registered bore WIN ID 20040862 (405661 mE, 6506650 mN) located adjacent to the west of the site, down slope from the development site, reported groundwater at 6.1 m BGS.
	Registered bore WIN ID 5541 (406739 mE, 6505999 mN) located to the west of the southern boundary and further down slope, reported groundwater at -4 m BTOC (i.e. artesian) or approximately 95 mAHD.
	Groundwater was encountered during drilling beneath the site at 15 m BGS at M5_400; and 15 m BGS at J_300 located at the south-western side of the site.
Groundwater quality	Samples of groundwater collected during drilling reported a pH of 6.25 and EC of 1,500 to 2,000 µS/cm indicating groundwater conditions are slightly acidic and fresh to brackish.
Inferred groundwater flow direction	The inferred flow direction beneath Stage 1 is south-west (Coffey, 2006). Regional flow is to the west.

4.5 Hydrology

One watercourse runs to the west along the southern edge of the site. This has been rehabilitated and fenced as part of a Midland Brick and Landcare project. Regional drainage is likely to be towards these watercourses.

5. Acid sulphate soil assessment

The acid sulphate soil sampling and analysis plan was formulated on the basis of information documented in Department of Environment – Draft Identification and Investigation of Acid Sulphate Soils (Draft for comment May 2006).

5.1 Soil sampling and analysis strategy

The site has been extensively drilled on a 50 m x 50 m grid for the exploration of clay. A geological/hydro-geological model of the site has been developed utilising the MBC and PB drilling results on both sites.

MBCs assessment of the clay deposits included laboratory analysis for total sulphur and total carbon by LECO and particle size analyses. MBCs laboratory is NATA accredited.

The results of MBCs drilling demonstrated:

- The site occurs in an area comprising gravely sands (overburden), overlying clay from a depth of between 1 and 6 m BGS. The clay extended to a depth of at least 21 m BGS (PB borehole J-300).
- Total concentration (by LECO) of carbon and sulphur in the top 14 m of the soil profile ranged from 0.006%-C to 0.87%-C and 0.001%-S to 0.93%-S respectively. The average concentration of carbon and sulphur was 0.14%-C and 0.064%-S respectively;
- The clayey soils within the top 14 m had a pH (using a 1:5 soil/water solution) ranging from 2.8 to 9.1. The average pH of clayey soils was 4.5; and
- The results indicate some actual acidity occurred on-site with the possibility of potential acidity.

Therefore, a targeted soil investigation strategy was developed incorporating sample locations previously drilled by MBC and proximal to proposed earthworks. The investigation strategy was designed to verify the findings from review of the Midland Brick exploration above.

The soil investigation included:

- Installation of 4 soil bores 10 to 20 m BGS, targeting excavation areas. Two soil bores were installed within the neighbouring Lot 5 where MBC had proposed to excavate clay which occurs beneath the proposed Muchea Livestock saleyards;
- Field testing of soils at 0.25 m intervals from all bores to 3 m and every 1 m thereafter for field pH (pH_F) and field pH after oxidation (pH_{FOX}) (at PB, Pinjarra Laboratory);
- Laboratory analysis at 0.5 m intervals to 2 m BGS and each meter thereafter for all soil bores via Chromium Reducible Sulphur Suite (SCR) (ALS Environmental method EA033 for actual and potential acidity and acid based accounting); and
- Laboratory analysis at 0.5 m intervals to 2 m BGS and each meter thereafter for all soil bores via LECO for total sulphur (ALS Environmental method ED042T: Total sulphur by LECO)

The S_{CR} method was chosen as it is less sensitive to interference from organic sulphur. The reduced inorganic sulphur compounds measured by this method are: 1) pyrite and other iron

disulphides, 2) elemental sulphur, and 3) acid volatile sulphides (eg. greigite and mackinawite). Pyrite and iron-disulphides are the primary constituents of concern.

LECO analysis gives a total sulphur content by inductive furnace for complete combustion of sulphur compounds. A worst case scenario would be where all sulphur present is potentially acid generating.

5.2 Soil sampling programme

Soil bore and surface water sample locations are provided in Figure 6 and respective bore logs are provided in Appendix C. Table 5.1 summarises the methodology adopted during the fieldwork for the assessment of soils.

Table 5.1: Soil Assessment Methodology

Activity	Details
Drilling	Hand auger to 1.5 m BGS and subsequent air core rotary drilling was undertaken by Midland Brick.
Soil Logging	Soil and rock type classification based on AS1726 – 1993.
Soil Sampling	Soil samples were obtained within the first 1.5 m using hollow stem hand auger and from subsequent depths by cyclone.
Bore Abandonment	Bores were backfilled using drill cuttings.
Sample Preservation	Samples were stored on ice while on-site and whilst in transit to the laboratory.
Sample Handling	Samples were sent to the laboratory accompanied by a Chain of Custody.
Analytical Assessment	Samples were analysed at ALS Environmental using the chromium reducible sulphur suite (S_{CR}) method and LECO.

5.3 Soil assessment criteria

Action criteria for the assessment of the environmental risk of acid sulphate soils have been established in the Western Australia's *Identification and Investigation of Acid Sulphate Soils* (2004). The criteria are used to define when acid sulphate soils disturbed at a site will need to be treated and managed. The action criteria are based on the sum of existing plus potential acidity, calculated as equivalent sulphur (e.g. s-TAA +S_{CR} in %S units) or equivalent acidity (e.g. TAA + TPA in mol H^+/tonne). The highest laboratory result was used to assess against the action criteria.

As clay content tends to influence the soils natural pH buffering capacity, the action criteria are grouped by three broad texture categories – coarse, medium and fine. Table 5.2 summarises the action criteria.

Table 5.2: Texture Based Acid Sulphate Soils Action Criteria

Type of Material		Action Criteria if <1,000 tonnes of material is disturbed		Action Criteria if >1,000 tonnes of material is disturbed	
Texture Range	Approx. Clay Content	Equivalent Sulphur (%)	Equivalent Acidity (mol H^+/tonne)	Equivalent Sulphur (%)	Equivalent Acidity (mol H^+/tonne)
Coarse – sands to loamy sands	≤5%	0.03	18	0.03	18
Medium – sandy loams to light clays	5 – 40%	0.06	36	0.03	18
Fine – medium to heavy clays and silty clays	≥40%	0.1	62	0.03	18

The action criteria used in this assessment is for the fine texture range for disturbances greater than 1,000 tonnes. In addition, the indicator pH values were used to assist with identifying likely acid generating soils. The pH indicator values and their interpretation:

- pH_F ≤4. Oxidation of sulphides probably occurred in past – presence of actual acid sulphate soil (AASS) (when pH >4 but ≤5 indicates an acid soil, but cause of acidity needs to be further investigated by laboratory analysis); and
- pH_{FOX} <3, and a significant reaction. Strongly indicates potential acid sulphate soil (PASS).
- pH_{FOX} - pH_F. Large differences are an indication of potential acid sulphate soil (PASS) present (Figure 4).

5.4 Results

5.4.1 Quality Assurance / Quality Control (QA/QC)

Specific QA/QC requirements that have been checked and assessed for this investigation are summarised in Table 5.3 and 5.4.

Table 5.3: Field Data Validation

QA/QC Requirement	Completed	Comments
Samples were stored on ice in eskies in the field and delivered to the laboratory within 24 hr. Upon receipt at the laboratory the samples were sieved at -45µm and frozen.	Yes	It is considered that the handling and storage of samples for acid sulphate soils analysis was acceptable.
Sample retrieval	Yes	Samples within the overlying gravely sandy soil and from the upper clay horizon were collected by hollow stem hand auger. Samples from depth were retrieved using air core rotary drilling technique with the sample being collected within a cyclone. It was not possible to use hollow stem auger due to the tightness of clays. Due to the potential for air to interfere with laboratory analyses caution has been exercised in interpretation of results.
Review of graphical plots of pH_F and pH_{FOX} for the occurrence of apparently unusual or anomalous results e.g. laboratory results that appear to be inconsistent with field observations or measurements	Yes	Review of lab and field pH data confirms the results of pH field tests behave in an entirely predictable manner.

In view of the intensive field sampling points, duplicate analysis was not considered necessary as part of the QA/QC requirement for this investigation.

Table 5.4: Laboratory Data Validation

QA/QC Requirement	Completed	Comments
NATA accredited analysis	Yes	ALS, Perth and Amdel, Vic are NATA accredited for the analyses performed.
Interlaboratory split samples	Mostly	A comparison between plots of field pH_F and laboratory measured pH KCl, whilst one would expect differences in pH measurements by the different techniques, provides a reasonable indication of the accurateness of the laboratory and field testing.
Use of appropriate analytical procedures	Yes	The chromium reducible sulphur suite is considered appropriate in this instance as it is less sensitive to acid volatile sulphur and elemental sulphur. The inclusion of peroxide oxidisable sulphur may have provided additional useful information regarding the nature of sulphides present.
Acceptable laboratory QC results	Yes	ALS Environmental reported: ▪ Analysis Holding Times compliance ▪ Quality Control Type Frequency Compliance ▪ Quality Control Outliers compliance

In summary, the analytical results were of acceptable quality for the purposes of this report.

5.4.2 Results of field pH tests

Field pH (pH_F) and field peroxide pH (pH_{FOX}) tests were carried out at 0.25 m intervals for all soil bores to determine the acid generating potential of the soils. The test results are provided in Appendix D and summarised in Appendix E. The field pH vertical profile results are presented in Figure 4(a-d), and are discussed below.

- pHF in the surficial gravely sands was generally slightly acidic at around pH 5-6.
- A sharp decrease in pHF (increase in actual acidity) was evident at the clay horizon (circa 1-6 m BGS). Within the clay, pHF steadily decreased with depth, from pH 5 at around 2 m BGS to a low of pH 3.63 at 10 m BGS (borehole M5_400).
- Within borehole J_300, there was a sharp increase in pHF and correspondingly sharp decrease in pHFOX at around 16 m BGS, coincident with encountered groundwater. At 18.75 m BGS, pHFOX was 1.1.
- pHFOX was generally 1-2 pH units less than pHF. Noticeable exceptions included at 8.25 (E5_950) and 8 m BGS (E5_750), coincident with encountered groundwater, where no appreciable difference between pHF and pHFOX was observed.

5.4.3 Results of laboratory analysis

The field test indicated that acid sulphate soils were likely present across the site. To verify laboratory analysis was carried out at 0.5 m intervals to 2 m BGS and each meter thereafter for all soil bores. Results of chromium reducible sulphur, titratable actual acidity and total sulphur by LECO are included as in D, and are summarised in Table 4.5:

- Laboratory results between samples collected by hand auger and air core were comparable e.g. E5_750 1m (hand augered silty clay) and E5-750 1.5m (air cored silty clay). Therefore, the use of air core drilling technique did not interfere significantly with results.
- The laboratory results indicated combined actual and potential acidity greater than or equal to 18.7 moles H+/tonne occurs on-site.
- The overlying gravely sands have lowest net acidity, actual acidity ranging from 18-45 moles H+/tonne. The pH in KCl within the overlying sand ranged from 4.8 to 5.6.
- Clay soils within the unsaturated zone have net acidity ranging from 14-75 moles H+/tonne, due entirely to actual acidity
- Clay soils located beneath the watertable have the highest net acidity, due to the presence of potential and potential acidity.

In summary, the soils across the site have acid producing capability with equivalent acidity exceeding the action criteria.

Table 4.5: Potentially acidifying soils

Bore	Sample Depth	Soil Type	Total sulphur	pH_{KCL}	Potential Acidity	Potential Acidity	Actual Acidity	Net Acidity
E5_750	0-1	Sand	0.03	5.0	<10	-	16	22
E5_750	1-3	Silty Clay	0.02-0.08	4.7-5.0	<10	-	16-30	20-35
E5_750	3-6	Clay	0.02	4.8	<10	-	21-30	26-37
E5_750	6-7	Silty Clay	0.03	4.7	<10	-	31	37
E5_750	7-10	Clay	0.01-0.02	4.5-4.7	<10	-	31-41	37-42
E5_950	0-3	Sand	0.01-0.06	4.8-5.6	<10-10	-	19-35	20-45
E5_950	3-6	Clay	0.01-0.04	4.5-4.8	<10	-	11-36	14-38
E5_950	6-9.5	Silty Clay	0.02-0.06	4.5-4.6	<10	-	31-41	33-46
M5_400	0-1.5	Sand	<0.01	5.5-5.6	<10	-	8	12
M5_400	1.5-15	Clay (dry)	<0.010.02	4.4-5.5	<10	-	36-57	37-75
M5_400	15-21	Clay (wet)	0.2-0.86	4.2-4.4	<10	36-232	80-121	120-335
J_300	0-1.5	Sand	0.02-0.04	5.3	<10-11	-	12-39	18-39
J_300	1.5-15	Clay (dry)	<0.01-0.04	4.5-5	<10	-	16-55	17-56
J_300	15-20	Clay (wet)	<0.01-0.56	4.6-4.8	<10-190	-	28-46	36-223

Notes:

1: Total sulphur by LECO; Potential acidity is by chromium reducible sulphur; potential acidity is measured where pH KCl<4.5; actual titratable acidity; net acidity = TAA + potential + TPA; all results in mole H+/tonne oven dry basis.

5.4.4 Results of background water quality tests

Field measurements of pH were from surface water bodies in the general area surrounding the site, including stock water dams immediately south of Muchea East Road and a spring discharging water into the creek along Muchea East Road. The pH of dam waters was approximately 6.5, similar to the pH of rainwater. The pH of spring water was also 6.5.

Coffey (November 2006) reported groundwater in the general area surrounding the site was slightly to moderately acidic with pH's ranging from 3.01 (MW4) to 6.24 (MW9) and fresh (370 mg/L-TDS at MW1) to brackish (6,000 mg/L-TDS at MW12).

5.4.5 Extent of disturbance

Disturbance of the soils across the site will include the overlying topsoil, gravely sands and the clay resource.

The mean average thickness of overburden (including gravels and sand), which will be placed back on the site, is approximately 5.4 m. Beneath this an average 8.5 m band of clay is expected to be removed down to within 2 m to 5 m of the base of the clay aquitard. That is the excavations are not expected to encounter groundwater.

Excavated clays will be removed from the site and processed at Midland Brick and all overburden will be placed back on the site and the topsoil re-spread. The total disturbed area within Stage 1 is not expected to exceed 13 ha and the final landform will be internally draining.

6. Qualitative risk assessment

For a potential risk of acid pH to ecosystems, the following components are required for a complete exposure pathway:

- a source (e.g. actual or potential acid sulphate soils); and
- a transport mechanism between the source and the receiving ecosystem groundwater

Tables 6.1, 6.2 and 6.3 list the possible sources, transport mechanisms and receptors identified at the site.

Table 6.1: Potential sources of contamination

Acid Sources	Other contaminants
Actual acidity in overlying gravely sands	Acidity plus potential for mobilisation of heavy metals e.g. As, Al, Fe and reduced nutrient availability e.g. Nitrate
Actual acidity in clays	same
Actual and potential acidity in clays beneath the watertable	same

Table 6.2: Potential transport mechanisms

Transport Mechanism	Relevant processes
Vertical rainfall infiltration	Chemical speciation, dissolution, precipitation, ion exchange processes. This is considered unlikely given the low permeability of underlying clays. However, very gradual leaching of acidity from the soil profile is likely to occur naturally.
Lateral groundwater contaminant migration	Should contaminants enter the groundwater it is possible lateral migration could occur.
Overland flow	Topographic controls, sedimentation, bigeochemical processes. This is considered the most relevant transport mechanism.

Table 6.3: Potential receptors

Receptors	Pathways
Ecologies of creeks to the north and south of the site and Ellen Brook	The most likely migration pathway is overland flow
The beneficial use of groundwater for drinking water	Leaching of contaminants through the clay soils beneath the site to intercept groundwater is not likely.
The beneficial use of stormwater for stock drinking water or for irrigation of pasture	Lateral migration in groundwater and limited vertical migration in the vadose zone

Table 5.4 lists all the potential complete exposure pathways that may be applicable for impacts from the site in the event the site is developed.

Table 6.4: Potentially complete exposure pathways

Exposure Pathway	Risk
Adverse impact to surface water bodies (streams) by soil or water containing high levels of acidity migrating from the site via *overland flow*.	High
Adverse impacts on the beneficial use of groundwater from *acidity* .	Low

7. Conclusion

Based on the findings of the acid sulphate soil investigation at the site Parsons Brinckerhoff concludes that.

- The site slopes gently towards the south with a grade of approximately 18%. Surface drainage in the general area surrounding the site is towards an unnamed creek adjacent to Muchea east Road which runs along the southern boundary.
- The site is underlain by weathered grey/brown mottled clay of a marine origin from a depth of approximately 2 m to 8 m BGS. Horizons of organic silty clays occurred at depth. The clay is overlain by a gravely sand, which will be returned to a depth of 5.4 m following extraction.
- Groundwater was encountered within silty clays at approximately 15-17m BGS at the south-western corner and greater than 21m up slope or northern extent of the workings. Once the overburden is placed back on the surface the cover over watertable will vary from 7-10 m BGS.
- The vulnerability of groundwater to contamination is low based on the depth to groundwater and strong chemical attenuation properties of the underlying clay lithologies (Appleyard 1993 In: Davidson 1995).
- Soil pH tests indicated:
  - the overlying gravely sand is slightly acidic with pH at around 5-6;
  - a sharp decrease in pH_F was evident at the clay horizon (circa 1-6 m BGS) and within the clay pH_F steadily decreased with depth from pH 5 at around 2 m BGS to a low of pH 3.63 at 10 m BGS (borehole M5_400).
- Both laboratory and field results indicate actual and potential acidity exceeds the WA Department of Environment and Conservation assessment criteria.
- The likely source of actual acidity is precipitation of iron sulphides under anoxic marine conditions and subsequent oxidation of sulphides forming sulphuric acid as sea levels declined. Some of the acidity would have been leached by rainfall infiltration. In addition some of the acidity may have been lost by displacement of cations (e.g. Al3+, Mg2+) on cation exchange sites of clay minerals.
- Potential acidity was only encountered beneath the watertable (e.g. within borehole J_300 at around 15 m BGS), as expected because of the relatively permanent anoxic condition. Perched water encountered within silty clay at E5_950 and E5_750 at around 8 m BGS has negligible potential acidity, possibly due to oxic conditions and leaching of acidity from within the more permeable silty clays at this depth.

8. Acid sulphate soil management plan

The following management practices are recommended to prevent potentially complete exposure pathways from occurring during Stage 1 and, therefore, minimise the risk of harm to identified receptors as a result of the site works defined in Section 1 of this report.

The overall objectives are to:

- minimise mobilisation of acidity from disturbed areas;
- retain stormwater runoff from disturbed areas in detention basins and excavation voids and treat as required with lime dosing to neutralise acidity prior to any release or re-use; and
- facilitate the re-establishment of a vegetative cover to prevent erosion as part of the longer term management of the site.

Groundwater management

- The depth of excavations should be limited to the unsaturated zone and not extend below permanent groundwater where PASS most likely occurs.
- Groundwater was not encountered across the northern half of Stage 1 to a maximum depth of 21m BGS. It was encountered at the south-western corner at 15 m BGS (PB borehole J300) and across the central southern portion of Stage 1 at approximately 17 m BGS (MBC borehole L5-400) and 12 m BGS (MBC borehole L-400).

Drainage management

- Prior to commencing earthworks stormwater diversion drains will be constructed at the up-gradient boundary to minimise stormwater migration across worked areas.
- Stormwater runoff from worked areas shall be retained in stormwater detention ponds e.g. pit voids.
- Water levels within detention ponds shall be monitored to prevent overtopping.
- Any stormwater released from the site shall be monitored and treated as required.
- Roadside drainage system designed for proper discharge of runoff. To avoid erosion of soil.

Rehabilitation of exposed soils

- All slopes that have been disturbed during earthworks are to be stabilised.
- Topsoil stripped from the site is to be respread across the site with lime if necessary for revegetation.

Management of stockpiles

- Stockpiles including overburden, topsoil and clay stored on-site should be managed in a manner that will retain any leachate by stormwater runoff and prevent erosion through being stored within an undercover enclosure.

8.1 Monitoring programme

The following monitoring program is proposed for the protection of identified sensitive environmental receptors:

8.1.1 Surface water

- The Wandena Creek and the Muchea East Road creek will be screened for baseline conditions prior to earthworks and monitored regularly for at least two years after cessation of excavations, to confirm surface water bodies have not been adversely impacted. Monitoring frequency will be monthly during periods of high stream flow.
- The pH of water in detention basins and excavation voids will be checked especially for re-use and when overtopping is more likely e.g. greater than 80% capacity.

8.1.2 Groundwater

- Baseline groundwater quality should be established prior to commencing operations.
- Groundwater monitoring should be undertaken from a network of suitable monitoring bores during the life of the operation and for a period of at least two years following cessation of operations to confirm that groundwater has not been adversely impacted.

8.2 Performance criteria

Table 8.1 summarises the performance criteria that will be adopted for evaluating the management plan. These criteria are for assessing impact on off-site/down-stream to the development site.

Table 8.1: Performance Criteria

Medium	Acceptable Threshold
Streams and Groundwater	Less than 10% or 0.05 pH variation from background With respect to heavy metals in groundwater these should not exceed acceptable thresholds by 10x or background concentrations by 15 % where background concentration already exceeds adopted threshold.

9. Limitations

Scope of Services

This acid sulphate soil investigation and management plan report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Parsons Brinckerhoff (PB) ("scope of services").

Reliance on Data

In preparing the report, PB has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, PB has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. PB will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to PB.

Environmental Conclusions

In accordance with the scope of services, PB has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions.

Also, it should be recognised that site conditions, including the extent and concentration of contaminants, can change with time.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for Benefit of Client

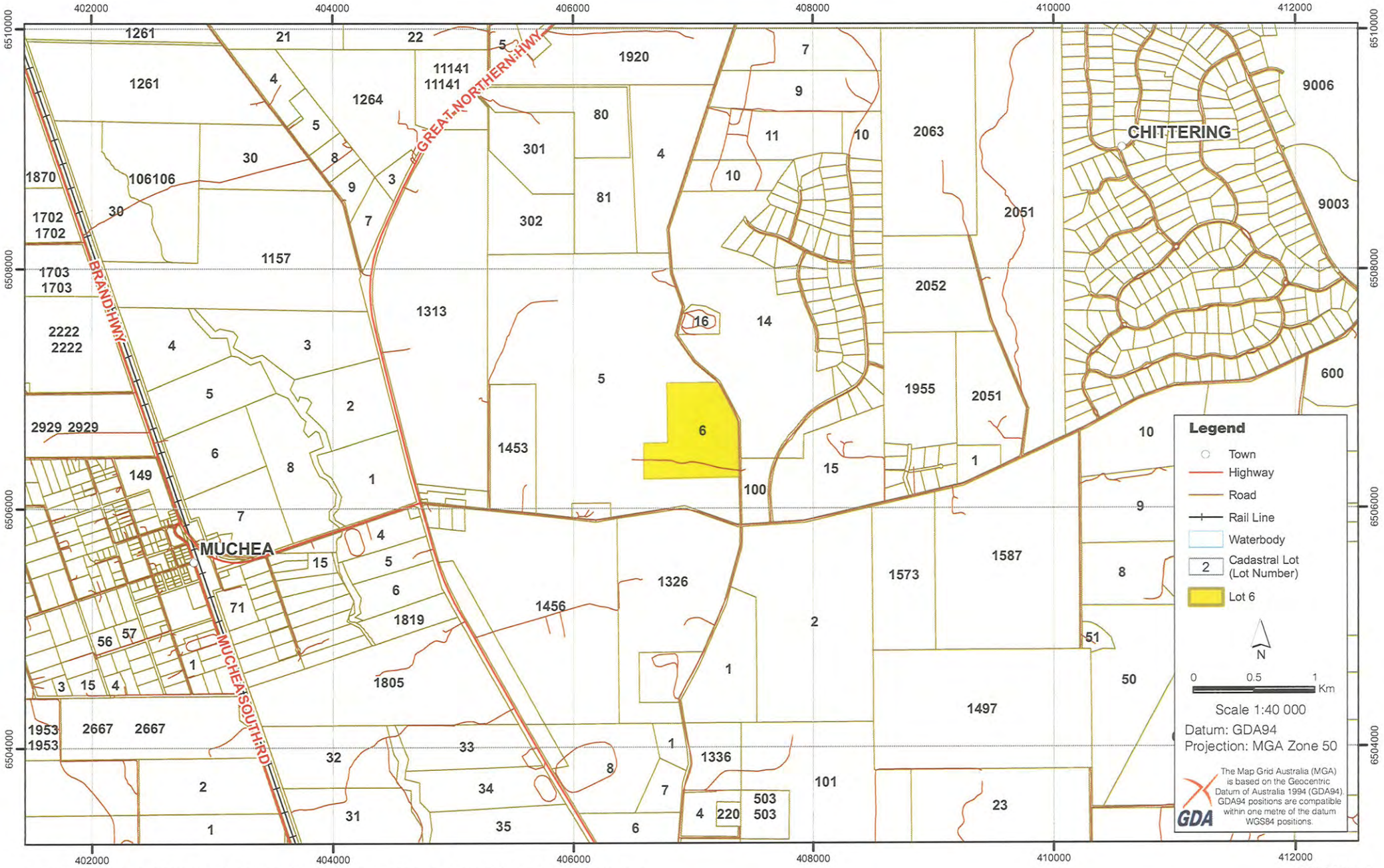
The report has been prepared for the benefit of the Client and no other party. PB assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of PB or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

PB will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

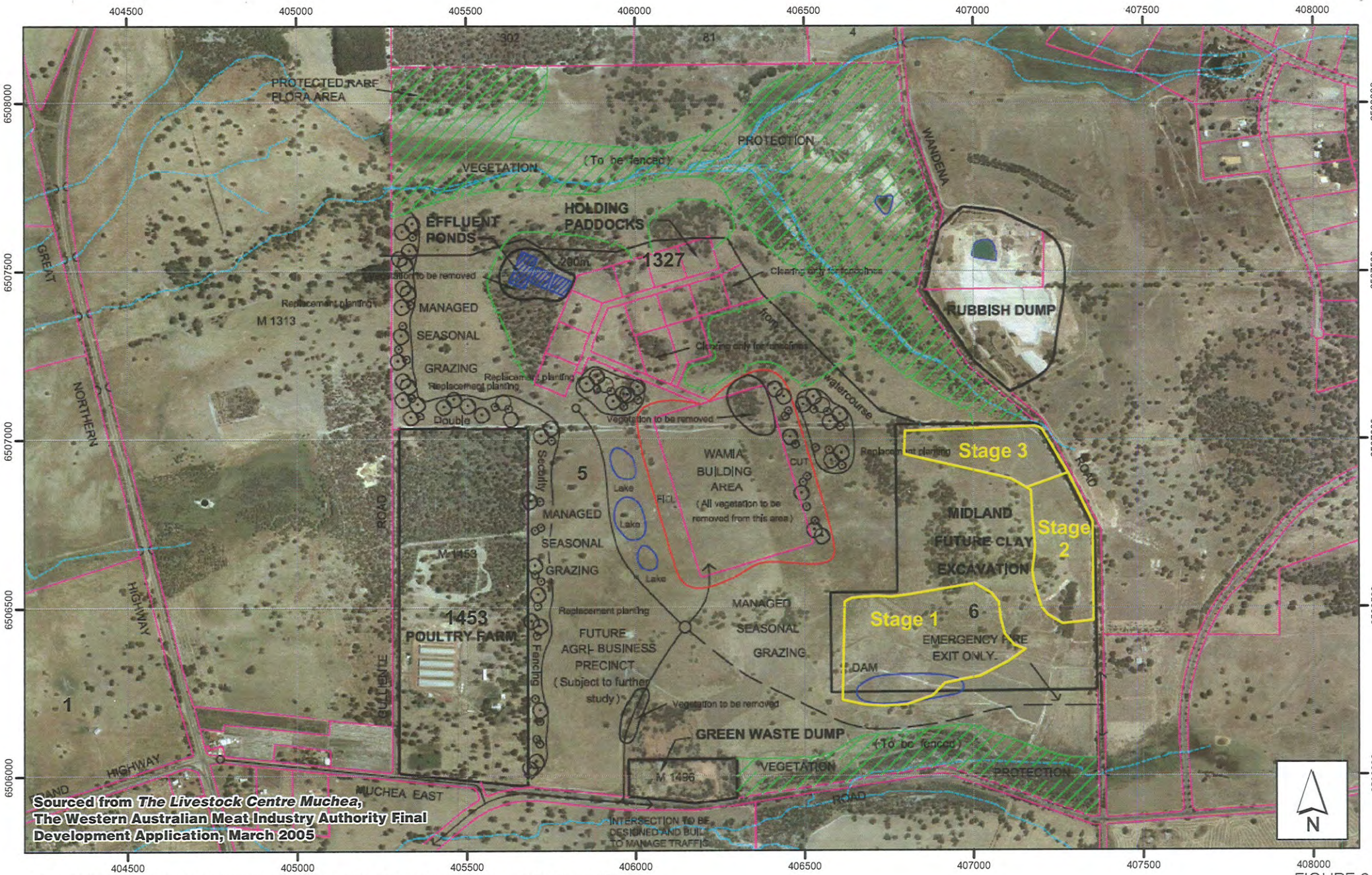
Figures



ACID SULPHATE SOIL MANAGEMENT PLAN - LOT 6 WANDENA ROAD, MUCHEA

FIGURE 1

SITE LOCATION

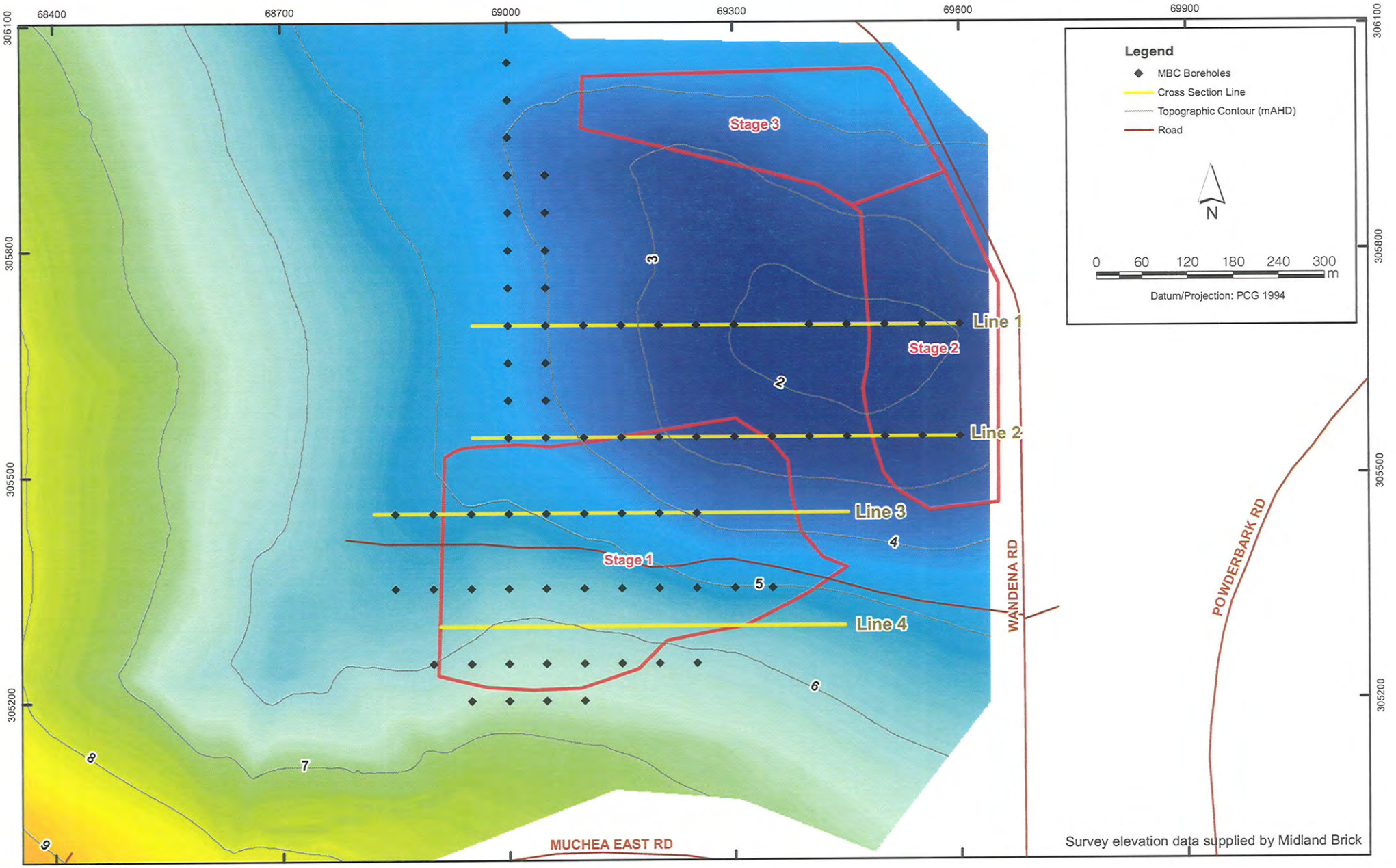


Sourced from *The Livestock Centre Muchea*, The Western Australian Meat Industry Authority Final Development Application, March 2005

ACID SULPHATE SOIL MANAGEMENT PLAN - LOT 6 WANDENA ROAD, MUCHEA

FIGURE 2

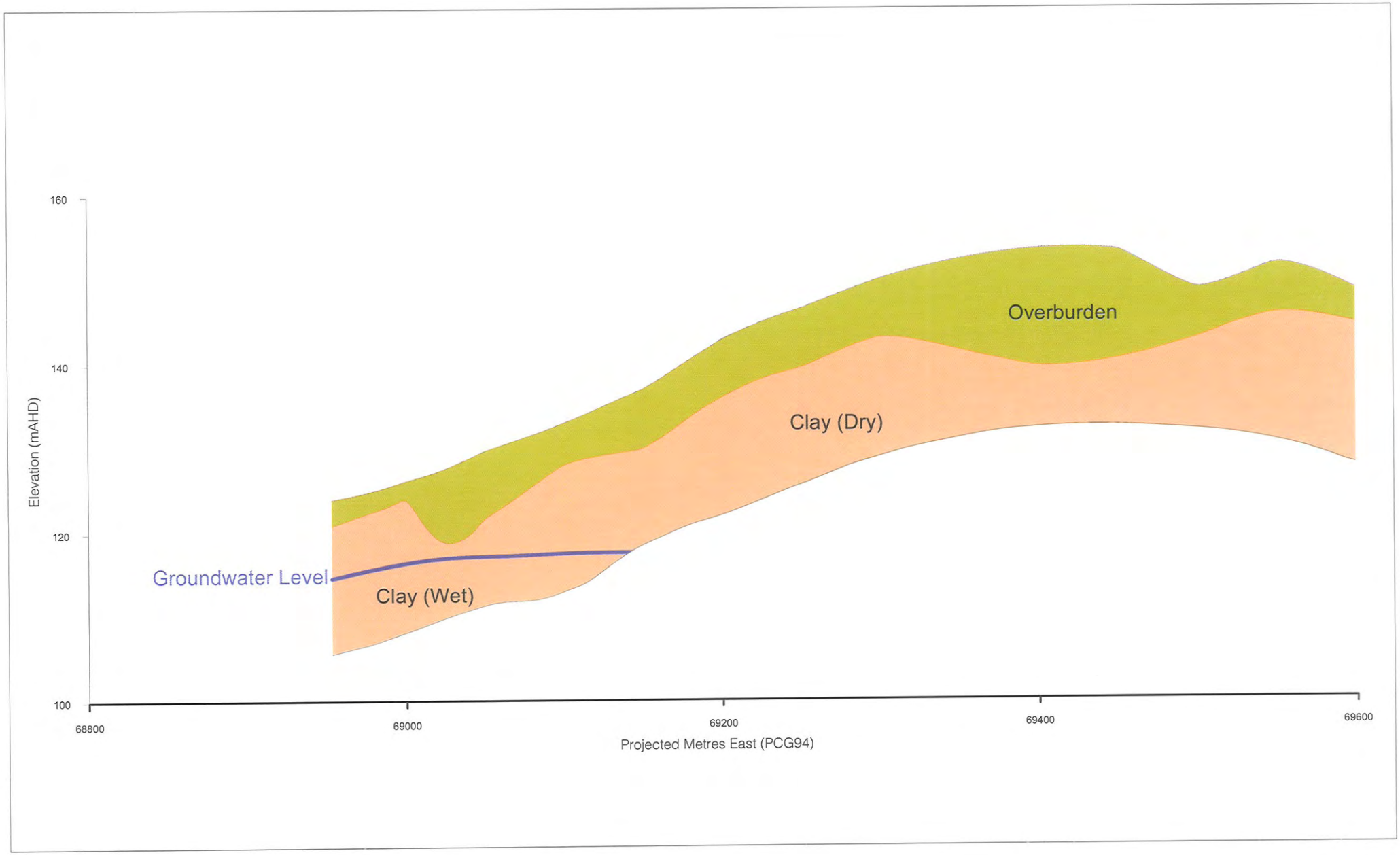
DETAILED SITE PLAN (showing proposed future landuse)



ACID SULPHATE SOIL MANAGEMENT PLAN - LOT 6 WANDENA ROAD, MUCHEA

FIGURE 3

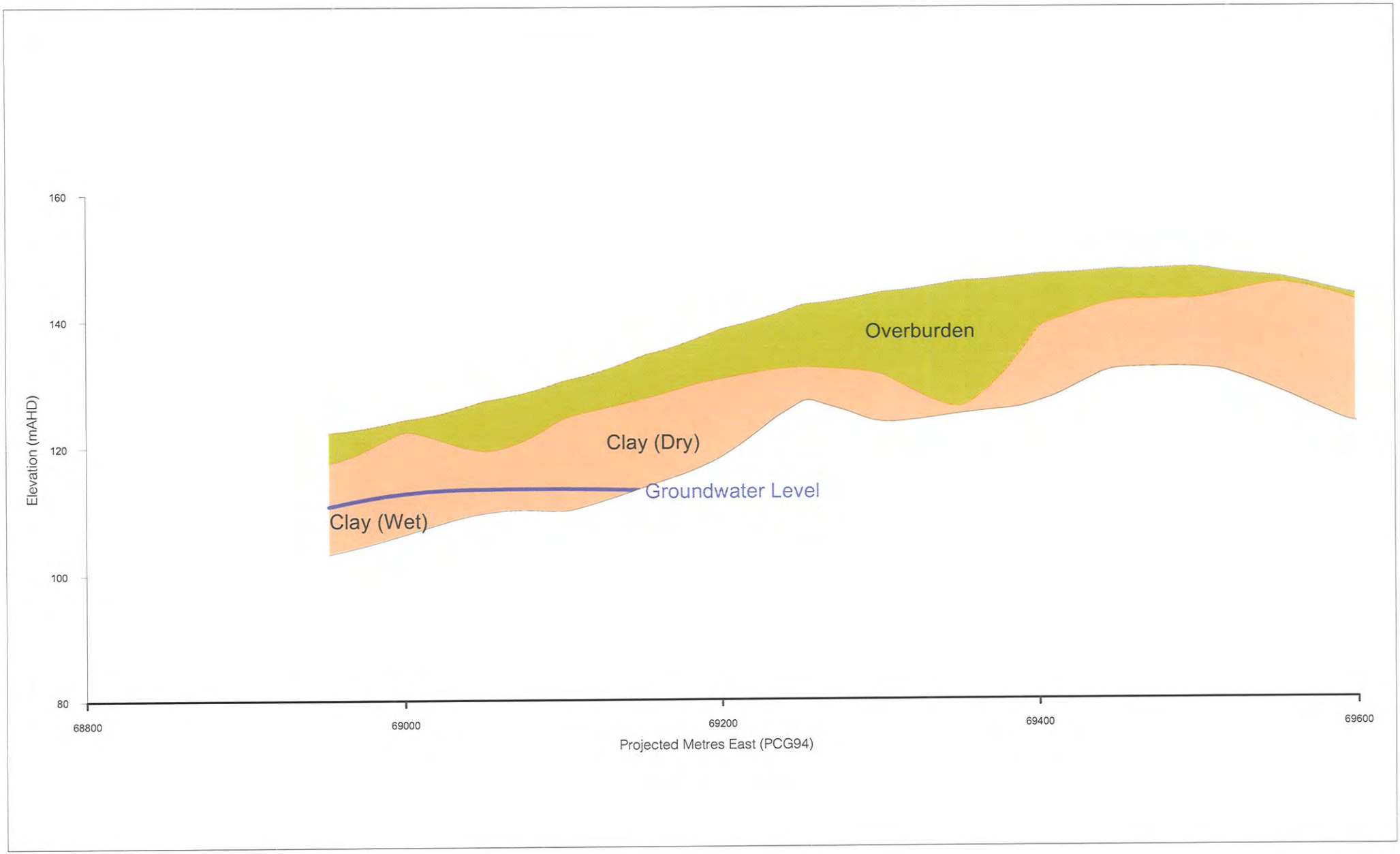
CROSS SECTION LINE LOCATIONS



ACID SULPHATE SOIL MANAGEMENT PLAN - LOT 6 WANDENA ROAD, MUCHEA

FIGURE 3A

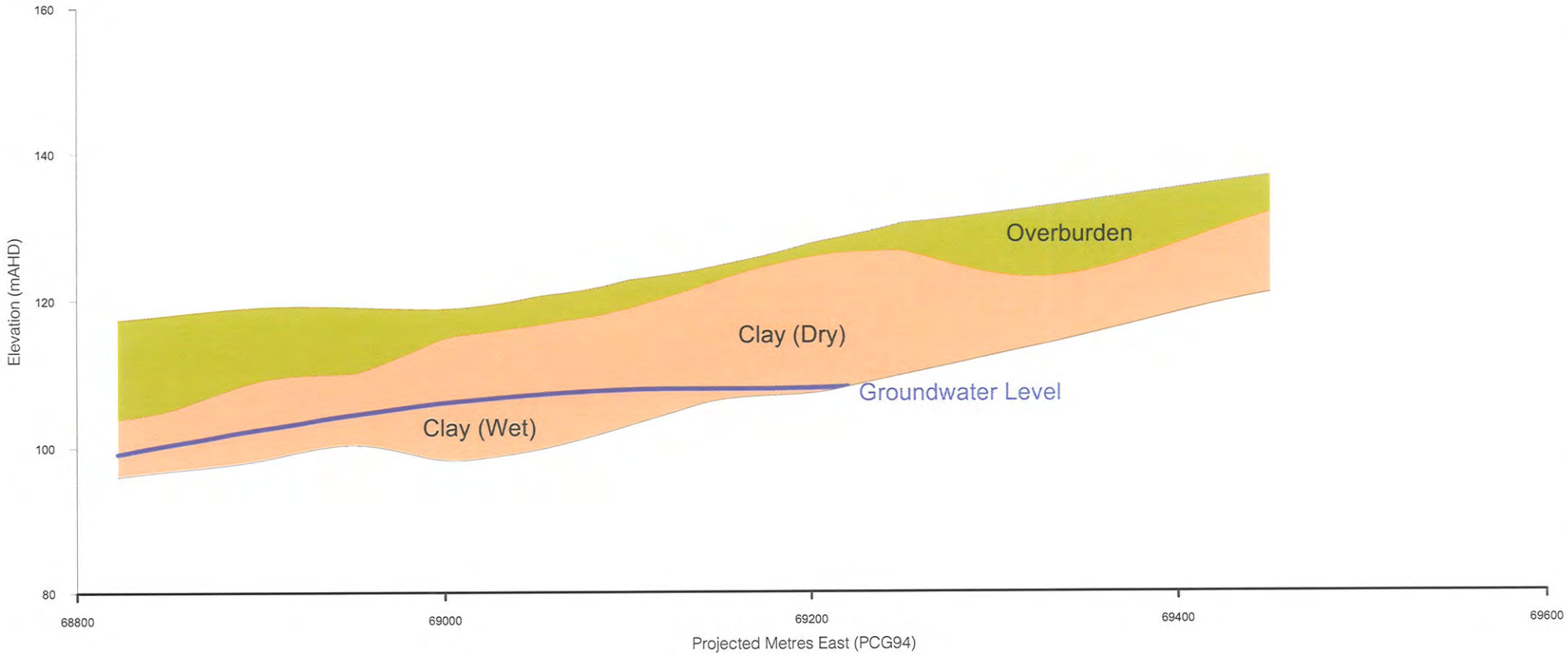
GEOLOGICAL MODEL - LINE 1 (305700mN)



ACID SULPHATE SOIL MANAGEMENT PLAN - LOT 13 WANDENA ROAD, MUCHEA

FIGURE 3B

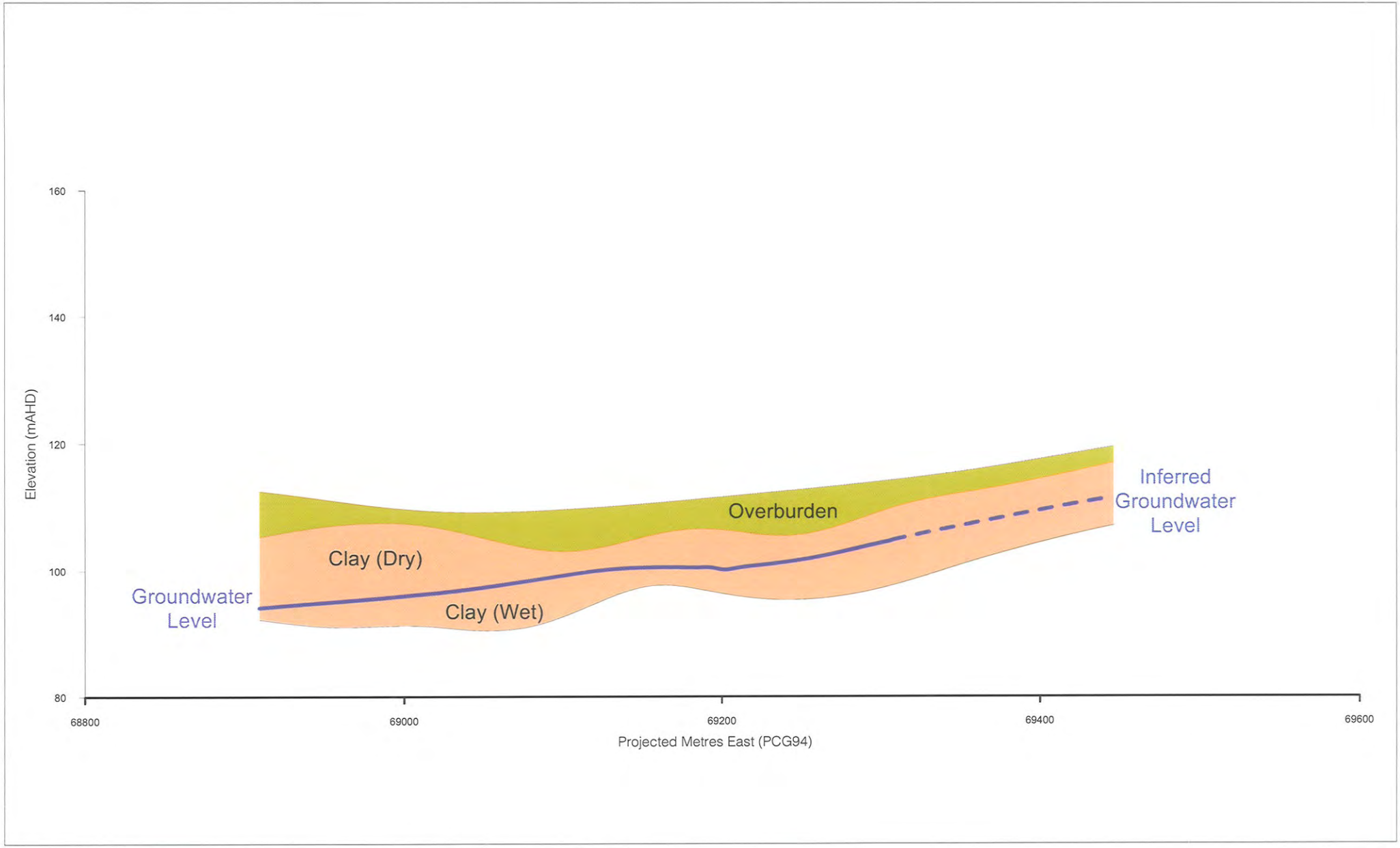
GEOLOGICAL MODEL - LINE 2 (305550mN)



ACID SULPHATE SOIL MANAGEMENT PLAN - LOT 13 WANDENA ROAD, MUCHEA

FIGURE 3C

GEOLOGICAL MODEL - LINE 3 (305450mN)



ACID SULPHATE SOIL MANAGEMENT PLAN - LOT 13 WANDENA ROAD, MUCHEA

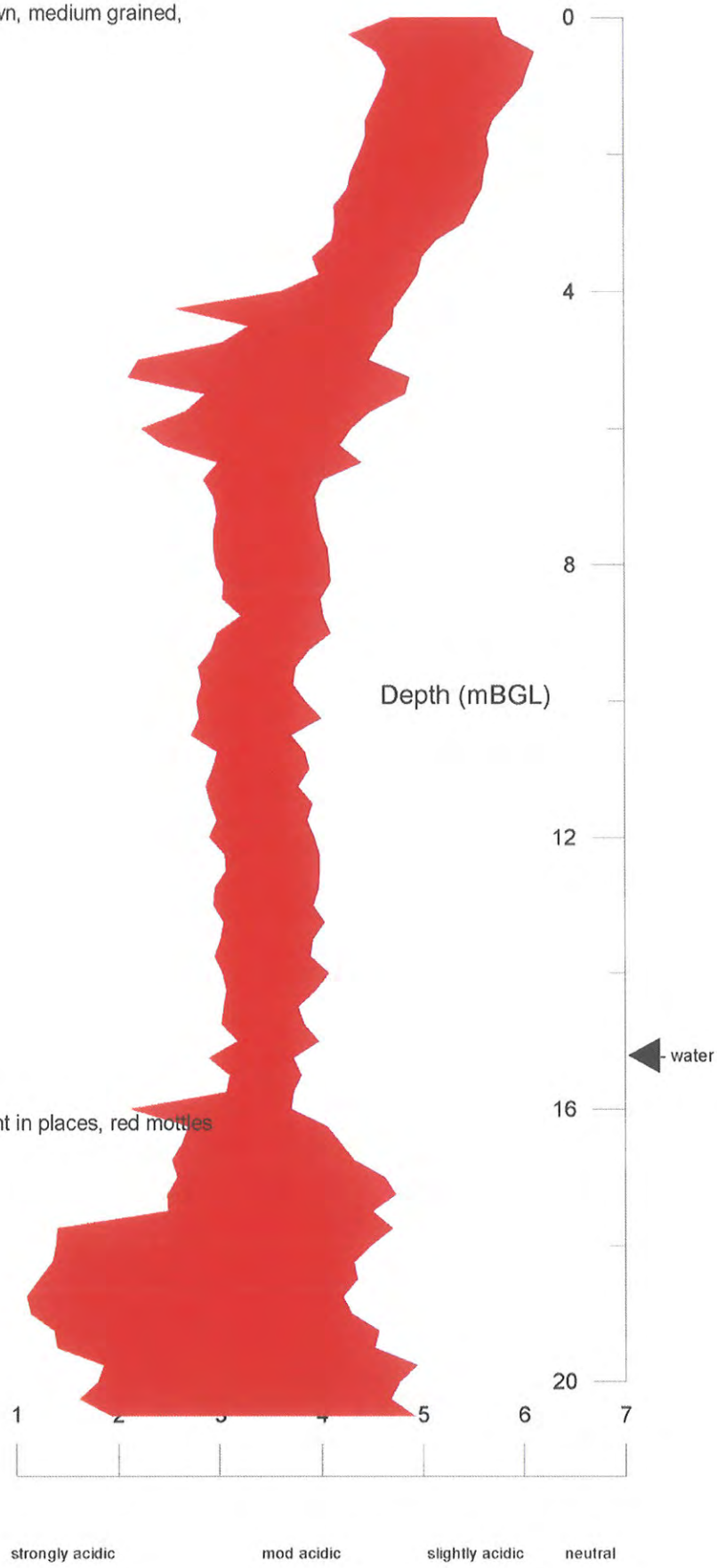
FIGURE 3D

GEOLOGICAL MODEL - LINE 4 (305300mN)

0-1.5mBGL **SAND:** gravelly sand, light brown, medium grained, sub-angular, minor OM

11.5-12.5mBGL **SILTY CLAY:**

1.5-20mBGL **CLAY:** grey/brown, plastic, tight in places, red mottles



ASS Management Plan - Lot 6 Wandena Road, Muchea

POTENTIAL ACIDITY; J_300

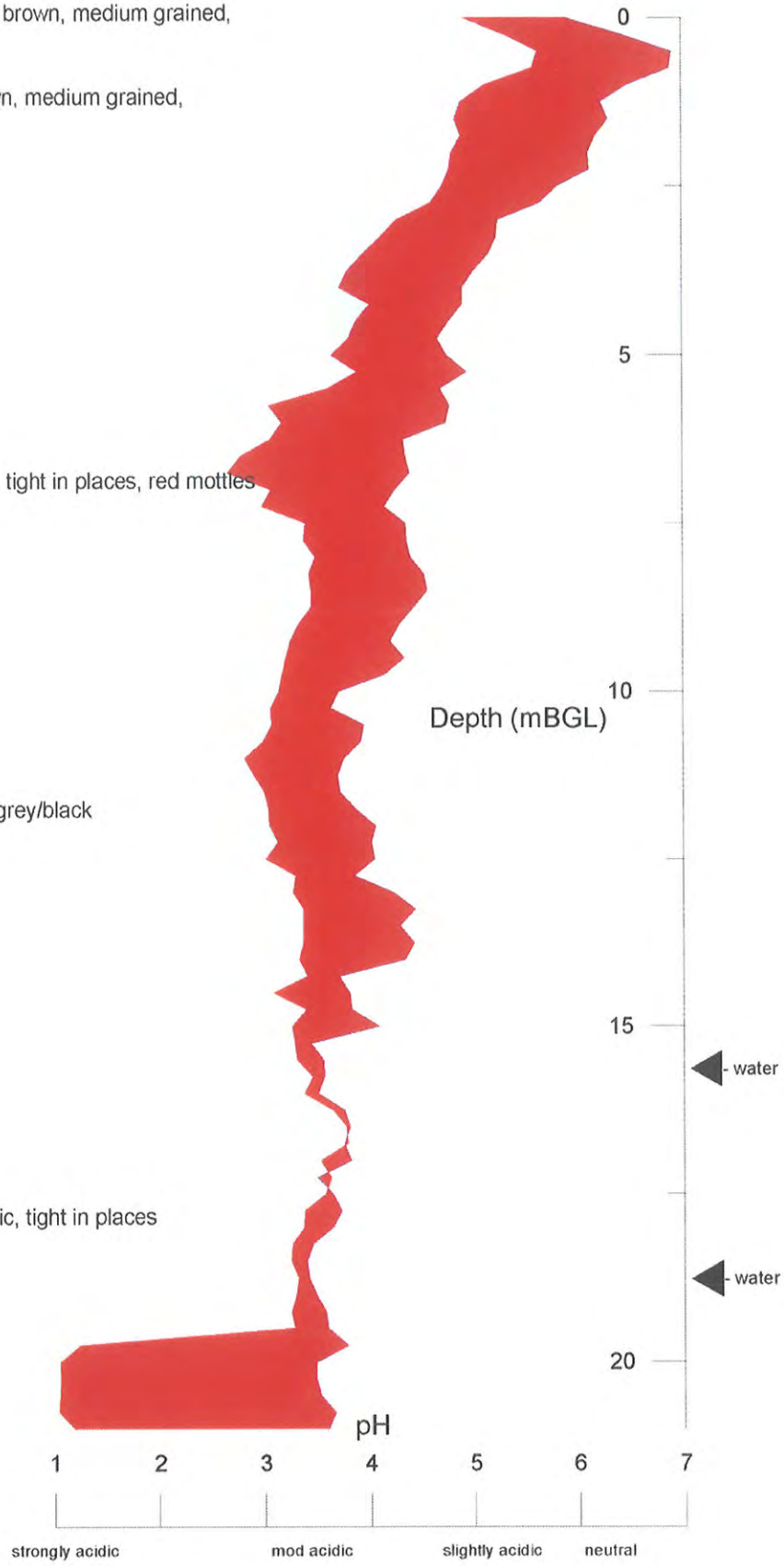
0-0.5mBGL **GRAVELLY SAND:** light brown, medium grained, sub-angular, minor OM

0.5-2.5mBGL **SILTY SAND:** light brown, medium grained, sub-angular

2.5-20mBGL **CLAY:** grey/brown, plastic, tight in places, red mottles

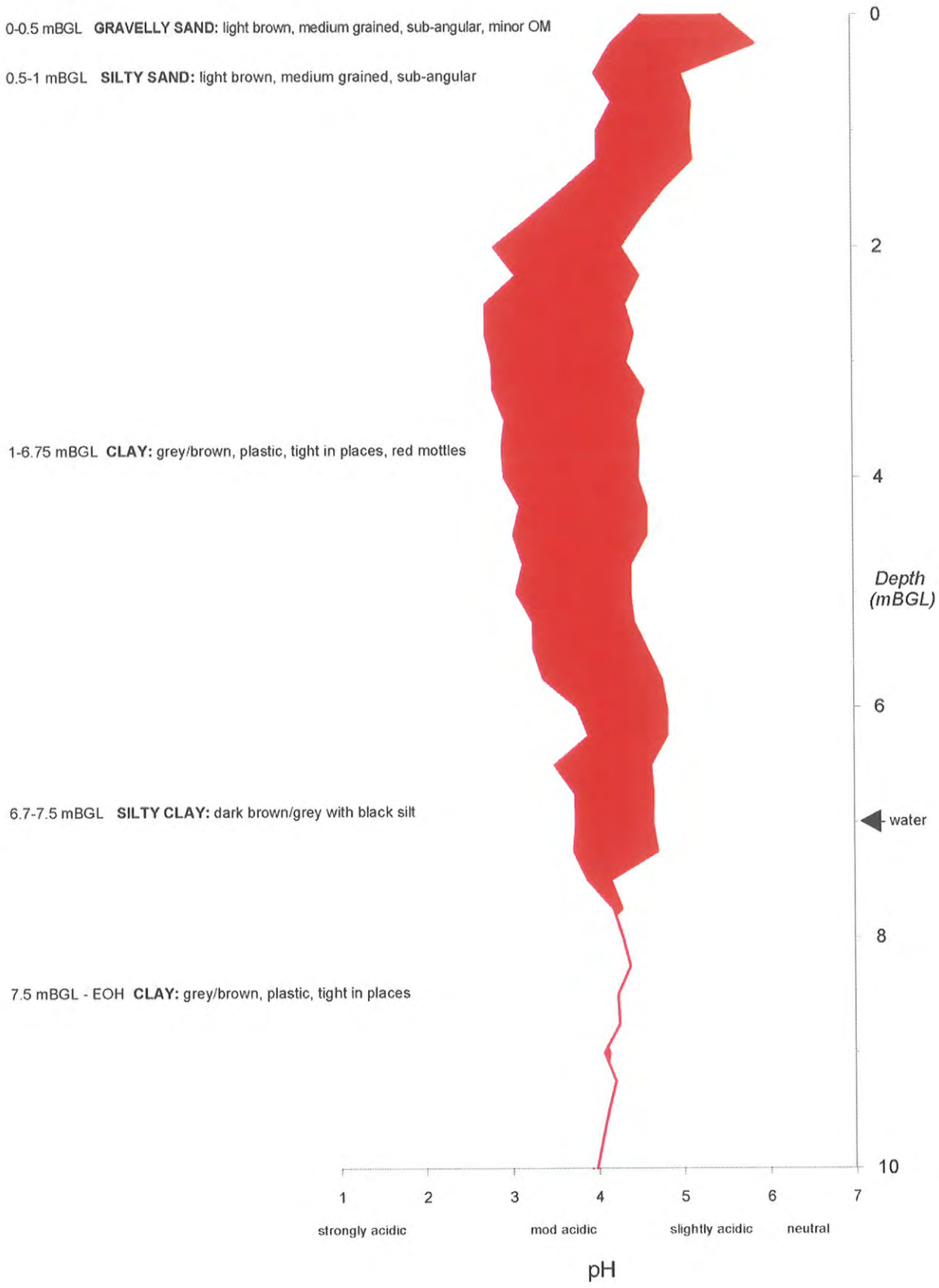
20-21mBGL **ORGANIC CLAY:** dark grey/black

7.5-eohmBGL **CLAY:** grey/brown, plastic, tight in places



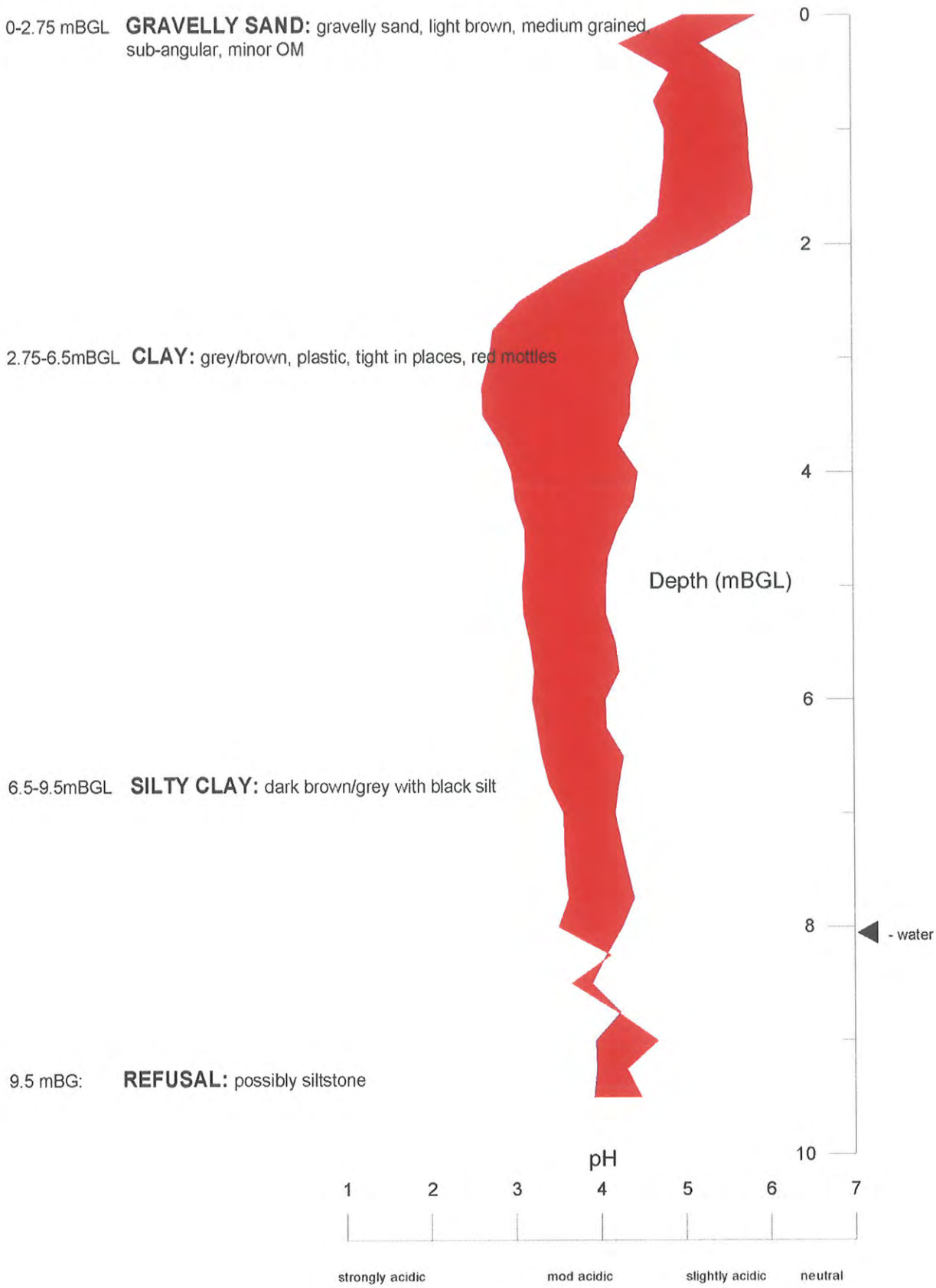
ASS Management Plan - Lot 6 Wandena Road, Muchea

POTENTIAL ACIDITY; M5_400



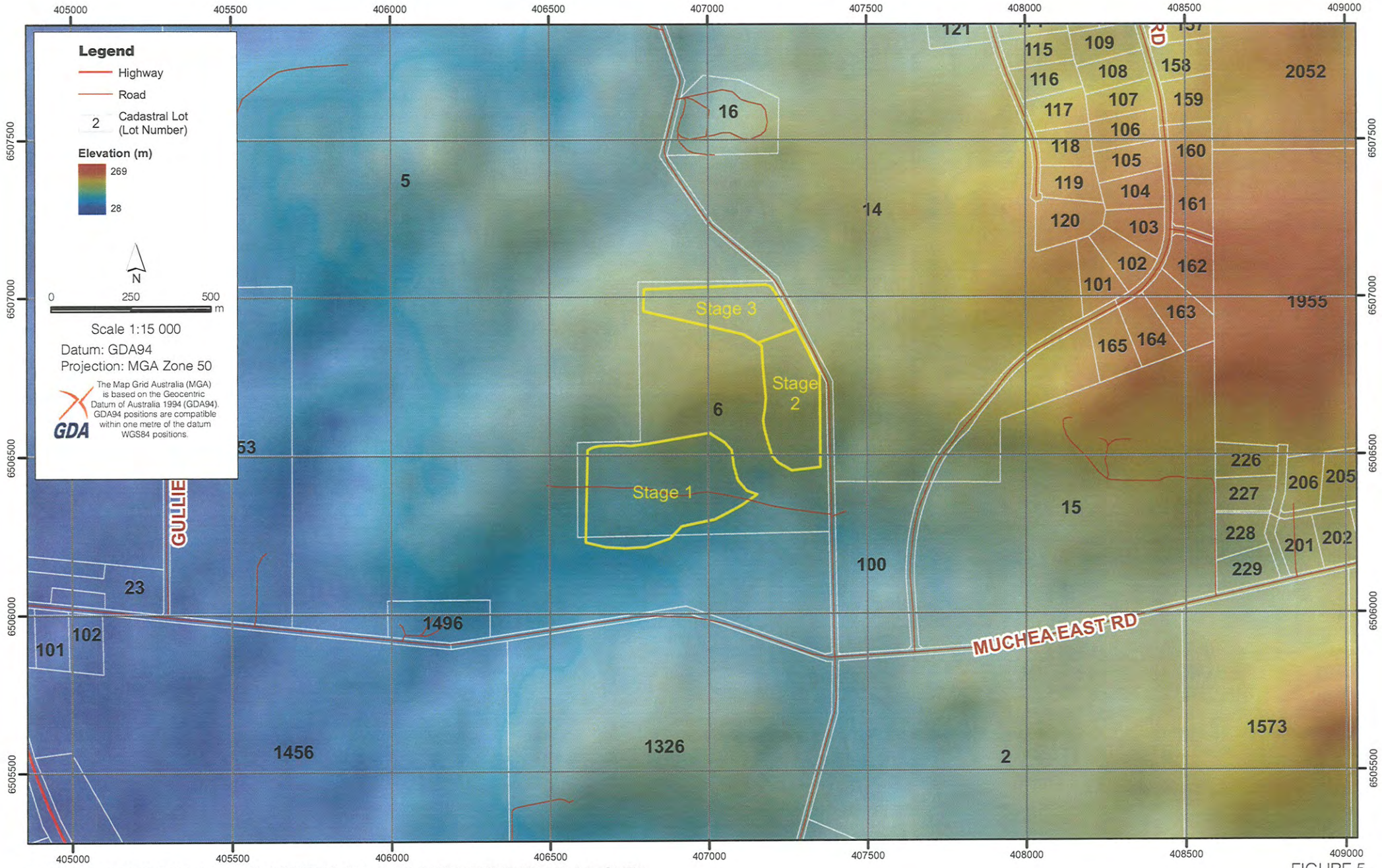
ASS Management Plan - Lot 6 Wandena Road, Muchea

POTENTIAL ACIDITY; E5_750



ASS Management Plan - Lot 6 Wandena Road, Muchea

POTENTIAL ACIDITY; E5_950



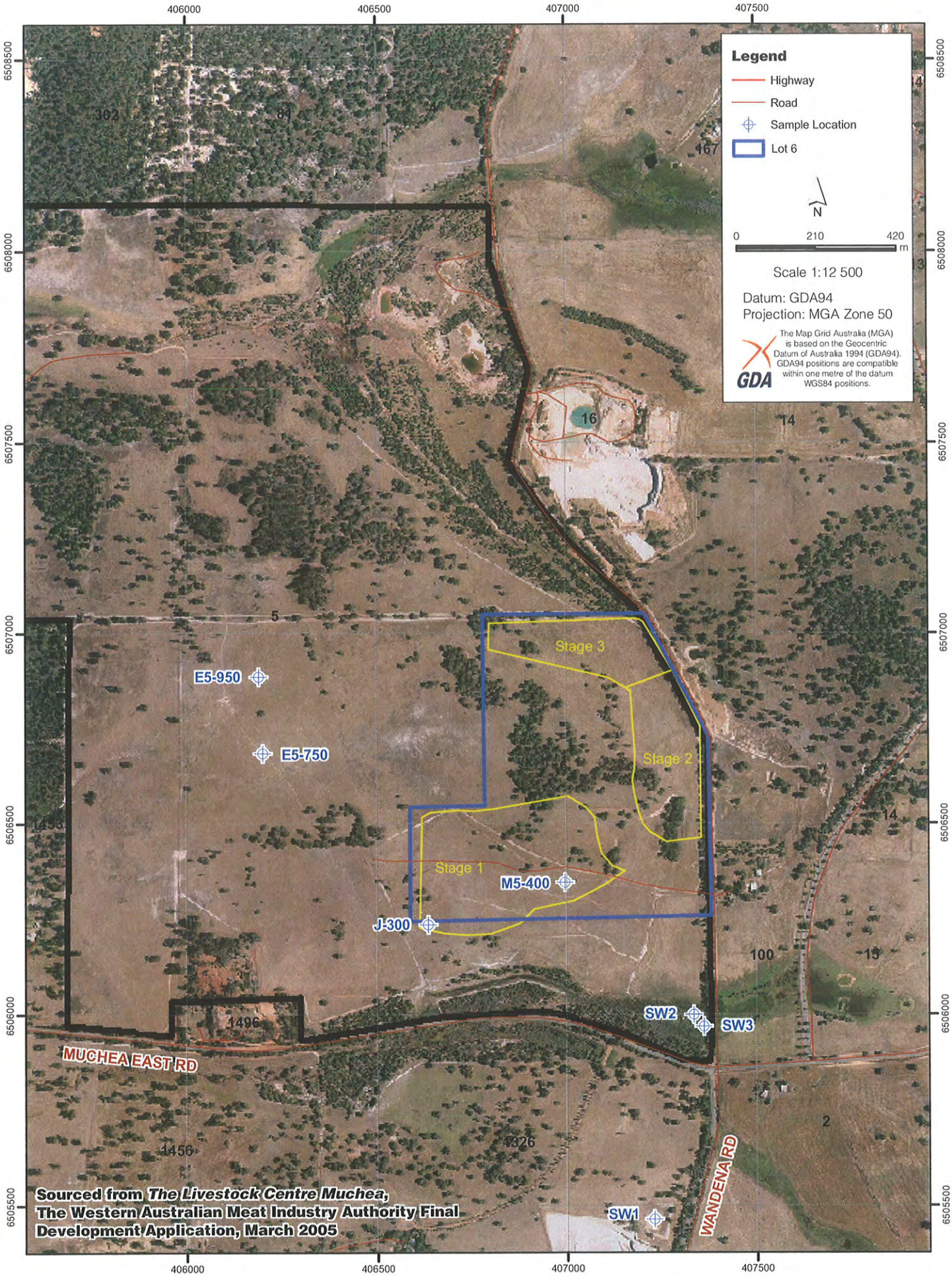
ACID SULPHATE SOIL MANAGEMENT PLAN - LOT 6 WANDENA ROAD, MUCHEA

FIGURE 5

DIGITAL ELEVATION MODEL

PARSONS BRINCKERHOFF • Email: perth@pb.com.au

DRN: JH CHKD: GR • Date: 14/12/2006 • PLAN No: 2145267A



ACID SULPHATE SOIL MANAGEMENT PLAN - LOT 6 WANDENA ROAD, MUCHEA

FIGURE 6

SAMPLE LOCATIONS

Appendix A

Extractive Industry Licence

SHIRE OF CHITTERING
Post Office Box 70
Great Northern Highway
BINDOON WA 6502

ABN: 48 445 751 800

OFFICE HOURS:
Monday to Friday
8.30am-4.30pm

Telephone: (08) 9576 1044
Facsimile: (08) 9576 1250

Email: chatter@chittering.wa.gov.au
Website: www.chittering.wa.gov.au

'Keeping the Balance'

OUR REF: MH: LD: 10.9.10 144/05
Enquiries to: Max Hipkins, Consulting Planner

14TH December 2005

Midland Brick
102 Great Northern Highway
MIDDLE SWAN WA 6056

Dear Sir / Madam ,

RE: SAT Review of Planning Application – Extractive Industry Lot 13 Wandena Road, Muchea

The above matter was presented to the Council meeting of the 30th November 2005 for consideration, whereby it was resolved as follows: -

That Council advises the Applicant and the State Administrative Tribunal in the matter of DR 584 of 2005 that it:

1. ***Consents to the Applicant's Draft Minute of Proposed Consent Orders received 16 November 2005, as follows:***
   1. ***The application for review be allowed.***
   2. ***The terms of the approval the subject of this application apply to the three staged proposed Extractive Industry use as set out in report entitled Evacuation – Rehabilitation Management plan – Lot 13 Wandena road, Muchea (the report) dated May 2005 accompanying the application for planning approval.***
   3. ***The conditions of approval of the respondent advised by letter to the applicant dated 15 September 2005 be amended as follows:***
      3.1 Conditions 4, 5, 7, 8, 9, 10, 14 and 18 be substituted as follows:

      <u>Condition 4</u>
      Prior to the commencement of each stage of excavation as shown on Figure 6 of the report:
      1. ***An assessment shall be conducted to determine whether acid sulphate soils are present on the land and, if present, their extent and severity;***
      2. ***If the stage is found to contain acid sulphate soils, an Acid Sulphate Soils Management Plan (ASSMP) shall be submitted and approved by the Council in consultation with the Department of Environment; and***
      3. ***Operations shall be carried out in accordance with the provisions of the approved management plan.***

      <u>Condition 5</u>
      Prior to the commencement of each stage of excavation a Soil and Water Monitoring Program, including methodology, will be submitted and approved by Council (in consultation with the Department of Environment) incorporating:
      1. ***Monitoring of soils and water excavated within areas identified as 'high risk' of containing Acid Sulphate Soil material (in accordance with an approved ASSMP); and***

2. *Periodic monitoring of water quality retained within on-site excavations.*

Condition 7
No discharge of pit-water to waterways will occur without prior approval from Council.

Condition 8
An Annual Report will be submitted to Council that includes:
1. *The progress of excavation;*
2. *Monitoring program results and findings;*
3. *Progress of rehabilitation;*
4. *Contingency actions and outcomes; and*
5. *Community complaints and responses.*

Condition 9
Rehabilitation of the pit to include surface water control measures on all pit faces to prevent gully erosion, and final batters to be graded to provide safe entry and exit slopes should access to standing water within the pit be required or accidentally occur.

Condition 10
A Close-out Plan will be submitted and approved by Council prior to the cessation of clay excavation works on each stage incorporating:
1. *Final revegetation and contouring plan;*
2. *Demarcation of surface water catchments;*
3. *Excavation pit hydrology, water balance and landscaping; and*
4. *Ongoing monitoring requirements.*

Condition 14
The hours of operation shall be limited to 0600 to 1800 Monday to Saturday. Any proposed operation outside of this time period will require written permission from Council.

Condition 18
Prior to clay transport, water shall be applied to all clay loads to eliminate dust generation during transit.

3.2 Conditions 6 & 17 be deleted
3.3 A further condition be added as follows;

Condition 25
A suitability qualified consultant be engaged to conduct ethnographic and archaeological surveys of this area in accordance with Part 4 Aboriginal Heritage Act 1972.

4. *The advice notes to those conditions do not form a part of the terms of this approval.*
5. *There be no order costs.*

2. *Would have no objection to the term of the planning consent being altered to coincide with the term of the Extractive Industry Licence, namely 5 (five) years;*
3. *Authorises the Chief Executive Officer to finalise the matter with the State Administrative Tribunal on the basis of 1 and 2 above;*
4. *Acknowledges the Application for Excavation Licence received 16 November 2005.*

A copy of the Council report is attached for your records.

If you require further information please contact Council's Consulting Planner, Max Hipkins by email on max@chittering.wa.gov.au or telephone 08 95761044.

Yours faithfully

Kenn Donnohoe
ACTING CHIEF EXECUTIVE OFFICER

Enc: Council Report
CC: State Administrative Tribunal
Level 4, 12 St Georges Tce
PERTH WA 6000

Appendix B

DoE Site Summary Form

Department of Environment

Site Summary Form (Acid Sulfate Soils Assessment)

For completion by person(s) submitting report(s) for assessment by the Department of Environment (DoE) as per the information requirements of the *Acid Sulfate Soils Guidelines Series*. Completion of this form assists the DoE in maintaining an accurate and consistent record for the site.

Please note: A completed Site Summary Form must accompany each report submitted to the DoE for assessment. Copies of all relevant Certificates of Title must accompany this form.

Site Location Details:

Site Name (e.g. where site may be known by a common/ business name)

Lot No. Lot 6 **House No.** **Street** Wandena Rd

Suburb Muchea **State** WA **Postcode**

Crown Reserve (if applicable)

Certificate(s) of Title (or equivalent) Volume/Folio:

Is a hard copy of Certificate of Title and associated sketch for the site attached? (Y/N) If No, why not?

Current Owner/Occupier Details:

Site Owner (Name and address) Midland Brick

Site Occupier (Name and address) same

Site Status (at time of reporting):

Previous and current land use (e.g. market gardens, industrial, landfill, marina) agriculture grazing

Proposed land use (e.g. high density residential/child care facility, ornamental lake, canal development) quarry (clay)

Nature of proposed works (e.g. installation of deep sewer, cut and fill, excavation for ornamental lake)

Are ASS present on the site? yes

Proposed works:

Are ASS proposed to be disturbed by excavation?
(If yes, provide details e.g. soil volumes, depths, lateral extent, etc) yes (see attached)

Are ASS proposed to be disturbed by groundwater modification?
(e.g. dewatering, groundwater abstraction, drainage, aquifer recharge/re-injection)
(If yes, provide details e.g. cone of depression, dewatering/drainage volumes, pumping rates, depths, lateral extent, etc) No

If dewatering is proposed, has a dewatering licence been applied for from the Department of Water? I f not, why not?	NA
Is dredging proposed? I f yes, provide details	No

Investigations

Desktop assessment (e.g. ASS risk map, elevation, vegetation, iron staining, corrosion, scalds, water quality, peat swamp)	See attached
Field inspection and screening (e.g. description of soils, pH and peroxide field tests, water pH & acidity)	as above
Laboratory analysis of soils and water for existing acidity and acid generating potential (e.g. SPOCAS, S_{CR}, water quality)	as above
Where laboratory analysis has been undertaken, is the laboratory NATA accredited for ALL analytes and analytical methodologies used? (Y/N) (If No, why not?)	yes
Identified substances and relevant media (e.g. sulfides in soil, arsenic in soil and/or groundwater, jarosite in soil, iron monosulfides, metal hydroxides)	See attached

History of Investigation:

Have previous site investigations been undertaken? (Y/N - if yes, please provide details below) yes

Report title, date and author: Preliminary Site Assessment for ASS Style 1 Lot 6 Wanderer Rd Madeira (BBG, 2006)

Declaration:

The information presented in this Site Summary Form is a true representation of the information within the attached report(s)/document(s).

Full name (print)	Anthony G. Ralph
Position held	Snr Env Scientist, PG
Signature	
Date	16/2/07

Please ensure that a hardcopy of the current Certificate(s) of Title and associated sketch accompanies the Site Summary Form. The DoE cannot proceed with the assessment of the report in the absence of this information.

Appendix C

Bore Logs

BOREHOLE ENVIRONMENTAL LOG

BOREHOLE NO.
E5_750
SHEET 1 OF 1

Client:	WAMIA	Date Commenced:	11/04/06
Project:	WAMIA Acid Sulphate Soils Investigation	Date Completed:	11/04/06
Borehole Location:	Muchea	Recorded By:	GR
Project Number:	200616511	Log Checked By:	EB

Drill Model/Mounting: Air Core — Hole Angle: 90° — Surface RL:
Borehole Diameter: — Bearing: --- — Co-ords: E 406202 N 6506684

Borehole Information						Field Material Description					
1	2	3	4	5	6	7	8	9	10	11	12	13
METHOD	SUPPORT	WATER	RL(m) DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE		HAND PENETROMETER (kPa)	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.50					SAND: Grey / brown, loamy	D			
			1.00 1					SILTY SAND: Tan, some gravel				
			1.25					SILTY CLAY: Tan / grey, with orange mottles, some gravels				
			2					SILTY CLAY: Dark brown / grey, with orange mottles				
			3.00 3					CLAY: Grey, crumbly, with dark brown silt				
			3.75 4					CLAY: grey				
			5									
			5.50					CLAY: Light grey, with red / brown mottles				
			6									
			6.25					CLAY: Light clay				
			6.50					CLAY: Grey, with red / brown mottles and black layers				
			6.75 7					SILTY CLAY: Dark brown / black silt with grey clay				
		▼ 11/04/06	7.50					CLAY: Brown / grey, wet	W			
			7.75 8					CLAY: Dark grey / brown, with red mottling, wet				
			9									
			10					END OF BOREHOLE AT 10.00 m				

This borehole log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

BOREHOLE ENVIRONMENTAL LOG

BOREHOLE NO.
E5_950
SHEET 1 OF 1

Client:	WAMIA	Date Commenced:	11/04/06
Project:	WAMIA Acid Sulphate Soils Investigation	Date Completed:	11/04/06
Borehole Location:	Muchea	Recorded By:	GR
Project Number:	200616511	Log Checked By:	EB

Drill Model/Mounting: **Air Core** Hole Angle: **90°** Surface RL:
Borehole Diameter: Bearing: --- Co-ords: **E 406191 N 6506885**

Borehole Information						Field Material Description					
1	2	3	4	5	6	7	8	9	10	11	12	13
METHOD	SUPPORT	WATER	RL(m) DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE		HAND PENETROMETER (kPa)	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.00					SAND: fine, loamy, brown, some gravels	D			
			1									
			2.00 2					SILTY SAND: Brown, with some grey clay	M			
			2.25					SAND: loam, grey clay, with orange mottles				
			2.75					CLAY: Light grey, crumbly				
			3									
			3.75					CLAY: Light grey, with orange and red mottles				
			4									
			5.00 5					CLAY: Light grey, no mottles				
			6									
			6.50					SILTY CLAY: Brown / grey				
			6.75					SILTY CLAY: Brown / clay				
			7.00 7					SILTY CLAY: Brown / grey, with red mottles				
			8.00 8					SILTY CLAY: Dark brown, with red mottles				
		▼ 11/04/06	8.25					SILTY CLAY: Brown / grey	W			
			9									
								BEDROCK: Refusal assumed granite bedrock				
			10					END OF BOREHOLE AT 9.50 m				

This borehole log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

BOREHOLE ENVIRONMENTAL LOG

BOREHOLE NO.
J_300
SHEET 1 OF 1

Client:	WAMIA	Date Commenced:	11/04/06
Project:	WAMIA Acid Sulphate Soils Investigation	Date Completed:	11/04/06
Borehole Location:	Muchea	Recorded By:	GR
Project Number:	200616511	Log Checked By:	EB

Drill Model/Mounting: Air Core | Hole Angle: 90° | Surface RL:
Borehole Diameter: | Bearing: --- | Co-ords: E 406635 N 6506234

Borehole Information						Field Material Description					
1	2	3	4	5	6	7	8	9	10	11	12	13
METHOD	SUPPORT	WATER	DEPTH(m) RL(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE		HAND PENETROMETER (kPa)	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.50					SILTY SAND: Grey / brown, with some organic matter	D			
			1.00 1					SAND: Brown, gravelly loam				
			1.50					SAND: Orange / brown, gravelly loam				
			2					SANDY CLAY: Tan, gravel				
			2.50					CLAY: Tan / grey mottling				
			3.00 3					CLAY: Grey / light brown, orange mottling				
			3.50					CLAY: Grey / light brown, orange mottling, with some dark clods				
			3.75 4.00 4					CLAY: Light grey				
			5					CLAY: Grey				
			5.75 6.00 6					CLAY: Dark grey / brown, clods of organic matter				
								CLAY: Brown / grey				
			6.75 7.00 7					CLAY: Brown, with grey flecks				
								CLAY: Brown, with grey flecks				
			7.75 8.00 8					CLAY: Grey / brown				
								CLAY: Grey				
			8.50 8.75 9					CLAY: Grey, with dark brown organic clods				
								CLAY: Grey				
			9.25					CLAY: Grey, with dark brown clods, minor orange mottles				
			9.75 10					CLAY: Brown silty organic matter, with grey clay				
			10.25					CLAY: Grey, with minor brown silt				
			10.50					CLAY: Brown silty organic matter, with grey clay				
			10.75 11					CLAY: Grey				
			11.25					CLAY: Grey, with orange mottling				
			11.50					SILTY CLAY: brown / grey, with orange mottles				
			12					SILTY CLAY: Grey / brown, moist	M			
			12.25 12.50					SILTY CLAY: Grey / brown, with orange mottles, moist				
			13					CLAY: Brown / grey, red layering (suspect coffee rock), moist				
			13.75 14									
		11/04/06	15.00 15					CLAY: Grey, with red mottling, wet	W			
			16									
			16.50 17					CLAY: Dark brown, moist, with mottling	M			
			18									
			18.25					CLAY: Dark Grey				
			19									
			20.00 20									
			21					END OF BOREHOLE AT 21.00 m				

This borehole log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

BOREHOLE ENVIRONMENTAL LOG

BOREHOLE NO.
M5_400
SHEET 1 OF 1

Client:	WAMIA	Date Commenced:	11/04/06
Project:	WAMIA Acid Sulphate Soils Investigation	Date Completed:	11/04/06
Borehole Location:	Muchea	Recorded By:	GR
Project Number:	200616511	Log Checked By:	EB

Drill Model/Mounting: Air Core | Hole Angle: 90° | Surface RL:
Borehole Diameter: | Bearing: --- | Co-ords: E 406997 N 6506346

Borehole Information						Field Material Description				
1	2	3	4	5	6	7	8	9	10	11	12	13
METHOD	SUPPORT	WATER	RL(m) DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE		HAND PENETROMETER (kPa)	STRUCTURE AND ADDITIONAL OBSERVATIONS
			1					SAND: Brown loam, gravel, dry, minor clay content	D			
			1.25					CLAYEY SAND: Light brown, garvel, dry				
			1.50 2					SANDY CLAY: Brown, red mottles, white flecks				
			2.50 3					SANDY CLAY: Brown				
			3.75					CLAY: Grey / brown				
			4.00 4					CLAY: Grey				
			4.25					CLAY: Pale grey				
			5.00 5					CLAY: Grey / brown with red mottles				
			5.25					CLAY: Brown				
			5.50					CLAY: Grey / brown, possible organics				
			6.00 6					CLAY: Grey				
			7.00 7					CLAY: Brown, gritty, grey flecks				
			7.25					CLAY: Brown / grey				
			7.50 8					CLAY: Pale grey				
			8.75					CLAY: Grey				
			9.00 9					CLAY: Brown, with red mottles				
			9.50					CLAY: Dark grey				
			9.75					CLAY: Brown / grey				
			10.00 10					CLAY: Grey / brown, with red mottles, moist	M			
			10.50					CLAY: Grey / brown, moist	D			
			10.75					CLAY: Grey / brown, dry				
			11.00 11					CLAY: Dark grey, with red mottles, slightly moist	M			
			11.50 12					CLAY: Grey, orange mottles, moist				
			12.75					CLAY: Light brown, / grey, orange mottles, moist				
			13.00 13					CLAY: Grey, with red mottles				
			13.50 14					CLAY: Brown / grey, with red mottles				
		▼ 11/4/06	15.00 15					CLAY: Brown / grey, with red mottles, wet	W			
			16.00 16					CLAY: Brown / grey, with red mottles, moist	M			
			16.25					CLAY: Brown, with red mottles, some moisture				
			17.25					CLAY: Dark brown, with possible organic matter, dry	D			
			17.50 18					CLAY: Dark brown, with red mottles, dry				
		▼ 11/4/06	18.25					CLAY: Dark brown, with red mottles, wet	W			
			19									
			19.50					CLAY: Dark grey / brown, with red mottles, dry to moist	M			
			19.75 20					CLAY: Dark grey / black, organic matter (peat), no odour				
			21					END OF BOREHOLE AT 21.00 m				

This borehole log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

Appendix D

Laboratory Certificates of Analysis

ALS Environmental

CERTIFICATE OF ANALYSIS

Client	: PARSONS BRINCKERHOFF AUST P/L	Laboratory	: ALS Environmental Perth	Page	: 1 of 17
Contact	: MR EWAN BOTTERILL	Contact	: Shaun Crabb	Work Order	: EP0600907
Address	: 1 ALVAN STREET SUBIACO WA AUSTRALIA 6008	Address	: 10 Hod Way Malaga WA Australia 6090		
E-mail	: ebotterill@pb.com.au	E-mail	: Shaun.Crabb@alsenviro.com		
Telephone	: 08 9489 9700	Telephone	: 61-8-9209-7655		
Facsimile	: 08 9380 4060	Facsimile	: 61-8-9209-7600		
Project	: 200616511	Quote number	: EN/008/05	Date received	: 20 Apr 2006
Order number	: - Not provided -			Date issued	: 8 May 2006
C-O-C number	: - Not provided -			No. of samples	- Received : 68
Site	: Muchea				Analysed : 68

ALSE - Excellence in Analytical Testing

NATA Accredited Laboratory 825

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

This document has been digitally signed by those names that appear on this report and are the authorised signatories. Digital signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	Position	Department
Kim McCabe	Inorganics Supervisor	Inorganics - NATA 825 (818 - Brisbane)
Shaun Crabb	Laboratory Manager	Perth Inorganics - NATA 825 (15847 - Perth)

ALS Environmental

Comments

This report for the ALSE reference EP0600907 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- **Analytical results for samples submitted**

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

- **Surrogate control limits**

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

Specific comments for Work Order **EP0600907**

ANC not required because pH KCl less than 6.5

Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. Conversion to liming rate in kg/m3 = kg/t x wet bulk density in t/m3.

ALS Environmental

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : E5_750 0.50	E5_750 1.0	E5_750 1.50	E5_750 2.0	E5_750 3.0
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-001	EP0600907-002	EP0600907-003	EP0600907-004	EP0600907-005
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	5.2	5.0	5.0	4.7	4.9
Titratable Actual Acidity (23F)		2	mole H+ / t	14	16	17	30	16
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.02	0.02	0.03	0.05	0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.02	0.04	0.03	0.06	0.04
Net Acidity (acidity units)		10	mole H+ / t	15	22	20	35	22
Liming Rate		1	kg CaCO3/t	1	2	1	3	2
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.02	0.04	0.03	0.06	0.04
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	15	22	20	35	22
Liming Rate excluding ANC		1	kg CaCO3/t	1	2	1	3	2
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	0.02	0.03	0.03	0.08	0.02

ALS Environmental

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : E5_750 4.0	E5_750 5.00	E5_750 6.0	E5_750 7.00	E5_750 8.00
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-006	EP0600907-007	EP0600907-008	EP0600907-009	EP0600907-010
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.8	4.8	4.8	4.7	4.5
Titratable Actual Acidity (23F)		2	mole H+ / t	21	27	30	31	41
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.03	0.04	0.05	0.05	0.06
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.04	0.05	0.06	0.06	0.07
Net Acidity (acidity units)		10	mole H+ / t	26	30	37	37	42
Liming Rate		1	kg CaCO3/t	2	2	3	3	3
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.04	0.05	0.06	0.06	0.07
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	26	30	37	37	42
Liming Rate excluding ANC		1	kg CaCO3/t	2	2	3	3	3
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	0.02	0.02	0.02	0.03	0.02

ALS Environmental

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : E5_750 9.0	E5_750 10.0	E5_950 0.50	E5_950 1.0	E5_950 1.50
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-011	EP0600907-012	EP0600907-013	EP0600907-014	EP0600907-015
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.6	4.7	5.5	5.4	5.6
Titratable Actual Acidity (23F)		2	mole H+ / t	38	68	30	19	29
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.06	0.11	0.05	0.03	0.05
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.06	0.11	0.05	0.03	0.05
Net Acidity (acidity units)		10	mole H+ / t	39	68	30	20	30
Liming Rate		1	kg CaCO3/t	3	5	2	2	2
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.06	0.11	0.05	0.03	0.05
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	39	68	30	20	30
Liming Rate excluding ANC		1	kg CaCO3/t	3	5	2	2	2
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	0.01	0.01	<0.01	<0.01	0.01

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : M5_400 10	M5_400 11.00	M5_400 12.00	M5_400 13.00	M5_400 14.00
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-016	EP0600907-017	EP0600907-018	EP0600907-019	EP0600907-020
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.7	4.7	4.6	4.7	4.5
Titratable Actual Acidity (23F)		2	mole H+ / t	65	55	49	65	64
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.10	0.09	0.08	0.10	0.10
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	<10
EA033-D: Retained Acidity								
Net Acid Soluble Sulfur (20Je)		0.02	% S	----	----	----	----	<0.02
acidity - Net Acid Soluble Sulfur (a-20J)		10	mole H+ / t	----	----	----	----	<10
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02	% pyrite S	----	----	----	----	<0.02
KCl Extractable Sulfur (23Ce)		0.02	% S	----	----	----	----	0.02
HCl Extractable Sulfur (20Be)		0.02	% S	----	----	----	----	0.03
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.10	0.09	0.08	0.11	0.12
Net Acidity (acidity units)		10	mole H+ / t	66	57	50	67	74
Liming Rate		1	kg CaCO3/t	5	4	4	5	6
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.10	0.09	0.08	0.11	0.12
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	66	57	50	67	74
Liming Rate excluding ANC		1	kg CaCO3/t	5	4	4	5	6
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	0.09	0.10	0.04	0.13	0.03

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : M5_400 15.00	M5_400 16.00	M5_400 17.00	M5_400 18.00	M5_400 19.00
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-021	EP0600907-022	EP0600907-023	EP0600907-024	EP0600907-025
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.4	4.2	4.4	4.3	4.2
Titratable Actual Acidity (23F)		2	mole H+ / t	80	92	99	121	105
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.13	0.15	0.16	0.19	0.17
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	<10
EA033-D: Retained Acidity								
Net Acid Soluble Sulfur (20Je)		0.02	% S	0.08	0.27	0.50	0.22	0.30
acidity - Net Acid Soluble Sulfur (a-20J)		10	mole H+ / t	36	128	232	103	139
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02	% pyrite S	0.06	0.20	0.37	0.16	0.22
KCl Extractable Sulfur (23Ce)		0.02	% S	0.05	<0.02	0.02	0.03	<0.02
HCl Extractable Sulfur (20Be)		0.02	% S	0.12	0.29	0.52	0.25	0.31
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.19	0.35	0.54	0.36	0.39
Net Acidity (acidity units)		10	mole H+ / t	120	221	335	227	244
Liming Rate		1	kg CaCO3/t	9	16	25	17	18
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.19	0.35	0.54	0.36	0.39
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	120	221	335	227	244
Liming Rate excluding ANC		1	kg CaCO3/t	9	16	25	17	18
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	0.20	0.66	0.86	0.52	0.64

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : E5_950 2.0	E5_950 3.00	E5_950 4.00	E5_950 5.00	E5_950 6.00
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-026	EP0600907-027	EP0600907-028	EP0600907-029	EP0600907-030
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	5.1	4.8	5.4	4.8	4.8
Titratable Actual Acidity (23F)		2	mole H+ / t	35	32	11	31	30
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.06	0.05	<0.02	0.05	0.05
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.07	0.06	0.02	0.05	0.05
Net Acidity (acidity units)		10	mole H+ / t	45	39	14	32	30
Liming Rate		1	kg CaCO3/t	3	3	1	2	2
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.07	0.06	0.02	0.05	0.05
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	45	39	14	32	30
Liming Rate excluding ANC		1	kg CaCO3/t	3	3	1	2	2
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	0.06	0.03	0.02	0.02	0.01

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : E5_950 7.00	E5_950 8.00	E5_950 9.00	M5_400 0.50	M5_400 20.00
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-031	EP0600907-032	EP0600907-033	EP0600907-034	EP0600907-035
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.5	4.6	4.6	5.6	4.1
Titratable Actual Acidity (23F)		2	mole H+ / t	36	41	31	7	129
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.06	0.06	0.05	<0.02	0.21
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	1.03
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	642
EA033-D: Retained Acidity								
Net Acid Soluble Sulfur (20Je)		0.02	% S	----	----	----	----	0.06
acidity - Net Acid Soluble Sulfur (a-20J)		10	mole H+ / t	----	----	----	----	27
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02	% pyrite S	----	----	----	----	0.04
KCl Extractable Sulfur (23Ce)		0.02	% S	----	----	----	----	0.11
HCl Extractable Sulfur (20Be)		0.02	% S	----	----	----	----	0.17
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.06	0.07	0.05	<0.02	1.28
Net Acidity (acidity units)		10	mole H+ / t	38	46	33	<10	798
Liming Rate		1	kg CaCO3/t	3	3	2	<1	60
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.06	0.07	0.05	<0.02	1.28
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	38	46	33	<10	798
Liming Rate excluding ANC		1	kg CaCO3/t	3	3	2	<1	60
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	0.04	0.06	0.02	<0.01	1.59

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: M5_400 21.00	J_300 0.50	J_300 1.00	J_300 1.50	J_300 2.00
Sample Matrix Type / Description				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID				EP0600907-036	EP0600907-037	EP0600907-038	EP0600907-039	EP0600907-040
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.2	5.3	5.3	5.3	5.0
Titratable Actual Acidity (23F)		2	mole H+ / t	100	12	14	39	16
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.16	<0.02	0.02	0.06	0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	0.97	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	607	11	<10	<10	<10
EA033-D: Retained Acidity								
Net Acid Soluble Sulfur (20Je)		0.02	% S	<0.02	----	----	----	----
acidity - Net Acid Soluble Sulfur (a-20J)		10	mole H+ / t	<10	----	----	----	----
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02	% pyrite S	<0.02	----	----	----	----
KCl Extractable Sulfur (23Ce)		0.02	% S	0.12	----	----	----	----
HCl Extractable Sulfur (20Be)		0.02	% S	0.12	----	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	1.13	0.04	0.03	0.06	0.03
Net Acidity (acidity units)		10	mole H+ / t	707	23	18	39	17
Liming Rate		1	kg CaCO3/t	53	2	1	3	1
Net Acidity excluding ANC (sulfur units)		0.02	% S	1.13	0.04	0.03	0.06	0.03
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	707	23	18	39	17
Liming Rate excluding ANC		1	kg CaCO3/t	53	2	1	3	1
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	1.45	0.04	0.02	0.02	<0.01

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : J_300 3.00	J_300 4.00	J_300 5.00	J_300 6.00	J_300 7.00
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-041	EP0600907-042	EP0600907-043	EP0600907-044	EP0600907-045
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.8	4.7	4.7	4.6	4.6
Titratable Actual Acidity (23F)		2	mole H+ / t	22	33	40	44	44
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.04	0.05	0.06	0.07	0.07
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.04	0.06	0.06	0.08	0.07
Net Acidity (acidity units)		10	mole H+ / t	22	35	41	47	44
Liming Rate		1	kg CaCO3/t	2	3	3	4	3
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.04	0.06	0.06	0.08	0.07
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	22	35	41	47	44
Liming Rate excluding ANC		1	kg CaCO3/t	2	3	3	4	3
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	<0.01	<0.01	<0.01	<0.01	0.01

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : J_300 8.00	J_300 9.00	J_300 10.00	J_300 11.00	J_300 12.00
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-046	EP0600907-047	EP0600907-048	EP0600907-049	EP0600907-050
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.5	4.8	4.6	4.9	4.6
Titratable Actual Acidity (23F)		2	mole H+ / t	55	39	44	21	48
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.09	0.06	0.07	0.03	0.08
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.09	0.07	0.07	0.04	0.08
Net Acidity (acidity units)		10	mole H+ / t	56	41	44	24	48
Liming Rate		1	kg CaCO3/t	4	3	3	2	4
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.09	0.07	0.07	0.04	0.08
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	56	41	44	24	48
Liming Rate excluding ANC		1	kg CaCO3/t	4	3	3	2	4
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	<0.01	<0.01	0.01	<0.01	0.04

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: J_300 13.00	J_300 14.00	J_300 15.00	J_300 16.00	M5_400 1.0
Sample Matrix Type / Description:				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time:				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID:				EP0600907-051	EP0600907-052	EP0600907-053	EP0600907-054	EP0600907-055
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.7	4.6	4.9	4.7	5.4
Titratable Actual Acidity (23F)		2	mole H+ / t	43	38	32	28	10
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.07	0.06	0.05	0.04	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	14	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.07	0.06	0.05	0.07	0.02
Net Acidity (acidity units)		10	mole H+ / t	43	39	33	42	14
Liming Rate		1	kg CaCO3/t	3	3	2	3	1
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.07	0.06	0.05	0.07	0.02
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	43	39	33	42	14
Liming Rate excluding ANC		1	kg CaCO3/t	3	3	2	3	1
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	0.02	0.01	<0.01	<0.01	<0.01

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : M5_400 1.50	M5_400 2.00	M5_400 3.00	M5_400 4.00	M5_400 5.00
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-056	EP0600907-057	EP0600907-058	EP0600907-059	EP0600907-060
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	5.5	5.5	4.7	4.6	4.6
Titratable Actual Acidity (23F)		2	mole H+ / t	8	8	36	42	37
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	<0.02	<0.02	0.06	0.07	0.06
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	<0.02	<0.02	0.06	0.08	0.06
Net Acidity (acidity units)		10	mole H+ / t	12	12	37	48	40
Liming Rate		1	kg CaCO3/t	<1	<1	3	4	3
Net Acidity excluding ANC (sulfur units)		0.02	% S	<0.02	<0.02	0.06	0.08	0.06
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	12	12	37	48	40
Liming Rate excluding ANC		1	kg CaCO3/t	<1	<1	3	4	3
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01

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Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : M5_400 6.00	M5_400 7.00	M5_400 8.00	M5_400 9.00	J_300 17.00
Sample Matrix Type / Description :				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time :				11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00	11 Apr 2006 15:00
Laboratory Sample ID :				EP0600907-061	EP0600907-062	EP0600907-063	EP0600907-064	EP0600907-065
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.6	4.4	4.6	4.7	4.8
Titratable Actual Acidity (23F)		2	mole H+ / t	40	57	36	57	32
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.06	0.09	0.06	0.09	0.05
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	<10	<10	<10	<10	<10
EA033-D: Retained Acidity								
Net Acid Soluble Sulfur (20Je)		0.02	% S	----	0.03	----	----	----
acidity - Net Acid Soluble Sulfur (a-20J)		10	mole H+ / t	----	15	----	----	----
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02	% pyrite S	----	0.02	----	----	----
KCl Extractable Sulfur (23Ce)		0.02	% S	----	0.04	----	----	----
HCl Extractable Sulfur (20Be)		0.02	% S	----	0.07	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.07	0.12	0.06	0.10	0.06
Net Acidity (acidity units)		10	mole H+ / t	44	75	40	60	36
Liming Rate		1	kg CaCO3/t	3	6	3	4	3
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.07	0.12	0.06	0.10	0.06
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	44	75	40	60	36
Liming Rate excluding ANC		1	kg CaCO3/t	3	6	3	4	3
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	<0.01	0.01	<0.01	0.02	<0.01

ALS Environmental

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID : J_300 18.00 / Sample Matrix Type / Description : SOIL / Sample Date / Time : 11 Apr 2006 15:00 / Laboratory Sample ID : EP0600907-066	J_300 19.00 / SOIL / 11 Apr 2006 15:00 / EP0600907-067	J_300 20.00 / SOIL / 11 Apr 2006 15:00 / EP0600907-068		
EA033-A: Actual Acidity								
pH KCl (23A)		0.1	pH Unit	4.7	4.6	4.8		
Titratable Actual Acidity (23F)		2	mole H+ / t	46	39	33		
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	0.07	0.06	0.05		
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)		0.02	% S	0.12	0.16	0.30		
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t	78	99	190		
EA033-E: Acid Base Accounting								
ANC Fineness Factor		0.5		1.5	1.5	1.5		
Net Acidity (sulfur units)		0.02	% S	0.20	0.22	0.36		
Net Acidity (acidity units)		10	mole H+ / t	124	138	223		
Liming Rate		1	kg CaCO3/t	9	10	17		
Net Acidity excluding ANC (sulfur units)		0.02	% S	0.20	0.22	0.36		
Net Acidity excluding ANC (acidity units)		10	mole H+ / t	124	138	223		
Liming Rate excluding ANC		1	kg CaCO3/t	9	10	17		
ED042T: Total Sulphur by LECO								
Sulphur - Total as S (LECO)		0.01	%	0.30	0.47	0.56		

ALS Environmental

Surrogate Control Limits

- No surrogates present on this report.

ALS Environmental

QUALITY CONTROL REPORT

Client	:	**PARSONS BRINCKERHOFF AUST P/L**	**Laboratory**	: ALS Environmental Perth	**Page**	:	1 of 10
Contact	:	MR EWAN BOTTERILL	**Contact**	: Shaun Crabb			
Address	:	1 ALVAN STREET SUBIACO WA AUSTRALIA 6008	**Address**	: 10 Hod Way Malaga WA Australia 6090	**Work order**	:	**EP0600907**
					Amendment No.	:	
Project	:	200616511	**Quote number**	: EN/008/05	**Date received**	:	20 Apr 2006
Order number	:	- Not provided -			**Date issued**	:	8 May 2006
C-O-C number	:	- Not provided -					
Site	:	Muchea					
E-mail	:	ebotterill@pb.com.au	**E-mail**	: Shaun.Crabb@alsenviro.com	**No. of samples**		
Telephone	:	08 9489 9700	**Telephone**	: 61-8-9209-7655	**Received**	:	68
Facsimile	:	08 9380 4060	**Facsimile**	: 61-8-9209-7600	**Analysed**	:	68

This final report for the ALSE work order reference EP0600907 supersedes any previous reports with this reference.

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- Laboratory Duplicates (DUP); Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Samples (LCS); Recovery and Acceptance Limits
- Matrix Spikes (MS); Recovery and Acceptance Limits

Work order specific comments

ANC not required because pH KCl less than 6.5

Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. Conversion to liming rate in kg/m3 = kg/t x wet bulk density in t/m3.

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Accredited for compliance with ISO/IED 17025

This document has been digitally signed by those names that appear on this report and are the authorised signatories. Digital signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	Department
Kim McCabe	Inorganics - NATA 825 (818 - Brisbane)
Shaun Crabb	Perth Inorganics - NATA 825 (15847 - Perth)

Quality Control Report - Laboratory Duplicates (DUP)

The quality control term **Laboratory Duplicate** refers to an intralaboratory split sample randomly selected from the sample batch. Laboratory duplicates provide information on method precision and sample heterogeneity.
- Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** = *Limit of Reporting,* ***RPD*** = *Relative Percent Difference.*
* Indicates failed QC. The permitted ranges for the RPD of Laboratory Duplicates (relative percent deviation) are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:- Result < 10 times LOR, no limit - Result between 10 and 20 times LOR, 0% - 50% - Result > 20 times LOR, 0% - 20%

Matrix Type: SOIL

Laboratory Duplicates (DUP) Report

Laboratory Sample ID	*Client Sample ID*	*Analyte name*	*LOR*	*Original Result*	*Duplicate Result*	*RPD*
EA033-A: Actual Acidity						
EA033-A: Actual Acidity - (QC Lot: 203486)				**pH Unit**	**pH Unit**	**%**
EP0600907-001	E5_750 - 0.50	pH KCl (23A)	0.1 pH Unit	5.2	5.2	0.0
		Titratable Actual Acidity (23F)	2 mole H+ / t	14	15	0.0
		sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	0.02	0.02	0.0
EP0600907-011	E5_750 - 9.0	pH KCl (23A)	0.1 pH Unit	4.6	4.6	0.0
		Titratable Actual Acidity (23F)	2 mole H+ / t	38	36	3.6
		sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	0.06	0.06	0.0
EA033-A: Actual Acidity - (QC Lot: 203487)				**pH Unit**	**pH Unit**	**%**
EP0600907-021	M5_400 - 15.00	pH KCl (23A)	0.1 pH Unit	4.4	4.4	0.0
		Titratable Actual Acidity (23F)	2 mole H+ / t	80	82	2.3
		sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	0.13	0.13	0.0
EP0600907-031	E5_950 - 7.00	pH KCl (23A)	0.1 pH Unit	4.5	4.6	2.2
		Titratable Actual Acidity (23F)	2 mole H+ / t	36	36	0.0
		sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	0.06	0.06	0.0
EA033-A: Actual Acidity - (QC Lot: 203488)				**pH Unit**	**pH Unit**	**%**
EP0600907-041	J_300 - 3.00	pH KCl (23A)	0.1 pH Unit	4.8	4.7	2.5
		Titratable Actual Acidity (23F)	2 mole H+ / t	22	22	0.0
		sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	0.04	0.04	0.0
EP0600907-051	J_300 - 13.00	pH KCl (23A)	0.1 pH Unit	4.7	4.7	0.0
		Titratable Actual Acidity (23F)	2 mole H+ / t	43	44	0.0
		sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	0.07	0.07	0.0
EA033-A: Actual Acidity - (QC Lot: 203489)				**pH Unit**	**pH Unit**	**%**
EP0600907-061	M5_400 - 6.00	pH KCl (23A)	0.1 pH Unit	4.6	4.6	0.0
		Titratable Actual Acidity (23F)	2 mole H+ / t	40	42	5.2
		sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	0.06	0.07	0.0
EA033-B: Potential Acidity						

Matrix Type: SOIL

Laboratory Duplicates (DUP) Report

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EA033-B: Potential Acidity - continued						
EA033-B: Potential Acidity - (QC Lot: 203486)				% S	% S	%
EP0600907-001	E5_750 - 0.50	Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	<0.02	0.0
		Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	<10	0.0
EP0600907-011	E5_750 - 9.0	Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	<0.02	0.0
		Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	<10	0.0
EA033-B: Potential Acidity - (QC Lot: 203487)				% S	% S	%
EP0600907-021	M5_400 - 15.00	Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	<0.02	0.0
		Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	<10	0.0
EP0600907-031	E5_950 - 7.00	Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	<0.02	0.0
		Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	<10	0.0
EA033-B: Potential Acidity - (QC Lot: 203488)				% S	% S	%
EP0600907-041	J_300 - 3.00	Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	<0.02	0.0
		Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	<10	0.0
EP0600907-051	J_300 - 13.00	Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	<0.02	0.0
		Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	<10	0.0
EA033-B: Potential Acidity - (QC Lot: 203489)				% S	% S	%
EP0600907-061	M5_400 - 6.00	Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	<0.02	0.0
		Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	<10	0.0
EA033-D: Retained Acidity						
EA033-D: Retained Acidity - (QC Lot: 203487)				% S	% S	%
EP0600907-021	M5_400 - 15.00	Net Acid Soluble Sulfur (20Je)	0.02 % S	0.08	0.08	0.0
		Acidity - Net Acid Soluble Sulfur (a-20J)	10 mole H+ / t	36	37	0.0
		sulfidic - Net Acid Soluble Sulfur (s-20J)	0.02 % pyrite S	0.06	0.06	0.0
		KCl Extractable Sulfur (23Ce)	0.02 % S	0.05	0.05	0.0
		HCl Extractable Sulfur (20Be)	0.02 % S	0.12	0.13	0.0
EA033-E: Acid Base Accounting						
EA033-E: Acid Base Accounting - (QC Lot: 203486)						%
EP0600907-001	E5_750 - 0.50	ANC Fineness Factor		1.5	1.5	0.0
		Net Acidity (sulfur units)	0.02 % S	0.02	0.02	0.0
		Net Acidity (acidity units)	10 mole H+ / t	15	15	0.0

Matrix Type: SOIL

Laboratory Duplicates (DUP) Report

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EA033-E: Acid Base Accounting - continued						
EA033-E: Acid Base Accounting - (QC Lot: 203486) - continued				kg CaCO3/t	kg CaCO3/t	%
EP0600907-001	E5_750 - 0.50	Liming Rate	1 kg CaCO3/t	1	1	0.0
		Net Acidity excluding ANC (sulfur units)	0.02 % S	0.02	0.02	0.0
		Net Acidity excluding ANC (acidity units)	10 mole H+ / t	15	15	0.0
		Liming Rate excluding ANC	1 kg CaCO3/t	1	1	0.0
EP0600907-011	E5_750 - 9.0	ANC Fineness Factor		1.5	1.5	0.0
		Net Acidity (sulfur units)	0.02 % S	0.06	0.06	0.0
		Net Acidity (acidity units)	10 mole H+ / t	39	38	3.5
		Liming Rate	1 kg CaCO3/t	3	3	0.0
		Net Acidity excluding ANC (sulfur units)	0.02 % S	0.06	0.06	0.0
		Net Acidity excluding ANC (acidity units)	10 mole H+ / t	39	38	3.5
		Liming Rate excluding ANC	1 kg CaCO3/t	3	3	0.0
EA033-E: Acid Base Accounting - (QC Lot: 203487)						%
EP0600907-021	M5_400 - 15.00	ANC Fineness Factor		1.5	1.5	0.0
		Net Acidity (sulfur units)	0.02 % S	0.19	0.20	0.0
		Net Acidity (acidity units)	10 mole H+ / t	120	122	1.6
		Liming Rate	1 kg CaCO3/t	9	9	0.0
		Net Acidity excluding ANC (sulfur units)	0.02 % S	0.19	0.20	0.0
		Net Acidity excluding ANC (acidity units)	10 mole H+ / t	120	122	1.6
		Liming Rate excluding ANC	1 kg CaCO3/t	9	9	0.0
EP0600907-031	E5_950 - 7.00	ANC Fineness Factor		1.5	1.5	0.0
		Net Acidity (sulfur units)	0.02 % S	0.06	0.06	0.0
		Net Acidity (acidity units)	10 mole H+ / t	38	38	0.0
		Liming Rate	1 kg CaCO3/t	3	3	0.0
		Net Acidity excluding ANC (sulfur units)	0.02 % S	0.06	0.06	0.0
		Net Acidity excluding ANC (acidity units)	10 mole H+ / t	38	38	0.0
		Liming Rate excluding ANC	1 kg CaCO3/t	3	3	0.0
EA033-E: Acid Base Accounting - (QC Lot: 203488)						%
EP0600907-041	J_300 - 3.00	ANC Fineness Factor		1.5	1.5	0.0
		Net Acidity (sulfur units)	0.02 % S	0.04	0.04	0.0

Matrix Type: SOIL

Laboratory Duplicates (DUP) Report

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EA033-E: Acid Base Accounting - continued						
EA033-E: Acid Base Accounting - (QC Lot: 203488) - continued				mole H+ / t	mole H+ / t	%
EP0600907-041	J_300 - 3.00	Net Acidity (acidity units)	10 mole H+ / t	22	22	0.0
		Liming Rate	1 kg CaCO3/t	2	2	0.0
		Net Acidity excluding ANC (sulfur units)	0.02 % S	0.04	0.04	0.0
		Net Acidity excluding ANC (acidity units)	10 mole H+ / t	22	22	0.0
		Liming Rate excluding ANC	1 kg CaCO3/t	2	2	0.0
EP0600907-051	J_300 - 13.00	ANC Fineness Factor		1.5	1.5	0.0
		Net Acidity (sulfur units)	0.02 % S	0.07	0.07	0.0
		Net Acidity (acidity units)	10 mole H+ / t	43	44	0.0
		Liming Rate	1 kg CaCO3/t	3	3	0.0
		Net Acidity excluding ANC (sulfur units)	0.02 % S	0.07	0.07	0.0
		Net Acidity excluding ANC (acidity units)	10 mole H+ / t	43	44	0.0
		Liming Rate excluding ANC	1 kg CaCO3/t	3	3	0.0
EA033-E: Acid Base Accounting - (QC Lot: 203489)						%
EP0600907-061	M5_400 - 6.00	ANC Fineness Factor		1.5	1.5	0.0
		Net Acidity (sulfur units)	0.02 % S	0.07	0.07	0.0
		Net Acidity (acidity units)	10 mole H+ / t	44	46	5.6
		Liming Rate	1 kg CaCO3/t	3	3	0.0
		Net Acidity excluding ANC (sulfur units)	0.02 % S	0.07	0.07	0.0
		Net Acidity excluding ANC (acidity units)	10 mole H+ / t	44	46	5.6
		Liming Rate excluding ANC	1 kg CaCO3/t	3	3	0.0
ED042T: Total Sulphur by LECO						
ED042T: Total Sulphur by LECO - (QC Lot: 208744)				%	%	%
EB0603893-006	Anonymous	Sulphur - Total as S (LECO)	0.01 %	0.05	0.06	18.2
EP0600907-010	E5_750 - 8.00	Sulphur - Total as S (LECO)	0.01 %	0.02	0.02	0.0
ED042T: Total Sulphur by LECO - (QC Lot: 208745)				%	%	%
EP0600907-020	M5_400 - 14.00	Sulphur - Total as S (LECO)	0.01 %	0.03	0.03	0.0
EP0600907-030	E5_950 - 6.00	Sulphur - Total as S (LECO)	0.01 %	0.01	0.01	0.0
ED042T: Total Sulphur by LECO - (QC Lot: 208746)				%	%	%
EP0600907-040	J_300 - 2.00	Sulphur - Total as S (LECO)	0.01 %	<0.01	<0.01	0.0

Matrix Type: SOIL

Laboratory Duplicates (DUP) Report

Laboratory Sample ID	*Client Sample ID*	*Analyte name*	*LOR*	*Original Result*	*Duplicate Result*	*RPD*
ED042T: Total Sulphur by LECO - continued						
ED042T: Total Sulphur by LECO - (QC Lot: 208746) - continued				%	%	%
EP0600907-050	J_300 - 12.00	Sulphur - Total as S (LECO)	0.01 %	0.04	0.03	28.6
ED042T: Total Sulphur by LECO - (QC Lot: 208747)				%	%	%
EP0600907-060	M5_400 - 5.00	Sulphur - Total as S (LECO)	0.01 %	<0.01	0.01	0.0
EP0600907-068	J_300 - 20.00	Sulphur - Total as S (LECO)	0.01 %	0.56	0.54	3.6

Quality Control Report - Method Blank (MB) and Laboratory Control Samples (LCS)

The quality control term **Method / Laboratory Blank** refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC type is to monitor potential laboratory contamination. The quality control term **Laboratory Control Sample (LCS)** refers to a known, interference free matrix spiked with target analytes or certified reference material. The purpose of this QC type is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of actual laboratory data. Abbreviations: LOR = Limit of reporting.

Matrix Type: SOIL

Method Blank (MB) and Laboratory Control Samples (LCS) Report

		Method blank result	Actual Results		Recovery Limits	
			Spike concentration	Spike Recovery	Dynamic Recovery Limits	
Analyte name	LOR			LCS	Low	High
EA033-A: Actual Acidity						
EA033-A: Actual Acidity - (QC Lot: 203486)		pH Unit	pH Unit	%	%	%
pH KCl (23A)	0.1 pH Unit	<0.1	----	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	<0.02	----	----	----	----
Titratable Actual Acidity (23F)	2 mole H+ / t	<2	----	----	----	----
EA033-A: Actual Acidity - (QC Lot: 203487)		pH Unit	pH Unit	%	%	%
pH KCl (23A)	0.1 pH Unit	<0.1	----	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	<0.02	----	----	----	----
Titratable Actual Acidity (23F)	2 mole H+ / t	<2	----	----	----	----
EA033-A: Actual Acidity - (QC Lot: 203488)		pH Unit	pH Unit	%	%	%
pH KCl (23A)	0.1 pH Unit	<0.1	----	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	<0.02	----	----	----	----
Titratable Actual Acidity (23F)	2 mole H+ / t	<2	----	----	----	----
EA033-A: Actual Acidity - (QC Lot: 203489)		pH Unit	pH Unit	%	%	%
pH KCl (23A)	0.1 pH Unit	<0.1	----	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	<0.02	----	----	----	----
Titratable Actual Acidity (23F)	2 mole H+ / t	<2	----	----	----	----
EA033-B: Potential Acidity						
EA033-B: Potential Acidity - (QC Lot: 203486)		mole H+ / t	mole H+ / t	%	%	%
Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	----	----	----	----
Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	----	----	----	----
EA033-B: Potential Acidity - (QC Lot: 203487)		mole H+ / t	mole H+ / t	%	%	%
Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	----	----	----	----
Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	----	----	----	----
EA033-B: Potential Acidity - (QC Lot: 203488)		mole H+ / t	mole H+ / t	%	%	%
Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	----	----	----	----

Matrix Type: SOIL

Method Blank (MB) and Laboratory Control Samples (LCS) Report

Analyte name	*LOR*	*Method blank result*	*Actual Results*		*Recovery Limits*	
			Spike concentration	*Spike Recovery*	*Dynamic Recovery Limits*	
				LCS	*Low*	*High*
EA033-B: Potential Acidity - continued						
EA033-B: Potential Acidity - (QC Lot: 203488) - continued		% S	% S	%	%	%
Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	----	----	----	----
EA033-B: Potential Acidity - (QC Lot: 203489)		mole H+ / t	mole H+ / t	%	%	%
Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	----	----	----	----
Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	----	----	----	----
EA033-E: Acid Base Accounting						
EA033-E: Acid Base Accounting - (QC Lot: 203486)				%	%	%
ANC Fineness Factor		<0.5	----	----	----	----
Liming Rate	1 kg CaCO3/t	<1	----	----	----	----
Net Acidity (acidity units)	10 mole H+ / t	<10	----	----	----	----
Net Acidity (sulfur units)	0.02 % S	<0.02	----	----	----	----
EA033-E: Acid Base Accounting - (QC Lot: 203487)				%	%	%
ANC Fineness Factor		<0.5	----	----	----	----
Liming Rate	1 kg CaCO3/t	<1	----	----	----	----
Net Acidity (acidity units)	10 mole H+ / t	<10	----	----	----	----
Net Acidity (sulfur units)	0.02 % S	<0.02	----	----	----	----
EA033-E: Acid Base Accounting - (QC Lot: 203488)				%	%	%
ANC Fineness Factor		<0.5	----	----	----	----
Liming Rate	1 kg CaCO3/t	<1	----	----	----	----
Net Acidity (acidity units)	10 mole H+ / t	<10	----	----	----	----
Net Acidity (sulfur units)	0.02 % S	<0.02	----	----	----	----
EA033-E: Acid Base Accounting - (QC Lot: 203489)				%	%	%
ANC Fineness Factor		<0.5	----	----	----	----
Liming Rate	1 kg CaCO3/t	<1	----	----	----	----
Net Acidity (acidity units)	10 mole H+ / t	<10	----	----	----	----
Net Acidity (sulfur units)	0.02 % S	<0.02	----	----	----	----
ED042T: Total Sulphur by LECO						
ED042T: Total Sulphur by LECO - (QC Lot: 208744)		%	%	%	%	%

Matrix Type: SOIL

Method Blank (MB) and Laboratory Control Samples (LCS) Report

Analyte name	LOR	Method blank result	Actual Results		Recovery Limits	
			Spike concentration	Spike Recovery	Dynamic Recovery Limits	
				LCS	Low	High
ED042T: Total Sulphur by LECO - continued						
ED042T: Total Sulphur by LECO - (QC Lot: 208744) - continued		%	%	%	%	%
Sulphur - Total as S (LECO)	0.01 %	----	100	99.0	70	130
	0.01 %	<0.01	----	----	----	----
ED042T: Total Sulphur by LECO - (QC Lot: 208745)		%	%	%	%	%
Sulphur - Total as S (LECO)	0.01 %	----	100	100	70	130
	0.01 %	<0.01	----	----	----	----
ED042T: Total Sulphur by LECO - (QC Lot: 208746)		%	%	%	%	%
Sulphur - Total as S (LECO)	0.01 %	<0.01	----	----	----	----
	0.01 %	----	100	99.0	70	130
ED042T: Total Sulphur by LECO - (QC Lot: 208747)		%	%	%	%	%
Sulphur - Total as S (LECO)	0.01 %	----	100	99.0	70	130
	0.01 %	<0.01	----	----	----	----

ALS Environmental

Quality Control Report - Matrix Spikes (MS)

The quality control term **Matrix Spike (MS)** refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC type is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQO's). 'Ideal' recovery ranges stated may be waived in the event of sample matrix interferences. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** *= Limit of Reporting,* ***RPD*** *= Relative Percent Difference.*

* Indicates failed QC

Matrix Spike (MS) Report

					Actual Results		Recovery Limits	
					Sample Result	Spike Recovery	Static Limits	
Analyte name	Laboratory Sample ID	Client Sample ID	LOR	Spike Concentration		MS	Low	High
- (QC Lot:)						%	%	%

- **No Matrix Spike (MS) carried out on this Work Order.**

ALS Environmental

INTERPRETIVE QUALITY CONTROL REPORT

Client	:	**PARSONS BRINCKERHOFF AUST P/L**	**Laboratory**	:	ALS Environmental Perth	**Page**	: 1 of 6
Contact	:	MR EWAN BOTTERILL	**Contact**	:	Shaun Crabb		
Address	:	1 ALVAN STREET SUBIACO WA AUSTRALIA 6008	**Address**	:	10 Hod Way Malaga WA Australia 6090	**Work order**	: **EP0600907**
						Amendment No.	:
Project	:	200616511	**Quote number**	:	EN/008/05	**Date received**	: 20 Apr 2006
Order number	:	- Not provided -				**Date issued**	: 8 May 2006
C-O-C number	:	- Not provided -					
Site	:	Muchea					
E-mail	:	ebotterill@pb.com.au	**E-mail**	:	Shaun.Crabb@alsenviro.com	**No. of samples**	
Telephone	:	08 9489 9700	**Telephone**	:	61-8-9209-7655	**Received**	: 68
Facsimile	:	08 9380 4060	**Facsimile**	:	61-8-9209-7600	**Analysed**	: 68

This Interpretive Quality Control Report was issued on 8 May 2006 for the ALS work order reference EP0600907 and supersedes any previous reports with this reference.
This report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Type Frequency Compliance
- Summary of all Quality Control Outliers
- Brief Method Summaries

ALS Environmental

Interpretive Quality Control Report - Analysis Holding Time

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the sample aliquot was taken. Elapsed time to analysis represents time from sampling where no extraction / digestion is involved or time from extraction / digestion where this is present. For composite samples, sampling date/time is taken as that of the oldest sample contributing to that composite. Sample date/time for laboratory produced leaches are taken from the completion date/time of the leaching process. Outliers for holding time are based on USEPA SW846, APHA, AS and NEPM (1999). Failed outliers, refer to the 'Summary of Outliers'.

Matrix Type: SOIL

Analysis Holding Time and Preservation

Method / Container / Client Sample ID(s)	Date Sampled	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Pass?	Date analysed	Due for analysis	Pass?
EA033: Chromium Suite for Acid Sulphate Soils							
80* dried soil							
E5_750 - 0.50, E5_750 - 1.0,	**11 Apr 2006**	**24 Apr 2006**	11 Apr 2007	Pass	**26 Apr 2006**	11 Apr 2007	Pass
E5_750 - 1.50, E5_750 - 2.0,							
E5_750 - 3.0, E5_750 - 4.0,							
E5_750 - 5.00, E5_750 - 6.0,							
E5_750 - 7.00, E5_750 - 8.00,							
E5_750 - 9.0, E5_750 - 10.0,							
E5_950 - 0.50, E5_950 - 1.0,							
E5_950 - 1.50, M5_400 - 10,							
M5_400 - 11.00, M5_400 - 12.00,							
M5_400 - 13.00, M5_400 - 14.00,							
M5_400 - 15.00, M5_400 - 16.00,							
M5_400 - 17.00, M5_400 - 18.00,							
M5_400 - 19.00, E5_950 - 2.0,							
E5_950 - 3.00, E5_950 - 4.00,							
E5_950 - 5.00, E5_950 - 6.00,							
E5_950 - 7.00, E5_950 - 8.00,							
E5_950 - 9.00, M5_400 - 0.50,							
M5_400 - 20.00, M5_400 - 21.00,							
J_300 - 0.50, J_300 - 1.00,							
J_300 - 1.50, J_300 - 2.00,							
J_300 - 3.00, J_300 - 4.00,							
J_300 - 5.00, J_300 - 6.00,							
J_300 - 7.00, J_300 - 8.00,							
J_300 - 9.00, J_300 - 10.00,							
J_300 - 11.00, J_300 - 12.00,							
J_300 - 13.00, J_300 - 14.00,							
J_300 - 15.00, J_300 - 16.00,							
M5_400 - 1.0, M5_400 - 1.50,							
M5_400 - 2.00, M5_400 - 3.00,							
M5_400 - 4.00, M5_400 - 5.00,							
M5_400 - 6.00, M5_400 - 7.00,							
M5_400 - 8.00, M5_400 - 9.00,							
J_300 - 17.00, J_300 - 18.00,							
J_300 - 19.00, J_300 - 20.00							
ED042T: Sulphur - Total as S (LECO)							

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Matrix Type: SOIL

Analysis Holding Time and Preservation

Method / Container / Client Sample ID(s)	Date Sampled	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Pass?	Date analysed	Due for analysis	Pass?
ED042T: Sulphur - Total as S (LECO) - **continued**							
80° dried soil							
E5_750 - 0.50, E5_750 - 1.0, E5_750 - 1.50, E5_750 - 2.0, E5_750 - 3.0, E5_750 - 4.0, E5_750 - 5.00, E5_750 - 6.0, E5_750 - 7.00, E5_750 - 8.00, E5_750 - 9.0, E5_750 - 10.0, E5_950 - 0.50, E5_950 - 1.0, E5_950 - 1.50, M5_400 - 10, M5_400 - 11.00, M5_400 - 12.00, M5_400 - 13.00, M5_400 - 14.00, M5_400 - 15.00, M5_400 - 16.00, M5_400 - 17.00, M5_400 - 18.00, M5_400 - 19.00, E5_950 - 2.0, E5_950 - 3.00, E5_950 - 4.00, E5_950 - 5.00, E5_950 - 6.00, E5_950 - 7.00, E5_950 - 8.00, E5_950 - 9.00, M5_400 - 0.50, M5_400 - 20.00, M5_400 - 21.00, J_300 - 0.50, J_300 - 1.00, J_300 - 1.50, J_300 - 2.00, J_300 - 3.00, J_300 - 4.00, J_300 - 5.00, J_300 - 6.00, J_300 - 7.00, J_300 - 8.00, J_300 - 9.00, J_300 - 10.00, J_300 - 11.00, J_300 - 12.00, J_300 - 13.00, J_300 - 14.00, J_300 - 15.00, J_300 - 16.00, M5_400 - 1.0, M5_400 - 1.50, M5_400 - 2.00, M5_400 - 3.00, M5_400 - 4.00, M5_400 - 5.00, M5_400 - 6.00, M5_400 - 7.00, M5_400 - 8.00, M5_400 - 9.00, J_300 - 17.00, J_300 - 18.00, J_300 - 19.00, J_300 - 20.00	**11 Apr 2006**	**8 May 2006**	8 Oct 2006	Pass	**8 May 2006**	8 Oct 2006	Pass

ALS Environmental

Interpretive Quality Control Report - Frequency of Quality Control Samples

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which this work order was processed. Actual rate should be greater than or equal to the expected rate.

Matrix Type: SOIL

Frequency of Quality Control Samples

Quality Control Sample Type / Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
EA033: Chromium Suite for Acid Sulphate Soils	7	68	**10.3**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
ED042T: Sulphur - Total as S (LECO)	8	74	**10.8**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
Laboratory Control Samples (LCS)					
EA033: Chromium Suite for Acid Sulphate Soils	4	68	**5.9**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
ED042T: Sulphur - Total as S (LECO)	4	74	**5.4**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
Method Blanks (MB)					
EA033: Chromium Suite for Acid Sulphate Soils	4	68	**5.9**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
ED042T: Sulphur - Total as S (LECO)	4	74	**5.4**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement

Interpretive Quality Control Report - Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged on the 'Quality Control Report'. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot.

Non-surrogates

- **For all matrices, no RPD recovery outliers occur for the duplicate analysis.**
- **For all matrices, no method blank result outliers occur.**
- **For all matrices, no laboratory spike recoveries breaches occur.**
- **For all matrices, no matrix spike recoveries breaches occur.**

Surrogates

- **For all matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time

The following report highlights outliers within this 'Interpretive Quality Control Report - Analysis Holding Time'.

- **No holding time outliers occur.**

Outliers : Frequency of Quality Control Samples

The following report highlights outliers within this 'Interpretive Quality Control Report - Frequency of Quality Control Samples'.

- **No frequency outliers occur.**

ALS Environmental

Method Reference Summary

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

Matrix Type: SOIL

Method Reference Summary

Preparation Methods

EN020PR : Drying at 85 degrees, bagging and labelling (ASS) - In house

GEO30 : Dry and Pulverise (up to 100g) -

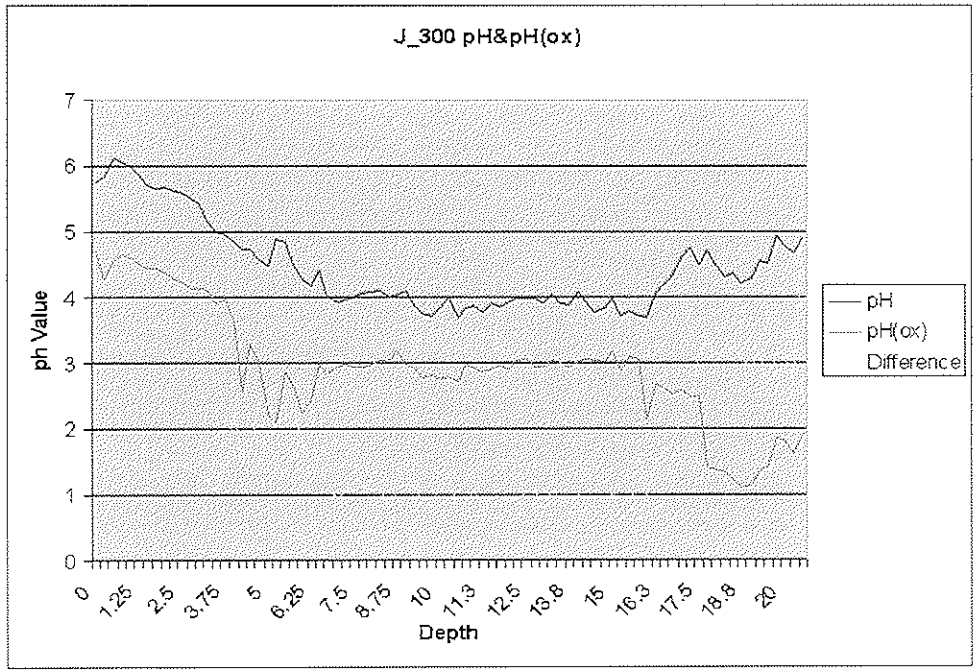
Analytical Methods

EA033 : Chromium Suite for Acid Sulphate Soils - Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.

ED042T : Sulphur - Total as S (LECO) - In-house. Dried and pulverised sample is combusted in a LECO furnace at 1350C in the presence of strong oxidants / catalysts. The evolved S (as SO2) is measured by infra-red detector

Depth	pH	pH(ox)	Difference
0	5.75	4.7	1.47
0.25	5.81	4.28	1.26
0.5	6.12	4.55	1.47
0.75	6.05	4.65	1.44
1	6	4.61	1.48
1.25	5.85	4.52	1.41
1.5	5.71	4.44	1.27
1.75	5.65	4.44	1.27
2	5.67	4.38	1.37
2.25	5.62	4.3	1.36
2.5	5.6	4.26	1.47
2.75	5.5	4.13	1.36
3	5.42	4.14	1.31
3.25	5.15	4.11	1.23
3.5	5	3.92	1.02
3.75	4.96	3.98	1.35
4	4.84	3.61	2.27
4.25	4.72	2.57	1.43
4.5	4.71	3.29	1.68
4.75	4.57	3.03	2.37
5	4.47	2.2	2.37
5.25	4.88	2.1	2.02
5.5	4.83	2.86	2.16
5.75	4.49	2.67	2.26
6	4.3	2.23	1.85
6.25	4.18	2.45	1.19
6.5	4.4	2.99	1.56
6.75	4.01	2.84	1.07
7	3.94	2.94	0.96
7.25	3.96	2.98	1.02
7.5	3.99	2.94	1.05
7.75	4.06	2.94	1.1
8	4.08	2.96	1.04
8.25	4.09	3.04	1.06
8.5	3.99	3.03	0.78
8.75	4.02	3.21	1.04
9	4.09	2.98	1.17
9.25	3.88	2.92	1.09
9.5	3.75	2.79	0.93
9.75	3.72	2.82	0.95
10	3.84	2.77	1.04
10.25	4	2.8	1.28

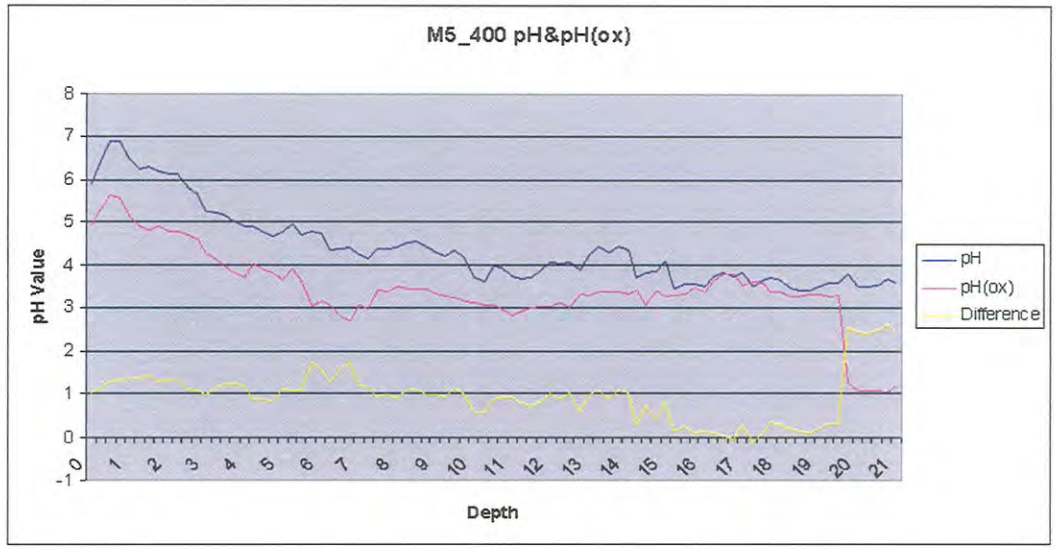
Depth	pH	pH(ox)	Difference
10.5	3.7	2.72	0.72
10.75	3.84	2.98	0.91
11	3.88	2.93	1.02
11.25	3.77	2.86	0.86
11.5	3.91	2.91	0.94
11.75	3.86	2.97	0.96
12	3.93	2.9	0.88
12.25	3.98	3.05	0.92
12.5	3.98	3.06	1.03
12.75	3.97	2.95	1.03
13	3.92	2.94	0.88
13.25	4.03	3.04	1.02
13.5	3.91	3.01	0.96
13.75	3.89	2.95	0.86
14	4.07	3.03	1
14.25	3.94	3.07	0.9
14.5	3.77	3.04	0.75
14.75	3.83	3.02	0.65
15	3.97	3.18	1.08
15.25	3.72	2.89	0.62
15.5	3.8	3.1	0.73
15.75	3.72	3.07	1.6
16	3.7	2.12	1.01
16.25	4.05	2.69	1.42
16.5	4.19	2.63	1.66
16.75	4.32	2.53	1.74
17	4.62	2.58	2.14
17.25	4.73	2.48	2.24
17.5	4.5	2.49	3.1
17.75	4.7	1.4	3.31
18	4.48	1.39	3.13
18.25	4.32	1.35	3.1
18.5	4.35	1.22	3.25
18.75	4.21	1.1	3.07
19	4.3	1.14	2.93
19.25	4.56	1.37	3.16
19.5	4.52	1.4	2.66
19.75	4.94	1.86	3.14
20	4.77	1.8	3.15
20.25	4.68	1.62	2.74
20.5	4.92	1.94	4.92



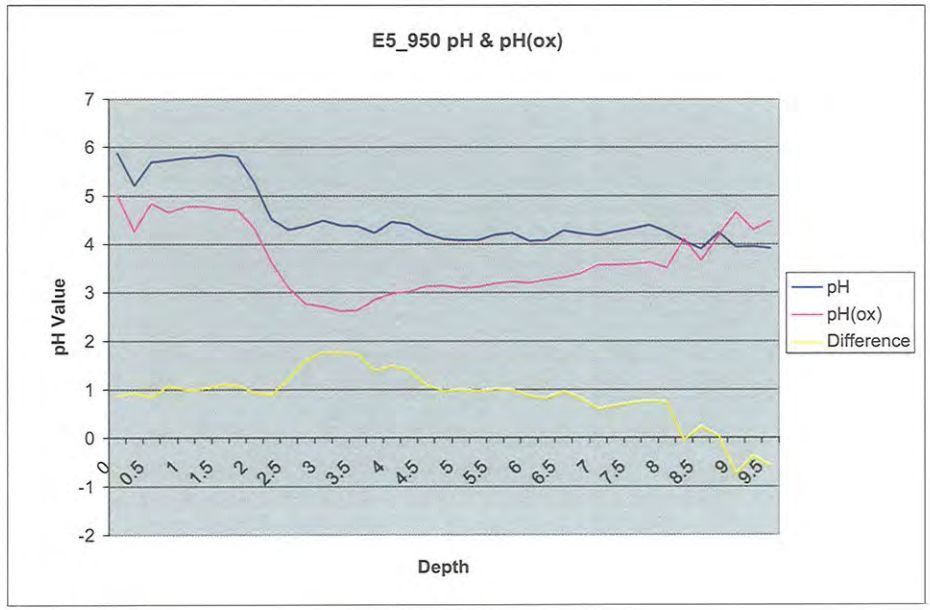
Field pH test results M5_400

Depth	pH	pH(ox)	Difference
0	5.9	4.91	0.99
0.25	6.43	5.31	1.12
0.5	6.9	5.63	1.27
0.75	6.88	5.58	1.3
1	6.48	5.12	1.36
1.25	6.23	4.89	1.34
1.5	6.3	4.83	1.47
1.75	6.18	4.89	1.29
2	6.11	4.8	1.31
2.25	6.12	4.78	1.34
2.5	5.81	4.71	1.1
2.75	5.65	4.6	1.05
3	5.25	4.27	0.98
3.25	5.23	4.11	1.12
3.5	5.16	3.95	1.21
3.75	5.01	3.8	1.21
4	4.9	3.72	1.18
4.25	4.9	4.01	0.89
4.5	4.77	3.88	0.89
4.75	4.66	3.81	0.85
5	4.75	3.65	1.1
5.25	4.94	3.89	1.05
5.5	4.69	3.61	1.08
5.75	4.78	3.05	1.73
6	4.74	3.17	1.57
6.25	4.33	3.06	1.27
6.5	4.35	2.78	1.57
6.75	4.39	2.66	1.73
7	4.25	3.07	1.18
7.25	4.15	2.98	1.17
7.5	4.35	3.4	0.95
7.75	4.36	3.38	0.98
8	4.4	3.49	0.91
8.25	4.53	3.43	1.1
8.5	4.56	3.45	1.11
8.75	4.43	3.45	0.98
9	4.29	3.33	0.96
9.25	4.2	3.25	0.95
9.5	4.34	3.21	1.13
9.75	4.15	3.17	0.98
10	3.71	3.14	0.57
10.25	3.63	3.06	0.57

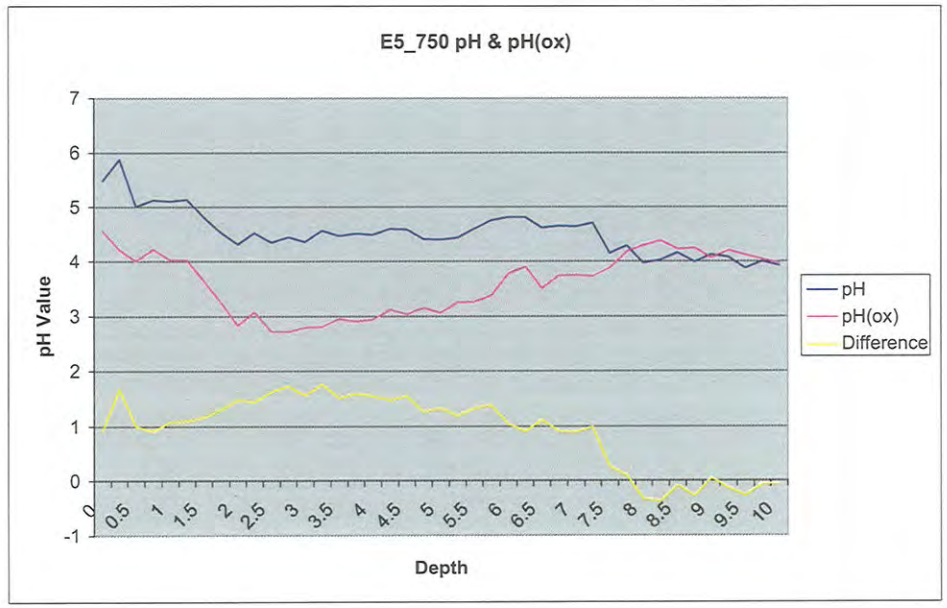
Depth	pH	pH(ox)	Difference
10.5	3.95	3.07	0.88
10.75	3.92	2.99	0.93
11	3.76	2.81	0.95
11.25	3.7	2.9	0.8
11.5	3.72	3	0.72
11.75	3.87	3.04	0.83
12	4.06	3.05	1.01
12.25	4.02	3.13	0.89
12.5	4.05	3.02	1.03
12.75	3.86	3.3	0.56
13	4.23	3.27	0.96
13.25	4.44	3.37	1.07
13.5	4.29	3.37	0.92
13.75	4.43	3.37	1.06
14	4.34	3.33	1.01
14.25	3.71	3.41	0.3
14.5	3.81	3.08	0.73
14.75	3.83	3.4	0.43
15	4.09	3.26	0.83
15.25	3.44	3.29	0.15
15.5	3.56	3.31	0.25
15.75	3.57	3.46	0.11
16	3.51	3.38	0.13
16.25	3.76	3.65	0.11
16.5	3.81	3.78	0.03
16.75	3.76	3.79	-0.03
17	3.82	3.53	0.29
17.25	3.5	3.63	-0.13
17.5	3.65	3.58	0.07
17.75	3.73	3.38	0.35
18	3.65	3.37	0.28
18.25	3.46	3.26	0.2
18.5	3.4	3.25	0.15
18.75	3.42	3.32	0.1
19	3.49	3.3	0.19
19.25	3.58	3.25	0.33
19.5	3.6	3.28	0.32
19.75	3.79	1.24	2.55
20	3.49	1.05	2.44
20.25	3.49	1.06	2.43
20.5	3.53	1.05	2.48
20.75	3.67	1.04	2.63
21	3.6	1.19	2.41



Depth	pH	pH(ox)	Difference
0	5.88	5.01	0.87
0.25	5.2	4.26	0.94
0.5	5.69	4.85	0.84
0.75	5.73	4.66	1.07
1	5.78	4.79	0.99
1.25	5.79	4.78	1.01
1.5	5.84	4.74	1.1
1.75	5.8	4.71	1.09
2	5.26	4.32	0.94
2.25	4.51	3.62	0.89
2.5	4.3	3.08	1.22
2.75	4.37	2.76	1.61
3	4.48	2.71	1.77
3.25	4.38	2.62	1.76
3.5	4.37	2.63	1.74
3.75	4.23	2.84	1.39
4	4.46	2.97	1.49
4.25	4.41	3.01	1.4
4.5	4.22	3.12	1.1
4.75	4.1	3.13	0.97
5	4.08	3.09	0.99
5.25	4.08	3.11	0.97
5.5	4.19	3.18	1.01
5.75	4.23	3.23	1
6	4.07	3.2	0.87
6.25	4.08	3.26	0.82
6.5	4.28	3.31	0.97
6.75	4.22	3.4	0.82
7	4.18	3.57	0.61
7.25	4.25	3.58	0.67
7.5	4.32	3.59	0.73
7.75	4.4	3.63	0.77
8	4.26	3.51	0.75
8.25	4.07	4.12	-0.05
8.5	3.9	3.66	0.24
8.75	4.24	4.2	0.04
9	3.94	4.67	-0.73
9.25	3.95	4.31	-0.36
9.5	3.92	4.48	-0.56



Depth	pH	pH(ox)	Difference
0	5.47	4.55	0.92
0.25	5.87	4.2	1.67
0.5	5	4	1
0.75	5.12	4.21	0.91
1	5.1	4.03	1.07
1.25	5.13	4.03	1.1
1.5	4.8	3.64	1.16
1.75	4.53	3.24	1.29
2	4.3	2.82	1.48
2.25	4.51	3.07	1.44
2.5	4.34	2.71	1.63
2.75	4.44	2.71	1.73
3	4.35	2.79	1.56
3.25	4.56	2.8	1.76
3.5	4.46	2.94	1.52
3.75	4.5	2.9	1.6
4	4.48	2.93	1.55
4.25	4.59	3.11	1.48
4.5	4.58	3.03	1.55
4.75	4.4	3.14	1.26
5	4.39	3.06	1.33
5.25	4.43	3.25	1.18
5.5	4.59	3.26	1.33
5.75	4.75	3.37	1.38
6	4.81	3.77	1.04
6.25	4.81	3.9	0.91
6.5	4.62	3.5	1.12
6.75	4.65	3.74	0.91
7	4.64	3.75	0.89
7.25	4.7	3.72	0.98
7.5	4.15	3.88	0.27
7.75	4.28	4.18	0.1
8	3.97	4.29	-0.32
8.25	4.02	4.38	-0.36
8.5	4.16	4.23	-0.07
8.75	3.99	4.25	-0.26
9	4.13	4.07	0.06
9.25	4.08	4.2	-0.12
9.5	3.87	4.12	-0.25
9.75	4	4.05	-0.05
10	3.93	3.98	-0.05



Appendix E

Results Summary Tables

Table 1 Field Description and ASS Comparison for TLC Muchea

Field Observations					Field Test			Lab pH				Action Criteria
Sample ID												
Location	Depth/mBGL		Soil Description	Depth to Water	pHF*	pHFOX	pHF - pHFOX	pH KCl	TAA	S_{CR}	Net Acidity* (S_{CR})
	From	To		mBGL	pH units	pH units	pH units	pH units	% pyriteS	%S	%S
Assessment Criteria				-	4	4	1	NV	0.03	0.03	0.03
E5_750: 406202mE / 6506684mN											
E5_750	0	0.5	SAND: Grey / brown, loamy		5	4	1	5.2	0.02	<0.02	0.02
E5_750	0.5	1	SILTY SAND: Tan, some gravel		5.1	4.03	1.07	5	0.02	<0.02	0.04
E5_750	1	1.5	SILTY CLAY: Tan / grey, with orange mottles, some gravels		4.8	3.64	1.16	5	0.03	<0.02	0.03
E5_750	1.5	2	SILTY CLAY: Dark brown / grey, with orange mottles		4.3	2.82	1.48	4.7	0.05	<0.02	0.06
E5_750	2	3	SILTY CLAY: Dark brown / grey, with orange mottles		4.35	2.79	1.56	4.9	0.02	<0.02	0.04
E5_750	3	4	CLAY: Grey, crumbly, with dark brown silt		4.48	2.93	1.55	4.8	0.03	<0.02	0.04
E5_750	4	5	CLAY: grey		4.39	3.06	1.33	4.8	0.04	<0.02	0.05
E5_750	5	6	CLAY: Light grey, with red / brown mottles		4.81	3.77	1.04	4.8	0.05	<0.02	0.06
E5_750	6	7	SILTY CLAY: Dark brown / black silt with grey clay		4.64	3.75	0.89	4.7	0.05	<0.02	0.06
E5_750	7	8	CLAY: Dark grey / brown, with red mottling, wet	7.5	3.97	4.29	-0.32	4.5	0.06	<0.02	0.07
E5_750	8	9	CLAY: Dark grey / brown, with red mottling, wet		4.13	4.07	0.06	4.6	0.06	<0.02	0.06
E5_750	9	10	CLAY: Dark grey / brown, with red mottling, wet		3.93	3.98	-0.05	4.7	0.11	<0.02	0.11
E5_950: 406191mE / 6506885mN											
E5_950	0	0.5	SAND: fine, loamy, brown, some gravels		5.69	4.85	0.84	5.5	0.05	<0.02	0.05
E5_950	0.5	1	SAND: fine, loamy, brown, some gravels		5.78	4.79	0.99	5.4	0.03	<0.02	0.03
E5_950	1	1.5	SAND: fine, loamy, brown, some gravels		5.84	4.74	1.1	5.6	0.05	<0.02	0.05
E5_950	1.5	2	SAND: fine, loamy, brown, some gravels		5.26	4.32	0.94	5.1	0.06	<0.02	0.07
E5_950	2	3	CLAY: Light grey, crumbly		4.48	2.71	1.77	4.8	0.05	<0.02	0.06
E5_950	3	4	CLAY: Light grey, with orange and red mottles		4.46	2.97	1.49	5.4	<0.02	<0.02	0.02
E5_950	4	5	CLAY: Light grey, with orange and red mottles		4.08	3.09	0.99	4.8	0.05	<0.02	0.05
E5_950	5	6	CLAY: Light grey, no mottles		4.07	3.2	0.87	4.8	0.05	<0.02	0.05
E5_950	6	7	SILTY CLAY: Brown / clay		4.18	3.57	0.61	4.5	0.06	<0.02	0.06
E5_950	7	8	SILTY CLAY: Dark brown, with red mottles		4.26	3.51	0.75	4.6	0.06	<0.02	0.07
E5_950	8	9	SILTY CLAY: Brown / grey	8.25	3.94	4.67	-0.73	4.6	0.05	<0.02	0.05
E5_951	9	10	BEDROCK: Refusal assumed granite bedrock								
M5_400: 406997mE / 6506346mN											
M5_400	0	0.5	SAND: Brown loam, gravel, dry, minor clay content		6.9	5.63	1.27	5.6	<0.02	<0.02	<0.02
M5_400	0.5	1	SAND: Brown loam, gravel, dry, minor clay content		6.48	5.12	1.36	5.4	<0.02	<0.02	0.02
M5_400	1	1.5	CLAYEY SAND: Light brown, garvel, dry		6.3	4.83	1.47	5.5	<0.02	<0.02	<0.02
M5_400	1.5	2	SANDY CLAY: Brown, red mottles, white flecks		6.11	4.8	1.31	5.5	<0.02	<0.02	<0.02
M5_400	2	3	SANDY CLAY: Brown		5.25	4.27	0.98	4.7	0.06	<0.02	0.06
M5_400	3	4	CLAY: Grey / brown		4.9	3.72	1.18	4.6	0.07	<0.02	0.08
M5_400	4	5	CLAY: Grey / brown with red mottles		4.75	3.65	1.1	4.6	0.06	<0.02	0.06
M5_400	5	6	CLAY: Grey / brown, possible organics		4.74	3.17	1.57	4.6	0.06	<0.02	0.07
M5_400	6	7	CLAY: Grey		4.25	3.07	1.18	4.4	0.09	<0.02	0.12
M5_400	7	8	CLAY: Pale grey		4.4	3.49	0.91	4.6	0.06	<0.02	0.06
M5_400	8	9	CLAY: Grey		4.29	3.33	0.96	4.7	0.09	<0.02	0.1
M5_400	9	10	CLAY: Brown / grey		3.71	3.14	0.57	4.7	0.1	<0.02	0.1
M5_400	10	11	CLAY: Grey / brown, dry		3.76	2.81	0.95	4.7	0.09	<0.02	0.09
M5_400	11	12	CLAY: Grey, orange mottles, moist		4.06	3.05	1.01	4.6	0.08	<0.02	0.08
M5_400	12	13	CLAY: Light brown, / grey, orange mottles, moist		4.23	3.27	0.96	4.7	0.1	<0.02	0.11
M5_400	13	14	CLAY: Brown / grey, with red mottles		4.34	3.33	1.01	4.5	0.1	<0.02	0.12
M5_400	14	15	CLAY: Brown / grey, with red mottles		4.09	3.26	0.83	4.4	0.13	<0.02	0.19
M5_400	15	16	CLAY: Brown / grey, with red mottles, wet	15	3.51	3.38	0.13	4.2	0.15	<0.02	0.35
M5_400	16	17	CLAY: Brown, with red mottles, some moisture		3.82	3.53	0.29	4.4	0.16	<0.02	0.54
M5_400	17	18	CLAY: Dark brown, with red mottles, dry		3.65	3.37	0.28	4.3	0.19	<0.02	0.36
M5_400	18	19	CLAY: Dark brown, with red mottles, wet	18.25	3.49	3.3	0.19	4.2	0.17	<0.02	0.39
M5_400	19	20	CLAY: Dark grey / black, organic matter (peat), no odour		3.49	1.05	2.44	4.1	0.21	1.03	1.28
M5_400	20	21	CLAY: Dark grey / black, organic matter (peat), no odour		3.6	1.19	2.41	4.2	0.16	0.97	1.13
J_300: 406635mE / 6506234mN											
J_300	0	0.5	SILTY SAND: Grey / brown, with some organic matter		6.12	4.55	1.47	5.3	<0.02	<0.02	0.04
J_300	0.5	1	SAND: Brown, gravelly loam		6	4.61	1.48	5.3	0.02	<0.02	0.03
J_300	1	1.5	SAND: Orange / brown, gravelly loam		5.71	4.44	1.27	5.3	0.06	<0.02	0.06
J_300	1.5	2	SANDY CLAY: Tan, gravel		5.67	4.38	1.37	5	0.02	<0.02	0.03
J_300	2	3	CLAY: Tan / grey mottling		5.42	4.14	1.31	4.8	0.04	<0.02	0.04
J_300	3	4	CLAY: Light grey		4.84	3.61	2.27	4.7	0.05	<0.02	0.06
J_300	4	5	CLAY: Grey		4.47	2.2	2.37	4.7	0.06	<0.02	0.06
J_300	5	6	CLAY: Dark grey / brown, clods of organic matter		4.3	2.23	1.85	4.6	0.07	<0.02	0.08
J_300	6	7	CLAY: Brown, with grey flecks		3.94	2.94	0.96	4.6	0.07	<0.02	0.07
J_300	7	8	CLAY: Grey / brown		4.08	2.96	1.04	4.5	0.09	<0.02	0.09
J_300	8	9	CLAY: Grey		4.09	2.98	1.17	4.8	0.06	<0.02	0.07
J_300	9	10	CLAY: Brown silty organic matter, with grey clay		3.84	2.77	1.04	4.6	0.07	<0.02	0.07
J_300	10	11	CLAY: Grey		3.88	2.93	1.02	4.9	0.03	<0.02	0.04
J_300	11	12	SILTY CLAY: brown / grey, with orange mottles		3.93	2.9	0.88	4.6	0.08	<0.02	0.08
J_300	12	13	SILTY CLAY: Grey / brown, with orange mottles, moist		3.92	2.94	0.88	4.7	0.07	<0.02	0.07
J_300	13	14	CLAY: Brown / grey, red layering (suspect coffee rock), moist		4.07	3.03	1	4.6	0.06	<0.02	0.06
J_300	14	15	CLAY: Brown / grey, red layering (suspect coffee rock), moist		3.97	3.18	1.08	4.9	0.05	<0.02	0.05
J_300	15	16	CLAY: Grey, with red mottling, wet	15	3.7	2.12	1.01	4.7	0.04	0.02	0.07
J_300	16	17	CLAY: Dark brown, moist, with mottling		4.62	2.58	2.14	4.8	0.05	<0.02	0.06
J_300	17	18	CLAY: Dark brown, moist, with mottling		4.48	1.39	3.13	4.7	0.07	0.12	0.2
J_300	18	19	CLAY: Dark Grey		4.3	1.14	2.93	4.6	0.06	0.16	0.22
J_300	19	20	CLAY: Dark Grey		4.77	1.8	3.15	4.8	0.05	0.3	0.36

Notes: BGL = below ground level; Net Acidity* = TAA + S_{CR}, pHF* = 1 : 5 soil / deionised water

APPENDIX E

Vegetation Survey Report

ASSESSMENT OF FLORA AND VEGETATION VALUES

AND A RE-ASSESSMENT OF BLACK-COCKATOOS

USAGE ON THE

MIDLAND BRICK MUCHEA 6 SURVEY AREA

Prepared for

Midland Brick

Prepared by

Mattiske Consulting Pty Ltd

March 2022

Mattiske Consulting Pty Ltd

Disclaimer and Limitation

This report has been prepared on behalf of and for the exclusive use of Midland Brick, and is subject to and issued in accordance with the agreement between Midland Brick and Mattiske Consulting Pty Ltd. Mattiske Consulting Pty Ltd accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party.

This report is based on the scope of services defined by Midland Brick, budgetary and time constraints imposed by Midland Brick, the information supplied by Midland Brick (and its agents), and the method consistent with the preceding.

DOCUMENT HISTORY

Report	Version	Prepared By	Reviewed By	Submitted to Client	
				Date	Copies
Internal Review	V1	E Mattiske	E Mattiske	-	-
Draft Report	V2	E Mattiske	E Mattiske	10/2/2022	Email
Draft Report	V3	E Mattiske	E Mattiske	11/03/2022	Email
Final Report	V4	E Mattiske	E Mattiske	25/03/2022	Email

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LIST OF ABBREVIATIONS

BAM Act:	*Biosecurity and Agriculture Management Act 2007* (WA)
BC Act:	*Biodiversity Conservation Act 2016* (WA)
BOM:	Bureau of Meteorology
DAWE:	Department of Agriculture, Water and the Environment
DBCA:	Department of Biodiversity, Conservation and Attractions
EP Act:	*Environmental Protection Act 1986* (WA)
EPA:	Environmental Protection Authority
EPBC Act:	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
IBRA:	Interim Biogeographical Regionalisation for Australia
PEC:	Priority ecological community
TEC:	Threatened ecological community
TPFL:	Threatened and Priority Flora (WA Herbarium)
WAH:	Western Australian Herbarium (PERTH)

1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned by Midland Brick in the spring months of 2021 to complete an assessment of flora and fauna values on the proposed expansion area of the Muchea 6 operations.

The Muchea 6 site has been operating for some time and currently is undergoing a potential expansion of its operations. The Muchea 6 site has been subject to previous agricultural activities and as such remnants of grazing pressures and clearing activities were carried out on the site prior to the development of the extractive industry.

Site visits were undertaken by Dr Libby Mattiske (Mattiske Consulting) and Caragh Sinclair (Midland Brick) in November 2021 and Tony Kirkby (Cockatoo specialist) in December 2021. These field trips supplement the earlier work by Jen Wilcox from Western Wildlife (2015).

The range of flora on the site is very limited due to the previous grazing activities and as such only 4 native and 9 introduced species were recorded in 2021. The latter low diversity reflects the degree of past disturbances from earlier agricultural activities.

The vegetation mapped as "E1" is dominated by open woodlands of Wandoo (*Eucalyptus wandoo*) with the occasional Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) over mainly introduced grasses and herbs.

No threatened or priority ecological communities listed at the State or Federal levels pursuant to the *Wildlife Conservation Act* 1950 or the *Environment Protection Biodiversity and Conservation Act* 1999 were recorded in the BGC Muchea project area (Department of Biodiversity, Conservation and Attraction 2022b 2022c; Department of Agriculture, Water and the Environment 2022c).

Vegetation condition across the survey area ranged from degraded to completely degraded in the majority of the Muchea 6 site. The area has been subject to previous extraction activities and also grazing, so the vegetation consists mainly of *Eucalyptus wandoo* (Wandoo) and occasional Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) with little understorey remaining over the majority of the area.

Two trees had suitable hollows for Black-Cockatoos. The two trees that had suitable hollows for Black-Cockatoos will not be cleared or impacted by the proposed expansion activities. A range of trees were highlighted by Western Wildlife (2015) and were re-assessed by Tony Kirkby in 2021. Although some had larger diameters at breast height only a few of these larger trees will be cleared and none have potential tree hollows suitable for the Black-Cockatoo nesting.

Of the proposed 89 trees to be cleared with diameters at breast height >30cm:

- a total of 8 trees have a DBH >80cm or more but none of these has suitable hollows for Black-Cockatoos;
- a total of 12 trees have small hollows which are not suitable for Black-Cockatoos;
- a total of 8 trees have large hollows that are not showing any sign of use by Black-Cockatoos or are not sufficiently suitable dimensions for Black-Cockatoos.
- neither of the two trees highlighted by Kirkby in 2021 will be cleared as part of the proposed expansion.

In summary, the main biological values of the area relate to the various stands of predominantly *Eucalyptus wandoo* (Wandoo) and some *Corymbia calophylla* (Marri) and the two trees with suitable hollows for Black-Cockatoos and also the trees which support Black-Cockatoo foraging activities.

In terms of the ten native vegetation clearing principles, only Principle (b) associated with the fauna species may be at variance with the clearing principles. However as the trees with suitable hollows will be avoided in the expansion, the remaining impact relates to the reduction in tree canopy for foraging.

2. INTRODUCTION

Mattiske Consulting Pty Ltd was commissioned by Midland Brick in the spring months of 2021 to complete an assessment of flora and fauna values on the proposed expansion area of the Muchea 6 operations. A such this work supplements the earlier work by Jen Wilcox of Western Wildlife (2015) on the Black-Cockatoos.

The Muchea 6 site has been operating for some time and currently is undergoing a potential expansion of its operations. The Muchea 6 site has been subject to previous agricultural activities and as such remnants of grazing pressures and clearing activities were carried out on the site prior to the development of the extractive industry.

2.1 Location

The Muchea 6 site operated by Midland Brock is located approximately 50km north of Perth. The survey area includes primarily agricultural areas with patches of remnant trees and a previous pit associated with extraction of clay and a pond area. The survey areas occur within the Drummond Botanical District, part of the greater South-West Botanical District (Beard 1990).

2.2 Climate

Beard (1990) describes the climate of the Drummond Botanical District as warm Mediterranean with 5-6 dry months per year. Figure 1 shows the average climate data of the Pearce RAAF Airbase (rainfall, minimum and maximum temperature), (BOM 2022). The seasonal wetter and cooler months in winter and the drier and hotter months in summer typify the regional conditions.

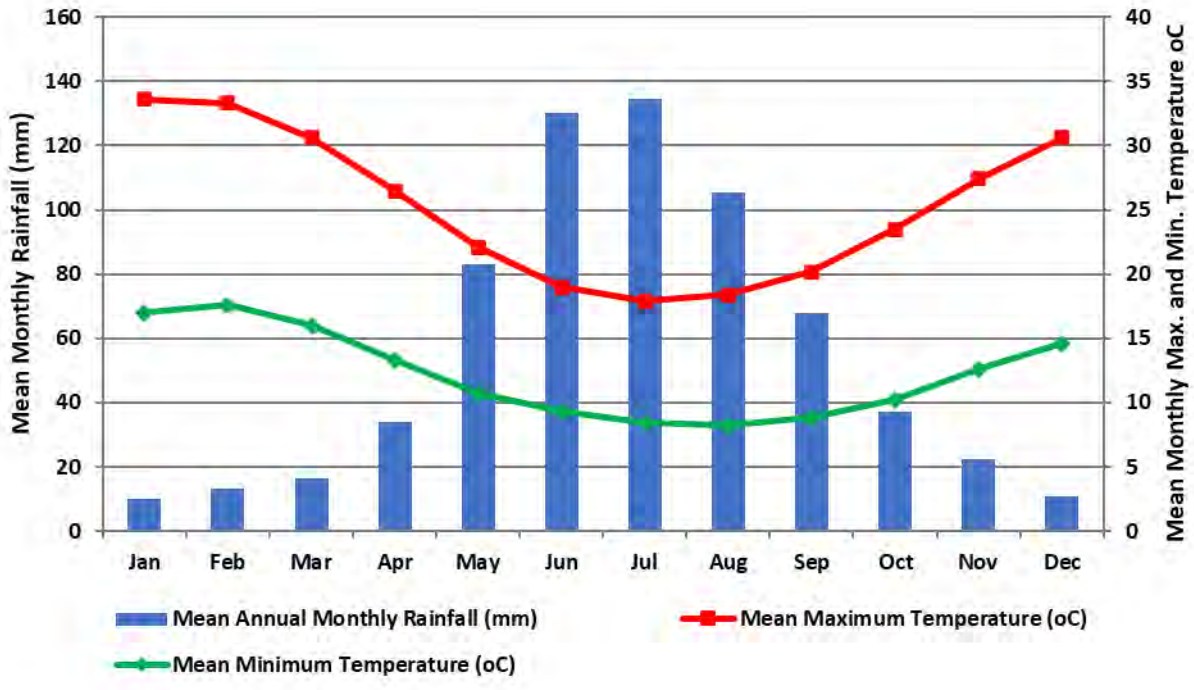

Figure 1: Summary of Climatic data from Bureau of Meteorology (BOM 2022) for the Pearce RAAF Airbase 009053 (Rainfall, Minimum and Maximum Temperatures ^{o}C)

2.3 Western Australia's Flora – A Legislative Perspective

At the State level, the *Biodiversity Conservation Act 2016* provides for taxa of native flora (and fauna) to be specially protected because they are subject to identifiable threats. Protection of these taxa has been

identified as being warranted because they may become extinct, are threatened, or are otherwise in need of special protection. Ecological communities that are deemed to be threatened are afforded protection under the *Environmental Protection Act 1986*. Listings of threatened species and communities are reviewed annually by the Western Australian Threatened Species Scientific Committee (TSSC), which is a body appointed by the Minister for the Environment and supported by the DBCA. The TSSC reviews threatened and specially protected flora (and fauna) listings on an annual basis. Recommendation for additions or deletions to the listings of specially protected flora (and fauna) is made to the Minister for the Environment by the TSSC, via the Director General of the DBCA, and the WA Conservation Commission. Under Schedule 1 of the *Biodiversity Conservation Act 2006*, the Minister for the Environment may declare that a class or description of flora to be threatened flora throughout the State, by notice published in the *Government Gazette* (DBCA 2022a).

At the Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999*, a nomination process exists, to list a threatened species or ecological community. Additions or deletions to the lists of Threatened species and communities are made by the Minister for Agriculture, Water and the Environment, on advice from the Federal Threatened Species Scientific Committee. *Environment Protection and Biodiversity Conservation Act 1999* lists of Threatened flora and ecological communities are published on the Department of Agriculture, Water and the Environment website (2022b, 2022c).

2.4 Threatened and Priority Flora

Flora within Western Australia that is considered to be under threat may be classed as either threatened flora or priority flora. Where flora has been gazetted as threatened flora under the *Biodiversity Conservation Act* 2006, it is an offence "to take" such flora without the written consent of the Minister. The *Biodiversity Conservation Act* 2006 states that "to take" flora includes to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority flora constitute species which are considered to be under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. Such species are considered to potentially be under threat, but do not have legislative protection afforded under the *Biodiversity Conservation Act* 2016. The DBCA categorises priority flora according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such species, with P1 listed species being the most threatened, and P5 the least. Priority flora species are regularly reviewed, and may have their priority status changed when more information on the species becomes available. Appendix A1 sets out definitions of both threatened and priority flora (DBCA 2022a).

At the Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999*, threatened species can be listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent, by the Commonwealth Minister for Agriculture, Water and the Environment. Refer to Appendix A2 for a description of each of these categories of threatened species. Under the *Environment Protection and Biodiversity Conservation Act 1999*, a person must not take an action that has or will have a significant impact on a listed threatened species without approval from the Commonwealth Minister for Agriculture, Water and the Environment, unless those actions are not prohibited under the Act.

2.5 Threatened and Priority Ecological Communities

An ecological community is defined as a naturally occurring biological assemblage that occurs in a particular type of habitat composed of specific abiotic and biotic factors. At the State level, ecological communities may be considered as threatened once they have been identified as such by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. A threatened ecological community is defined, under the *Environmental Protection Act 1986*, as an ecological community listed, designated or declared under a written law or a law of the Commonwealth as threatened, endangered or vulnerable. There are four State categories of threatened ecological communities, or TECs: presumed totally destroyed (PD); critically endangered (CR); endangered (EN); and vulnerable (VU) (DBCA 2019).

A description of each of these categories of TECs is presented in Appendix A3. Threatened ecological communities are gazetted as such (DBCA 2022b).

At the Commonwealth level, some Western Australian TECs are listed as threatened, under the *Environment Protection and Biodiversity Conservation Act 1999*. Under the *Environment Protection and Biodiversity Conservation Act 1999*, a person must not take an action that has or will have a significant impact on a listed threatened ecological community without approval from the Commonwealth Minister for the Agriculture, Water and the Environment, unless those actions are not prohibited under the Act. A description of each of these categories of TECs is presented in Appendix A4. The current *Environment Protection and Biodiversity Conservation Act 1999* list of threatened ecological communities can be located on the DAWE (2022c) website.

Ecological communities identified as threatened, but not listed as threatened ecological communities, can be classified as priority ecological communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. The DBCA categorises priority ecological communities according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such ecological communities, with P1 communities being the most threatened and P5 the least. Appendix A5 sets out definitions of priority ecological communities (DEC 2013). A list of current priority ecological communities can be viewed at the DBCA (2022c) website.

2.6 Clearing of Native Vegetation

Under the *Environmental Protection Act 1986*, the clearing of native vegetation requires a permit to do so, from the Department, Water and Environmental Regulations (DWER) or the Department of Mines, Industry Regulation and Safety (DMIRS), unless that clearing is exempted under specific provisions listed in Schedule 6 of the Act, or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Under the *Environmental Protection Act* (1986), "native vegetation" means indigenous aquatic or terrestrial vegetation, and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation. Under the *Environmental Protection Act 1986*, Section 51A, "clearing" means the killing or destruction of, the removal of, the severing or ringbarking of trunks or stems of, or the doing of any other substantial damage to, some or all of the native vegetation in an area, and includes the draining or flooding of land, the burning of vegetation, the grazing of stock, or any other act or activity, that causes any of the aforementioned consequences or results.

Under the *Environmental Protection Act 1986*, ten principles are set out, under which native vegetation should not be cleared. These principles state that native vegetation should not be cleared, if:

a. it comprises a high level of biological diversity;

b. it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;

c. it includes, or is necessary for the continued existence of, threatened flora;

d. it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community;

e. it is significant as a remnant of native vegetation in an area that has been extensively cleared;

f. it is growing in, or in association with, an environment associated with a watercourse or wetland;

g. the clearing of the vegetation is likely to cause appreciable land degradation;

h. the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;

i. the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or

j. the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 5, sets out prescribed clearing actions that do not require a clearing permit, as defined in Section 51C of the *Environmental Protection Act 1986*.

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 6 –"Environmentally sensitive areas" are defined as "the area covered by vegetation within 50 m of threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the threatened flora is located".

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* - Regulation 6 (Environmentally sensitive areas), the area covered by a threatened ecological community, is similarly considered an Environmental sensitive area and therefore non-permitted, unless Ministerial approval is granted.

2.7 Declared Plant (Pest) Species

Section 22 of Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act) makes provision for a plant taxon to be listed as a declared pest organism in respect to parts of, or the entire State. According to the BAM Act, a declared pest is defined as a prohibited organism (section 12), or an organism for which a declaration under section 22 (2) of the Act is in force.

Under the *Biosecurity and Agriculture Management Regulations 2013* (WA), declared pest plants are placed in one of three control categories, C1 (exclusion), C2 (eradication) or C3 (management), which determines the measures of control which apply to the declared pest (Table A4.1). The current listing of declared pest organisms and their control category is through the Western Australian Organism List (Department of Primary Industries and Regional Development 2022).

2.8 Local and Regional Significance

Flora or vegetation may be locally or regionally significant in addition to statutory listings by the State or Federal Government.

In regards to flora; species, subspecies, varieties, hybrids and ecotypes may be significant other than as threatened flora or priority flora, for a variety of reasons, including:

- a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status
- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution; and
- being poorly reserved (EPA 2004).

Vegetation may be significant because the extent is below a threshold level and a range of other reasons, including:

- scarcity;
- unusual species;
- novel combinations of species;

- a role as a refuge;
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- being representative of the range of a unit (particularly, a good local and/or regional example of a unit in "prime" habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- a restricted distribution (EPA 2004).

Vegetation communities are locally significant if they contain Priority Flora species or contain a range extension of a particular taxon outside of the normal distribution. They may also be locally significant if they are very restricted to one or two locations or occur as small isolated communities. In addition, vegetation communities that exhibit unusually high structural and species diversity are also locally significant.

Vegetation communities are regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of threatened Flora.

Determining the significance of flora and vegetation may be applied at various scales, for example, a vegetation community may be nationally significant and governed by statutory protection as well as being locally and regionally significant.

3. OBJECTIVES

Mattiske Consulting Pty Ltd was commissioned by Midland Brick in the spring months of 2021 to complete an assessment of flora and fauna values on the proposed expansion area of the Muchea 6 operations. A such this work supplements the earlier work by Jen Wilcox of Western Wildlife (2015) on the Black-Cockatoos.

The reconnaissance survey was undertaken in accordance with the EPA (2016a and 2016b) and Commonwealth (2013) survey guidance statements. A detailed survey was not undertaken due to the extensive clearing in the past from historical grazing activities and previous extraction of clay materials in a section of Muchea 6.

- Record the flora, vegetation and fauna values in the area through sampling;
- Undertake searches for flora species using foot traverses;
- Collect and identify the vascular plant species present in the Survey Area;
- Collate and identify weeds within the survey areas;
- Review the conservation status of the vascular plant species recorded by reference to current literature and current listings by the DBCA (2022a) and plant collections held at the Western Australian State Herbarium (WAH 1998-), and listed by the DAWE (2022a) under the *Environment Protection and Biodiversity Conservation Act 1999*;
- Identify any threatened or priority ecological communities recorded by reference to current literature and current listings by the DBCA (2022b, 2022c) and as listed by the DAWE (2022c) under the *Environment Protection and Biodiversity Conservation Act 1999*;
- Undertake targeted work on the fauna habitat values and any potential usage of the area;
- Provide recommendations on the local and regional significance of the vegetation; and
- Prepare a report summarising the findings.

4. METHODS

This report provides a summary that incorporates key points from recent site inspections Dr Mattiske, Caragh Sinclair in November 2021 and Tony Kirkby in December 2021. Survey tracks are summarized in Figure 2 as attached. This aerial image also reflects the degree of previous clearing on the majority of the areas.

The trees on the survey area were re-assessed for the presence of suitable hollows for Black-Cockatoo species by Tony Kirkby and also for other key activities by the Black-Cockatoos. Hollows with a suitable entrances were further inspected using a pole camera and all hollows were checked for dimensions and also signs of activity such as evidence of physical chewing of the tree stems by the bird. GPS locations were taken handheld GPS (GDA 94). The assessments were undertaken in line with current guidelines.

An assessment of the impact of weed invasion or vegetation condition was undertaken on the basis of the vegetation condition scale from Keighery (1994) (Appendix A7).

All plant specimens collected during the field surveys were dried and processed in accordance with the requirements of the Western Australian Herbarium. The plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the WAH (1998-).

The descriptions of plant communities within the survey area are based on the structural forms of Australian vegetation developed by Beard (1990).

4.1 Survey Limitations and Constraints

An assessment of the survey against a range of factors which may have had an impact on the outcomes of the present survey was made (Table 1). Based on this assessment, the present survey has not been subject to constraints which would affect the thoroughness of the survey, and the conclusions which have been formed.

N

0 40 80 m

Scale: 1:5,000
MGA94 (Zone 50)

CAD Ref: a2866F003_03

Date: March 2022 | Rev: A | A4

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Midland Brick
Muchea 6
Tracks on Aerial Imagery

Figure: **2**

Table 1: Potential Flora and Vegetation Survey Limitations for Survey Area

Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a constraint:** The study has been undertaken in an area that has been well studied and documented with ample literature available (Beard 1976; 1990; Heddle et al. 1980; Mattiske and Havel 1998; Mitchell *et al.* 2002).
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint:** Due to sufficient rainfall, all life forms were sampled adequately during the time of the survey. All site characteristics were adequately sampled during the time of the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a constraint:** The proportion of flora surveyed was adequate; although due to the degraded nature of most areas the range of native flora was low.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a constraint:** The information collected during the survey was sufficient to assess the vegetation that was present during the time of the survey.
Mapping reliability.	**Not a constraint:** Aerial photography of a suitable scale with previous mapping (Mattiske Consulting Pty Ltd 2012) shown was used. Sites were chosen from these aerials to plan quadrats in representative areas of plantations and remnants. Opportunistic sites were also used if differences were noticed during on ground reconnaissance. Vegetation communities were assigned to each quadrat based on previous mapping, topography, soil type, presence/absence and percent foliage cover of vegetation.
Timing, weather, season, cycle.	**Not a constraint:** It is generally accepted that flora and vegetation surveys are conducted in late spring (after late rains in the southwest in 2021) in the South-West Botanical Province (EPA 2004). Rainfall prior to the survey was deemed to be sufficient (Figure 2).
Disturbances (fire flood, accidental human intervention, etc.).	**Potential constraint:** Extensive grazing pressures have been experienced within the Muchea 6 area and this combined with previous extraction activities has led to degraded remnants in the survey area.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint:** Sites were chosen from aerial maps to review the values in the degraded woodlands on the Muchea 6 area.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint:** The available resources were adequate to complete the survey.
Access problems (i.e. ability to access survey area).	**Not a constraint:** Existing tracks enabled adequate access to survey the vegetation within the survey area. Where access was not available by car, it was easily traversed by foot.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a constraint:** All survey personnel have the appropriate training in sampling and identifying the flora of the region.

5. RESULTS

5.1 Landform and Soils

The underlying land system as illustrated on Figure 3 is the Reagan system, namely:

. **Reagan System** - Gentle Slopes from the Dandaragan plateau to the Pinjarra plain. Brown, yellow and pale sands that may be shallow to very deep with clay or duricrust underlying. Variable low woodland and shrubland of *Eucalyptus, Banksia* and *Acacia* species.

The Muchea 6 area covers some 49.98ha which occurs as 0.94% of the total extent of this land system.

The Regan System has also been subdivided into 4 soil landscape mapping units consisting of subsystems and phases on the Muchea 6 site, namely:

. **Reagan 222Re-1g Phase** – covering 21.26ha of the 22.05ha in the wider area; with gentle slopes of gravelly deep pale sands often over clay or duricrust. Very low woodland and shrubland with scattered low trees. *Banksia prionotes, Nuytsia floribunda, Adenanthos* species and a few stunted *Eucalyptus marginata*.

. **Reagan 222Re-1x Phase** – covering 28.17ha of the 576.36ha in the wider area; with gentle slopes of loose brown or pale sands with a sandy fabric. Low woodland and shrubland with scattered low trees Banksia *prionotes, Nuytsia floribunda, Adenanthos* species and stunted *Eucalyptus marginata*.

. **Reagan 222Re10 Subsystem** – covering 0.10ha of the 674.01ha in the wider area; with drainage depressions on the Dandaragan Plateau. Generally duplex, some uniform fine, yellow to yellowish brown alluvial soils. *Corymbia calophylla* and *Eucalyptus wandoo* with occasional *Eucalyptus marginata. Melaleuca* species., reeds and *Eucalyptus rudis* in wet areas.

. **Reagan 222Re5 Subsystem** – covering 0.45ha of the 51.87ha in the wider area; with level to very gently inclined swampy drainage lines with poorly drained grey siliceous and pale yellow-brown sands. Low woodland of *Corymbia calophylla, Eucalyptus wandoo*, some *Eucalyptus marginata. Melaleuca* species, *Eucalyptus rudis* and reeds in wet areas.

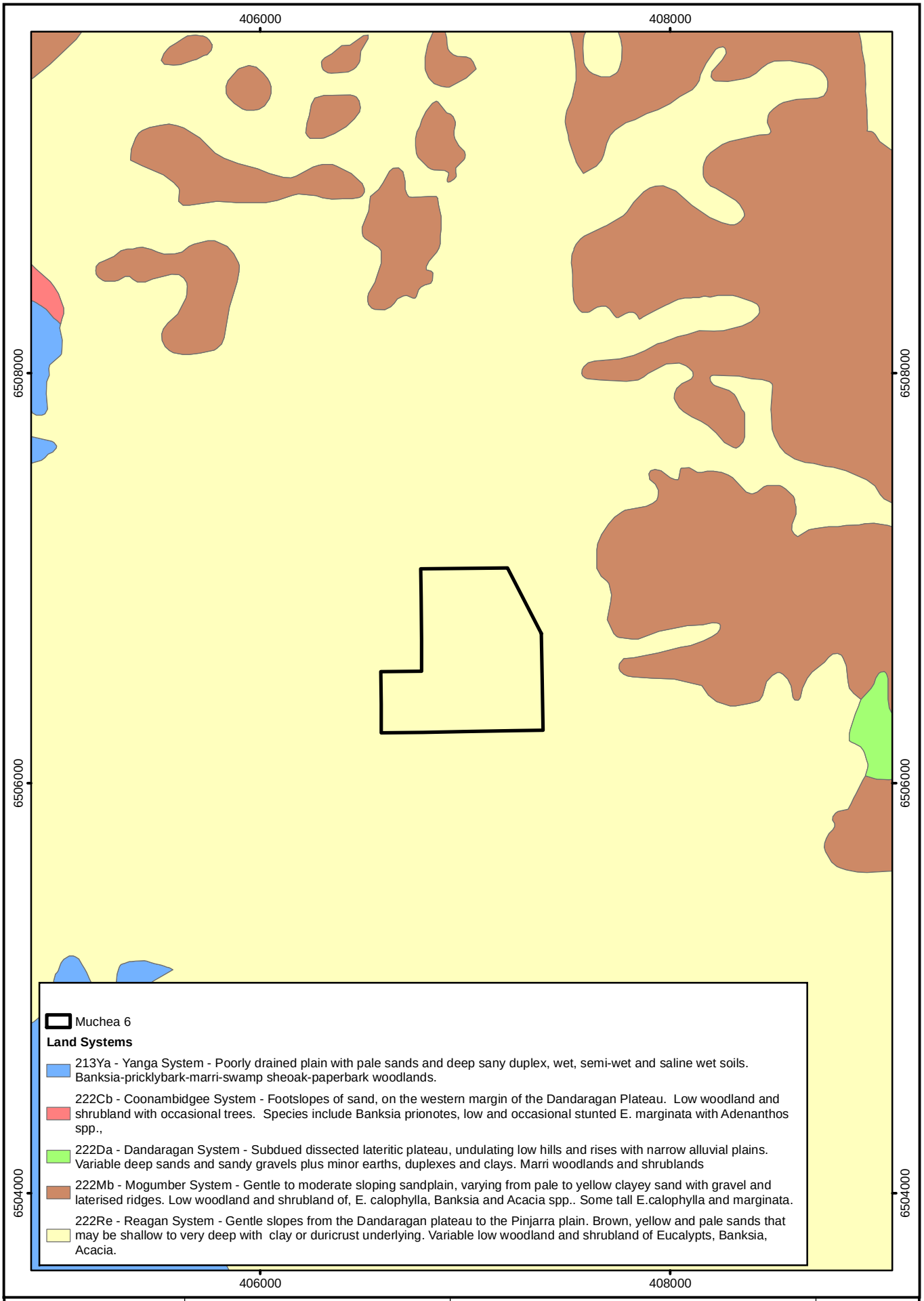
5.2 Pre-European Vegetation

The survey area lies in the Drummond Botanical Sub-districts within the Darling Botanical District of the South-west Botanical Province (Beard 1979, 1980 and 1990).

The underlying Pre-European vegetation as illustrated on Figure 5 is the Gingin system, namely:

. **Gingin System** – Mainly *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri)

The Muchea 6 area covers some 49.98ha which occurs as 0.89% of the total extent of this Pre-European vegetation mapping unit.



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Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a2866F006

Date: March 2022 | Rev: A | A4

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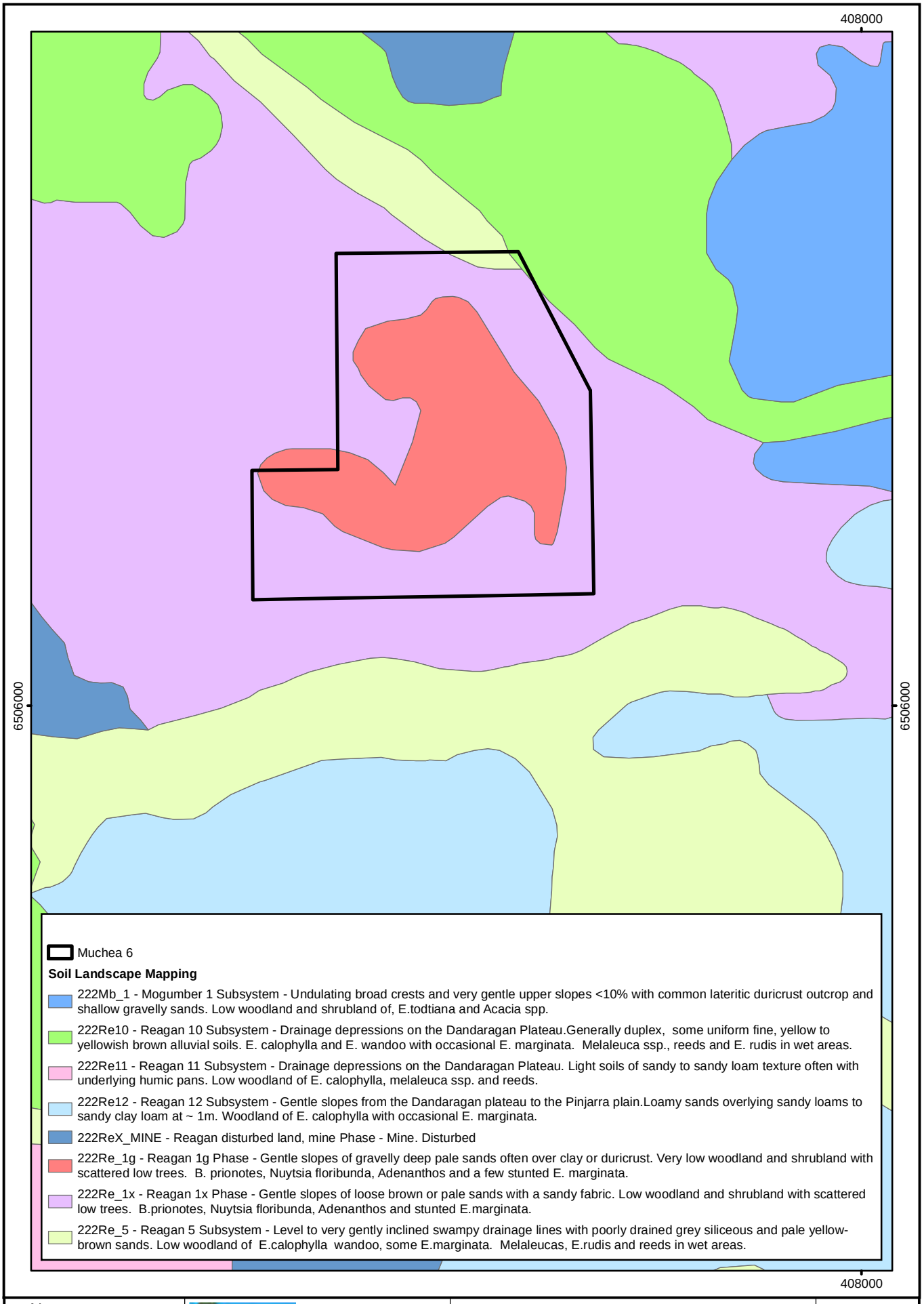
Midland Brick
Muchea 6
Land Systems

Figure: **3**



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Scale: 1:11,866
MGA94 (Zone 50)

CAD Ref: a2866F007

Date: March 2022 | Rev: A | A4

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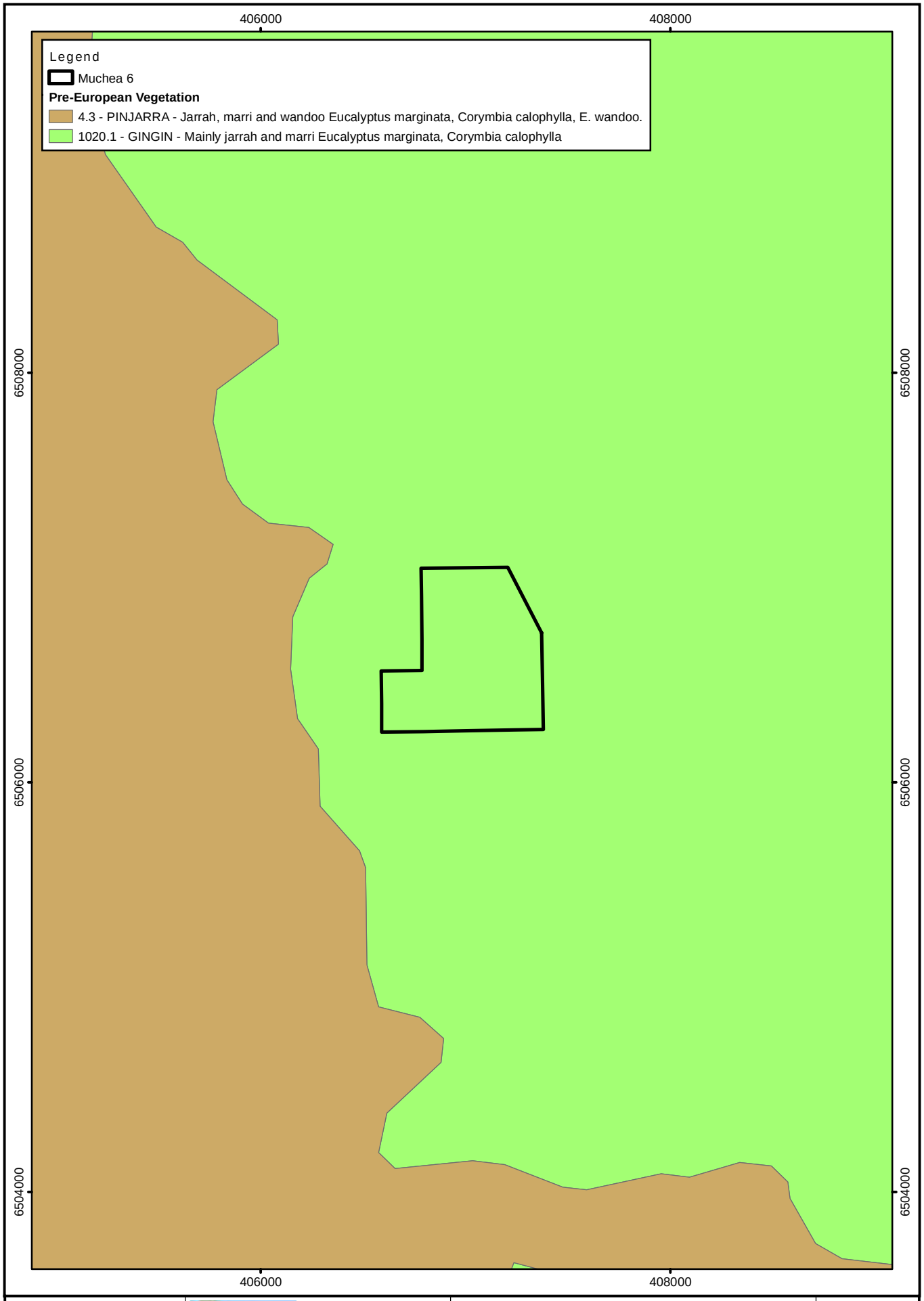
Midland Brick
Muchea 6
Soil Landscape Mapping

Figure: **4**



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Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a2866F005

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Midland Brick
Muchea 6
Pre-European Vegetation

Figure: **5**

5.3 Vegetation Complexes

The two vegetation complexes defined by Heddle *et al.* 1980) and later updated by Mattiske and Havel (1998) included Mogumber and Reagan complexes (Figure 6), namely:

- Mogumber South – Open Woodland of *Corymbia calophylla* with some mixtures of *Eucalyptus marginata* subsp. *thalassica* and a second storey of *Eucalyptus todtiana-Banksia attenuata-Banksia menziesii-Banksia ilicifolia* on sandy-gravels on the uplands in arid and per-arid zones.
- Reagan – Mixture of low open woodland of *Banksia* species – *Eucalyptus todtiana* to closed heath of Myrtaceae – Proteaceae species depending on depth of soils on escarpment in arid and per-arid zones.

The vegetation as defined in Mogumber and Reagan do not reflect the local dominance of the *Eucalyptus wandoo* which reflects the dominance of clays in the local soils. The latter is not surprising as the vegetation complex mapping was based on regional datasets rather than local data sets specific to the Muchea 6 site. Both these vegetation complexes (Mogumber – South and Reagan) are poorly represented in the conservation estates and less than 7% remains for both complexes within the land areas managed by the Government of Western Australia (2019). Only 1.19% and 3.72% of the Mogumber South and Reagan area respectively in lands protected (IUCN-I-IV) for Conservation (%).

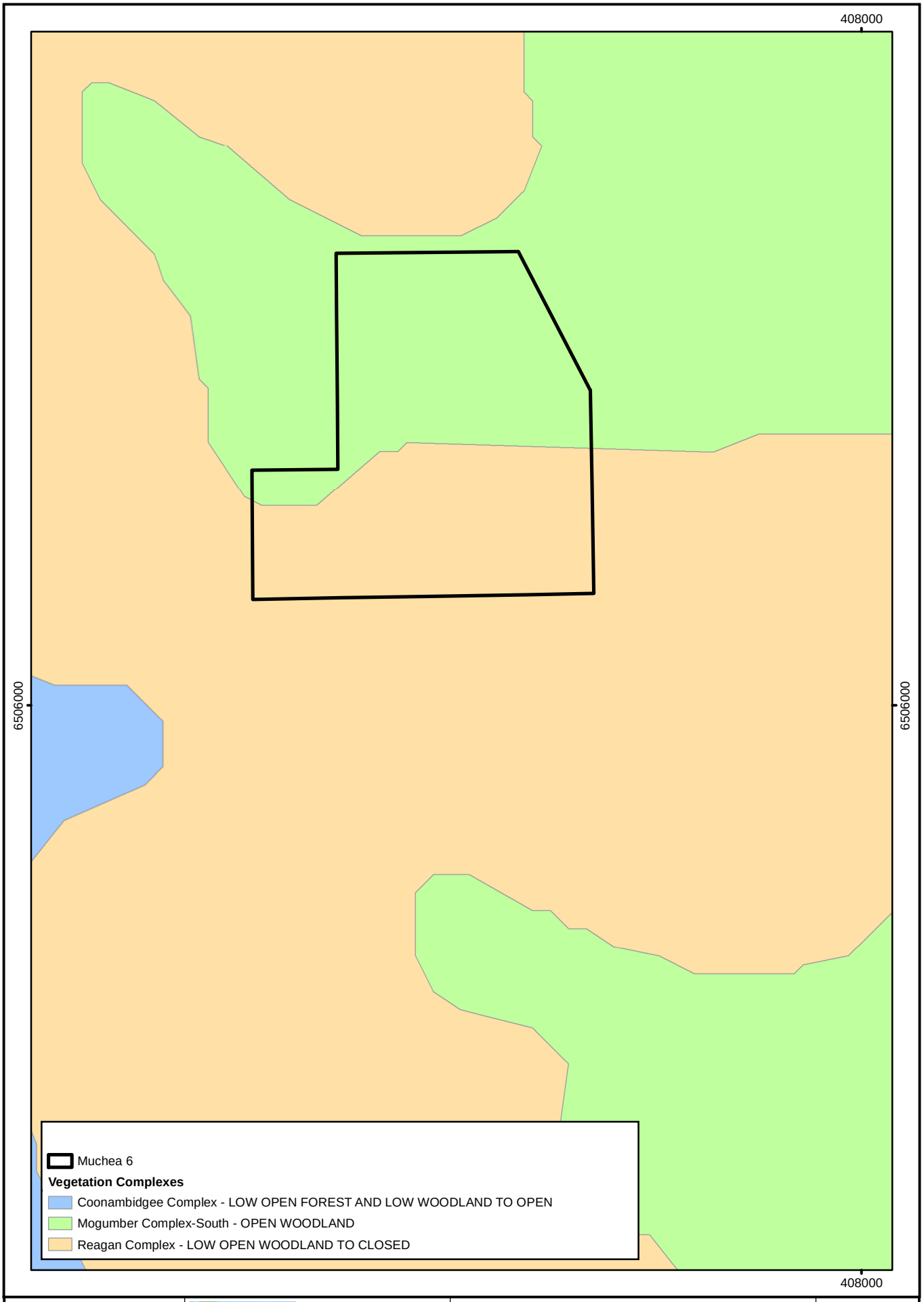
5.4 Recorded Flora and Vegetation

The range of flora on the site is very limited due to the previous grazing activities and as such only 4 native and 9 introduced species were recorded, Table 2. The latter low diversity reflects the degree of past disturbances from earlier agricultural activities, Figures 1 and 2. None of the introduced species are listed as Weeds of National Significance (DAWE 2022a). **Echium plantagineum* is a listed as a declared weed under section 22(2) of the State Biosecurity and Agriculture Management Act 2007l (DPIRD 2022).

The vegetation mapped as "E1" on Figure 7 is dominated by open woodlands of Wandoo (*Eucalyptus wandoo*) with the occasional Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) over mainly introduced grasses and herbs, see Photographs 1 to 3 below. The lower lying areas on the north-eastern corner of the survey area support more Marri trees but due to the degree of disturbance have not been highlighted on the vegetation mapping.

No threatened or priority ecological communities listed at the State or Federal levels pursuant to the *Wildlife Conservation Act* 1950 or the *Environment Protection Biodiversity and Conservation Act* 1999 were recorded in the BGC Muchea 6 survey area (Department of Biodiversity, Conservation and Attraction 2022b, 2022c; Department of Agriculture, Water and the Environment 2022c).

The native understorey is virtually absent, and the entire area is currently accessible to livestock.



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Scale: 1:11,866
MGA94 (Zone 50)

CAD Ref: a2866F008

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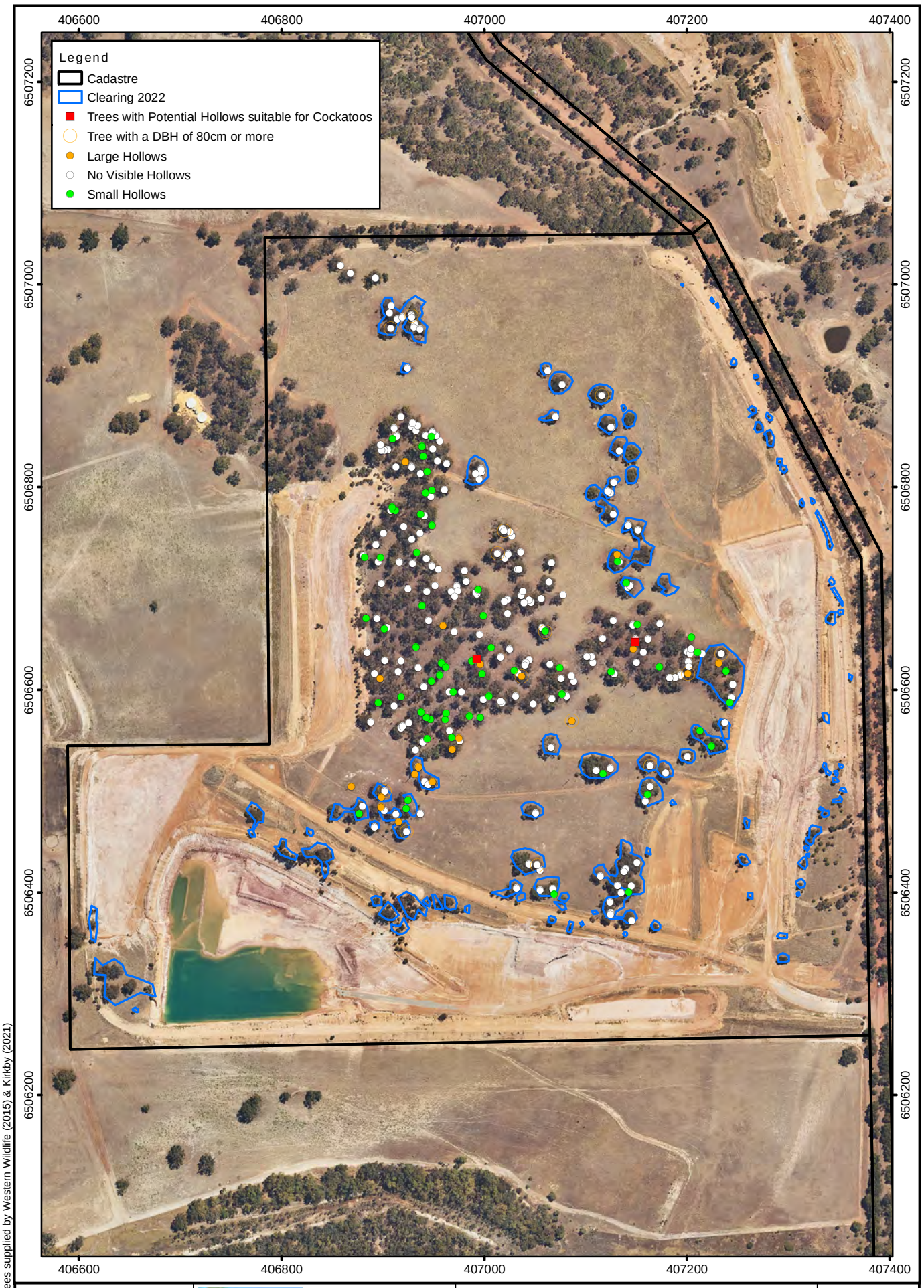
Midland Brick
Muchea 6
Vegetation Complexes

Figure: **6**



Potential Habitat Trees supplied by Western Wildlife (2015) & Kirkby (2021)

N

0 40 80 m

Scale: 1:5,000
MGA94 (Zone 50)

CAD Ref: a2866F009

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Midland Brick - Muchea 6

Key Tree Values and Proposed Clearing Areas

Figure: **7**

Table 2: Vascular Plant Species recorded on Muchea 6, 2021
Note: * denotes introduced species

Family	Species
Amaranthaceae	*Ptilotus polystachyus*
Asteraceae	**Hypochaeris glabra* **Ursinia anthemoides*
Boraginaceae	**Echium plantagineum*
Myrtaceae	*Corymbia calophylla* *Eucalyptus wandoo*
Poaceae	**Avena fatua* **Briza maxima* **Bromus diandrus* **Ehrharta calycina* **Ehrharta longiflora* **Lolium rigidum*
Xanthorrhoeaceae	*Xanthorrhoea preissii*

Photograph 1: Woodland of *Eucalyptus wandoo – Corymbia calophylla* in small gully on southern section of the Muchea 6 area. Note lack of understorey and dominance of introduced grasses and herbs

Photograph 2: Woodland of *Eucalyptus wandoo – Corymbia calophylla* in central section of remnant trees on the Muchea 6 area. Note lack of understorey and dominance of introduced grasses and herbs

Photograph 3: Woodland of *Eucalyptus wandoo* in northern section of remnant trees on the Muchea 6 area. Note lack of understorey and dominance of introduced grasses and herbs

5.5 Black-Cockatoo Re-assessment

Tony Kirkby (Black-Cockatoo specialist) undertook a re-assessment of the trees in December 2021. This wok entailed comprehensive foot traverses, camera observations of any potential hollows suitable for Black-Cockatoo nesting. These field trips supplement the earlier work by Jen Wilcox from Western Wildlife (2015).

Two trees with suitable hollows showing signs of use such as chewing at the entrance were located within the survey area, see Figure 7. These trees are shown as an overlay over the vegetation as defined by Mattiske and also the previous highlighted trees by Jen Wilcox. The trees as highlighted by Jen Wilcox in 2015 were re-assessed by Tony Kirkby in 2021. Although some had larger diameters at breast height only a few of these larger trees will be cleared and none have potential tree hollows suitable for the Black-Cockatoo nesting.

Tree 1141- 407149E: 6506647N. Hollow with suitably sized entrance and chewing both at rim and internally. Highly Likely a Black-Cockatoo breeding hollow. This tree also contains another suitable hollow with external chewing at entrance but which is now occupied by feral European Honey Bees *Apis mellifera.*

In summary, these locations in the expansion area should be avoided, if possible, to minimize impacts to these trees Therefore, the main value of these Wandoo woodlands is for potential usage by the Black-Cockatoos.

Tree 1141 showing extensive chewing.

Tree 1148 - 406993E: 6506630N. Hollow with suitably sized entrance and chewing both at rim and internally. Highly Likely a Black-Cockatoo breeding hollow.

Tree 1148 showing internal chewing.

Of the proposed 89 trees to be cleared with diameters at breast height >30cm:

. a total of 8 trees have a DBH >80cm or more but none of these has suitable hollows for Black-Cockatoos;

. a total of 12 trees have small hollows which are not suitable for Black-Cockatoos;

. a total of 8 trees have large hollows that are not showing any sign of use by Black-Cockatoos or are not sufficiently suitable dimensions for Black-Cockatoos.

. neither of the two trees highlighted by Kirkby in 2021 will be cleared as part of the proposed expansion.

All the native vegetation in the study area is likely to be Black-Cockatoo foraging habitat, as the canopy of primarily Wandoo and the occasional Marri and Jarrah trees provides seeds for foraging by Black-Cockatoos. Evidence of Black-Cockatoo foraging (chewed eucalypt fruits or flowers) was not observed during the site visit in 2015, however Western Wildlife indicated that Carnaby's Black-Cockatoo may be a seasonal visitor to the area. The Forest Red-tailed Black-Cockatoo potentially forages in the area throughout the year, whenever Marri and Jarrah fruits are available. However, the habitat is less suitable for this species, as they prefer Marri dominated forests and woodlands and Wandoo dominates the Muchea 6 area.

The areas of pasture have negligible value as Black-Cockatoo foraging habitat, though even scattered trees within the pasture have foraging value.

Whilst main of the trees had smaller hollows and a few logs occurred in the areas of remnant vegetation, there was a lack of fauna utilising the area.

6. REVIEW OF 10 NATIVE VEGETATION CLEARING PRINCIPLES

The observations were reviewed against the 10 clearing principles as defined under the EPA Regulations (2004) on the Native Vegetation Clearing.

Principle (a): Native vegetation should not be cleared if it comprises a high level of biodiversity.

As indicated by the lack of understorey plant species and the high ratio of introduced plant species to native plant species. This area is not considered to contain levels of high biodiversity due to the restricted size of the proposed clearing area and also the historical raw material extraction activities and past agricultural activities.

Clearing of the vegetation is not at variance with this Principle.

Principle (b): Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significant habitat for fauna indigenous to Western Australia.

The assessment area supporting remnant vegetation is relatively restricted in area (6.789ha), however only the eastern, southern and northern fringes of the main woodland area will be cleared during the expansion totally some 2.09 ha. In addition, this 2.09ha is an over-estimation of the impacts as some of the expansion areas within the blue polygons on Figure 7 area very disturbed. Neither of the trees that were highlighted as potential suitable hollows for Black-Cockatoos by Kirkby 2021 occur in the proposed expansion area. The other trees with larger hollows were also checked for suitable dimensions and also any activity and none were located. The trees were checked with a camera on a pole. As indicated in the Western Wildlife (2015) report, foraging activities are likely to be occasional and seasonal and mainly by the Carnaby's Black-Cockatoos. The usage by the Red-tailed Black-Cockatoos is even more unlikely as this area occurs on the fringes of this species main occurrence and also their preference for Marri and Jarrah rather than Wandoo. The lack of understorey species also reduced the usage of the area for foraging activities by the Black-Cockatoos.

Clearing of the vegetation may be at variance with this Principle if occasional foraging activities are undertaken.

Principle (c): Native Vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.

No naturally occurring threatened or priority flora species were present in the assessment area.

Clearing of the vegetation is not at variance with this Principle.

Principle (d): Native vegetation should not be cleared if it compromises the whole or part of, or is necessary for the maintenance of a threatened ecological community.

No threatened ecological communities were present in the assessment area.

Clearing of the vegetation is not at variance with this Principle.

Principle (e): Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

The assessment area occurs within mainly historical agricultural areas so the values from a flora and vegetation perspective are limited. There has been some rehabilitation on the adjacent property to the

north, however the main value of the remaining vegetation is the Wandoo trees and the value of these trees to the Black-Cockatoos. As such the remnant vegetation is degraded due to previous activities and as such provides only some values in the overstorey species.

Clearing of the vegetation is not at variance with this Principle.

Principle (f): Native vegetation should not be cleared if it is growing in, or in association with, and environment associated with a watercourse or wetland.

There is a small valley in the southern section (see Photograph 1) and the area in the northern sections tends to slope to the north. No watercourse of wetland (other than the artificial water body in the south resulting from extraction activities) persist on the Muchea 6 area.

Clearing of the vegetation is not at variance with this Principle.

Principle (g): Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

The assessment area does not occur near any adjacent or nearby conservation areas as the area is surrounded by agricultural properties.

Clearing of the vegetation is not at variance with this Principle.

Principle (h): Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Clearing is unlikely to cause further degradation due to the highly modified nature of the Muchea 6 site.

Clearing of the vegetation is not at variance with this Principle.

Principle (i): Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water

Clearing is unlikely to cause deterioration in the quality of surface or underground water.

Clearing of the vegetation is not at variance with this Principle.

Principle (j): Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

In view of the size of the proposed clearing and the location on mid and upper slopes, clearing activities are not likely to cause, or exacerbate, the incidence of flooding.

Clearing of the vegetation is not at variance with this Principle.

7. DISCUSSION

Mattiske Consulting Pty Ltd was commissioned by Midland Brick in the spring months of 2021 to complete an assessment of flora and fauna values on the proposed expansion area of the Muchea 6 operations. The work in 2021 supplements the earlier Black-Cockatoo work by Jen Wilcox from Western Wildlife (2015).

se field trips supplement the earlier work by Jen Wilcox from Western Wildlife (2015).

The range of flora on the site is very limited due to the previous grazing activities and as such only 4 native and 9 introduced species were recorded. The latter low diversity reflects the degree of past disturbances from earlier agricultural activities.

The vegetation mapped as "E1" is dominated by open woodlands of Wandoo (*Eucalyptus wandoo*) with the occasional Marri (*Corymbia calophylla*) over mainly introduced grasses and herbs.

No threatened or priority ecological communities listed at the State or Federal levels pursuant to the *Wildlife Conservation Act* 1950 or the *Environment Protection Biodiversity and Conservation Act* 1999 were recorded in the BGC Muchea project area (Department of Biodiversity, Conservation and Attraction 2022b, 2022c; Department of Agriculture, Water and the Environment 2022c).

Vegetation condition across the survey area ranged from degraded to completely degraded in the majority of the Muchea 6 site. The area has been subject to previous extraction activities and also grazing, so the vegetation consists mainly of *Eucalyptus wandoo* (Wandoo) and *Corymbia calophylla* (Marri) with little understorey remaining over the majority of the area.

Two trees had suitable hollows for Black-Cockatoos and the tree species and the trees would be foraged by the Black-Cockatoos. The two trees that had suitable hollows for Black-Cockatoos will not be cleared or impacted by the proposed expansion activities. Very few smaller hollows were present in the trees and there were a few logs on the ground that could be used for fauna.

In summary, the main biological values of the area relate to the various stands of predominantly *Eucalyptus wandoo* (Wandoo) and the occasional *Corymbia calophylla* (Marri) and *Eucalyptus marginata* (Jarrah) over very sparse understorey species dominated by grasses and herbs; as well as the two trees with suitable hollows for Black-Cockatoos and also the trees which support Black-Cockatoo foraging activities.

In terms of the ten native vegetation clearing principles, only Principle (b) associated with the fauna species may be at variance with the clearing principles in some seasonal activities. However as the trees with suitable hollows will be avoided in the expansion, the remaining impact relates primarily to the reduction in tree canopy for foraging.

8. ACKNOWLEDGEMENTS

The authors would like to thank the environmental team from Midland Brick for assistance with this project.

9. LIST OF PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were involved in this project:

Name	Position	Project Involvement	Flora Collection Permit
Dr E.M. Mattiske	Managing Director & Principal Ecologist	Planning, Field work, Management & Reporting	FB62000019
Tony Kirkby	Specialist Black-Cockatoo Researcher	Field Studies and Reporting	-

10. REFERENCES

Beard, J.S. 1979, The vegetation of the Pinjarra Area, Western Australia. Map and Explanatory Memoir,1:250,000 Series. Vegmap Publications, Perth.

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APPENDIX A1: THREATENED AND PRIORITY FLORA DEFINITIONS

Under section 179 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), **threatened flora** are categorised as extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent (Table A1.1).

Table A1.1 Federal definition of Threatened Flora Species

Note: Adapted from section 179 of the *EPBC Act 1999.*

CODE	CATEGORY	DEFINITION
Ex	**Extinct**	Species which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild**	Species which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered**	Species which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered**	Species which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable**	Species which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent**	Species which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

The *Biodiversity Conservation Act 2016* (*BC Act*) provides for (amongst other things) the protection of flora facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future in Western Australia under Part 10, Division 2.

Threatened flora are listed in the *Wildlife Conservation (Rare Flora) Notice 2018* (under Part 2 of the *BC Act*; DBCA 2022a) and are categorised under Schedules 1-3**.** A flora species is defined as **threatened** if it is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future, pursuant to sections 20, 21 and 22 of the *BC Act*. Threatened species are categorised as critically endangered, endangered, and vulnerable (Table A1.2).

Table A1.2 State definition of Threatened Flora Species

Note: Adapted from DBCA (2022a).

CODE	CATEGORY	DEFINITION
CR	**Critically endangered**	Species considered to be facing an extremely high risk of becoming extinct in the wild (listed under Schedule 1 of the *Wildlife Conservation (Rare Flora) Notice 2018*).
EN	**Endangered**	Species considered to be facing a very high risk of becoming extinct in the wild (listed under Schedule 2 of the *Wildlife Conservation (Rare Flora) Notice 2018*).
VU	**Vulnerable**	Species considered to be facing a high risk of becoming extinct in the wild (listed under Schedule 3 of the *Wildlife Conservation (Rare Flora) Notice 2018*).

Priority flora species are defined as “possibly threatened species that do not meet the survey criteria, or are otherwise data deficient; or are adequately known, are rare but not threatened, meet criteria for near threatened or have recently been removed from the threatened species list for other than taxonomic reasons” (DBCA 2022a). Priority species are not afforded any additional protection under state or federal legislation, however are considered significant under the Environmental Protection Authority’s *Environmental Factor Guideline: Flora and Vegetation* (EPA 2016b). The Department of Biodiversity, Conservation and Attractions categorises priority flora into four categories: Priority 1; Priority 2, Priority 3 and Priority 4 (Table A1.3).

Table A1.3: State definition of Priority Flora Species

Note: Adapted from DBCA (2022a).

CODE	CATEGORY	DEFINITION
P1	**Priority 1:** Poorly-known species	Known from one or a few locations (< 5) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation; or are otherwise under threat of habitat destruction or degradation. In urgent need of further survey.
P2	**Priority 2:** Poorly-known species	Known from one or a few locations (< 5). Some occurrences are on lands managed primarily for nature conservation. In urgent need of further survey.
P3	**Priority 3:** Poorly-known species	Known from several locations and the species does not appear to be under imminent threat; or from few but widespread locations with either a large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. In need of further survey.
P4	**Priority 4:** Rare, Near Threatened, and other species in need of monitoring	**a) Rare - Species** that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. **b) Near Threatened -** Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. **c) Other -** Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX A2: THREATENED AND PRIORITY ECOLOGICAL COMMUNITY DEFINITIONS

Under section 181 of the *EPBC Act 1999*, **threatened ecological communities** are categorised as critically endangered, endangered and vulnerable (Table A2.1).

Table A2.1 Federal definition of Threatened Ecological Communities

Note: Adapted from section 181 and section 182 of the *EPBC Act*.

CATEGORY	DEFINITION
Critically Endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

The *Biodiversity Conservation Act 2016* (*BC Act*) provides for (amongst other things) some protection of ecological communities at risk of collapse in Western Australia under Part 3 (Division 2).

Threatened ecological communities (TECs) are listed in the *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment (28 June 2018)* (under Part 2 of the *BC Act*; DBCA 2022b). An ecological community is defined as **threatened** if "it is facing an extremely high risk of collapse in the immediate, near or medium-term future", pursuant to sections 28, 29 and 30 of the *BC Act*. Threatened ecological communities are categorised as critically endangered, endangered, and vulnerable (Table A2.2). Some of these TECs are also endorsed by the Federal Minister as threatened, and some of these are listed under the *EPBC Act* and therefore afforded legislative protection at the Commonwealth level.

Table A2.2 State definition of Threatened Ecological Communities

Note: Adapted from DBCA (2022b).

CODE	CATEGORY	DEFINITION
CR	**Critically Endangered**	An ecological community will be listed as CR when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting **any one or more of** the following criteria: **1.** The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; **2.** The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or **3.** The ecological community is highly modified with potential of being rehabilitated in the immediate future.
EN	**Endangered**	An ecological community will be listed as EN when it has been adequately surveyed and is not CR, but is facing a very high risk of total destruction in the near future. The ecological community must meet **any one or more of** the following criteria: **1.** The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; **2.** The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or **3.** The ecological community is highly modified with potential of being rehabilitated in the short term future.
VU	**Vulnerable**	An ecological community will be listed as VU when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet **any one or more of** the following criteria: **1.** The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; **2.** The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; or **3.** The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

Priority ecological communities (PECs) are defined as possible threatened ecological communities that do not meet the stringent survey criteria for the assessment of threatened ecological communities, and are listed by the DBCA (2022c) in the *Priority Ecological Communities for Western Australia – Version 32 (15 July 2021)*. Similarly, to priority flora, PECs are not afforded additional legislative protection, however are considered significant under the EPA (2016b) *Environmental Factor Guideline: Flora and Vegetation*. The Department of Biodiversity, Conservation and Attractions categorises priority ecological communities into five categories: Priority 1; Priority 2, Priority 3, Priority 4 and Priority 5 (Table A2.3).

Table A2.3 State definition of priority ecological communities

Note: Adapted from DBCA (2022c).

CODE	CATEGORY	DEFINITION
P1	**Priority 1** (Poorly known ecological communities)	Ecological communities that are known from very few, restricted occurrences (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Most of these occurrences are not actively managed for conservation (e.g. located within agricultural or pastoral lands, urban areas, or active mineral leases) and for which immediate threats exist.
P2	**Priority 2** (Poorly known ecological communities)	Communities that are known from few small occurrences (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation.
P3	**Priority 3** (Poorly known ecological communities)	**1.** Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation; **2.** Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat; or **3.** Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	**Priority 4** (Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring)	**1.** Rare – Communities known from few occurrences that are considered to have been adequately surveyed, sufficient knowledge is available, and are considered not to be currently threatened. **2.** Near Threatened – Communities considered to have been adequately surveyed and do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable. **3.** Communities that have been removed from the list of threatened communities during the past five years.
P5	**Priority 5** (Conservation Dependent ecological communities)	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX A3: CATEGORIES AND CONTROL MEASURES OF DECLARED PEST (PLANT) ORGANISMS IN WESTERN AUSTRALIA

Section 22 of Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act) makes provision for a plant taxon to be listed as a declared pest organism in respect to parts of, or the entire State. According to the BAM Act, a declared pest is defined as a prohibited organism (Section 12), or an organism for which a declaration under Section 22 (2) of the Act is in force.

Under the *Biosecurity and Agriculture Management Regulations 2013* (WA), declared pest plants are placed in one of three control categories, C1 (exclusion), C2 (eradication) or C3 (management), which determines the measures of control which apply to the declared pest (Table A4.1). The current listing of declared pest organisms and their control category is through the Western Australian Organism List (DPIRD 2022).

Table A3.1 Categories and control measures of declared pest (plant) organisms

Note: Adapted from *Biosecurity and Agriculture Management Regulations 2013*.

CONTROL CATEGORY	CONTROL MEASURES
C1 (Exclusion) '(a) Category 1 (C1) — Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented.' Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.	In relation to a category 1 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C2 (Eradication) '(b) Category 2 (C2) — Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is feasible.' Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.	In relation to a category 2 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C3 (Management) '(c) Category 3 (C3) — Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to: **(i)** alleviate the harmful impact of the declared pest in the area; or **(ii)** reduce the number or distribution of the declared pest in the area; or **(iii)** prevent or contain the spread of the declared pest in the area.' Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.	In relation to a category 3 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to: **(a)** alleviate the harmful impact of the declared pest in the area for which it is declared; or **(b)** reduce the number or distribution of the declared pest in the area for which it is declared; or **(c)** prevent or contain the spread of the declared pest in the area for which it is declared.

APPENDIX A4: OTHER DEFINITIONS

Environmentally sensitive areas

Environmentally sensitive areas are declared by the State Minister under section 51B of the *Environmental Protection Act 1986* (EP Act) and are listed in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, gazetted 8 April 2005. Specific environmentally sensitive areas relevant to this report include: a defined wetland and the area within 50 metres of the wetland; the area covered by vegetation within 50 metres of rare flora; the area covered by a threatened ecological community; a Bush Forever site – further areas and information are described in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*.

Conservation significant flora

Under the *Environmental Factor Guideline: Flora and Vegetation* (EPA 2016b), flora may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority species;
- locally endemic or associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- new species or anomalous features that indicate a potential new species;
- representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids; or
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Conservation significant vegetation

Under the *Environmental Factor Guideline: Flora and Vegetation* (EPA 2016b), vegetation may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority ecological communities;
- restricted distribution;
- degree of historical impact from threatening processes;
- a role as a refuge; or
- providing an important function required to maintain ecological integrity of a significant ecosystem.

APPENIX A5: DEFINITION OF VEGETATION CONDITION SCALE FOR THE SOUTH WEST AND INTERZONE BOTANICAL PROVINCES

Vegetation condition ratings relate to vegetation structure, level of disturbance at each structural layer and the ability of the vegetation unit to regenerate (Table 5.1). Vegetation condition provides complementary information for assessing the significance of potential impacts.

Table 5.1 Definition of Vegetation Condition Categories

Note: Adapted from Keighery (1994).

CATEGORY	DEFINITION
1 (Pristine)	Pristine or nearly so, no obvious sign of disturbance or damage caused by human activities since European settlement.
2 (Excellent)	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
3 (Very Good)	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4 (Good)	Vegetation structure significantly altered by obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
5 (Degraded)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
6 (Completely Degraded)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX F

Traffic Impact Statement

Traffic Impact Statement

Project:	Muchea 6
	Proposed Extraction Site
Client:	Midland Brick
Author:	Keli Li
Doc No:	2202021-TIS-001
Revision:	D

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Document Status: Client Review

Revision	Prepared By	Reviewed By	Approved By	Date
A	K.Li	J. Bridge	J. Bridge	04/03/22
B	K.Li	J. Bridge	J. Bridge	16/03/22
C	J. Bridge	-	J. Bridge	16/03/22
D	J. Bridge	-	J. Bridge	18/03/22

Disclaimer

File Reference: Y:\Jobs Active 2022\CE - Roads and Drainage\Midland Brick_Muchea 6 TIS_2202021\3. Documents\3.6 TIS\2202021-TIS-001_D.docx

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1. Introduction

1.1. Background

Midland Brick are renewing the Development Approval for their clay extraction at Lot 6 Wandena Road which located approximately 3.2 km north of Great Northern Highway / Wandena Road intersection. Shawmac have been engaged by Midland Brick to prepare a Traffic/Transport Impact Statement (TIS) to support the application.

The purpose of this report is to outline the details of the traffic impact and the location / geometry of the existing site access off Wandena Road (SLK 3.17) and determine if the proposed haulage activity is detrimental to safe road use.

Refer to **Figure 1** for the locality of the clay extraction site. An aerial view is also provided in **Figure 2**.

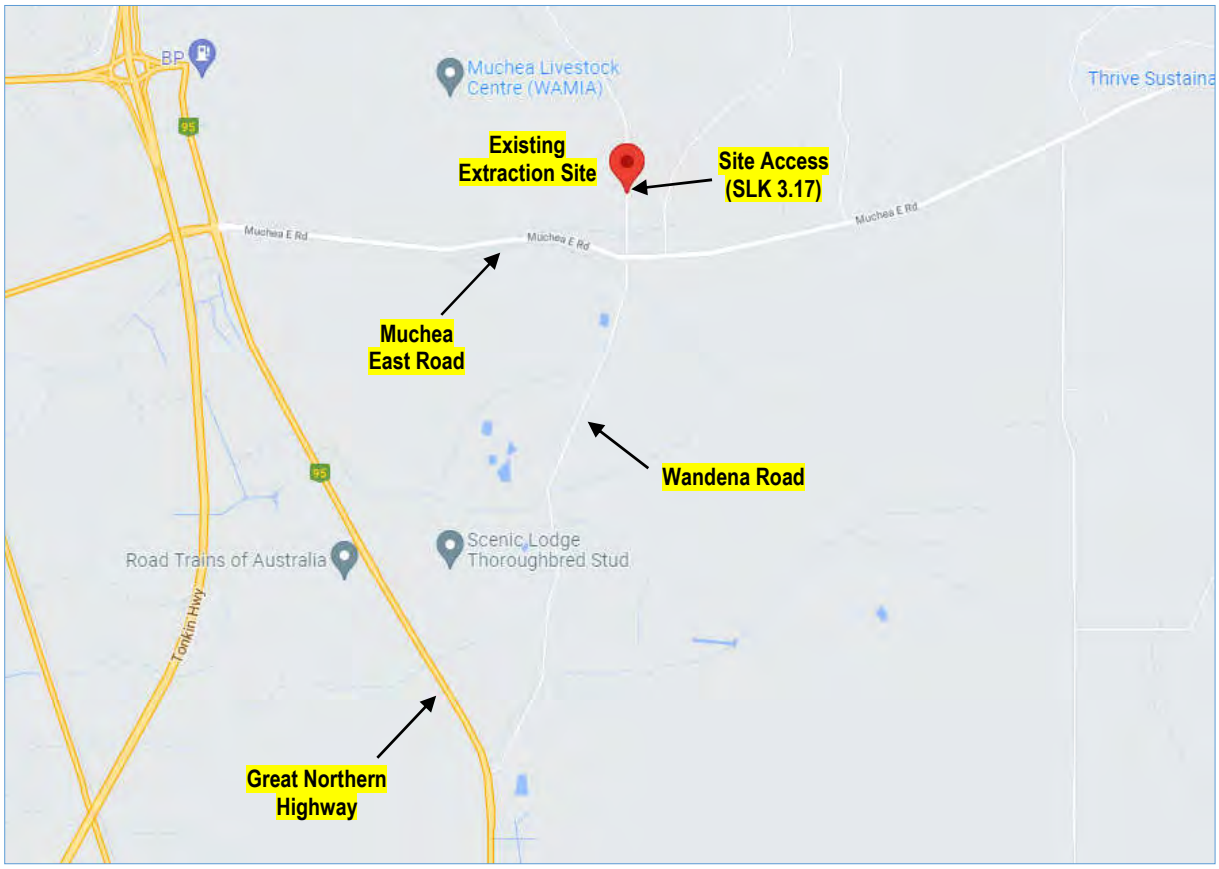


Figure 1: Site Locality

Figure 2: Site Access Aerial View

The TIS has been undertaken in accordance with the Western Australian Planning Commission's (WAPC) Transport Impact Assessment Guidelines for Developments: Volume 4 – Individual Developments (2016). The assessment includes:

- Collection of background data including traffic counts and crash data.
- Details of the transport metrics as provided by the client.
- Assessment of the site access off Wandena Road in accordance with MRWA and Austroads guidelines with regards to safety, sight distance requirements, geometry and interaction with non-site traffic.
- Traffic distribution on the adjacent road network including any relevant mid-block locations and at the subject intersection.
- Review of any site-specific safety issues associated with the proposal.

2. Existing Situation

2.1. Road Network

The layout and hierarchy of the existing road network according to the Main Roads WA Road Information Mapping System is shown in **Figure 3**.

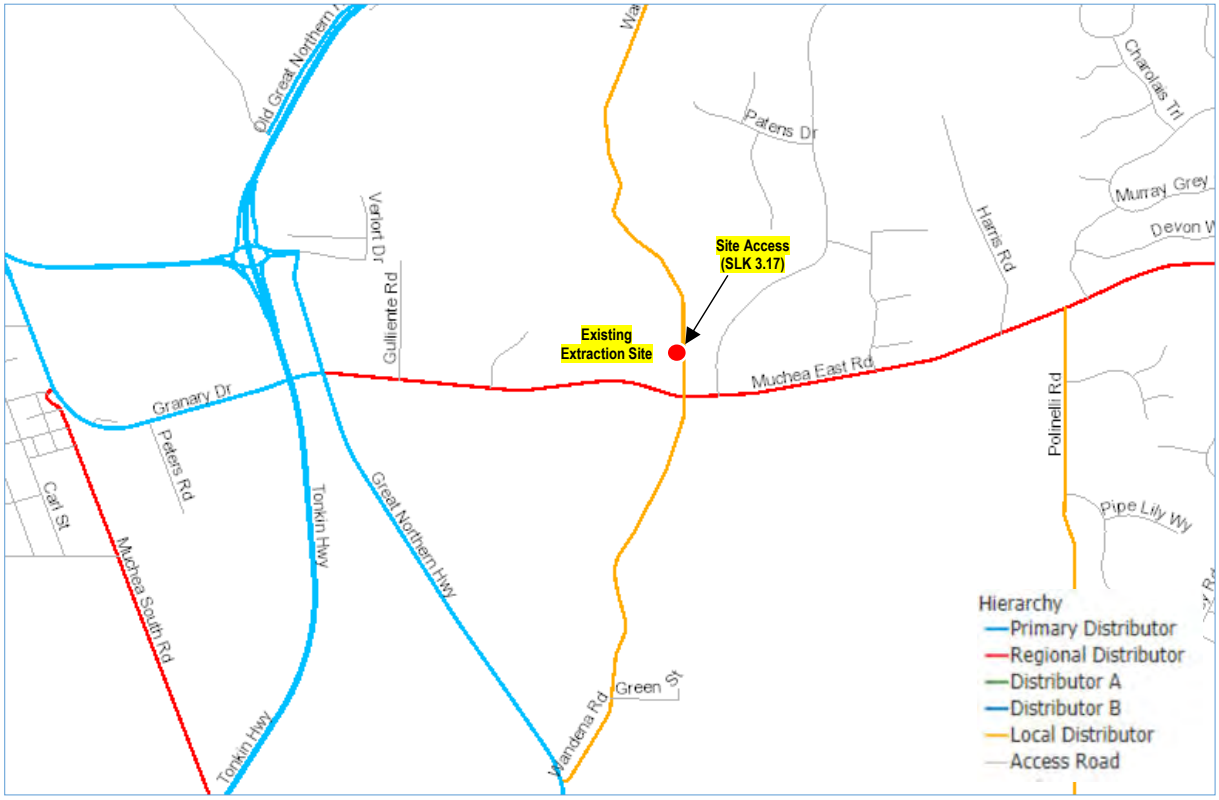


Figure 3: Adjacent Road Network

2.2. Carriageway Width and Cross Section

The carriageway and configuration of the surrounding road network is summarised in **Table 1**.

Table 1: Road Configuration

Road and Location	Road Type	Cross Section	Carriageway Width (Approx.)	Sealed Pavement Width (Approx.)
Wandena Road South of Muchea East Road	Local Distributor	Two-lane single carriageway	7.8m	7.8m
Wandena Road B/W Muchea East Road & Site Access	Local Distributor	Two-lane single carriageway	7.6m	5.7m
Wandena Road North of Site Access	Local Distributor	Two-lane single carriageway	7.0m	Unsealed

2.3. Traffic Volumes

There is no publicly available traffic data for Wandena Road from MRWA and the Shire of Chittering. Communication with the Shire indicates an estimate of daily traffic volume along Wandena Road is 220 vehicles per day at approximately 50m north of Muchea East Road (sealed section) and 37 vehicles per day at 5 km north of Muchea East Road (unsealed section). The majority of traffic on Wandena Road is generated by Muchea landfill site which is located 2.2 km north of Muchea East Road.

For the purpose of this assessment, it is conservatively assumed that the daily volume of 220 vpd does not include historical traffic generated by the study site (Midland Brick). Peak hour volume is assumed equivalent to 10% of daily volume.

A summary of traffic data is provided in **Table 2**.

Table 2: Traffic Volumes

Road / Direction	Location	Daily Volume	Peak Hour Volume	Data Source
Wandena Road NB	500m north of Muchea East Road	110	11	Shire of Chittering
Wandena Road SB	500m north of Muchea East Road	110	11	Shire of Chittering

2.4. RAV Status

As per MRWA HVS network mapping tool:

- Wandena Road is categorised under Tandem Drive RAV 2.1 network and Tri Drive 1.1 network without any conditions;

Figure 4 shows the Tandem Drive RAV 2.1 network for the road network in the local vicinity.

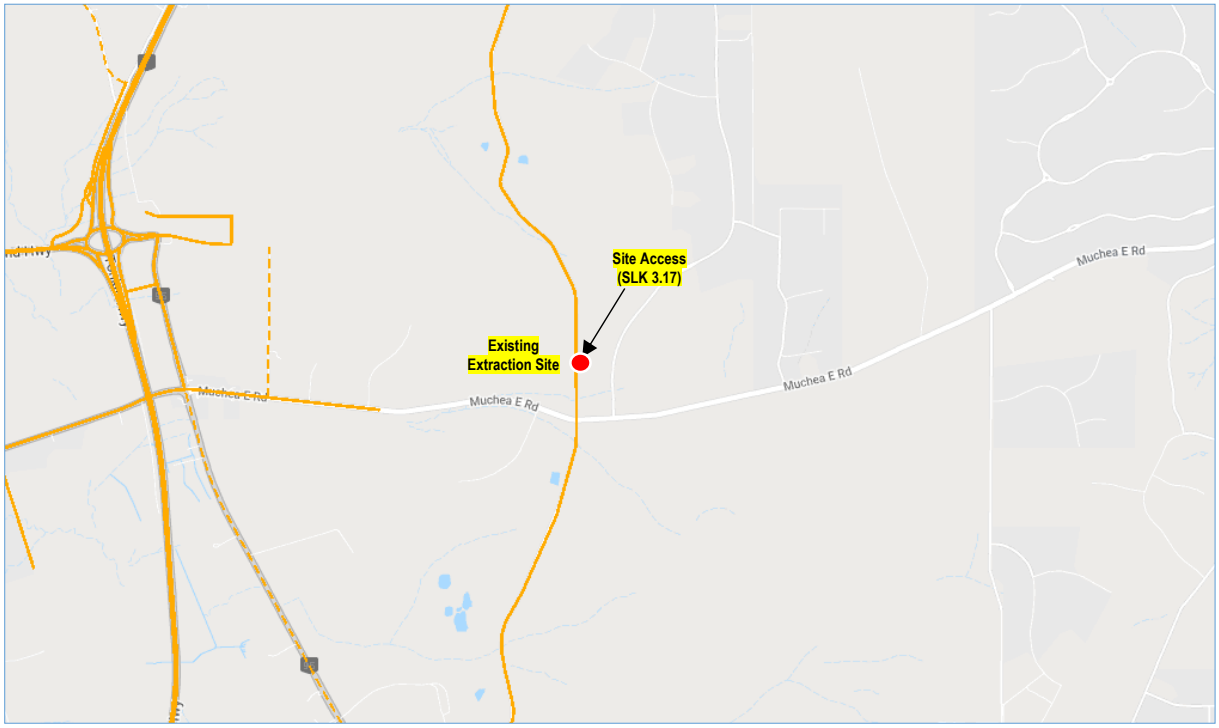


Figure 4: Tandem Drive RAV Network

2.5. Speed Limit

As per MRWA's Road Information Mapping System, Wandena Road is operating under a 110km/h speed limit as it is outside of built-up areas. The speed limit of the adjacent road network is shown in **Figure 5**.

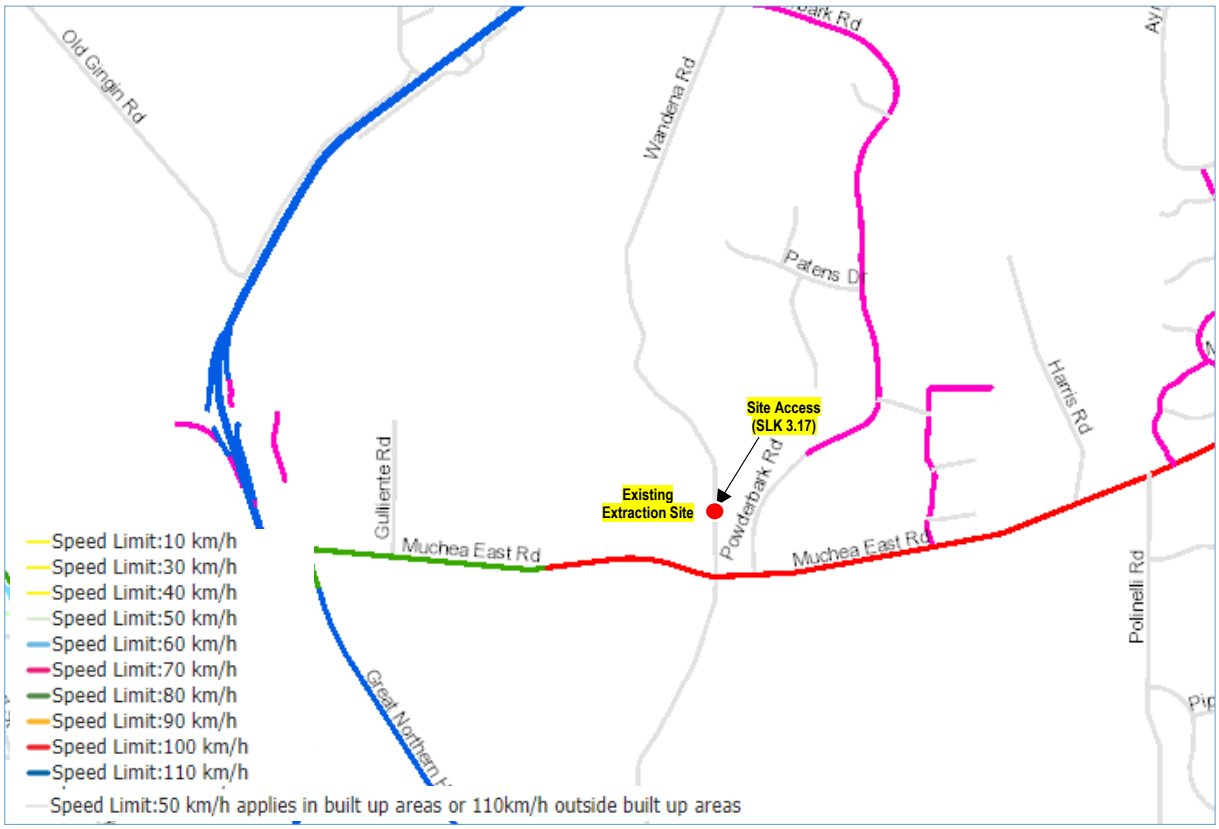


Figure 5: Speed Zoning

2.6. Crash History

Crash data for Wandena Road in the vicinity of the driveway was sourced from MRWA Crash Analysis Reporting System (CARS) for the 5-year period ending 11/11/2020. The report is summarised in **Table 3** and **Figure 6**.

Table 3: Crash History

Location	Accident Type	Severity	Event Nature
Wandena Road SLK 4.35	Midblock	Hospital	Non-Collision
Wandena Road SLK 2.74	Intersection	PDO Major	Rear End

Figure 6: Crash Data

2.7. Changes to Surrounding Transport Networks

There are no known changes to the adjacent network that have the potential to affect the assessment.

3. Transport Logistics

3.1. Proposed Development

It is proposed to extract materials from the site for 10 years.

3.2. Haulage Route

Loaded trucks will be exiting the site and hauling extracted clay towards the south along Wandena Road. Empty trucks will be returning in the opposite direction. There is no requirement for haulage to/from the north direction of the site access.

3.3. Operating Hours

Haulage will operate from 7:00 to 18:00pm (11 hours), Monday to Friday and 7:30 to 17:00 (9.5 hours) on Saturday.

3.4. Proposed Haulage Vehicle

It is proposed to use RAV 2 truck and dog combination with 42-tonne payload for the haulage. **Figure 7** for typical configurations of the RAV 2 truck and dog combination.

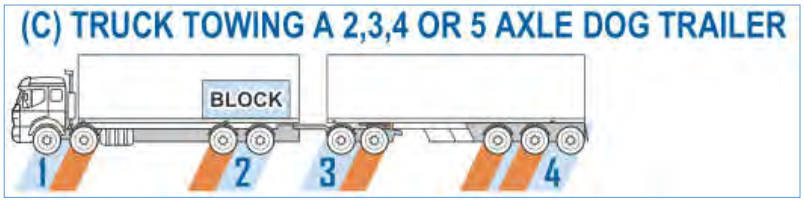


Figure 7: Typical Tandem Drive RAV 2 Truck and Dog Combination

3.5. Projected Traffic Generation

It has been advised that a maximum of 90 truck movements per day during cartage campaigns will be required for clay extraction from the site (90 total truck movements, 45 inbound and 45 outbound).

The daily truck movements will be evenly distributed over the 11-hour operating period. Therefore, a maximum 5 vph inbound and 5 vph outbound movements have been assumed for the purpose of the peak hour assessment.

In addition to the heavy vehicle movements, it is also expected that there will be approximately 5 light vehicles accessing the site once per day, however light vehicle movements are unlikely to occur during the peak hour of the road network and has been excluded from the peak hour assessment.

4. Traffic Impact Assessment

4.1. Assessment Years

Due to the connectivity of Wandena Road, the traffic growth is not expected to be significant. The development is therefore assessed based on current road network condition.

4.2. Impact on Roads

4.2.1. Road Minimum Widths

The sealed widths of Wandena Road were checked against the rural road minimum widths in accordance with Appendix A of the MRWA RAV assessment guideline.

As the proposed haulage movements are to and from the south of the existing access only, the widths to the north of the access have not been assessed.

Assessment of the road width to the south is shown below in **Table 4**.

Table 4: Rural Road Minimum Width

Road	Location	Background / Proposed AADT	Speed (RAV) (km/hr)	RAV Status	Existing / Required Min Seal Width (m)	Existing / Required Min Carriageway Width (m)
Wandena Road	South of Site Access	220 / 315	100	RAV 2	5.7 / 5.9	7.6 / 7.9
Wandena Road	South of Site Access	220 / 315	70	RAV 2	5.7 / 5.6	7.6 / 7.6

As shown above, the existing road carriageway width and seal widths do not comply with the RAV requirement for 100 km/hr speed. However, it should be noted that the extent of the road seal ends at the front of the site access, which is approximately 420m north of Muchea East Road intersection. RAV trucks travelling to and from the site are therefore unlikely to accelerate to 100 km/hr speed. Similarly, other road users utilising the road are unlikely to accelerate to 100km/hr as they approach the unsealed section of the road just north of the site access. As further noted in **Section 4.3.1**, the comfortable truck driving speed along the unsealed portion of Wandena Road is anticipated to be approximately 50km/hr due to narrow width, poor road condition and horizontal curve. Therefore, this assessment assumes a 70km/hr RAV speed for road width requirement south of the site access, and therefore existing geometry is above minimum requirement and deemed acceptable.

4.2.2. Road Safety

The crash history of the adjacent road network (as previously outlined in **Section 2.6**) does not suggest any particular safety issues in the existing road network.

The additional traffic movements generated by the operation are not considered to increase the likelihood of crashes.

4.3. Assessment of Development Access

4.3.1. General

A site visit was conducted on 18th February 2022 to confirm the sight distances at the access point, as well as a review of the general road condition in the vicinity.

It is noted from the site visit that the experienced comfortable driving speed along the unsealed portion of Wandena Road was approximately 50km/hr due to narrow widths, poor road condition and horizontal curves. Therefore, for the purpose of this assessment the following design speeds along the unsealed section of road have been adopted:

- Light Vehicles: 70 km/hr
- Heavy Vehicles: 60 km/hr

4.3.2. Safe Intersection Sight Distance

The Safe Intersection Sight Distance (SISD) is the minimum distance which should be provided on the major road at any intersection. SISD provides sufficient distance for a driver of a vehicle on the major road to observe a vehicle on a minor road approach moving into a collision situation (e.g., in the worst case, stalling across the traffic lanes) and to decelerate to a stop before reaching the collision point.

The required Safe Intersection Sight Distance (SISD) has been calculated in accordance with Austroads Part 4A Equation 2. The SISD is assessed based on the following parameters:

- An observation time of 3 seconds as per Austroads Part 3;
- A reaction time of 2.5 seconds;
- Design Speed:
    - Sealed Section: 100 km/hr for heavy vehicles and 110 km/hr for light vehicles.
    - Unsealed Section: 60 km/hr for heavy vehicles and 70 km/hr for light vehicles (refer previous **Section 4.3.1** for commentary).
- Deceleration coefficients for the purpose of SISD calculations are
    - 0.36 for light vehicles and 0.28 for heavy vehicles - northbound approach (sealed)
    - 0.26 for light vehicles at 70 km/hr speed and 0.21 for heavy vehicles at 60 km/hr speed – Southbound approach (unsealed);
- Driver eye height is 2.4m for trucks and 1.1m for cars.

The street view photos at the intersection are shown in **Figure 8** and **Figure 9**. The measurement of the SISD is shown in **Figure 10**.

Figure 8: Looking North – 3m Offset from Traffic Lane

Figure 9: Looking South - – 3m Offset from Traffic Lane

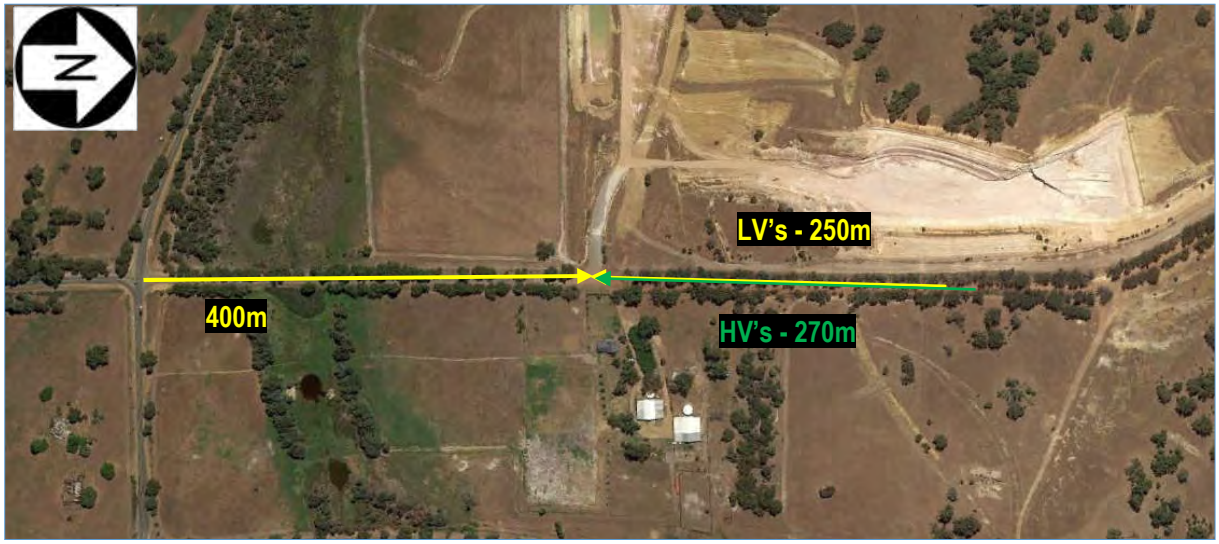


Figure 10: Sight Distance Measurement

The results are summarised in **Table 5**.

Table 5: SISD at Site Access

Location	Vehicle Type	Design Speed (km/h) (NB / SB)	Coefficient of Deceleration (NB / SB)	Decision Time (s)	Longitudinal Grade (NB / SB)*	Required SISD for NB / SB Traffic (m)	Available SISD (m) NB	Available SISD (m) SB
Wandena Road (SLK 3.17)	Trucks - Type 1	100** / 60***	0.28 / 0.21	3.0+2.5	4.0% / -9.0%	276 / 210	400	270
	Cars	110 / 70***	0.36 / 0.26	3.0+2.5	4.0% / -9.0%	287 / 220	400	250

*Positive for through traffic travelling uphill and negative for through traffic travelling downhill. Grades are estimated based on google street view as no survey was available at the time of preparation of this report.
**RAV's maximum legal limit is 100km/hr.
*** Refer previous **Section 4.3.1** for commentary on design speed assumption.

The assessment indicates that the available sight distance is above the minimum SISD requirements for traffic in both directions.

For southbound traffic, the available sight distance is above the minimum requirement for the assumed design speed as noted in **Section 4.3.1**. However, as the road is unsealed and drivers will travel at speeds depending on the road conditions, vehicle speed could vary.

Taking into consideration that the assessment is for a site access rather than an intersection, further investigation has been undertaken in reference to the MRWA Driveway Guideline that state the following:

> *Desirably the sight distance provided should be the Safe Intersection Sight Distance in accordance with Main Roads Supplement to Austroads GRD Part 4A. However, where this is not possible, sight distance equal to **Stopping Sight Distance (SSD)** for the design speed of the road shall be provided as an absolute minimum.*

The assessment for SSD for southbound traffic has been undertaken as per **Table 6**. The purpose of the additional assessment is to determine the maximum allowable speed that suits the available sight distance.

Table 6: SSD at Site Access

Location	Vehicle Type	Design Speed (km/h) (NB / SB)	Coefficient of Deceleration (NB / SB)	Decision Time (s)	Longitudinal Grade (NB / SB)	Required SISD for NB / SB Traffic (m)	Available SISD (m) NB	Available SISD (m) SB
Wandena Road (SLK 3.17)	Trucks - Type 1	NA / **70**	NA / 0.20	2.5	NA / -9.0%	NA / 221	NA	**270**
	Cars	NA / **80**	NA / 0.25	2.5	NA / -9.0%	NA / 213	NA	**250**

As shown in **Table 6**, the maximum allowable speed that suits the available sight distance, for the SSD criteria, is 80km/hr for cars and 70 km/hr for trucks.

As per **Section 4.3.1**, the comfortable 50km/hr driving speed experienced on site was due to narrow road width, poor road condition and horizontal curves. Therefore, it is anticipated that vehicles will be travelling at less than the allowable design speeds as detailed within the SISD and SSD assessments. Therefore, the sight distances to the driveway are considered acceptable.

It should be further noted that sightlines towards both directions are affected by the overgrown vegetation along the west side of the road. Therefore, it is recommended to implement a program of monitoring and maintenance of vegetation growth and scheduled vegetation trimming to ensure sightline is not affected.

4.3.3. Entering Sight Distance

The Entering Sight Distance (ESD) is the minimum distance for driver of a RAV, entering a through road, having appropriate sight distance to see a sufficient gap in oncoming traffic that will allow a RAV, with greater length and lower acceleration capacity, to clear the intersection safely.

The ESD is assessed based on the following parameters in accordance with MRWA's Standard RAV Route Assessment Guidelines:

- A reaction time of 4 seconds, and
- Deceleration coefficients for the purpose of ESD calculations are
    - 0.28 for heavy vehicles - northbound approach (sealed)
    - 0.21 for heavy vehicles at 60 km/hr speed – Southbound approach (unsealed);

The Entering Sight Distance (ESD) for existing and proposed access locations has been assessed in accordance with RAV Route Assessment Guideline (updated November 2019). A comparison of available and required ESD for RAV vehicles are summarised in **Table 7**.

Table 7: RAV Vehicle Entering Sight Distance

Location	Design Speed (km/h) (NB / SB)	Coefficient of Deceleration NB / SB	Reaction Time (s)	Longitudinal Grade (NB / SB)*	Required ESD for NB / SB Traffic (m)	Available ESD (m)	
						NB	SB
Wandena Road (SLK 3.17)	100 / 60**	0.28 / 0.21	4	4.0% / -9.0%	234 / 185	400	270

*Positive for through traffic travelling uphill and negative for through traffic travelling downhill.
*** Refer previous **Section 4.3.1** for commentary on design speed assumption.

As shown, the ESD for RAV to view southbound vehicles falls above the assessment speed limit but below minimum requirement for maximum legal limit. However, as per **Section 4.3.1** and **Section 4.3.2**, heavy vehicle speeds are not expected to be greater than 60km/hr.

4.3.4. Intersection Volumes

For the purpose of auxiliary lane assessment, the with-development peak hour volumes at the site access are shown in **Figure 11**.

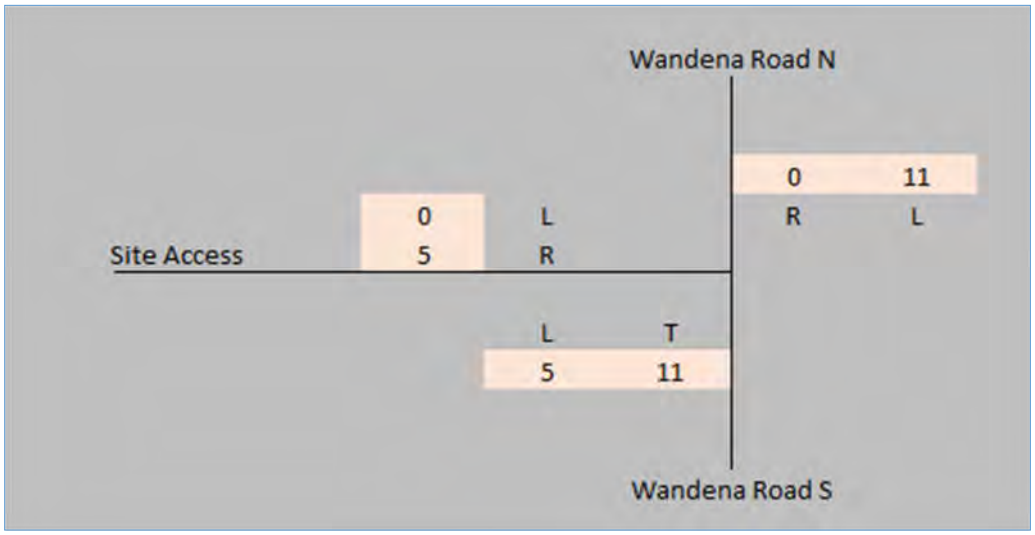
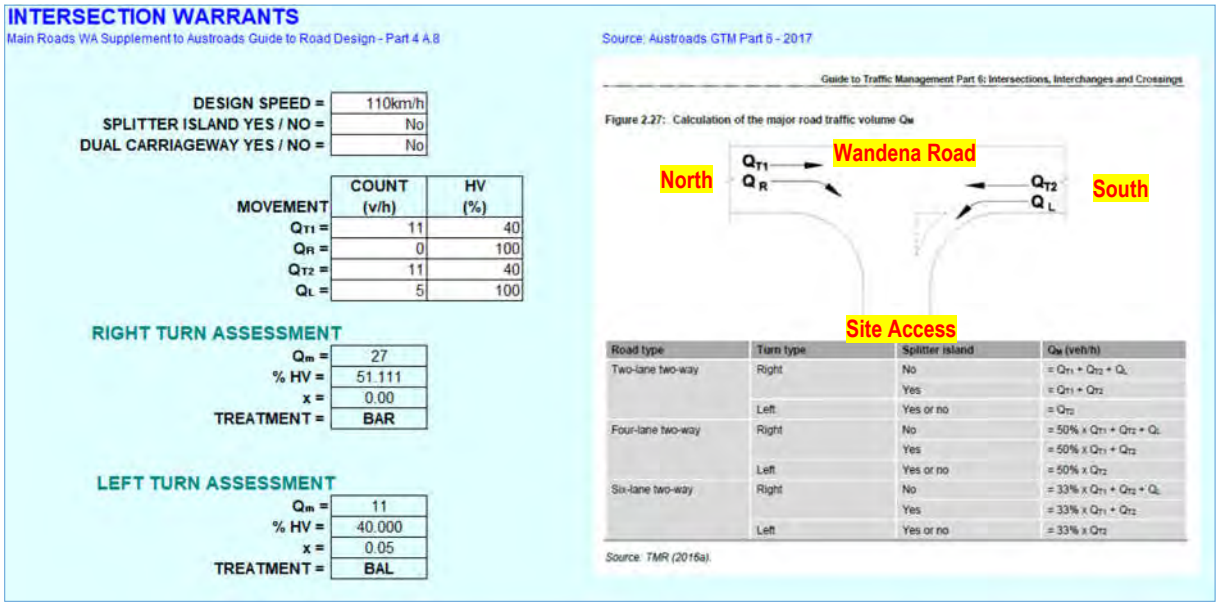


Figure 11: Intersection Volumes

4.3.5. Auxiliary Lanes

The requirement for turning treatments was calculated using the Intersection Warrants calculator provided in Main Roads WA Supplement to Austroads Guide to Road Design - Part 4 A.8. The results of the assessment are shown in **Figure 12**.



INTERSECTION WARRANTS

Main Roads WA Supplement to Austroads Guide to Road Design - Part 4 A,B

DESIGN SPEED =	110km/h
SPLITTER ISLAND YES / NO =	No
DUAL CARRIAGEWAY YES / NO =	No

MOVEMENT	COUNT (v/h)	HV (%)
Q_{T1} =	11	40
Q_R =	0	100
Q_{T2} =	11	40
Q_L =	5	100

RIGHT TURN ASSESSMENT

Q_m =	27
% HV =	51.111
x =	0.00
TREATMENT =	BAR

LEFT TURN ASSESSMENT

Q_m =	11
% HV =	40.000
x =	0.05
TREATMENT =	BAL

Source: Austroads GTM Part 6 - 2017

Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings

Figure 2.27: Calculation of the major road traffic volume Q_M

Road type	Turn type	Splitter island	Q_M (veh/h)
Two-lane two-way	Right	No	= $Q_{T1} + Q_{T2} + Q_L$
		Yes	= $Q_{T1} + Q_{T2}$
	Left	Yes or no	= Q_{T2}
Four-lane two-way	Right	No	= 50% x $Q_{T1} + Q_{T2} + Q_L$
		Yes	= 50% x $Q_{T1} + Q_{T2}$
	Left	Yes or no	= 50% x Q_{T2}
Six-lane two-way	Right	No	= 33% x $Q_{T1} + Q_{T2} + Q_L$
		Yes	= 33% x $Q_{T1} + Q_{T2}$
	Left	Yes or no	= 33% x Q_{T2}

Source: TMR (2016a).

Figure 12: Warrants for Turn Treatments on Major Roads at Unsignalised Intersections

As shown, the required left-turn and right turn treatments for the proposed intersection are a Basic Left Turn (BAL) and Basic Right Turn (BAR) treatment. These treatments are already installed and accordingly no further improvements are suggested.

4.3.6. Swept Path Assessment

A swept path analysis based on aerial photos and 27.5m MRWA RAV 2-4 vehicle template was completed to determine if the existing geometry of site access is sufficient to accommodate the proposed RAV vehicle movement. The swept path diagrams are shown below in **Figure 13** and **Figure 14**.

The assessment indicates the site access is able to accommodate (non-lane-correct) turning movements using RAV 2-4 vehicle template. Given the low volume nature of Wandena Road and achieved sight distances, the non-lane-correct movements are deemed acceptable and no further widening is required for the proposed development.

Figure 13: RAV 2 Access Movement

Figure 14: RAV 2 Egress Movement

5. Site Specific Issues

5.1. General

There are no other site-specific issues considered to be flaws to the proposal.

6. Conclusions

This TIS has concluded the following:

- The estimated traffic generation for the proposed haulage activity can be accommodated within the capacity of the existing road network.
- The additional traffic generated by the site is not considered to increase the likelihood of crashes.
- The available Safe Intersection Sight Distance and Entering Sight Distance at the site access location is deemed acceptable for the assumed design approach speeds, however they can be affected by overgrown vegetation towards both sides of the access. Therefore, it is recommended to implement a monitoring and maintenance program for vegetation growth and scheduled vegetation trimming to ensure sightline is not affected.
- The existing BAR/BAL configuration of the site access is considered appropriate to cater for the proposed additional traffic.
- The swept path assessment for the designated RAV vehicle movements indicates that the designated non-lane-correct movements can be completed satisfactorily and this is considered to be acceptable considering the low volume nature of Wandena Road and the achieved sight distances.

APPENDIX G

Environmental Noise Assessment

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Environmental Noise Assessment

"Muchea 6" Clay Pit
Wandena Road, Lower Chittering, 6084

Reference: 21116813-02

Prepared for:
Midland Brick

Report: 21116813-02

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Date:	Rev	Description	Prepared By	Verified
19/04/22	-	Final issued	Daniel Lloyd	

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1 INTRODUCTION

This report presents the noise assessment of the Midland Brick "Muchea 6" proposed clay pit operations on Wandena Road, Lower Chittering 6084. The site location and surrounding sensitive receivers are shown in *Figure 1-1.*

Figure 1-1 Project Locality and Sensitive Receiver Locations

The clay pit operations will be developed in five stages. Stages 1A, 2A and 3A will work from north to south and Stages 1B and 2B will work from west to east. The stockpiling area is located to the south of the site will move northwards as Stage 2B is excavated. This is illustrated in *Figure 1-2.*

Operations will be restricted to occur within the daytime hours of Monday to Saturday 7.00 a.m. to 7.00 p.m. and would include:

Clay Extraction:

- One (1) excavator and one (1) dozer working in the clay pits; and
- Two (2) haul trucks and one (1) water cart operating between the pits and the stockpiling area.

Clay Cartage:

- One (1) front-end loader (wheeled) within the stockpiling area; and
- Road Trucks will complete forty-five (45) loads equalling to 90 truck movements per day, operating between the stockpiling area and the road.

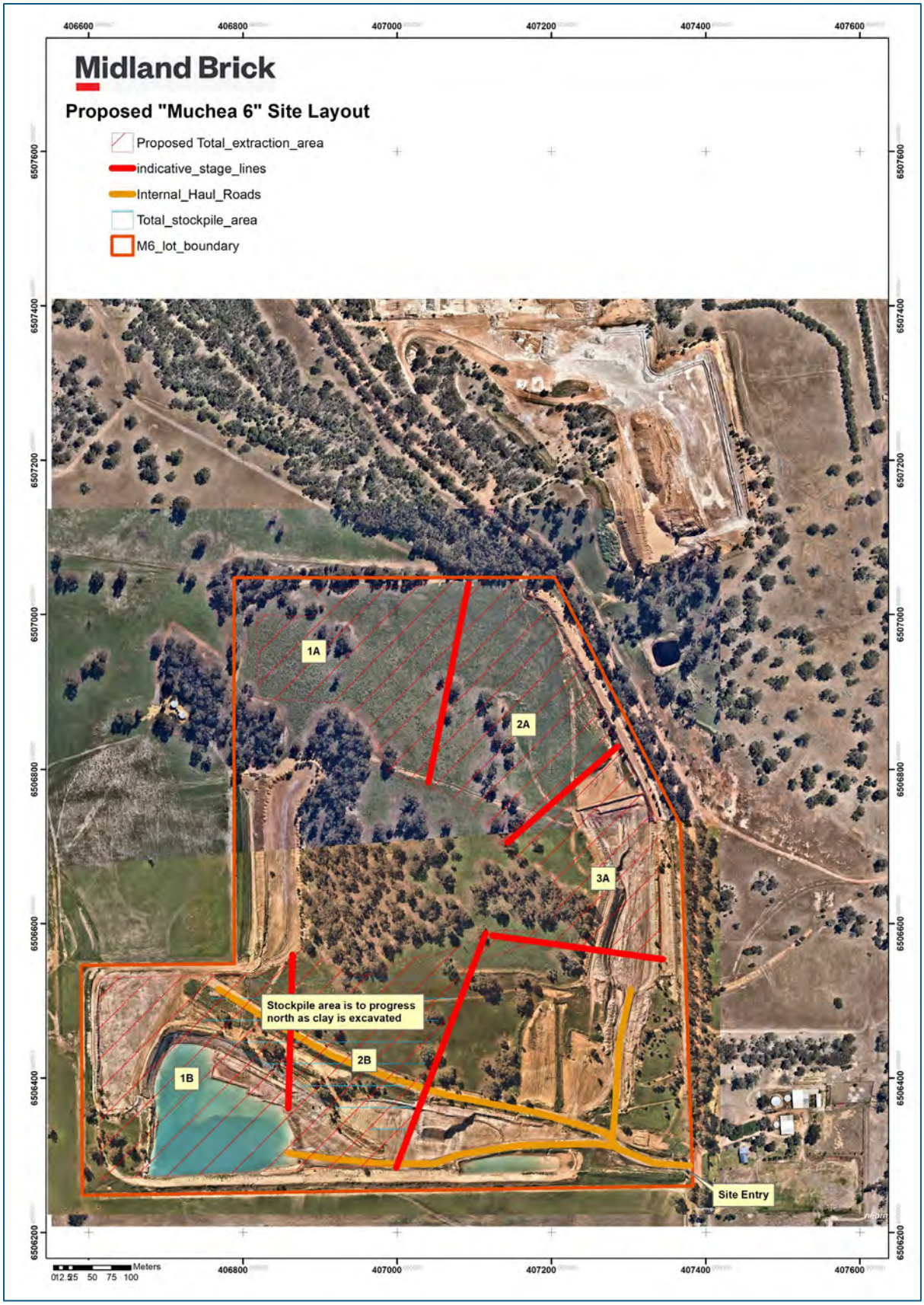


Figure 1-2 Pit Staging and Site Layout

2 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

2.1 Topsoil Removal and Development of Noise Bunds

This initial phase of the operations would be considered as construction under the Regulations with regulation 13, which refers to noise from construction sites, being applicable. As it is proposed to undertake this work during normal working hours (7.00 a.m. to 7.00 p.m. Monday to Saturday) the following regulation requirements apply:

Regulation 7 does not apply to … construction work carried out between 0700 hours and 1900 hours on any day which is not a Sunday or public holiday if the occupier of the premises … shows that –

a) The construction work was carried out in accordance with control of environmental noise practices set out in section 4 of AS 2436-2010Guide to noise and vibration control on construction, demolition and maintenance sites;

b) The equipment used on the premises was the quietest reasonably available; and

c) If the occupier was required to prepare a noise management plan … in respect of the construction site –

i. The noise management plan was prepared and given in accordance with the requirement, and approved by the Chief Executive Officer; and

ii. The construction work was carried out in accordance with the management plan, excluding any ancillary measure.

2.2 Excavation and Cartage Phase

For the extraction and cartage phase of the operations, regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (1) Noise emitted from any premises or public place when received at other premises –

(a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) Must be free of –

i. tonality;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

A "…noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard prescribed under regulation 7 after the adjustments of *Table 2-1* are made to the noise emission as measured at the point of reception.

Table 2-1 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5dB	+ 5dB	+ 10dB	+ 10 dB	+ 15 dB

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in *Table 2-2*.

Table 2-2 Baseline Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area[2]	All hours	60	75	80
Commercial	All hours	60	75	80
Industrial	All hours	65	80	90

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b)any other part of the premises within 15 metres of that building or that part of the building.
2. **any area other than highly sensitive area** means any other part of the premises greater than 15 metres from a building or part of the building used for a noise sensitive purpose.

As the pit is only operational between 7.00 a.m. and 7.00 p.m. Monday to Saturday, The shaded areas in *Table 2-2* are relevant.

As detailed in *Table 2-3*, the influencing factor applicable at the noise sensitive premises, varies between 0 and 3 dB, depending on the land uses surrounding the receiver. Note, the receiver numbers relate to *Figure 1-1*.

Table 2-3 Influencing Factor Calculation

Receiver	Description	Within 100 metre Radius	Within 450 metre Radius	Total
R1	Industrial Land	8 %	22 %	3 dB
	Commercial Land	0 %	0 %	0 dB
	Transport Factor			0 dB
	Total			**3 dB**
R2	Industrial Land	0 %	0 %	0 dB
	Commercial Land	0 %	0 %	0 dB
	Transport Factor			0 dB
	Total			**0 dB**
R3	Industrial Land	0 %	0 %	0 dB
	Commercial Land	0 %	0 %	0 dB
	Transport Factor			0 dB
	Total			**0 dB**
R4	Industrial Land	0 %	0 %	0 dB
	Commercial Land	0 %	0 %	0 dB
	Transport Factor			0 dB
	Total			**0 dB**
R5	Industrial Land	0 %	0 %	0 dB
	Commercial Land	0 %	0 %	0 dB
	Transport Factor			0 dB
	Total			**0 dB**
R6	Industrial Land	10 %	0 %	1 dB
	Commercial Land	0 %	0 %	0 dB
	Transport Factor			2 dB
	Total			**1 dB**
R7	Industrial Land	0 %	0 %	0 %
	Commercial Land	0 %	0 %	0 %
	Transport Factor			0 dB
	Total			**0 dB**

Based on the proposed hours of operations, *Table 2-4* shows the applicable assigned noise levels including the influencing factor and transport factor at each of the receiver locations. It will be the L_{A10} criteria that will determine compliance or otherwise with the regulations, so it is only this parameter which will be discussed in the assessment.

Table 2-4 Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
R1	0700 to 1900 hours Monday to Saturday (Day)	48	58	68
R2	0700 to 1900 hours Monday to Saturday (Day)	45	55	65
R3	0700 to 1900 hours Monday to Saturday (Day)	45	55	65
R4	0700 to 1900 hours Monday to Saturday (Day)	45	55	65
R5	0700 to 1900 hours Monday to Saturday (Day)	45	55	65
R6	0700 to 1900 hours Monday to Saturday (Day)	46	56	66
R7	0700 to 1900 hours Monday to Saturday (Day)	45	55	65
R1 Boundary	All Hours	60	75	80

It is noted the assigned noise levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as *a period of time of not less than 15 minutes, and not exceeding 4 hours*, which is determined by an *inspector* or *authorised person* to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission. An *inspector* or *authorised person* is a person appointed under Sections 87 & 88 of the *Environmental Protection Act 1986* and include Local Government Environmental Health Officers and Officers from the Department of Water and Environment Regulation. Acoustic consultants or other environmental consultants are not appointed as an *inspector* or *authorised person*. Therefore, whilst this assessment is based on a 4 hour RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.

It is further noted that under regulation 3, certain types of noise emission do not have to comply with the Regulations. In the case of this assessment these are:

(a) noise emissions from the propulsion and braking systems of motor vehicles operating on a road;

(g) noise emissions –

a. from a device for warning pedestrians installed at a pedestrian crossing on a road; or

b. from a device for warning of the passage of a train installed at a level crossing; or

c. from a safety warning device fitted to a building as a requirement of the Building Code as defined in the *Building Regulations 2012* regulation 3; or

d. for the purpose of giving a warning required under the *Mines Safety and Inspection Regulations 1995* regulation 8.26,

If every reasonable and practicable measure has been taken to reduce the effect of the noise emission consistent with providing an audible warning to people;

(h) noise emissions from –

a. a reversing alarm fitted to a motor vehicle, mobile plant, or mining or earthmoving equipment; or

b. a startup or movement alarm fitted to plant,

if

c. it is a requirement under another written law that such an alarm be fitted; and

d. it is not practicable to fit an alarm that complies with the written law under which it is required to be fitted and emits noise that complies with these Regulations;

It is considered that reversing alarms fitted to commercial vehicles and mobile plant e.g. HV trucks or loaders, are not exempt under the Regulations since they are not specifically required under another written law. The commonly used fixed noise output tonal reversing alarms also known as 'reversing beeper' emit, by their very nature, tonal and modulating noise at high levels. As such, this type of reversing alarm generally cannot comply with the Regulations even at distant receivers.

Midland brick will use broadband reversing alarms which can more readily comply with the Regulations.

3 METHODOLOGY

Computer modelling has been used to predict the noise impacts at various receivers. The advantage of modelling is that it is not affected by background noise sources and can provide the noise level for various weather conditions and operating scenarios if necessary.

The software used was *SoundPLAN 8.2* with the CONCAWE algorithms selected. These algorithms have been selected as they include the influence of wind and atmospheric stability. Input data required in the model are:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and
- Source sound power levels.

3.1 Meteorological Information

Meteorological information utilised is provided in *Table 3-1* and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Table 3-1 Modelling Meteorological Conditions

Parameter	Day (0700-1900)
Temperature (°C)	20
Humidity (%)	50
Wind Speed (m/s)	4
Wind Direction*	All
Pasquil Stability Factor	E

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

It is generally considered that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

3.2 Topographical Data

Topographical data was based on the publicly available spot levels on *GoogleEarth*.

3.3 Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). For this assessment, the areas within the clay extraction pits and the stockpiling areas have been set to 0.1 (10% absorption) as this consists of compressed sand with rough sections and product dumps etc. The remainder of the area is predominantly rural with grassed paddocks and a value of 1.0 has been used.

3.4 Source Sound Levels

The sound power levels used in the modelling are provided in *Table 3-2*.

Table 3-2 Source Sound Power Levels

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)
	31.5	63	125	250	500	1k	2k	4k	
Komatsu D375 Dozer	103	105	114	111	108	108	106	100	**113**
85 tonne Excavator (PC850)	98	109	119	110	103	99	91	84	**107**
Water Truck (Volvo road truck)	113	108	103	99	97	97	94	91	**101**
40 tonne haul truck (Bell B400)	113	108	105	100	99	98	96	92	**103**
Komatsu WA500 Wheel Loader	109	122	107	108	104	106	102	96	**110**
HV Truck moving at 25 km/h, L_{max}	113	108	103	99	97	97	94	91	**101**

With regards to the above, please note the following:

- All sources were modelled as point sources two metres above local ground level;
- Source levels are based on manufacturer's data or measured data;
- All levels represent L_{A10} noise levels.

In reality, the manufacturers' published sound power levels are often very conservative as they assume the equipment is running at maximum power. This is often not the case in reality and our experience is that upon measurement of equipment while working under normal conditions, the sound power levels are significantly less.

As the haul truck is the dominant noise source, being on natural surface, measurements were undertaken of a Bell B400 travelling at 25 km/h on a similar path to that proposed for the "Muchea 6" site in relation to Receiver R1. The results are presented in *Figure 3-1*, with the frequency analysis, which shows tonal noise components in the 160Hz frequency band, presented in *Figure 3-2.*

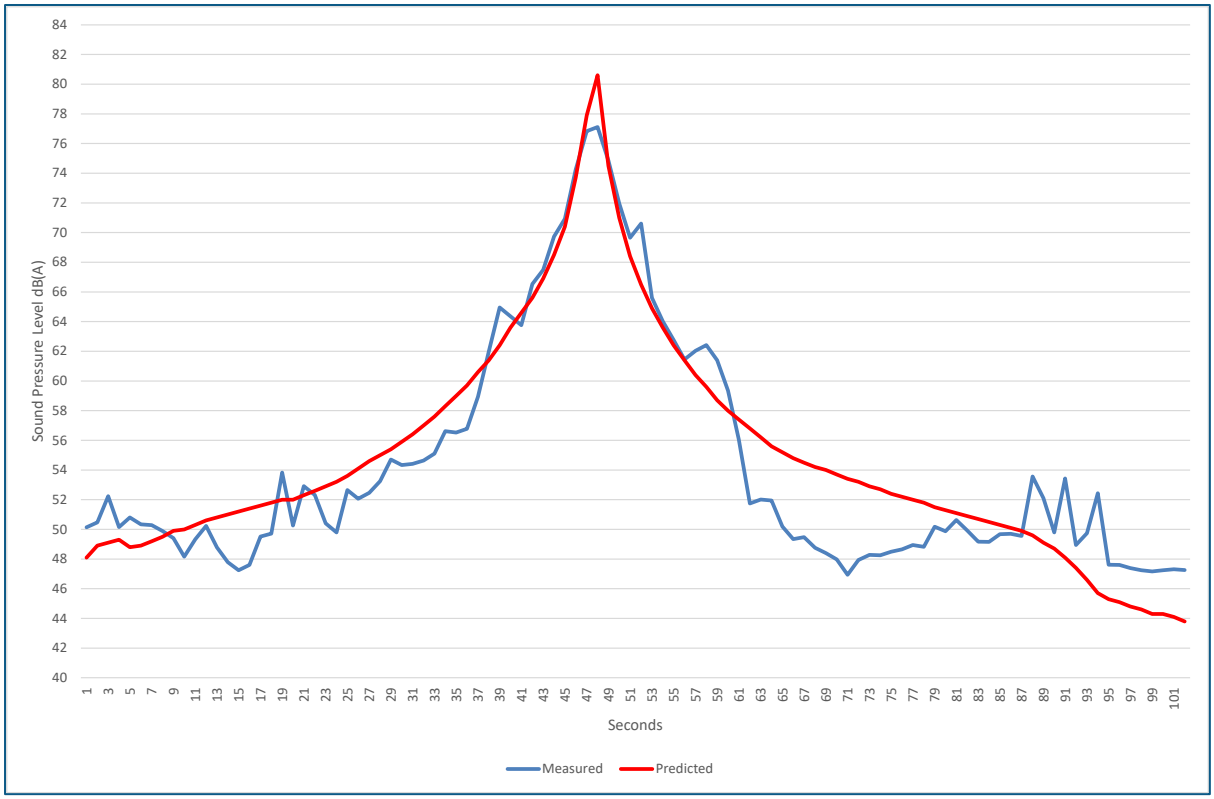


Figure 3-1 Comparison of Measured v Predicted Noise Levels for Haul Truck

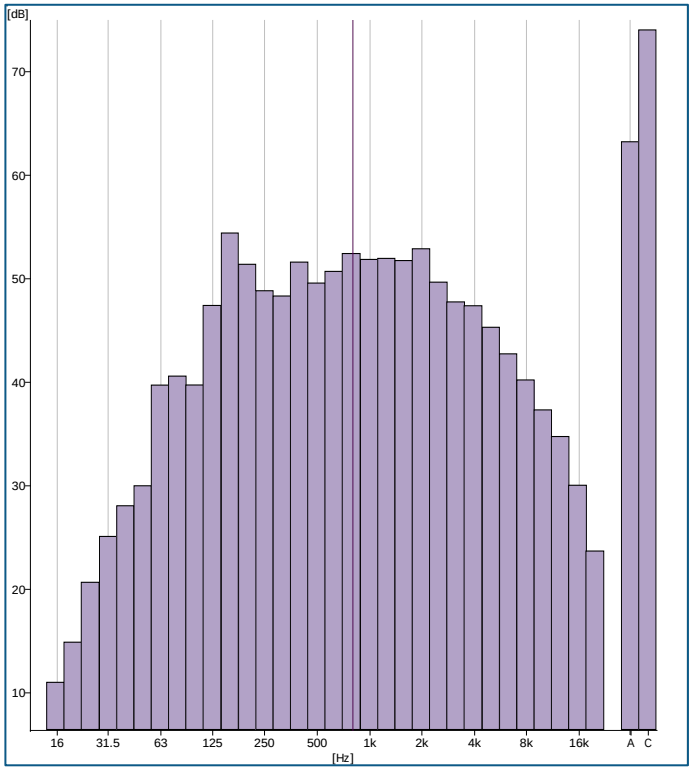


Figure 3-2 Frequency Analysis of Haul Truck

4 RESULTS

The predicted noise levels for each development stage are presented in the following sections, along with an assessment against the *Environmental Protection (Noise) Regulations 1997*.

Before extraction operations commence, the main bund on the eastern boundary of the site will be constructed, thus providing the maximum noise mitigation early in the development of the pit. The material used to construct the bund will be overburden sourced from Stages 1A, 2A and 3A. The extraction of overburden from these stages, where plant will be located on natural surface level, will comply with the regulations without the noise bund being constructed. The actual construction of the bund will be considered as a construction activity under Regulation 13.

At the start of each stage, topsoil will be scraped and pushed up to form a local noise bund on the boundary of the stage. This is also considered to be a construction activity under Regulation 13. While a bund is only really required for Stage 3A, it is good practice to reduce the noise as far as practicable for all stages. The location of the local bund should be on the stage southern or eastern boundary between the plant and receiver R1. The height of the bund is only critical for Stage 3A and at this location it should be at least 3.0m high.

The clay pit operations, which would be assessed under Regulations 7 and 8, will include a Komatsu D375 dozer and an 85 tonne excavator loading into 40 tonne haul trucks. The extraction will start at Stage 1A and progress southwards to Stage 3A. For stages 1B and 2B, the extraction will start at Stage 1B and progress eastwards. As detailed above, the noise bund on the eastern boundary will be in place for all operation phases.

The final depth of excavation will be approximately 15 metres below the existing ground level. For the purposes of this assessment, we have assumed the clay will be excavated at 5m benches. The predicted noise levels assume the plant is located on the first bench of 5m below ground level. As the pit proceeds to the second bench, the overall noise level should reduce further.

Clay will be stockpiled in the stockpile / loading area to the south of pit with trucks accessing site via the site entry on Wandena Road.

Based on the above, noise predictions were made for the following scenarios:

- Construction phase including noise bund building and topsoil removal and with 85 tonne excavator, Komatsu 375 dozer, WA500 wheel loader and a 40 tonne haul truck. The mobile plant is assumed to be at existing ground level;
- Overburden removal for supply of materials to construct the noise bund;
- Clay pit extraction with plant 5m below natural ground (considered to be the early phase of pit development) and the noise bund constructed. This includes an 85 tonne excavator, a Komatsu 375 dozer, one haul truck within the clay pit and one haul truck between the pit and the stockpiling area.
- Clay cartage which includes one wheeled-loader and trucks entering the site and driving to the stockpile area. Trucks are assumed to drive at a speed of 25 km/hr with 90 truck movements a day, equally spread over the 11 hours the pit will be operational in a day. The number of truck movements in a 4 hour period is approximately 36. All noise bunds are assumed to be in place before loading operations starts.

It should be noted that clay cartage and clay extraction would not occur simultaneously.

The predicted noise levels for each scenario are presented as follows:

Table 4-1 - Predicted Noise Levels during Construction and Removal of the Main Bund;

Table 4-2 - Predicted Noise Levels during Topsoil Removal;

Table 4-3 - Predicted Noise Levels during Removal of Overburden for Stages 1A, 2A and 3A;

Table 4-4 - Predicted Noise Levels during Extraction Operations; and

Table 4-5 - Predicted Noise Levels during Cartage Operations.

Table 4-1 Predicted Noise Levels during Construction and Removal of the Main Bund

Receiver	Predicted Noise Level, dB L_{A10}	
	North End	South End
R1	50.4	60.0
R2	39.9	39.4
R3	38.2	37.2
R4	38.7	36.8
R5	34.6	24.9
R6	16.0	35.0
R7	35.6	36.6
R1 Boundary	50.1	62.1

Table 4-2 Predicted Noise Levels during Topsoil Removal

Receiver	Predicted Noise Level, dB L_{A10}				
	Stage 1A	Stage 2A	Stage 3A	Stage 1B	Stage 2B
R1	28.4	31.3	42.4	45.5	51.6
R2	36.4	38.1	40.0	34.8	37.2
R3	35.7	37.2	38.5	26.3	35.4
R4	36.3	37.6	38.6	24.4	34.7
R5	35.6	35.7	34.1	16.5	14.1
R6	29.8	22.3	24.5	37.3	36.6
R7	28.0	24.7	26.9	39.2	38.8
R1 Boundary	28.3	31.4	42.7	46.1	52.3

Table 4-3 Predicted Noise Levels during Removal of Overburden to Construct the Bund

Receiver	Predicted Noise Level, dB L_{A10}		
	Stage 1A	Stage 2A	Stage 3A
R1	28.4	31.3	40
R2	36.4	38.1	39.1
R3	35.7	37.2	38.1
R4	36.3	37.6	38.6
R5	35.6	35.7	36.0
R6	29.8	22.3	25.6
R7	28.0	24.7	28.9
R1 Boundary	28.3	31.4	42.7

Table 4-4 Predicted Noise Levels during Extraction Operations

Receiver	Predicted Noise Level, dB L_{A10}				
	Stage 1A	Stage 2A	Stage 3A	Stage 1B	Stage 2B
R1	41.1	41.6	42.4	37.7	40.4
R2	35.1	38.6	40.0	25.9	28.6
R3	34.9	37.6	38.5	23.6	25.4
R4	35.7	37.9	38.6	23.2	23.9
R5	35.3	35.7	34.1	14.5	13.6
R6	25.4	25.1	24.5	36.8	36.8
R7	27.0	27.0	26.9	39.5	39.3
R1 Boundary	40.8	41.5	42.7	38.4	41.3

Table 4-5 Predicted Noise Levels during Cartage Operations

Receiver	Predicted Noise Level, dB L_{A10}
R1	40.2
R2	29.3
R3	26.4
R4	25.7
R5	11.8
R6	32.2
R7	35.0
R1 Boundary	41.0

Details of the main bund requirements are presented in *Figure 4-1*.

The predicted noise levels during the extraction operations and the stockpiling are presented graphically in *Figures 4-2 to 4-7.*

Figure 4-1

Signs and symbols

Bund

Length Scale

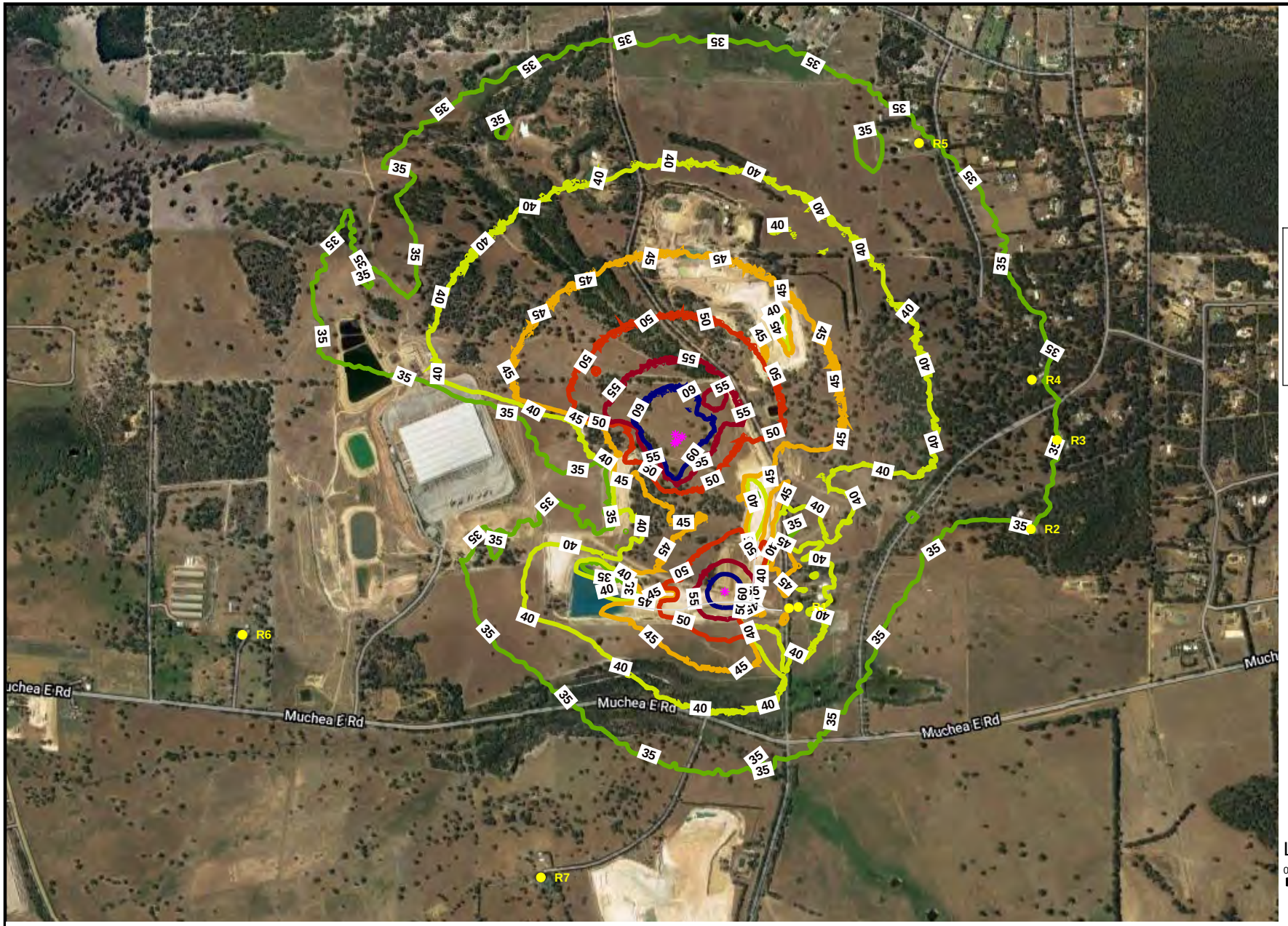
0 25 50 100 150 200 m

Muchea 6 Clay Extraction Pit - Main Noise Bund Details

Lloyd George Acoustics

www.lgacoustics.com.au
(08) 9401 7770

Figure 4-2



Signs and symbols

- Point source
- Receiver

Length Scale

0 75 150 300 450 600 m

Muchea 6 Clay Extraction Pit
Predicted L_{A10} Noise Levels for Stage 1A Extraction with Noise Bunds
Wind from All Directions

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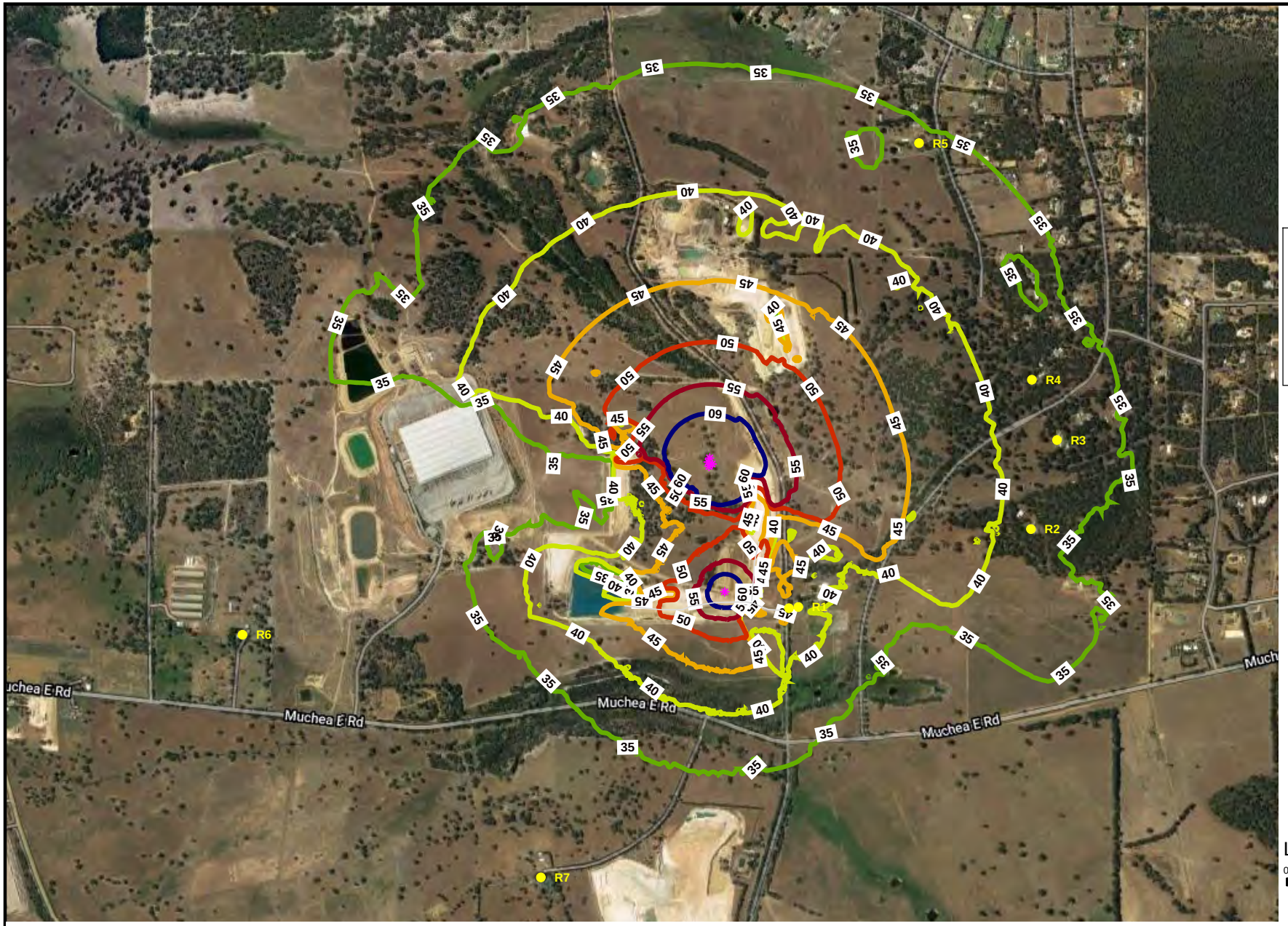
Figure 4-3



Muchea 6 Clay Extraction Pit
Predicted L_{A10} Noise Levels for Stage 2A Extraction with Noise Bunds
Wind from All Directions

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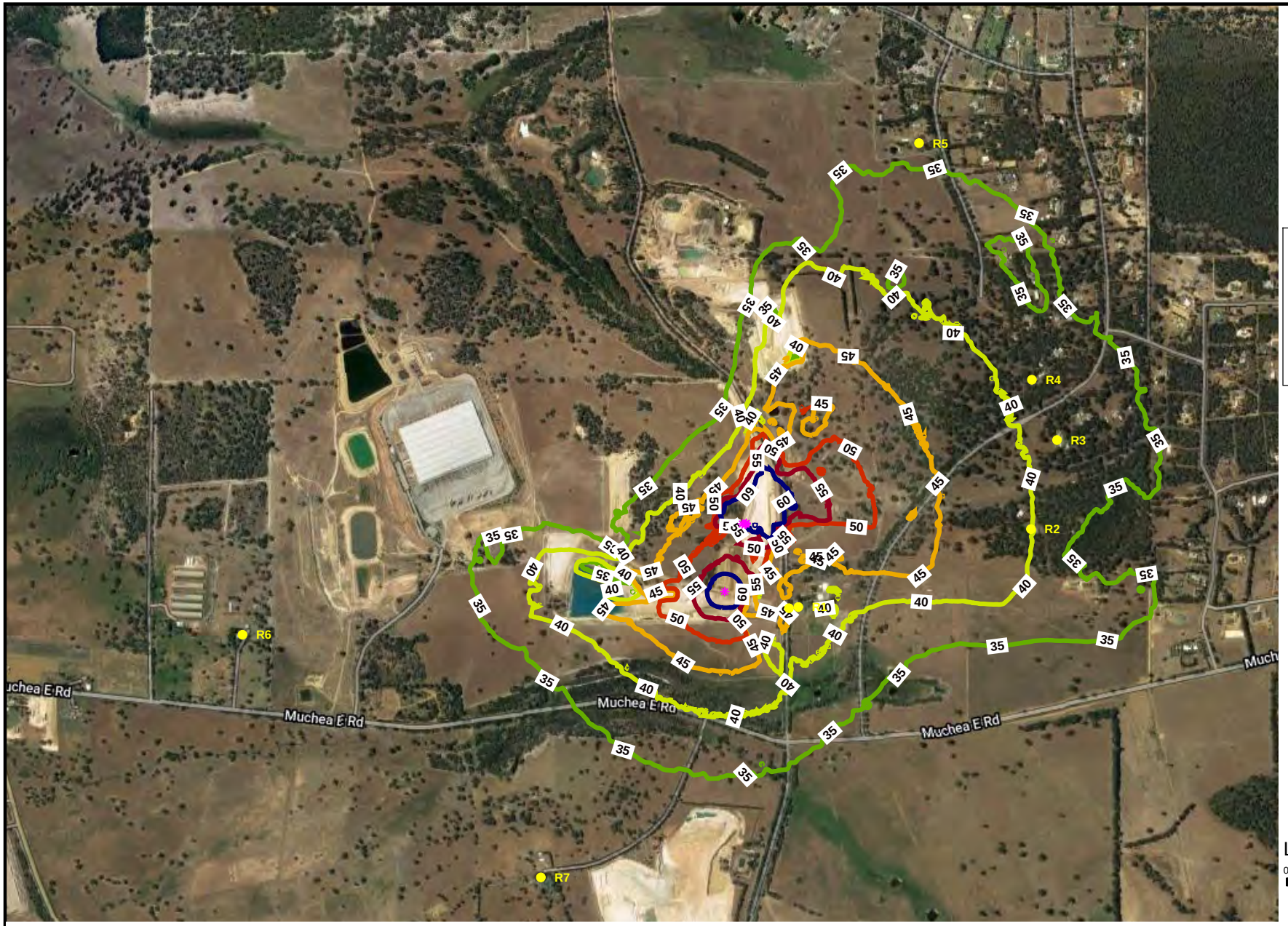
Figure 4-4



Muchea 6 Clay Extraction Pit
Predicted L_{A10} Noise Levels for Stage 3A Extraction with Noise Bunds
Wind from All Directions

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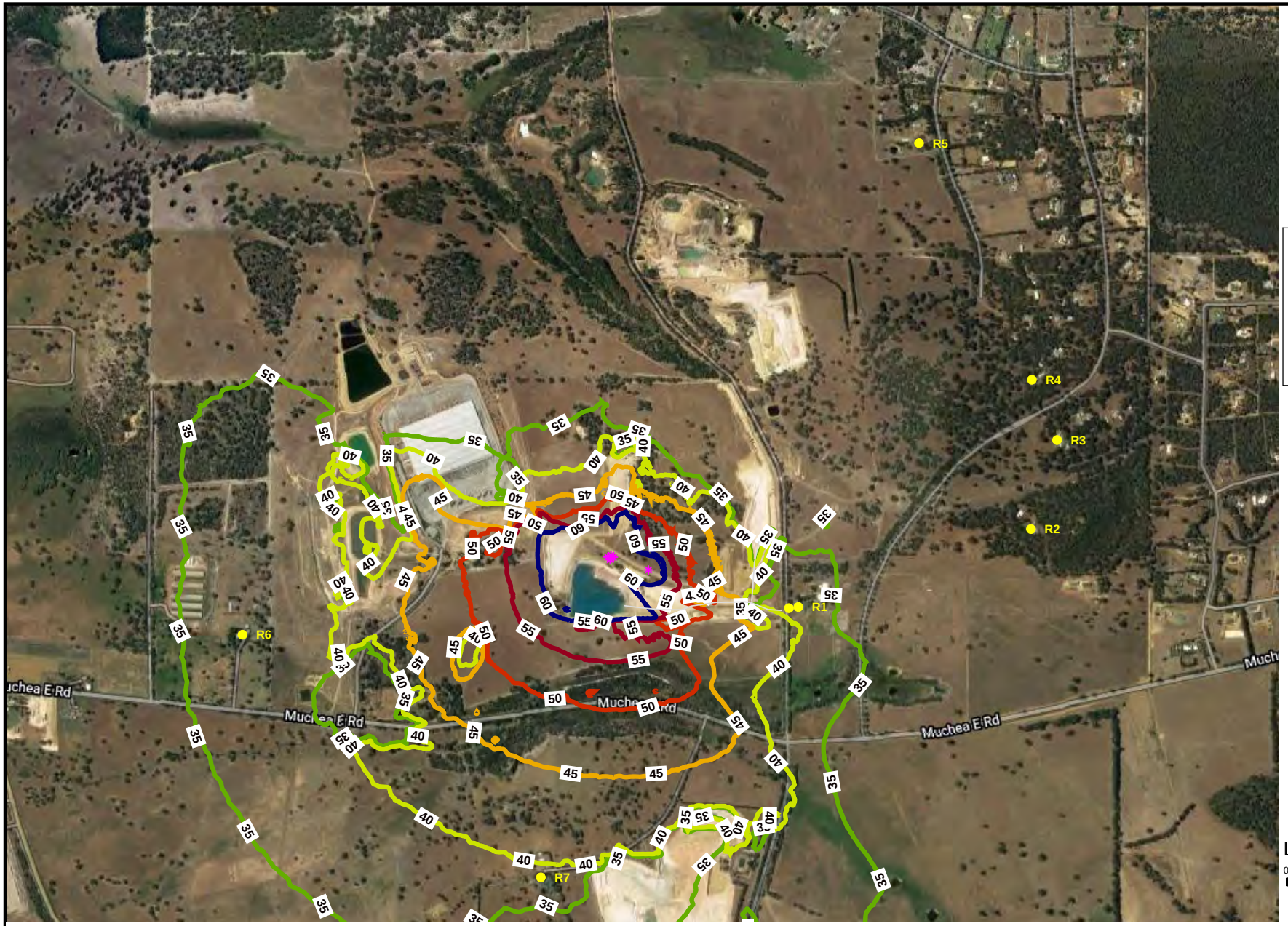
Figure 4-5



Signs and symbols

- Point source
- Receiver

Length Scale

0 75 150 300 450 600 m

Muchea 6 Clay Extraction Pit
Predicted L_{A10} Noise Levels for Stage 1B Extraction
Wind from All Directions

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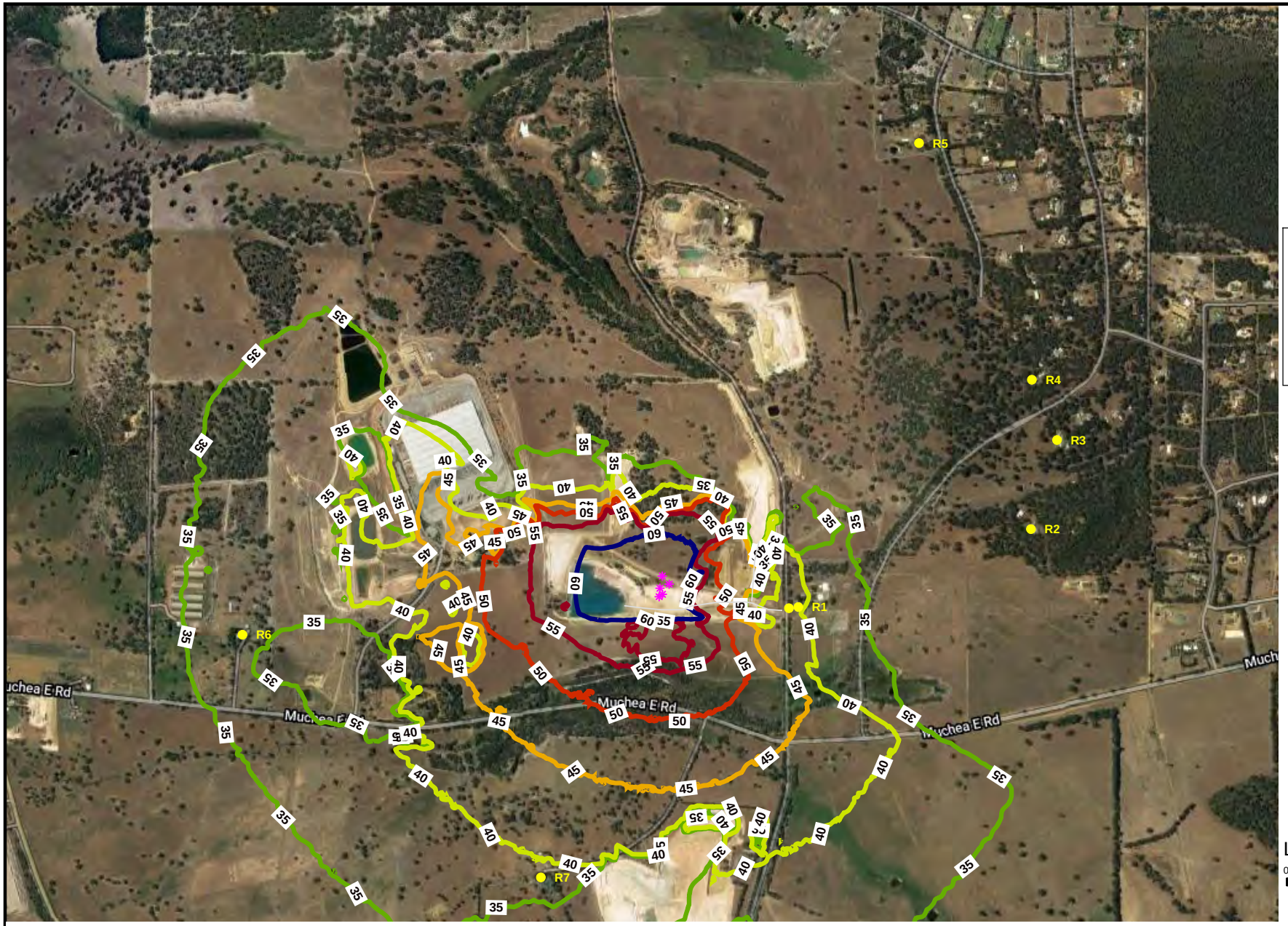
Figure 4-6



Signs and symbols

- Point source
- Receiver

Length Scale

0 75 150 300 450 600 m

Muchea 6 Clay Extraction Pit
Predicted L_{A10} Noise Levels for Stage 2B Extraction with Noise Bunds
Wind from All Directions

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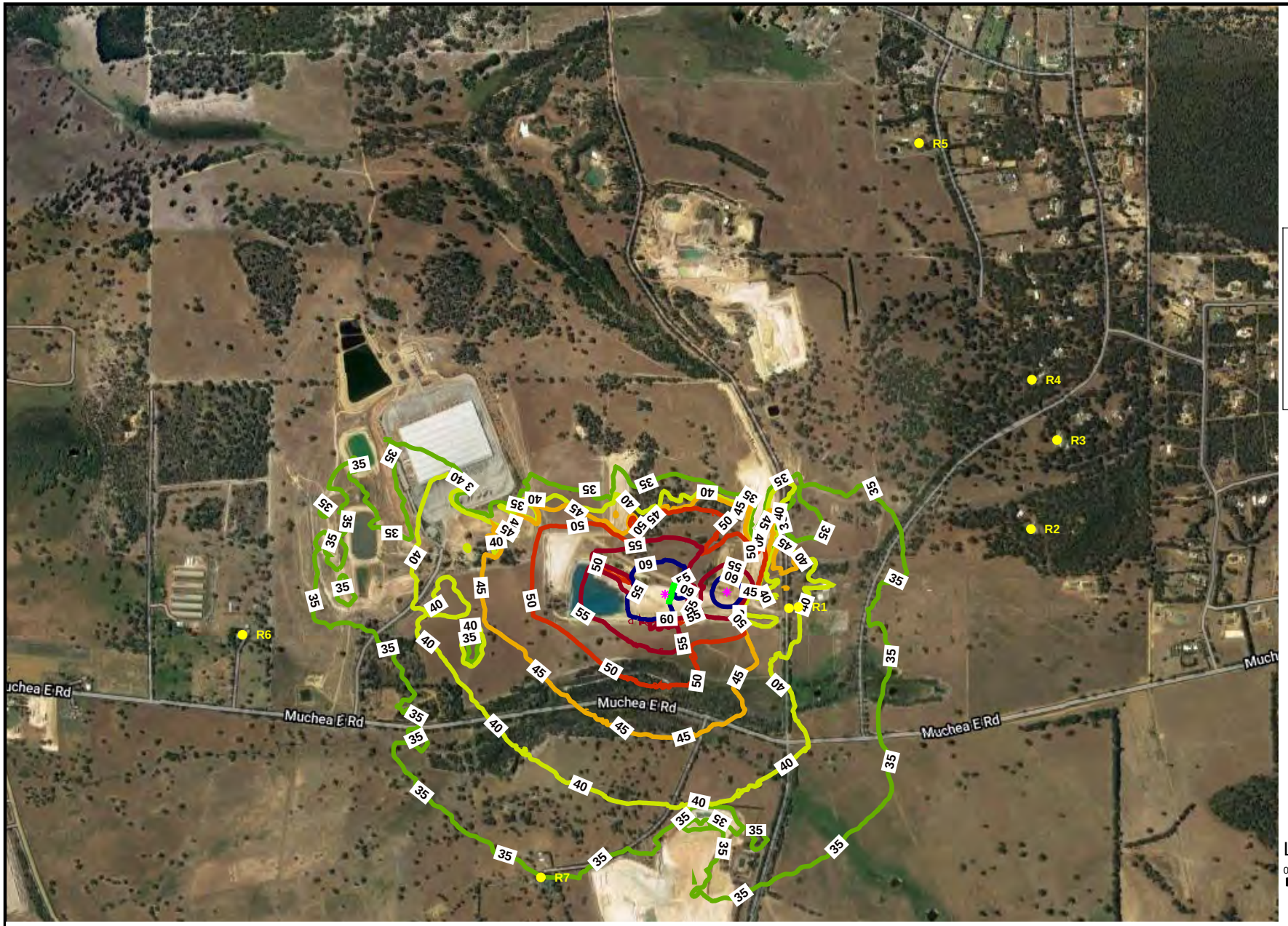
Figure 4-7



Muchea 6 Clay Extraction Pit
Predicted L_{A10} Noise Levels During Cartage Operations with Noise Bunds
Wind from All Directions

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5 ASSESSMENT

For the purposes of modelling, it has been assumed that all the equipment in each scenario will be operating simultaneously. This, coinciding with worst-case wind conditions, is likely to be a rare occurrence and therefore the predictions are considered to be conservative. There are no noise sources that are expected to be modulating or impulsive, however tonality may be present as discussed below.

5.1 Topsoil Removal and Bund Construction Phase

The removal of topsoil and the construction of the bund along the eastern boundary would occur during normal working hours i.e. 7.00 a.m. to 7.00 p.m. Monday to Saturday. As such activities are assessed under regulation 13 and therefore do not require assessment against the assigned levels in Regulations 7 and 8, the activities should be managed so that the noise impacts are as low as reasonably practicable.

From the results presented in *Tables 4-1 and 4-2*, it can be seen that apart from receiver R1, the noise impact during this phase is minimal and below the assigned levels. The highest impact at receiver R1 would occur during the construction of the bund. This is to be expected as the bund will be constructed close to this receiver to provide noise mitigation for the life of the mine.

It should be noted that the material used for the construction of the noise bund along the eastern boundary will be overburden sourced form Stages 1A, 2A and 3A. For these stages the removal of overburden, which is assessed under Regulations 7 and 8, will comply with the regulations.

5.2 Extraction of Overburden to Construct the Noise Bund

From the results presented in *Tables 4-3,* overburden extraction from Stages 1A, 2A and 3A has been shown to comply with the assigned levels under the regulations. The material will be used to construct the noise bund on the eastern boundary, which will then provide mitigation for the overburden removal of the remaining stages and the extraction phase for all stages.

5.3 Extraction Phase

The extraction phase of the operations would occur during normal daytime hours i.e. 7.00 a.m. to 7.00 p.m. Monday to Saturday.

From detailed analysis of the data, it was found that it is the haul truck that would be the dominant noise source particularly for Stages 1A to 3A, where it is required to use the haul road close to receiver R1.

As the noise from the haul truck is dominant, we would expect that tonality would be present and a penalty of +5 dB would need to be applied to the results (see *Table 2-1*). In determining the L_{A10} noise level of the haul truck, the noise was predicted to receiver R1 for the entire trip from the pits to the stockpiling area. Assuming 40 truck movements in a four-hour period, the L_{A10} noise levels was calculated as 40 dB(A).

Table 5-1 compares the predicted noise levels for the extraction phase, which have been adjusted for tonality, against the assigned levels for the daytime period.

Table 5-1 Assessment of Extraction Phase

Premises Receiving Noise	Assigned Level, dB L_{A10}	Adjusted Level*, dB L_{A10}					Comment
		Stage 1A	Stage 2A	Stage 3A	Stage 1B	Stage 2B	
R1	48	46.1	46.6	47.4	42.7	45.4	*Complies with Regulations*
R2	45	40.1	43.6	45	30.9	33.6	*Complies with Regulations*
R3	45	39.9	42.6	43.5	28.6	30.4	*Complies with Regulations*
R4	45	40.7	42.9	43.6	28.2	28.9	*Complies with Regulations*
R5	45	40.3	40.7	39.1	19.5	18.6	*Complies with Regulations*
R6	46	30.4	30.1	29.5	41.8	41.8	*Complies with Regulations*
R7	45	32	32	31.9	44.5	44.3	*Complies with Regulations*
R1 Bdry	60	45.8	46.5	47.7	43.4	46.3	*Complies with Regulations*

*Note: *Level adjusted by +5dB for tonality*

It can be seen from the above table that the daytime L_{A10} assigned level is achieved at all receiver locations during the extraction stages.

The results assume a conservative approach of all plant within a scenario operating simultaneously and the wind blowing towards the receiver locations. In reality, it is most likely that some plant will be stopped which would result in reduced noise emissions. In addition, as the pit life progresses and the pit floor is deeper, further reductions may be realised.

5.4 Cartage and Loading

The cartage of clay using road trucks entering the site from Wandena Road and loading/stockpile maintenance using the wheeled loader would occur during normal daytime hours i.e. 7.00 a.m. to 7.00 p.m. Monday to Saturday. These activities would not occur simultaneously with the extraction phases.

It has been assumed that 45 trucks per day (90 truck movements) would access the site. The assessment is only required when the trucks cross from the public road onto the site. They will then be protected by the bund after a very short time. This is illustrated in *Figure 5-1*.

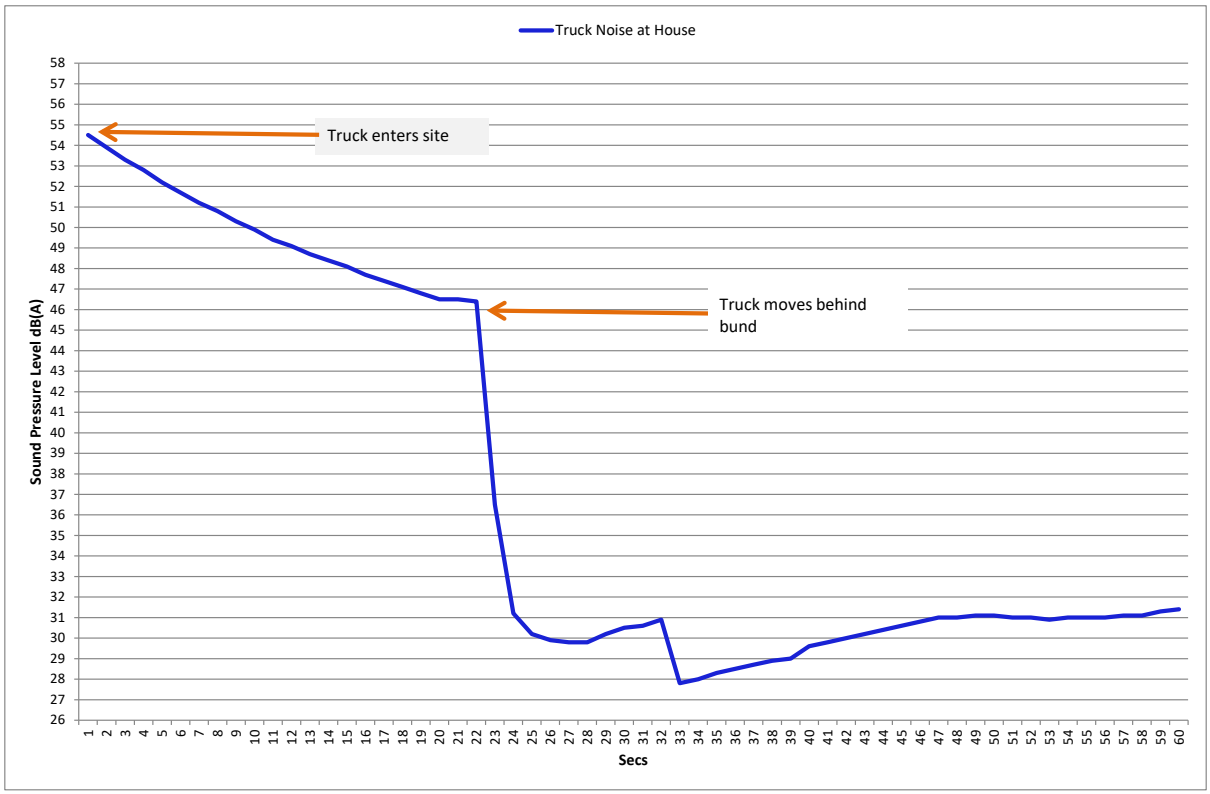


Figure 5-1 Noise from Trucks Entering Site at Receiver R1

As the noise from the loader is dominant, we would expect that tonality would be present and a penalty of +5 dB would need to be applied to the results (see *Table 2-1*).

To ensure compliance with the Regulations, the loader will need to be working behind a barrier having a height of at least 4.0m. We would recommend the bund be placed on the eastern boundary of the stockpile area to protect Receiver R1. The location of the bund is shown in *Figure 4-7.*

Table 5-2 compares the overall predicted noise levels, which have been adjusted for tonality, against the assigned levels for the daytime period.

Table 5-2 Assessment of Cartage and Clay Loading

Premises Receiving Noise	Assigned Level, dB L_{A10}	Clay Cartage dB L_{A10}	Clay Loading dB L_{A10}	Combined Noise Adjusted* dB L_{A10}	Comment Level*
R1	48	31.0	40.2	45.2	*Complies with Regulations*
R2	45	<20	29.3	34.3	*Complies with Regulations*
R3	45	<20	26.4	31.4	*Complies with Regulations*
R4	45	<20	25.7	30.7	*Complies with Regulations*
R5	45	<20	11.8	16.8	*Complies with Regulations*
R6	46	<20	32.2	37.2	*Complies with Regulations*
R7	45	<20	35.0	40.0	*Complies with Regulations*
R1 Boundary	60	29.0	41.0	46.0	*Complies with Regulations*

*Note: *Level adjusted by +5dB for tonality*

6 CONCLUSION

The results of this assessment have shown that with the recommended noise mitigation measures, the proposed clay pit operations of "Muchea 6" on Wandena Road, Lower Chittering, would comply with the requirements of the *Environmental Protection (Noise) Regulations 1997,* between the hours 7.00 a.m. to 7.00 p.m. Monday to Saturday.

The recommended noise mitigation measures include:

- Construction of a noise bund along the eastern perimeter (*Figure 4-1*);
- Construction of noise bunds on the southern boundaries of Stages 1A, 2A and 3A using topsoil;
- Construction of noise bunds on the eastern boundaries of Stages 1B and 2B using topsoil;
- Construction of a noise bund on the eastern boundary of the stockpiling area; and
- The use of broad-band reversing alarms.

Appendix A

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)
Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)
The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}
This is the noise level in decibels, obtained using the A frequency weighting and the S time weighting as specified in AS1259.1-1990. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}
This is the noise level in decibels, obtained using the A frequency weighting and the F time weighting as specified in AS1259.1-1990. This is used when assessing the presence of modulation only.

L_{APeak}
This is the maximum reading in decibels using the A frequency weighting and P time weighting AS1259.1-1990.

L_{Amax}
An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}
An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}
An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax}assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$value, is not to be exceeded at any time.

L_{A1}assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10}assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$or is more than 3 dB $L_{A\ Fast}$in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise
An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road
Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road
Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}) + \frac{1}{20}(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450})$$

where:

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a100m radius of the premises receiving the noise

$\%\text{TypeA}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a100m radius of the premises receiving the noise

$\%\text{TypeB}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period
Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise
Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise
Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise
Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

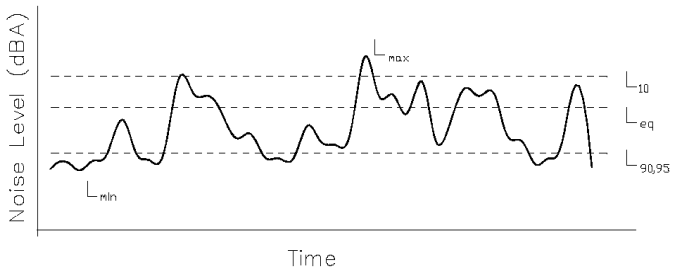
Peak Component Particle Velocity (PCPV)
The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x,y or z) measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

Peak Particle Velocity (PPV)
The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

RMSComponent Particle Velocity (PCPV)
The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Peak Particle Velocity (PPV)
The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Chart of Noise Level Descriptors



Typical Noise Levels