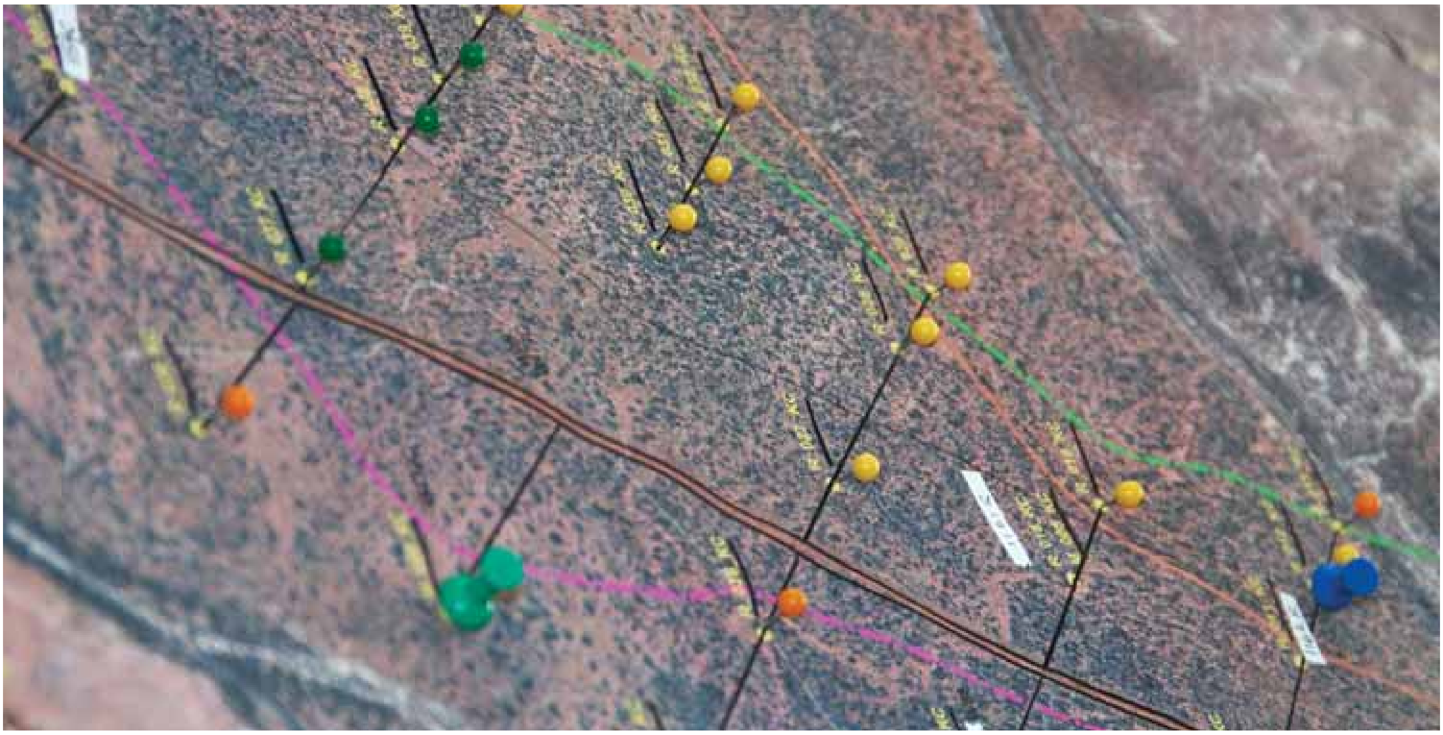
HANCOCK GALILEE PTY LTD

Kevin’s Corner Project Environmental Impact Statement

16 Waste



Section 16 General Waste

16.1 Overview

The Coordinator-General's Terms of Reference (ToR) for an environmental impact statement (EIS) for the Kevin's Corner Project (the Project) requires Hancock Galilee Pty Ltd (HGPL) to detail waste streams and management practices to be implemented to minimise the impacts of waste generation and disposal during the construction, operation and decommissioning phases of the project.

URS Australia Pty Ltd (URS) was engaged to identify and describe all likely sources, quantities and options for management of waste generated during construction, operation and decommissioning phases of the Project. This report focuses on management of solid and liquid waste streams on the basis of planning and design documentation available at the time of the assessment. The management of waste rock, excavated waste and tailings will rely on the strategies proposed for decommissioning and rehabilitation of the Project and is covered in Section 26.

16.2 Project Background

The Project aims to develop an integrated open cut and underground long-wall coal mine within the Galilee Basin, Queensland. The proposed mine plan will allow for a nominal production of up to 30 million tonnes per annum (Mtpa) of product coal over a 30 year period.

The mining lease is located 65 kilometres (km) north of the town of Alpha, 110 km south-west of the town of Clermont and approximately 340 km south-west of Mackay in Central Queensland. It is proposed that thermal quality coal will be mined and washed on site and railed a distance of 450 km to the Port of Abbot Point.

Project development is planned to commence construction in 2012 with first production in late 2014. It is anticipated that the project will employ 2,000 personnel during peak construction and a permanent workforce of 1,500 personnel to operate the mine, with periodic additions to 2,000 people.

16.3 Existing Environment

The project site and surrounding region is predominantly rural, with significant land being cleared by past land use practices.

Typically, the area is subject to a tropical climate with long periods of dry weather and seasonal rain falling primarily between November and April. Significant rainfall (enough to affect operations) is more likely to occur during the summer wet period, although intense rainfall may occur at other times of the year. Temperatures vary seasonally with mean maximum daytime temperatures ranging typically between 23 ºC in the winter and 35 ºC in the summer.

16.3.1 Existing Waste Management Facilities

There are a number of local landfills in the region, including industrial dumps, operated by regional councils. These facilities include refuse disposal sites at:

- Alpha;
- Aramac;

- Jericho;
- Muttaburra; and
- Emerald (landfill is closed to general public, open for industrial and bulky waste only).

These facilities charge a nominal rate for disposal of general waste and individual fees for contaminated or regulated wastes. Most facilities are closed during wet weather.

Hancock's Alpha Coal project adjacent to the Kevin's Corner Project has proposed to install a general solid waste (including putrescible) landfill on site.

Sewage treatment works are operated by Barcaldine Regional Council (Alpha) and Central Highlands Regional Council (Emerald).

The Kevin's Corner Project will utilise the multi-user rail and port facilities proposed for the Alpha Coal Project to transport, load and ship the combined production of these projects and future developments in the region.

16.4 Scope of Work

The TOR defines the scope of work to be completed, which is addressed in this report.

- Identify, quantify and describe waste sources associated with construction, operation and decommissioning of the project;
- Describe operational handling, storage and fate of all wastes including solid wastes, trade wastes and liquid wastes;
- Review cleaner production opportunities and detail realistic strategies for avoidance, minimisation, reuse/recovery and treatment to minimise the impacts of waste generation and disposal;
- Account for potential level of residual impact on environmental and community values e.g. vermin, insects and pests; and
- Consider the cumulative impacts of the development.

16.5 Legislative and Regulatory Framework

It is a requirement of the Terms of Reference that project waste is managed with regard to best practice waste management strategies and the *Environmental Protection (Waste) Policy 2000* (EPP (Waste)) and the *Environmental Protection (Waste) Regulation 2000* (EPR (Waste)).

This section of the report identifies the legislative drivers and regulatory framework relevant to the construction and operation of the Kevin's Corner Project.

16.5.1 Commonwealth Requirements

The National Waste Policy: Less Waste, More Resources (EPHC, 2009) builds on the National Strategy for Ecologically Sustainable Development (ESD) (COAG, 1992) commitments to improve resource efficiency and reduce the environmental impacts of waste disposal. Under this Strategy, it supports streamlined and accurate business reporting to the national pollutant inventory (and under a national product stewardship framework in future).

The National Pollutant Inventory (NPI) National Environmental Protection Measure (NEPM) (NEPC, 2008) was established to assist in reducing existing and potential impacts of emissions of certain substances to achieve the national goals of the NEPM. The NPI is an internet database of emission from various industrial and diffuse sources designed to provide publicly available information on the types and amounts of certain substances being emitted to air, land and water.

Emissions to land, air and water from the project will be reported annually in accordance with the NPI Guide (DECCW, 2010). The NPI Guide provides direction and guidance on NPI substances, trigger thresholds and reporting of emissions and transfers of waste.

Where the use of an NPI substance triggers the established threshold for that substance, emissions of that substance must be reported to the NPI. Emission estimation will be carried out in accordance with the most current Emission Estimation Technique Manuals (published online). The project's emissions will be reported to Australian Government Department of Sustainability, Environment, Water, Population and Communities and will be publicly accessible via the NPI database at www.npi.gov.au.

16.5.2 State Requirements

The Environmental Protection Act 1994 (EP Act) defines "waste" as anything that is:

(a) left over or unwanted by-product from an industrial, commercial, domestic or other activity; or
(b) surplus to the industrial, commercial, domestic or other activity generating wastes.

Under the EP Act, the strategic framework and regulatory requirements for managing waste are defined within the Environmental Protection Regulation (EPR) and waste-specific EPP (Waste) and the EPR (Waste).

The EPP (Waste) establishes the preferred hierarchy for waste management:

- waste avoidance;
- waste re-use;
- waste recycling;
- energy recovery from waste; and
- waste disposal.

The EPP (Waste) also requires that "cleaner production" be considered in determining how waste is managed. According to EPP (Waste), a cleaner production program means –

"a program to identify and implement ways of improving a production process so that the process –

(a) uses less energy, water or another input; or
(b) generates less waste; or
(c) generates waste that is less environmentally harmful."

Under the EPR, certain waste management activities, including disposal and transport of regulated waste, are considered to be environmentally relevant activities (ERA) and require approval. The Waste Regulation also contains requirements for handling specific waste streams and requires tracking of certain regulated wastes (section 17 Waste Regulation) from the point of generation to the point of final processing, recycling or disposal.

The EPR defines "general waste" as waste other than regulated waste. "Regulated waste" is defined in Section 65 of the EPR as:

"(1) Regulated waste is waste that—

(a) is commercial or industrial waste, whether or not it has been immobilised or treated; and

(b) is of a type, or contains a constituent of a type, mentioned in schedule 7 (of EPR).

(2) Waste prescribed under subsection (1) includes—

(a) for an element—any chemical compound containing the element; and

(b) anything that contains residues of the waste."

16.5.3 Local Authority Requirements

The proposed development is located within the Barcaldine Regional Council (BRC) Local Government Area (LGA).

Prior to Queensland's local government amalgamations on 15 March 2008, it was under the jurisdiction of Jericho Shire Council (JSC). Requirements of the JSC Planning Scheme 2006 have been considered with regards to the project's waste management strategy.

16.6 Waste Generation

Waste generation will occur throughout construction, operation and decommissioning of the project. This section identifies and describes these waste sources, likely volumes and characteristics in order to evaluate the efficiency of resource use and appropriateness of proposed management measures.

The waste streams generated from construction and operation of the Project were quantified and characterised on the basis of preliminary planning and design documentation provided by HGPL or, alternatively, construction and operation of similar projects of this type and scale.

16.6.1 Construction

The initial construction phase of the Project is scheduled for a period of up to 24-months. During this phase, project activities will include land clearing, bulk/civil earthworks, construction of accommodation, airport, rail loops, mine infrastructure and industrial components and installation of access roads and water, wastewater, power and communication services.

Waste generated during site preparation and construction will be segregated for reuse on site or subsequent collection for recycling or disposal to an existing landfill within the Barcaldine region.

The quantity of site preparation and construction waste for the main construction period was estimated through the application of the following methods and reference data.

- Self assessed wastage rates for building services (EPA, 2002) as a percentage of incoming construction materials.
- Composition of residential construction waste (EPA, 2002) adjusted to account for additional waste materials diverted and reused on site (e.g. earthen fill, green waste) or generated at lower levels (e.g. bricks, pavers and plasterboard).

- Publicly available waste data for similar large mine developments.

Conservative estimates of waste generation for the construction phase of the project are presented in Table 16-1. It is expected that pre-fabrication of some concrete and steel structures will further reduce waste generation. The waste management strategies identified in Table 16-1 demonstrate the application of the preferred waste management hierarchy in promoting options for on site reuse, recycling and treatment initiatives.

Green waste

Green waste includes vegetation cleared across the mining lease area associated with project construction. The quantity of green waste generated is expected to be moderately low as the land has been significantly cleared by past land-use practices. Green waste will be reused on site for land shaping and rehabilitation.

Building waste

Construction of the industrial area and other project buildings is expected to create concrete, masonry, metals, timber and other general building wastes. It is intended that most accommodation village components will be modularised and pre-fabricated and therefore unlikely to generate significant building waste to be managed on site.

Building wastes generated as a result of total construction requirements are conservatively estimated, for the purposes of the EIS, as equating to approximately ten percent of the total building materials required, allowing for defects, damage during transportation and off-cuts.

Where feasible, these wastes will be segregated to facilitate reuse on site or recycling off-site. Residual (non-recyclable) waste would be disposed to landfill either at Alpha or Emerald until the engineered landfill to be constructed on site is operational.

General waste

General municipal wastes will be generated from the construction accommodation village, mechanical, electrical and structural material handling equipment, piping and management facilities. It will typically comprise food scraps, paper and cardboard, glass, aluminium cans, plastics and packaging.

Where feasible, these wastes will be segregated to facilitate recycling, by the provision of recycling bins around the construction accommodation village, site offices and amenities. Residual (non-recyclable) waste would be disposed to landfill either at Alpha or Emerald until the engineered facility on site is operational

Wastewaters

Sewage will be generated from the construction management facilities and construction accommodation village. During construction of these facilities, sewage will be discharged to a temporary package Wastewater Treatment Plant (WWTP), which will be decommissioned and replaced by more permanent facilities at the end of the project's construction stage.

Sewage wastewaters generated during the project will be collected and treated to Class C effluent quality suitable for recycling on site in sub-soil irrigation with above ground heavy mulch. Periodically, the separated sludge and solids will be transported by a licensed contractor to an existing sewage treatment works located at either Alpha or Emerald.

Hazardous waste / Hydrocarbon waste

Hydrocarbon contaminated wastes will comprise used solvents, oils and lubricants produced from vehicle and production equipment maintenance, vehicle wash-down and minor leaks from refuelling operations. These waste materials become regulated wastes if generated in sufficient quantities.

Waste materials deemed hazardous will be isolated and removed off-site by licensed contractors.

Regulated waste

Some minor vehicle and earthmoving equipment maintenance activities will occur on site as required during the construction stage. As a result of these activities, regulated waste may include used or surplus:

- Tyres;
- Hydrocarbons (principally lubrication oils);
- Oil filters;
- Batteries; and
- Solvents and paints.

Preferentially, tyres will be reused for practical uses on site or removed by the tyre supplier for reprocessing. As a final option, waste tyres will be stored and appropriately disposed of once mining operations commence by burying in the mine overburden in a designated location that will be identified on the Environmental Management Register (EMR) managed by the Queensland Department of Environment and Resource Management (DERM).

Hydrocarbon-contaminated wastes during construction will be limited. Such wastes will comprise used solvents, oils and lubricants produced from major production equipment, mobile equipment and Coal Handling and Preparation Plant (CHPP) construction, minor vehicle maintenance and potentially minor leaks from refuelling operations. Hydrocarbon wastes will be collected into suitably bunded waste storage tanks or other suitable containment devices and removed off-site by a licensed contractor for reprocessing, recycling or final disposal.

Wet cell batteries will be stored in a central bunded facility for collection and removal off-site by a licensed contractor for reprocessing, recycling or final disposal.

HGPL will keep detailed records of waste removed from site, including details of contractors, treatment and final destination.

Table 16-1 Waste inventory during initial construction phase (24-month period)

Waste	Source	Estimation	Quantity	Units	Management Strategy
Green waste	Vegetation clearing during construction of mine and associated industrial facilities and amenities.	• Total area cleared is 8,000 hectares (ha) including remote run of mine (ROM) stockpiles and portals for underground access (HGPL, 2010). • 180 tonnes of biomass per hectare, including above and below ground biomass (Westman and Rogers, 1977).	1,440,000	tonnes	Suitable material to be used on site to provide fauna habitat. Remaining material to be chipped and mulched for reuse during progressive rehabilitation and revegetation. Burning of green wastes will only occur as a last resort, subject to obtaining necessary permits and approvals.
Concrete and bricks	Waste from new construction activities (e.g. ROM, OLC external MIAs and rail sleepers), airstrip, access and circulating roadways and car parking areas.	• Assume 0-2.5% of concrete construction materials to be used on site, based on self-assessed wastage rates for concrete trades (EPA, 2002). Projected wastage rate of 0.05% adopted. • Six tonnes of concrete can be made from one tonne cement.	3,000	tonnes	Concrete and brick will be stockpiled in designated storage areas for reuse (e.g. crushed for road base) or alternatively disposed on site. Contaminated material will be disposed to landfill, or off site for registered waste materials.
Processed wood products	Waste from new construction activities or temporary structures.	• Assume 20% mass equivalent (timber, plywood) of total construction waste stream, based on composition of residential construction waste (EPA, 2002).	3,000	tonnes	Stockpiled in designated storage area for reuse on site or alternatively removed by licensed contractor for reuse, reprocessing or final disposal.
Electrical wastes	Waste from new construction activities or temporary structures.	• Assume 2% mass equivalent of total construction waste stream.	1,000	tonnes	Stockpiled in designated storage area to be removed by licensed contractor for reuse, reprocessing or final disposal.
Sealers, resins, solvents and paints	Waste from new construction activities.	• Expect minimal quantities.	2	tonnes	Stockpiled in designated storage area to be removed by licensed contractor for reuse, reprocessing or final disposal.
Metals	Waste from new construction activities or temporary structures.	• Assume up to 10% mass equivalent of total construction waste stream, based on self-assessed wastage rates for building services (EPA, 2002).	900	tonnes	Metals will be source-separated for removal by a licensed operator for recycling. Residual (non-recyclable or contaminated) material would be disposed of to landfill – initially at either Alpha or Emerald until the on-site engineered landfill is operational.

Waste	Source	Estimation	Quantity	Units	Management Strategy
Plastic	Waste from new construction activities or from offices, crib rooms or accommodation.	• Assume up to 5% mass equivalent of total construction waste stream, based on composition of residential construction waste (EPA, 2002).	800	tonnes	Where feasible, these wastes will be segregated to facilitate reuse on site or recycling off-site. Residual (non-recyclable) material would be disposed of to landfill – initially at either Alpha or Emerald until the on-site engineered landfill is operational.
Paper and cardboard	Waste from new construction activities or from offices, crib rooms or accommodation.	• Assume 9% mass equivalent of total construction waste stream, based on composition of residential construction waste (EPA, 2002).	2,500	tonnes	Source-separated for removal by a licensed operator for recycling. Residual (non-recyclable) material would be disposed of to landfill – initially at either Alpha or Emerald until the on-site engineered landfill is operational.
Glass	Waste from new construction activities or from offices, crib rooms or accommodation.	• Assume 2% mass equivalent of total construction waste stream, based on composition of residential construction waste (EPA, 2002).	260	tonnes	Where feasible, these wastes will be segregated for recycling off-site. Residual (non-recyclable) material would be disposed of to landfill – initially at either Alpha or Emerald until the on-site engineered landfill is operational.
Putrescible waste	Waste from offices, crib rooms or accommodation.	• Assume 9% mass equivalent of total construction waste stream, based on composition of residential construction waste (EPA, 2002).	18,000	tonnes	General refuse is to be collected in covered bins and removed regularly (at least once per week) for recycling off-site or final disposal – initially to landfill at either Alpha or Emerald until the on-site engineered landfill is operational.
Batteries	Wet cell batteries from vehicles and dry cell batteries from phones, radios and other equipment.	Data sourced from other operating coal mines and scaled for size of project.	60	tonnes	Source-separated for removal and recycling by licensed operator.
Waste electrical and electronic equipment (WEEE)	Administration buildings or maintenance activities.	• Expect minimal quantities.	2	tonnes	Set up WEEE collection service with licensed WEE recycling operator.
Printer cartridges	Administration buildings.	• Expect minimal quantities.	0	tonnes	Used or empty laser and inkjet printer cartridges can be recycled.

Waste	Source	Estimation	Quantity	Units	Management Strategy
Oils	Routine servicing of plant, equipment and vehicles in workshop.	Data sourced from other operating coal mines and scaled for size of project. Note that underground equipment use less hydrocarbons than draglines, trucks and shovels (e.g. lubricant is diluted).	9,000	tonnes	Waste oil to be collected and stored in bunded holding tanks for collection by a licensed contractor for reuse, reprocessing, recycling or disposal. Where possible, pneumatic pumps should be used to transfer waste oil from machinery to bunded storage.
Grease trap waste	Accommodation village kitchen.	• Expect minimal quantities.	10	tonnes	Waste grease to be placed in a bunded storage container. Waste grease to be collected periodically by a licensed waste contractor for reuse, reprocessing, recycling or disposal.
Other regulated waste (including hydrocarbon and hydrocarbon contamination)	Routine servicing of plant, equipment and vehicles in workshop. Demolition, maintenance or construction activities.	Data sourced from other operating coal mines and scaled for size of project.	9,000	tonnes	Regulated waste to be stored appropriately for collection and removal by a licensed contractor for treatment. Regulated wastes will be tracked via an approved waste tracking system.
Drums	Small and bulk drums and other containers that typically contained oils and greases.	• Unable to estimate expected quantities.	20	tonnes	Empty drums to be stored in a covered, secure bunded area for periodic collection by a licensed contractor for reuse, reprocessing, recycling or disposal.
Explosives (blasting residue from use of ANFO explosive, boosters and detonator)	Defective explosives or packaging.	• HGPL's current design indicates that explosives will not likely be used on site during initial construction phase. • It is likely that the proposed new local quarry will use explosives which will be managed by the licensed operator independently.	0	tonnes	Explosive materials are to be treated in accordance with AS2187.2-2006 - Explosives Storage, Transport and Use, Part 2, Use of Explosives. Disposal to landfill is not suitable method of disposal. It is likely that waste explosive materials will be detonated/ burnt by emergency response officers. Following detonation, stainless steel casings will be recycled or disposed to landfill. Cardboard packaging can not be removed from site for recycling due to potential explosive residues.

Waste	Source	Estimation	Quantity	Units	Management Strategy
Asbestos	Removal of asbestos-containing materials discovered during excavation.	• Asbestos investigation in the event that asbestos is discovered. Expect minimal quantities (refer to Contamination Section).	TBD	tonnes	Asbestos to be removed and disposed by specialist contractor.
Tyres	Tyre failure and routine servicing of plant, equipment and vehicles in workshop.	• Construction vehicles (estimate 60 heavy vehicles) require tyre change every 12-months. Each tyre weighs up to 3 tonne. • Estimate 100 light and medium-sized service vehicles (i.e. excludes dump truck and large rubber tyred vehicles) will require tyre change once in 24-months construction period. Each tyre weighs approximately 50 kg.	1,500	tonnes	Tyres to be removed by tyre supplier for reprocessing. Alternatively, tyres will be stored for disposal once mine operations commence by burying in overburden at a designated location to be recorded on Environmental Management Register (EMR) administered by DERM.
Sewage effluent	Sewage effluent from offices, crib rooms, accommodation, kitchen and amenities.	• Sewage effluent projected on basis of project workforce numbers (240 L/person/day). • Estimate 1,800 personnel on site during peak construction.	350	ML	Dedicated package sewage treatment plant (pump out system) to be provided during construction until pipeline connected to permanent WWTP on site. Effluent treated to Class C quality and reused on site.
Sewage sludge	WWTP	• Volumetric fraction of solids in sewage effluent.	100	tonnes	Sludge to be periodically collected by licensed contractor for transport to an existing sewage treatment works located at Alpha or Emerald.

TBD: To be determined.

16.6.2 Operation

Over the project life, general operation of the mine will require continued land clearing, earthworks associated with mine development, mine industrial activities, blasting, rehabilitation, maintenance of mobile and fixed plant, administration activities, and operation of the accommodation village and associated services (e.g. water treatment, sewage treatment).

In general, the quantity of operational waste for each year of the project life was estimated by scaling publicly available waste data for similar large mine developments on the basis of project workforce or the Run of Mine (ROM) coal tonnes.

Conservative estimates of waste generation for the construction phase of the project are presented in Table 16-2. Waste management strategies are also outlined in Table 16-2, which indicate that options for on site reuse, recycling and treatment will be implemented to minimise disposal to landfill.

Green waste

Land clearing will continue as the mine develops; however volumes are expected to be low as the land has been cleared as part of previous land management practices. In particular, large vegetation materials such as hollow logs and hollow-bearing trees will be stockpiled for use in rehabilitation activities or placed in adjoining bushland.

Building waste

As the mine continues to develop, it is likely that building waste, including concrete, masonry, metals, timber and other general building wastes, will be generated from new construction works.

Where feasible, these wastes will be segregated to facilitate reuse on site or recycling off-site. Inert parts of the residual (non-recyclable) waste would be used as clean fill with the remainder disposed to the engineered landfill on site.

General waste

General municipal wastes will be generated from the accommodation village, administration facilities and crib rooms and will typically comprise food scraps, paper and cardboard, glass, aluminium cans, plastics and packaging. Where feasible, these wastes will be segregated to facilitate recycling, by the provision of recycling bins around these buildings. Residual (non-recyclable) waste would be disposed to the landfill to be constructed on site. Alternative waste treatment options such as thermal or biological treatment will be considered for implementation to maximise resource recovery on site.

Wastewaters

Sewage generated from the administration buildings, accommodation village and amenities will be collected and reticulated to a dedicated WWTP. Sewage wastewaters will be treated to Class C effluent quality suitable for recycling on site in sub-soil irrigation with above ground heavy mulch. Depending on the availability and final design of dewatering equipment in the WWTP, solids would be dewatered and disposed to the engineered landfill on site. Otherwise, periodical removal of the separated sludge and solids will be required.

Hydrocarbon

Hydrocarbon contaminated wastes will comprise used solvents, oils and lubricants produced from vehicle and production equipment maintenance, workshops, vehicle wash-down and minor leaks from refuelling operations. These waste materials become regulated wastes if generated in sufficient quantities. Such waste materials will be segregated and removed off-site by licensed contractors.

Regulated waste

Regulated waste generated during the operation of the project will be similar to that generated during construction and managed accordingly, as described in Section 16.6.1. That is, HGPL will keep detail records of waste removed from site. Documentation will include final waste processing including recycling or final disposal.

Laboratory testing and process measurement wastes will also be generated during the operation phase. These wastes will be handled in accordance with recognised industry best practices, typically by designated maintenance contractors with waste materials stored, handled and treated by a licensed operator for reprocessing, recycling or final disposal.

16.6.3 Decommissioning

Decommissioning of the project would involve deconstruction and removal of unsafe buildings, removal of industrial equipment and stabilising and rehabilitation of the project area for future use. Conservatively, decommissioning is assumed to be phased in over two years – the actual timeframe to be confirmed with regulators prior to decommissioning.

Estimated waste generation from this stage of the project is uncertain given the number of buildings and associated structures to be removed or that will remain on site is unknown. For the purposes of the EIS, it has been assumed that the waste types, quantity and associated waste management measures during the decommissioning phase, would be the same as the initial construction phase as described in Section 16.6.1.

Prior to the decommissioning works being carried out a detailed waste management plan would be prepared to confirm the estimated types, quantities and waste management measures implemented during this stage.

Table 16-2 Waste inventory during operational phase (annual)

Waste	Source	Estimation	Quantity	Units	Management Strategy
Green waste	Vegetation clearing during ongoing development of mine, according to mine plan.	• Total area cleared is 9,500 hectares – assume 5% disturbed each year. • 180 tonnes of biomass per hectare, including above and below ground biomass (Westman and Rogers, 1977).	42,750	tonnes	Suitable material to be used on site to provide fauna habitat. Remaining material to be chipped and mulched for reuse during progressive rehabilitation and revegetation. Burning of green wastes will only occur as a last resort, subject to obtaining necessary permits and approvals.
Concrete, brick and bitumen	Waste from minor maintenance of buildings, airstrip and roadways.	• Expect minimal quantities.	TBD	tonnes	Stockpiled in designated storage area for reuse on site (e.g. road base) or alternatively removed by licensed contractor for reuse or disposal.
Processed wood products	Waste from minor maintenance of buildings and pallets.	• Expect minimal quantities.	1	tonnes	Stockpiled in designated storage area for reuse on site or alternatively removed by licensed contractor for reuse or disposal. Where possible, pallets should be returned to supplier.
Electrical wastes	Maintenance of electrical systems within mine industrial area, administration and accommodation buildings.	• Expect minimal quantities.	1	tonnes	Stockpiled in designated storage area to be removed by licensed contractor for reuse or disposal at a licensed facility.
Sealers, resins, solvents and paints	Maintenance workshop.	• Expect minimal quantities.	1	tonnes	Stockpiled in designated storage area to be removed by licensed contractor for reuse or disposal at a licensed facility.
Metals	Maintenance workshop; or general waste from accommodation village, mess or administration building.	• Data sourced from operating coal mines and scaled to project.	2,000	tonnes	Source-separated for removal and recycling by licensed operator.

Waste	Source	Estimation	Quantity	Units	Management Strategy
Glass, plastic, paper and cardboard	Maintenance workshop; or general waste from accommodation village, mess or administration building.	• Expect minimal quantities.	300	tonnes	Source-separated for removal and recycling by licensed operator.
Putrescible waste	Accommodation village, mess, crib room or administration building.	• Data sourced from operating coal mines and scaled to project.	5,000	tonnes	General refuse to be collected in covered bins and removed to the on-site landfill at least once per week. General refuse bins will be presented with recycling bins to promote segregation of recoverable materials.
Batteries	Wet cell batteries from vehicles and dry cell batteries from phones, radios and other equipment collected in accommodation village or administration buildings.	• Data sourced from other operating coal mines and scaled for size of project.	40	tonnes	Source-separated for removal and recycling by licensed operator.
Waste electrical and electronic equipment (WEEE)	Administration buildings or maintenance activities.	• Expect minimal quantities.	1	tonnes	Set up WEEE collections services with suppliers.
Printer cartridges	Administration buildings.	• Expect minimal quantities.	0	tonnes	Used or empty laser and inkjet printer cartridges will be collected for recycling.
Oils	Routine servicing of plant, equipment and vehicles in workshop.	• Expect minimal quantities.	2,000	tonnes	Waste oil to be collected and stored in bunded holding tanks for collection by a licensed contractor for reuse, reprocessing, recycling or disposal. Where possible, pneumatic pumps should be used to transfer waste oil from machinery to bunded storage.
Grease trap waste	Accommodation village kitchen, workshop, shutdowns and dragline maintenance.	• Expect minimal quantities.	3	tonnes	Waste grease to be placed in a bunded storage container. Waste grease to be collected periodically by a licensed waste contractor for reuse, reprocessing, recycling or disposal.

Waste	Source	Estimation	Quantity	Units	Management Strategy
Other regulated waste	Assembly of draglines and other mining and processing equipment. Routine servicing of plant, equipment and vehicles in workshop.	• Expect minimal quantities.	2,000	tonnes	Regulated waste to be stored appropriately for collection and removal by a licensed contractor for treatment. Regulated wastes will be tracked via an approved waste tracking system.
Drums	Small and bulk drums and other containers that typically contained oils and greases from industrial area or workshop.	• Unable to estimate expected quantities.	5	tonnes	Empty drums to be stored in a covered, secure bunded area for periodic collection by a licensed contractor for reuse, reprocessing, recycling or disposal.
Explosives	Defective explosives and packaging.	• Average quantity of explosives used sourced from HGPL's own design calculations. • Assume 40% mass equivalent of explosive forms waste residue (Kelleher, 2002).	2,000	tonnes	Explosive materials are to be treated in accordance with AS2187.2-2006 - Explosives Storage, Transport and Use, Part 2, Use of Explosives. Disposal to landfill is not suitable method of disposal. It is likely that waste explosive materials will be detonated/ burnt by emergency response officers. Following detonation, stainless steel casings will be recycled or disposed to landfill. Cardboard packaging can not be removed from site for recycling due to potential explosive residues.
Asbestos	Removal of asbestos-containing materials discovered during excavation.	• Expect minimal quantities.	TBD	tonnes	Asbestos to be removed and disposed by specialist contractor.
Tyres	Tyre failure and routine servicing of plant, equipment and vehicles in workshop.	• Haul & Support vehicles (estimate 50 heavy vehicles) require tyre change every 12-months. Each tyre weighs up to 3 tonne. • Estimate 100 light and medium-sized service vehicles will require tyre change once in 24-months period. Each tyre weighs approximately 50 kilograms.	650	tonnes	Tyres to be removed by tyre supplier for reprocessing. Alternatively, tyres will be stored for disposal once mine operations commence by burying in overburden at a designated location to be recorded on Environmental Management Register (EMR) administered by DERM.

Waste	Source	Estimation	Quantity	Units	Management Strategy
Sewage effluent	Sewage effluent from offices, crib rooms, accommodation, kitchen and amenities. Industrial waste waters from industrial areas.	• Sewage effluent projected on basis of project workforce numbers (240 L/person/day). • Estimate 700 personnel on site during operation.	65	ML	Collected and diverted to sewage treatment plant on site for processing to Class C effluent quality for reuse on site.
Sewage sludge	Wastewater treatment plant.	• Volumetric fraction of solids in sewage effluent.	20	tonnes	Sludge to be disposed to landfill on site (dependent on availability/final design of dewatering equipment in WWTP). Alternatively, sludge will be collected by a licensed contractor for disposal at an existing sewage treatment works at Alpha or Emerald.

TBD: To be determined.

16.7 Waste Management

16.7.1 Waste Management Strategy

Waste management strategies designed for the Project consider waste management from the concept and planning stages through design, construction and operation.

The principle objective of the waste management strategy for the Project is to minimise the impacts of waste generation and disposal on land resources, water quality, air quality and to manage waste in a manner that avoids direct or indirect impacts on the environment or health of the Project workforce or local community.

The main strategies that will be adopted for the Project include waste minimisation (including waste segregation for reuse or recycling), cleaner production and appropriate waste disposal, consistent with the requirements of the ToR.

Waste Minimisation

In line with the preferred hierarchy for waste management, waste generation will be minimised through detailed design, sustainable procurement and efficient resource use during construction and operation. Effective waste planning allows for considerable flexibility in the management of wastes.

Adequate separation of components of the waste stream at the point of generation will be made available. Separate skips will be provided to maintain segregation and maximise economic reuse and recycling in preference to disposal to landfill. Colour-coded bins will promote segregation of cardboard/paper, steel, glass and aluminium cans in administration and accommodation buildings. Maintaining segregation of types of waste at point of generation or during storage or transportation makes recovery achievable; that is, by keeping each type of waste clean/uncontaminated and homogenous to enhance opportunities for reuse and prevent on site and off site pollution.

Waste streams will be assessed for potential reuse, prior to transport to an approved treatment facility. Where the waste material cannot be reused on site, a licensed contractor will be identified to remove and recycle waste at a licensed facility. Where reuse and recycling options are ruled out, waste will be removed by a licensed contractor for disposal to an approved landfill.

The Project will generate few wastes that have a market demand. There are likely to be opportunities to recycle aluminium cans, plastic containers, glass, paper and cardboard, scrap steel, tyres, pallets and conveyor belt at local recyclers. Some other wastes will be recycled and reused on site such as green waste, excavated soil, pallets, bunded containers, drums, conveyer belt and waste water. The project will review the marketability of its waste for recycling and reuse on a regular basis.

Cleaner Production

Cleaner production is designed to provide environmental, economic and other, less tangible benefits. It forms an important component of the continual improvement approach to management adopted by HGPL.

Cleaner production during detailed design and at the Project site will focus on implementing ways to improve resource efficiency and environmental performance of construction and production processes in order to:

- reduce the use of energy, water and other material resources;
- generate less waste in the production process; and/or
- generate waste that is less environmentally harmful or reusable for another process.

In general, cleaner production can be achieved through a selection of one or more of the following techniques.

- Input substitution (e.g. fuels, solvents).
- Product reformulation (e.g. raw coal markets).
- Production process modification (selection of the best available practicable technologies e.g. conveyors).
- Improved operation and maintenance (selection and use of the most appropriate processes and equipment and management practices).
- Reuse of resources that are otherwise wastes (e.g. putrescible waste, tailings).
- Closed-loop recycling (where a product is recycled and used again in the same form e.g. water).

The following aspects of the project demonstrate adoption of these cleaner production principles.

- Adoption of the waste management hierarchy as the cornerstone of waste management strategies.
- Selection of the best available practicable technology for coal extraction (fixed and mobile plant and equipment) to ensure appropriate energy intensity and production efficiency of ROM coal.
- Selection of the best available practicable technology for the CHPP to ensure efficient and optimum water and energy use, minimum dust emissions and waste minimisation.
- Location of the mining and infrastructure areas to minimise the clearing of vegetation.
- Recycling of process water through the coal processing phases, including recycling of tailings water back into the CHPP.
- Recycle water from sewage treatment primarily to processing or irrigation.

The development and implementation of comprehensive earthmoving equipment and fixed plant maintenance programs will ensure optimum performance and energy efficiency for all mechanical equipment used on site and will help to generate less waste and less indirect environmental effects.

Contracts with construction companies will encourage contractors to adopt waste minimisation procedures. This includes the purchase of materials cut to standard sizes, reuse of concrete formwork where practicable and source separation and segregation of recoverable materials.

16.7.2 Waste Management Procedures

The Environmental Management System (EMS) to be developed for the Project will address waste management in order to minimise the quantity of waste generated and improve on the waste disposal and management techniques adopted. The principles for waste minimisation and management are:

- implementation of the waste minimisation hierarchy;
- water conservation, treatment and reuse;

- efficient energy usage;
- compliance with national and state waste management policies, the EP Act and associated regulatory instruments as a minimum; and
- effective waste recycling and disposal systems.

16.7.3 Handling, Storage, Collection and Disposal

The site will be set up and managed to ensure maximum opportunity for segregation of waste stream components. During both construction and operational phases of the Project, a dedicated waste segregation, storage and transfer area will be set up in the LIA to accept and sort waste materials. Separate skips will be provided to collect and store nominated waste materials from Project construction and operation for reuse, recycling or disposal, including hazardous materials.

Colour-coded and signed bins will be used to identify points for collection and segregation of waste materials, including food waste, paper and recyclables to facilitate sorting and recovery of re-usable materials. The bins will be located throughout administration buildings and accommodation villages to achieve maximum economic waste recovery. These bins will be emptied into larger bins or skips regularly. All smaller bins and larger bins or skips will have lids to reduce the potential for attracting insects and vermin. General wastes will be collected regularly and transported for disposal to the nominated landfill.

Development of complete personnel, plant and equipment lists will occur during the engineering design of the Project. Equipment and bin sizing requirements will be designed and adjusted to meet waste generation rates during construction and operation phases of the Project. Preliminary estimates for equipment and personnel are presented in section 16.8.4.

At the Project site, an on site induction will inform site personnel of the required waste management procedures and facilities. Contractors will be required to place a high emphasis on housekeeping and cleanliness in the workforce accommodation areas. All work areas will be maintained in a neat and orderly manner and all hazardous wastes will be appropriately stored in bunded areas away from watercourses or other environmentally sensitive areas and in accordance with legislative requirements.

All incidents that deviate from the normal operating conditions will be reported internally and at such times immediate corrective actions initiated.

16.7.4 Preferred Waste Disposal Solution

Generally, solid waste landfills in the region are operated by local government as a municipal service for local residents and businesses. These facilities are small and not a suitable solution for long-term disposal of waste generated at the Kevin's Corner Project. In addition, these facilities are located more than 50 km from the Project site.

The scale of the Kevin's Corner Project demands a suitable waste disposal solution for long-term effective treatment of wastes generated by the Project. An engineered landfill will be developed to accommodate residual wastes generated from the Project that cannot be reused or recycled. A detailed description of the landfill design, construction and operation is presented in section 16.8.

16.7.5 Environmental Management

Environmental impacts from waste treatment and disposal may include odours, noise from transfer and transport, dust from transfer and transport, leachate from storage vessels and vermin/pests. The nominated waste management procedures will aim to control environmental impacts through:

- designated location for waste collection, sorting and transfer to collection vehicles;
- designated traffic routes for waste transport;
- covered storage vessels to minimise odours and vermin/pests;
- housekeeping practices; and
- monitoring.

Nuisances such as noise and dust can pose a health and safety risk to personnel on the Project site. Site personnel, contractors and visitors will utilise personal protective equipment (PPE) as appropriate to protect themselves against the hazards of dust and noise emissions in high exposure areas.

16.7.6 Other Waste Management Measures

Other waste management measures to be incorporated into the development and implementation of procedures and practices on site are outlined in this section.

Tyres

Where practical, tyres will be removed by the tyre supplier (or a licensed tyre recycler) for recycling, or used on-site for road barriers and demarcation. Otherwise tyres can be disposed of by burying in the mine overburden in designated locations, in accordance with the following principles (EPA, 2006).

- Tyres awaiting disposal or transport for take-back will be stockpiled in volumes less than 3 m in height and 200 m^2 in area. Fire precautions will include removal of grass and other flammable materials within a 10 m radius of the tyre store. Tyres will be stored in a manner that prevents water retention and minimises mosquito breeding events;
- Scrap tyres may be disposed of in overburden emplacements where tyres are placed as deep in the overburden as possible but not directly on the pit floor. Placement will ensure scrap tyres do not impede saturated aquifers and do not compromise the stability of the final landform; and
- Scrap tyre disposal sites will be recorded on the DERM's EMR.

Construction and demolition waste

Per EPA's Operation Policy titled 'Licensing requirements for construction and demolition wastes' (2002), if construction and demolition waste is separated into its constituent parts, the inert parts may be used as clean fill. Under the Policy, inert waste may include bricks/pavers/ceramics, concrete, and clean earthen fill.

Green waste

Green waste will be burned as a last resort, in accordance with the following principles.

- Ensuring appropriate buffer distances and fire breaks around asset protection zones, including HGPL, public and other privately owned assets, and protected areas, including important vegetation communities and habitats;
- Under favourable wind conditions to minimise risk of harm to sensitive receptors; and
- Prior and informed notice provided to adjacent landowners.

The burning of vegetation will be done with the approval of the Queensland Fire and Rescue Service and in accordance with an agreed fire management plan; however there will be very minimal burning due to previous agricultural clearing of large tracts of site and underground mining methods.

Environmental Management Register

Under the EP Act, sites used for a notifiable activity such as waste disposal must be listed on the EMR, which includes notifiable activities occurring on mining leases. All items of waste buried on-site that are classed as notifiable activities will be identified on the EMR managed by DERM. Post-mining, potential future landowners could find out about the location and details of any tyre disposal sites through a search of the EMR as part of the conveyancing process when purchasing property.

Land can only be removed from the EMR following an investigation by a member of a prescribed organisation, as listed in the EPR, and the preparation of a report that satisfies the DERM that the land is not contaminated.

Waste Tracking

The management of regulated waste in Queensland is subject to a waste tracking system. The WMP for the Project will incorporate an approved waste tracking system for those wastes that require tracking. The WMP will include procedures for identification and management of regulated wastes.

In addition, the treatment, storage and transport of regulated wastes require an Environmental Authority under the EP Act. Where a contractor carries out these activities, the contractor will be required to hold the appropriate approvals. This requirement will be incorporated into the WMP.

Spill Containment and Remediation

Standard procedures for the storage, handling, disposal and spill response for potentially hazardous waste materials will be adopted. This will require the use of spill containment material and spill clean up kits located at workshops.

Sites that become contaminated will be investigated, managed and remediated in accordance with the requirements of the contaminated land provisions of the EP Act.

Waste Monitoring

Waste monitoring and auditing of waste management activities and outcomes will be carried out at the Project site in order to:

- assess actual waste results and compare with predicted volumes, impacts and mitigation measures;
- monitor potential environmental impacts; and

- provide baseline data to enable continuous improvement of waste avoidance, reduction and management measures throughout the Project.

16.7.7 Waste Management Plans

The Project will develop and adopt detailed waste management plans to guide implementation of site-specific waste management procedures and practices for construction, operation and decommissioning phases.

Waste Management Plan (Construction)

A detailed Waste Management Plan (Construction) will be prepared as part of the Environmental Management Plan prior to the commencement of Project construction. The Waste Management Plan (Construction) will address the following.

- Identification of waste streams;
- Consideration of the waste management hierarchy when selecting waste management strategies, with emphasis on minimising any hazardous waste;
- Identification of solid, liquid or hazardous waste collection, storage and or disposal strategies;
- Training of all personnel on procedures concerning waste minimisation, handling, storage, reuse, segregation, collection and disposal;
- Concept design of engineered landfill on site for safe disposal of general solid waste, including putrescible, non-regulated and non-recyclable wastes;
- Waste not suitable for on-site disposal to be removed and transported from site by appropriately licensed contractor/s with disposal only to licensed recyclers or waste disposal facilities;
- Transport of any hazardous or regulated waste to comply with all relevant legislation including waste tracking requirements; and
- Monitoring of waste streams and auditing against the Waste Management Plan (Construction) to track performance against overall objectives.

All construction wastes will be managed in line with the Waste Management Plan (Construction).

Waste Management Plan (Operation)

A detailed Waste Management Plan (Operations) will be prepared as part of the Environmental Management Plan and Plan of Operations prior to the commencement of operations and updated annually to reflect current project activities. The Waste Management Plan (Operations) will address the following.

- Identification of waste streams and establishment of a baseline measurement for each stream;
- Consideration of the waste management hierarchy when selecting waste management strategies, with emphasis on minimising waste;
- Identification of solid, liquid or hazardous waste collection, storage and or disposal strategies;
- Training of all personnel on procedures concerning waste minimisation, handling, storage, reuse, segregation, collection and disposal;

- Waste removal and transport from site to be by appropriately licensed contractors with disposal only to licensed reprocessing, recycling or waste disposal facilities;
- Transport of any hazardous or regulated waste to comply with all relevant legislation including waste tracking requirements;
- Monitoring waste streams and identifying opportunities for reduction and reuse of wastes; and
- Auditing against the Waste Management Plan (Operations) to track performance against waste management strategy objectives.

All operational wastes will be managed in accordance with the procedures outlined in the Waste Management Plan (Operation).

Waste Management Plan (Decommissioning)

At the end of the Project life, remaining infrastructure will be decommissioned and removed from site in accordance with the appropriate Waste Management Plan, to be defined closer to the time of decommissioning.

Conceptual decommissioning and rehabilitation strategies developed for the Project are outlined in Section 26, including performance indicators to minimise residual impact on the environment.

16.8 Landfill Design

Waste streams and potential waste generation rates for the construction, operation and decommissioning phases of the Project are identified in section 16.6 and define the estimated landfill capacity requirement for the life of the Project.

The proposed waste disposal practices are consistent with those set out by guidelines published by Queensland DERM for waste disposal, typical waste management practices at similar operations, and other best practice methods, where practicable. The primary reference document is Landfill siting, design, operations and rehabilitation (DERM, 2008), last revised 26 June 2008.

An engineered landfill will be constructed on site as a long term waste disposal solution for residual wastes generated from the Project. The primary features of this landfill for disposal of general solid waste (including putrescible waste) include:

- Waste disposal cells
  - cell construction
  - daily and intermediate cover material (typically soil);
- Environmental management system
  - a groundwater monitoring system
  - a leachate management system
  - a final capping system
  - a landfill gas management system
  - a surface water management system
  - dust and odour management; and
- Site security.

16.8.1 Landfill Siting

DERM's landfill siting guidelines (2008) include several criteria for locating a general solid waste landfill. A review of the layout and topography of the mining lease identified a number of potential restrictions due to permanent and/or natural water features, mining activities, site access, drainage, flood levels, aerodrome runways and potential typical aircraft flight paths.

Existing Environment

The designated landfill site is north of the intersection of coordinate grid lines, 450,000 m Easting and 7,447,500 m Northing about 2 km west of Detention Basin 2 and 1.5 km north-northeast of Pit Water Dam 2. Thick scrub dominates the vegetative landscape whilst the land surface typically slopes gently toward the northwest. Review of available topographic maps did not reveal the presence of any significant perennial water bodies or natural drainage courses within a kilometre of the site; however Sandy Creek is 1 km west of the site.

Aerodrome Location and Aircraft Flight Paths

The Project site will accommodate a runway for turbine jet engine aircraft, and the runway orientation is northwest to southeast. The proposed landfill site is approximately 5 km from the end of the runway and at an angle of about fifty degrees to the landing and take-off flight paths.

Prevailing Winds

The proposed landfill site is favourable with regard to managing potential nuisances from landfill odours and wind-blown litter at the mine's accommodation village and on adjacent properties. Prevailing winds typically blow from the east and southeast. The proposed landfill location is northwest of the accommodation village and nearly 3 km from the nearest mine lease boundary, which is to the south of the proposed landfill location.

Flood Levels

Drainage and flood levels are critical considerations in the location and design of a landfill. The highest flood level estimate for the mine lease (particularly, along Sandy Creek) is far below the proposed location of the on site landfill and should pose no risk to the landfill. The landfill location is near the top of a localised watershed and local drainage should be manageable.

Site Access

The proposed landfill site must offer access that is easy and convenient for waste delivery yet inconvenient and/or difficult for unauthorised persons. The proposed location is well inside the mining lease boundary beyond primary entrance points and has other mine operations in the immediate vicinity. The location does not have any direct access from roads external to the mining lease, making the location favourable to meeting site access needs. The location is close enough to mine operations for economical disposal haulage. A perimeter fence surrounding the landfill facility will provide security against unauthorised access to the site.

16.8.2 Landfill Construction

The on site landfill will be constructed in a modular approach with sub-cells of the overall landfill having capacity of between three to five years. The on site landfill will include construction of six to eight sub-cells to form the entire landfill over a 25 to 30 year period. Each sub-cell will include liner, leachate management and landfill (LFG) management systems.

The landfill construction process will adopt rigid quality assurance system to ensure that construction materials and installation methods meet the relevant design specifications.

For schematic plans, sections and details of the landfill and landfill features refer to Figures 16-1, 16-2, 16-3, 16-4 and 16-5. These schematic concepts consider a traditional dump, compact and cover landfill. The ultimate waste management configuration might include other waste management features, such as composting, segregation of recyclable materials, waste-to-energy technologies and other features, depending on the viability of such features in the overall operation and performance of the waste management facility.

Landfill sizing

The proposed landfill must accommodate waste generation during mine construction, operation and decommissioning. Waste generation and landfill waste disposal capacity for each of the Project phases is summarised in Table 16-3.

Table 16-3 Landfill waste capacity estimate

Phase	Duration	Average waste generation rate		Total waste generation rate	
	years	tonnes /annum*	m^3/annum**	m^3	m^3***
Construction	2	12,500	36,765	73,530	92,000
Operation	30	5,062	8,437	253,110	316,000
Decommissioning	2	12,500	36,765	73,530	92,000
Total, all phases	34	N/A	81,967	400,170	500,000

* Waste generation rate estimates, regarding waste to landfill, are 12,500 t/annum over 2-year construction and decommissioning periods (including early works) and 5,062 t/annum for the operational life of the mine.
**Volume estimates are in-situ volume estimates for compacted waste in the landfill.
*** FS = factor of safety

Components of landfilling include the base liner, leachate drainage / collection layer, daily and intermediate cover and the final capping layers. Each of these components consumes some portion of volume of the total landfill capacity requirement. An estimate of the volume of each component within the total landfill structure is outlined in Table 16-4.

Based on these calculations, the total capacity of the landfill is approximately 981,500 m^3. This capacity requirement includes all waste disposal, liner, cover soil, capping soil and imported drainage aggregate i.e. the sum of the waste disposal capacity and the soil requirements. This landfill capacity volume gives the landfill a capacity (e.g. life span) of approximately 34 years – comprising two years for construction, 30 years of mine operation and two years of decommissioning.

Table 16-4 Estimated soil requirement

Feature	Area (m^2)	Thickness (m)	Volume (m^3)
Base Liner	98,200	0.60	58,900
Daily & Immediate Cover*			166,670
Final Capping Layers	97,100	2.00	194,200
Soil Need for Other Works**			42,200
Leachate Drainage Layer***	65,000	0.30	19,500
Total Volumes, All Features			481,470

* The basis for the volume estimate of daily and intermediate soil cover is a ratio of three parts waste to 1 part soil on the total waste volume of 500,000 m3 of waste.
**The basis of soil need for other associated works (roads, drainage, etc.) is an allowance of 10% of the gross soil need for landfill construction.
*** The leachate drainage layer is typically a coarse and durable, non-carbonate aggregate.

Cell Construction

Landfill construction typically occurs in three to five year cycles, giving adequate capacity to manage waste disposal over significant time without exposing the landfill lining to the weather and potential damage and deterioration for an extended period. The construction process systematically installs the liner and drainage layers and integrates subsequent cell construction with adjacent cell construction.

Daily Cover

The waste fill occurs in an orderly fashion to fill each waste cell in horizontal layers across the cell and then vertically in layers until the landfill cell reaches its capacity. Appropriate heavy machinery is used to compact each waste deposit to optimise the use of the landfill space and spreads the soil covering over the waste. Waste fill and compaction in each cell occurs periodically (typically daily) after which each period’s waste receives a cover of soil or alternative cover. The thickness of a daily soil cover is typically 200 millimetres (mm) to 300 mm, and may vary with soil availability and local environmental conditions. The soil cover serves to inhibit wind blown litter, introduction of surface water / rain to the waste profile, release of odours from the waste and infestation of rodents, insects and feral animals.

Intermediate Cover

The waste fill receives an intermediate layer of soil cover (typically 400 mm or more) after disposal of a significant quantity of waste or when a waste fill area might remain inactive for extended periods (say more than three months). The intermediate cover serves as medium to long-term protection of the waste fill against the risks of water infiltration, wind blown litter, odours and vermin.

Areas that receive intermediate cover also frequently receive a treatment of surface stabilisation with mulch and / or grass seeding to inhibit surface erosion due to wind and rain events.

The intermediate cover can be removed prior to filling to conserve landfill capacity and soil cover resources.

16.8.3 Environmental Management

Environmental management of a landfill begins before the first deposition of waste and continues for many years after the completion of waste fill and final capping of the waste fill surface. Figures 16-2, 16-3 and 16-4 illustrate conceptual schematics and details of primary environmental management system (EMS) features. Water is a significant component of environmental management for a landfill, and Figure 16-5 provides a conceptual water balance for the landfill, and the design stages of the landfill will include a water balance model of the facility. Primary objectives of the EMS are to:

- "fingerprint" the baseline environmental conditions (especially groundwater) before start-up of waste disposal operations;
- assess the environmental performance and stability of the landfill during waste fill operations and during the post-closure period;
- provide data for the ongoing revision and improvement to the system toward maintaining acceptable environmental performance; and
- ultimately, provide data that reflects a stable facility to mark the end of post-closure monitoring activities.

The typical life span of a landfill EMS is facility life (construction, operation and decommissioning) plus ten to thirty years of post-closure care.

Groundwater Management System

A groundwater monitoring (GWM) system is necessary to assess the environmental character of groundwater around the landfill facility before beginning of waste filling operations (base line "fingerprinting"), and to assess the environmental performance of the leachate containment system.

The proposed GWM model includes three wells around the landfill and associated works. One well has an up-gradient position with regard to waste fill and the other two have down-gradient positions (refer to Figure 16-1).

Base line fingerprinting of the local groundwater occurs by testing groundwater samples from each well on a regular, say quarterly, basis over at least one year prior to initiation of landfill operations. Once landfilling operations begin, a comparison of further groundwater testing results from those wells against the base line results gives an indication of the environmental performance of the leachate containment system. Results should indicate a consistent groundwater quality to confirm that the containment system remains sound and in satisfactory condition. If future assessments indicate a deterioration of groundwater quality, landfill operations and groundwater quality might require further assessment and testing to determine the cause of the changing water quality.

Precise determination of number, location and depth of GWM wells requires a hydrogeological investigation of the site. The investigation determines soil stratification and classifications, aquifer locations, groundwater flow rate and direction and basic physical and chemical groundwater characteristics. All these data, and possibly other factors, influence the final design of the GWM system.

Leachate Management System

The leachate management system of most solid waste landfills includes several features:

- Base liner, which might include several media;
- Drainage medium for the collection of leachate along the bottom of the landfill;
- One or more collection points for the leachate;

- Leachate extraction system (sump and pump) and transmission system; and
- A means of treating and reusing, discharging, or otherwise safely disposing of the collected leachate.

The base liner of a landfill serves to collect leachate that drains from waste fill and to inhibit the migration of landfill gas and leachate from the waste fill into the surrounding environment. Detail 1 on Figure 16-3 illustrates a concept of the base liner cross section. The construction of a base liner for a solid waste landfill is most typically of clayey soil with a characteristic maximum permeability of 1x10-9 m/sec, per Queensland DERM guidelines (2008) and widely accepted industry practice. The guideline specifies a minimum clay liner thickness of 0.6 m. The clay liner typically covers the sidewalls and base of waste cell excavations, inhibiting horizontal and vertical migration of leachate and landfill gas from the landfill into the surrounding natural environment.

Ideally, the source of clayey soil is from on-site excavations of the waste disposal cell(s); however, importation of suitable soils or use of flexible membrane liner (FML) is also common. Locations and costs of suitable natural materials typically drive the decision to use local or import natural materials, or to use synthetic materials. The most common choice for a FML is high-density polyethylene (HDPE); however, some designers may specify geosynthetic clay liner (GCL), PVC liners or other synthetic products.

The base liner contour is typically toward one or more leachate collection points in the base of the landfill. Excavation sidewalls form a four-to-one gradient from ground surface to the base of the landfill. The base slopes at three percent to a central drainage line in the centre of the landfill. The central drainage line slopes at 1.5% to a leachate collection sump at the lowest point in the waste cell excavation. The on site landfill concept includes one leachate collection sump.

The DERM guideline recommends use of a double, or composite, liner for landfills accepting putrescible waste (e.g. the on site landfill during the operational phase) and for landfills in sensitive areas. Until more information is available about the environmental, cultural and community sensitivities, and specific geology of the landfill location, the current liner design concept includes a single liner of compacted clayey soil. Further geotechnical, environmental and social studies of the area are necessary to determine the overall sensitivity of the area and the need, or otherwise, of a double liner system.

Should suitable clayey soil not be available for liner construction, the liner system might comprise only synthetic layers, and this scenario will remain unknown until further study of the area is complete.

The drainage medium is most typically a hard, durable, non-carbonaceous coarse aggregate that allows free drainage of liquids that collect in the bottom of the landfill. The DERM guideline (2008) dictates a 0.3 metres (m) thick drainage layer. The aggregate for the leachate drainage layer is commonly an imported material. When supply of suitable aggregate is not economically viable, alternative media are available. For the on site landfill design concept, the current assumption is that suitable aggregate is available.

The drainage medium covers the base of the landfill and offers an open flow path for leachate to reach the collection sump(s) at one or more low points of the waste disposal unit.

Once leachate reaches the sump(s) in the landfill base, extraction of the leachate is necessary to reduce accumulations to acceptable levels within the landfill. At the low point of the landfill (the leachate collection sump), a riser pipe in the sump serves as an access point to pump leachate from the landfill. The sump riser and pump configuration might vary, depending on availability of materials, depth of sump and other factors. The on site landfill is assumed to include a vertical riser of 1.2 m diameter and a total vertical length of about 14 m to exposure at the landfill surface. Leachate extraction will occur by means of a fixed (permanent) pump with on/off automation and discharge lines that connect to a transmission pipe, which discharges to a reed bed. The reed bed is the primary means of treatment for landfill leachate.

The current concept for leachate treatment at the on site landfill includes a leachate holding tank, a natural vegetation reed bed of a coarse drainage medium and reeds (Monto vetiver grass) planted in the drainage medium, an effluent holding dam and a recirculation pumping system. The reed bed and effluent holding dam will have a clayey soil lining to inhibit leachate migration from the area. Leachate from the landfill will flow into the leachate holding tank. The holding tank will discharge pre-determined batch volumes of leachate into the reed bed, filter the leachate through the reeds and drainage medium, and discharge into the collection dam. A recirculation pump within the dam will pump reed bed effluent back to the top of the reed bed for re-filtering, as necessary. Recirculation and refiltering occurs until the effluent quality is of satisfactory quality for on-site beneficial reuse (e.g. dust control, irrigation) or other appropriate disposal method. Figure 16-4 provides a schematic cross section of the leachate treatment system in this case.

Final Capping System

When the waste fill reach the outer limits of the waste disposal cell, construction of a final capping system occurs on those exterior surfaces over the top of the final waste fill. This final capping system is the ultimate encapsulation layer for the waste fill, and provides long-term protection to the surrounding environment and a stable surface that inhibits:

- exposure of humans to the waste fill;
- exposure of waste to the external environment; and thus, contact of surface runoff (rain) with the waste fill;
- surface erosion due to wind and rain;
- wind-blown litter;
- introduction of surface water / rain to the waste profile;
- release of odours and landfill gas from the waste; and
- infestations of rodents, insects and feral animals.

Traditionally, final cap layers have comprised a low-permeability clay-soil barrier layer, a general fill protection layer over the barrier layer and a surface growing medium layer. These types of final capping systems are difficult and costly to construct, and significant maintenance is crucial to maintaining the integrity of the capping system and the natural environment. The traditional capping system typically ranges in thickness from 1 m to 1.5 m.

The concept for the on site landfill incorporates a phyto-capping system. This more recent science incorporates a thick layer of clean general soil fill and use of native and/or introduced species to stabilise the soil surface and optimise evapotranspiration at the landfill surface. This type of system helps to minimise the potential for surface water infiltration and leachate generation. The overall cost of a phyto-cap is typically lower than a traditional cap due to lower QA construction requirements, lower soil unit costs and less long-term maintenance of the complete surface. Additionally, numerous engineering trials and significant field data validate provide supporting evidence that phyto-capping systems form an environmentally sound capping system that meets and / or exceeds DERM performance guidelines for capping systems. The current concept for the phyto-cap comprises about 2 m of clean general fill overlaid by about 200 mm of a reasonable growing medium (topsoil). Determining the ultimate thickness of the phyto-cap will occur during the detail design stages of the landfill. The surface vegetation would likely comprise a mix of local and introduced grass, shrub and tree species to optimise evapotranspiration. Phyto-caps encourage propagation of native fauna species more so than traditional grassed capping systems, and phyto-caps return the area to a much more natural-looking environment. Detail 2 on Figure 16-3 illustrates a concept of the final capping system cross section.

Landfill Gas Management System

Landfill gas (LFG), primarily methane, carbon dioxide and sulfide gases, is a by-product of anaerobic decomposition of organic matter. Landfill gas is a greenhouse gas (GHG) with high carbon value, and management of LFG is an important component in managing the overall carbon footprint of the Kevin's Corner mine site.

In the scale of solid waste landfills, the on site landfill will represent a small disposal facility, and the commercial beneficial use of LFG from the site will likely be unfeasible. Recent technologies in energy generation from LFG include small-scale power generators that might increase the feasibility of power generation for use at the disposal site. Additionally, an overall sustainability assessment of the waste facility during the detail design stages might support incorporation of landfill gas into a waste-to-energy (WTE) scheme for the waste management system.

If WTE technologies do not suit the on site landfill model, then the most practical management method for LFG at the on site landfill will likely include LFG collection, flaring, and perimeter migration monitoring. The collection component will likely comprise a manifolded system of LFG collection pipes within the waste fill, installed progressively as the waste fill progresses. The manifolded collection system will feed to a flare or generator for LFG burning and GHG reduction, or power generation and on-site beneficial use of the generated power. The monitoring system might comprise a series of shallow wells around the perimeter of the landfill. The primary intent of the wells is to detect horizontal LFG migration from the landfill, should that occur. Refer to Figure 16-2 for a schematic diagram of the LFG management system.

The conversion of LFG to power will require assessment of LFG generation projections and availability of small-scale power generation devices in conjunction with an overall assessment of sustainability options for the facility. Results of geotechnical and/or hydrogeological site investigations will dictate the locations and depths of LFG monitoring wells.

Surface Water Management System

The effective surface water management system proposed for the on site landfill incorporates a dual perimeter drainage system. The system will bypass 'clean' surface water that flows toward the site from up-gradient areas, and contain and treat 'dirty' sediment-laden surface water from active and operational areas of the landfill.

The system will require portable pumps to transmit water from excavations and other non-disposal areas that collect water to the sediment dam for treatment before release. The current sediment dam concept considers treatment by natural settlement of sediments from water. Further treatment requirements (e.g. flocculation) will require assessment of soil types at the landfill facility location. The final facility design will reflect the relevant need for settlement treatment methods.

The overall objectives of the surface water management system are to:

- control surface water flows rates and velocities to the extent practical;
- maintain continuity of landfilling operations during inclement / rainy weather;
- prevent unacceptable levels of soil erosion and sedimentation on the site; and
- prevent unauthorised release of sediment from the site to the surrounding environment.

Achievement of these objectives will require regular review of and revision to the surface water management system after each significant rain event, and as the drainage patterns of the site change with developing waste disposal activities. Figure 16-1 schematically illustrates the surface water management system.

Dust Management

Nuisance dust can pose a health and safety risk to personnel on and around the landfill facility. The following site considerations will play critical roles in combatting nuisance dust emissions:

- designation of traffic routes;
- driving speed limits;
- track maintenance;
- periodic watering of tracks to suppress dust emissions; and
- maintenance of vegetation on non-traffic areas.

These dust management techniques apply to construction, operation and closure phases of the landfill development. Dust management must be an integral component of the overall site maintenance program. As appropriate, site personnel, contractors and visitors will utilise appropriate PPE to protect themselves against the hazards of fugitive dust emissions.

Site Security

The landfill design will include a perimeter security fence and one primary access/ egress point. The typical security fence includes standard 2 m high chain wire fence with three-strand barbed wire on top. The primary access is the primary point of control for all traffic (vehicular and pedestrian) into and out of the site. The access point typically includes a gatehouse where a designated staff member monitors the movements of all personnel, contractors and visitors to the site. The fence also serves as a secondary control to capture wind-blown litter, and to prevent the ingress of feral animals and unauthorised persons. The security fence is typically secure (locked) when the site is unattended. A security option for the fence is the inclusion of lighting along the perimeter fence.

16.8.4 Personnel and Major Plant and Equipment

Over the life of the on site landfill, personnel and equipment requirements will be adjusted to meet the waste generation rates relevant to that phase of the Project. An estimate of personnel, plant and equipment to manage peak waste loads during the operation phase of the mine site (applying a peak factor of 2 to 2.25) includes*:

- 1 x weighbridge of capacity to handle the largest vehicle that landfill will service;
- 1 x equivalent Caterpillar D4 track dozer or 939 track loader;
- 1 x equivalent Caterpillar 816 waste compactor;
- 1 x tipper truck of 10 to 15 cubic metre capacity (part-time);
- 1 x GPS laser system on waste handling equipment for grade and fill control;
- 1 x 15 to 20 tonne excavator (part-time);
- 1 x motor grader (on stand-by for road maintenance);
- 1 x portable lighting plant (on stand-by);
- 2 portable pumps (1 x 40 mm and 1 x 75 mm);
- 1 equipment operator; and
- 1 site assistant/operator/labourer.

Development of more complete personnel, plant and equipment lists will occur during the engineering design of the waste disposal facility. Coordination of landfill equipment needs with other aspects of the mine site development and operation will assist in reducing duplication of personnel and equipment and reduce the overall operating and maintenance cost of the facility.

16.8.5 Landfill Operation

Waste transport vehicles will enter the secured area of the site via the mine site weighbridge and then go to the landfill. The site attendant will record vehicle and waste load data, and then direct the vehicle to the disposal area to discharge the load. The equipment operator will remove and retain previous cover material and spread and compact waste load deliveries across the active waste sub-cell through a day then cover the waste fill (typically with 200 mm of earth) at end of the day's operations, as necessary. Waste spreading, compacting and covering will occur on a periodic, typically daily, basis and in an orderly fashion. Fill will progress in horizontal layers across the sub-cell until waste fill covers the floor of the sub-cell. Waste fill will continue in subsequent horizontal layers over the first layer until the sub-cell is as full as is practical. The operators will periodically use GPS level control equipment to control the vertical and horizontal limits of fill within each sub-cell.

When a sub-cell is near capacity, construction begins on the next sub-cell (see relevant section on landfill construction). Filling continues in the next sub-cell when that new cell is ready, and waste filling operations progress until fill levels in the adjacent sub-cells are near equal. Fill layers continue to fill in horizontal levels across the adjacent cells and then upward in new layers. This process continues until the entire landfill reaches its waste disposal capacity.

Landfill operators must maintain similar processes of spreading, compacting and covering of waste throughout the entire process to ensure consistency in landfilling effort and optimisation of the available filling capacity of the landfill.

During appropriate stages of waste filling and in accordance with the LFG management plan, installation of LFG management system components will occur.

During filling operations, operators must remain mindful of health and safety, traffic flow patterns, surface water management, dust control, litter control and other best practices landfill management strategies.

16.8.6 Landfill Closure

Landfill closure activities begin as soon as significant areas of the landfill reach the proposed waste fill limits. At that time, the application of the final capping system can begin. The capping layer includes placement and compaction of a thick layer of general soil fill, a growing medium layer (typically topsoil or nutrient-augmented general fill) and a planting of prescribed vegetation (e.g. trees, shrubs and grasses) on the surface. As more areas of the landfill reach the waste fill limits, construction of the capping system extends across those areas, too, until the entire landfill has a complete and homogeneous capping layer. As appropriate, installation of LFG management system components occurs as the landfill cap progresses.

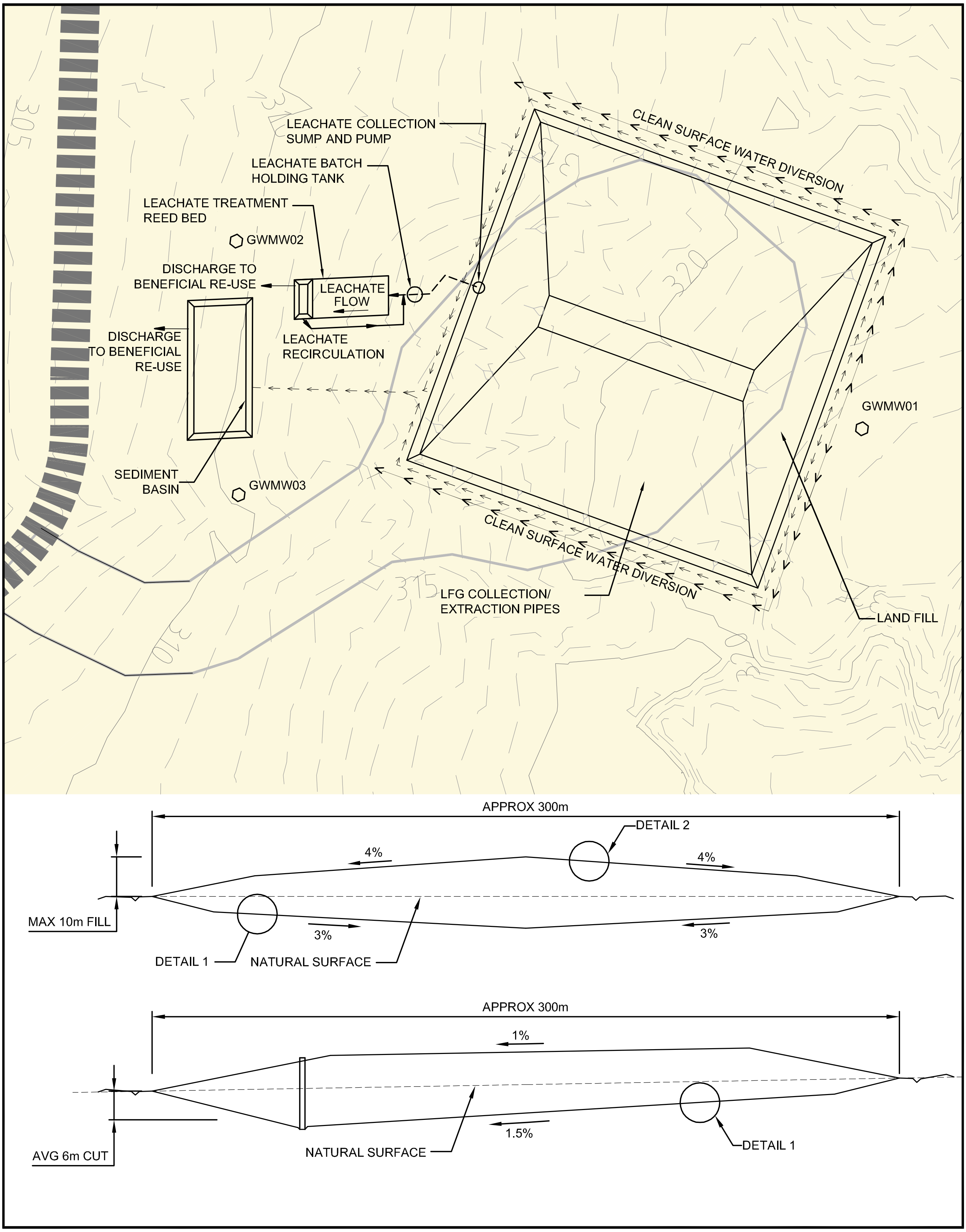
Where practical, the surface water flow from complete and stable area of the landfill should re-route to discharge to the natural environment (i.e. away from the landfill sediment dam). The ultimate goal for surface stabilisation is to create a stabile ground surface that inhibits erosion and surface water infiltration and yields surface water quality that is suitable for discharge to the natural environment.

16.8.7 Landfill Post-Closure

After completion of the final capping system components and installation of all components of the environmental management system, the post-closure care period of the landfill begins. Post-closure activities typically comprise site maintenance, monitoring and reporting activities, and might include monitoring and maintenance of and reporting on the following site features and systems:

- vegetation;
- waste fill settlement (with a goal of preventing accumulations of surface water);
- leachate and landfill gas;
- groundwater;
- surface water;
- erosion and sediment control;
- insect, vermin and feral animal infestations / colonisations; and
- site security.

Post-closure activities may last between 10 and 30 years, with the ultimate goal of proving environmental stability of the complete waste facility and cessation of maintenance and monitoring activities.



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Environmental Impact Statement

LANDFILL CONCEPTUAL PLAN AND SECTIONS

Job Number	4262 6660
Revision	B
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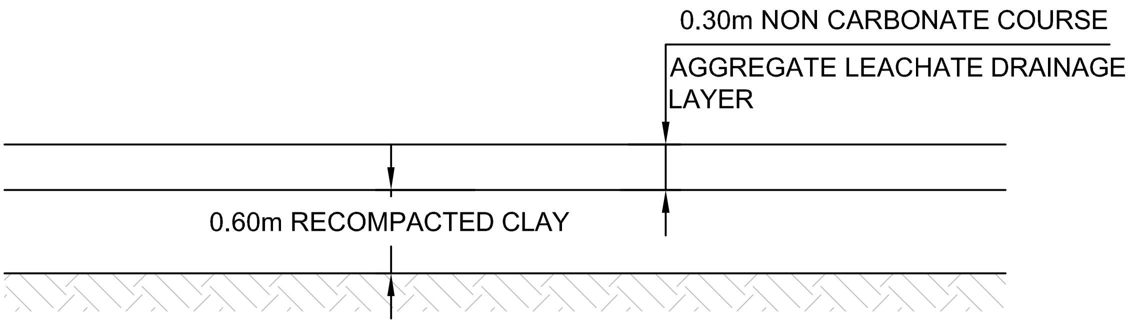
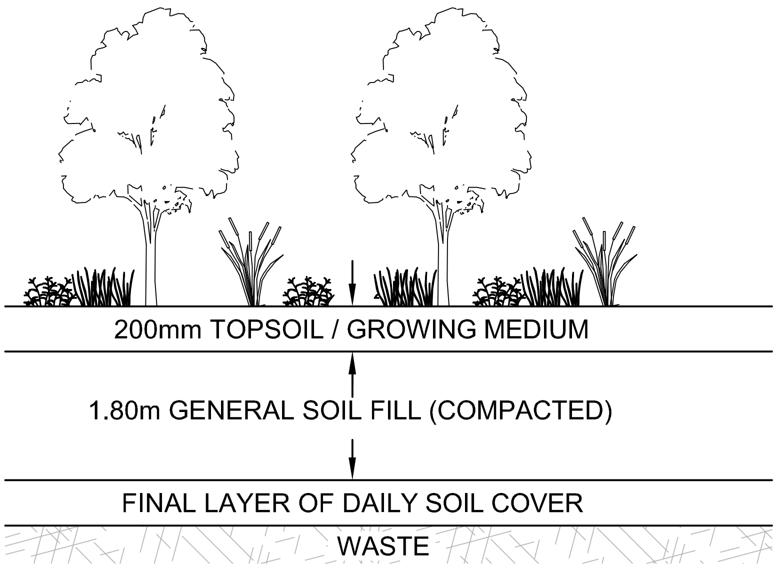
Figure: 16-1

File No: 42626000-g-1085.dwg



DETAIL 1
LANDFILL LINER AND LEACHATE DRAINAGE CONCEPT



DETAIL 2
LANDFILL PHYTO-CAP CONCEPT

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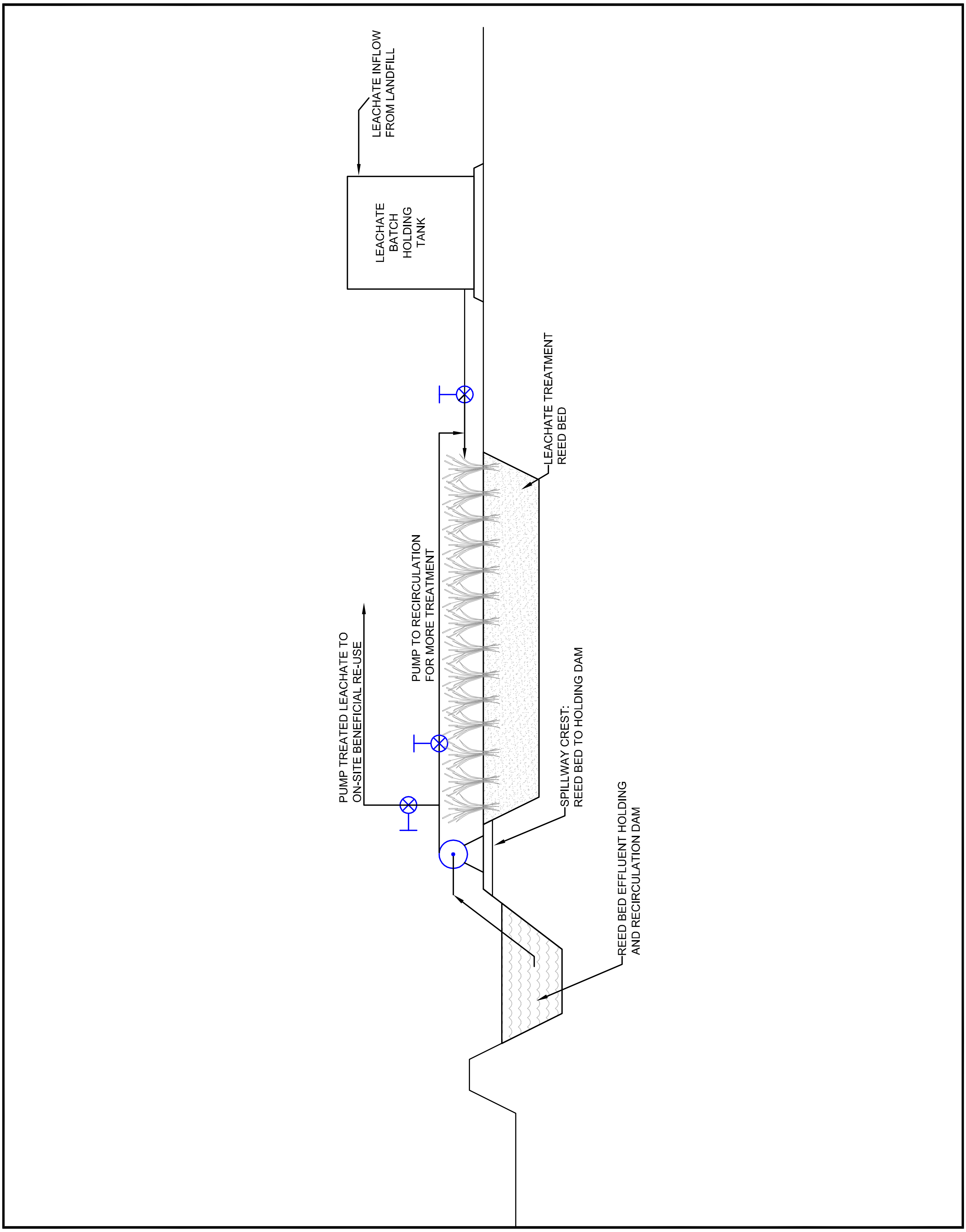

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LEACHATE TREATMENT SYSTEM

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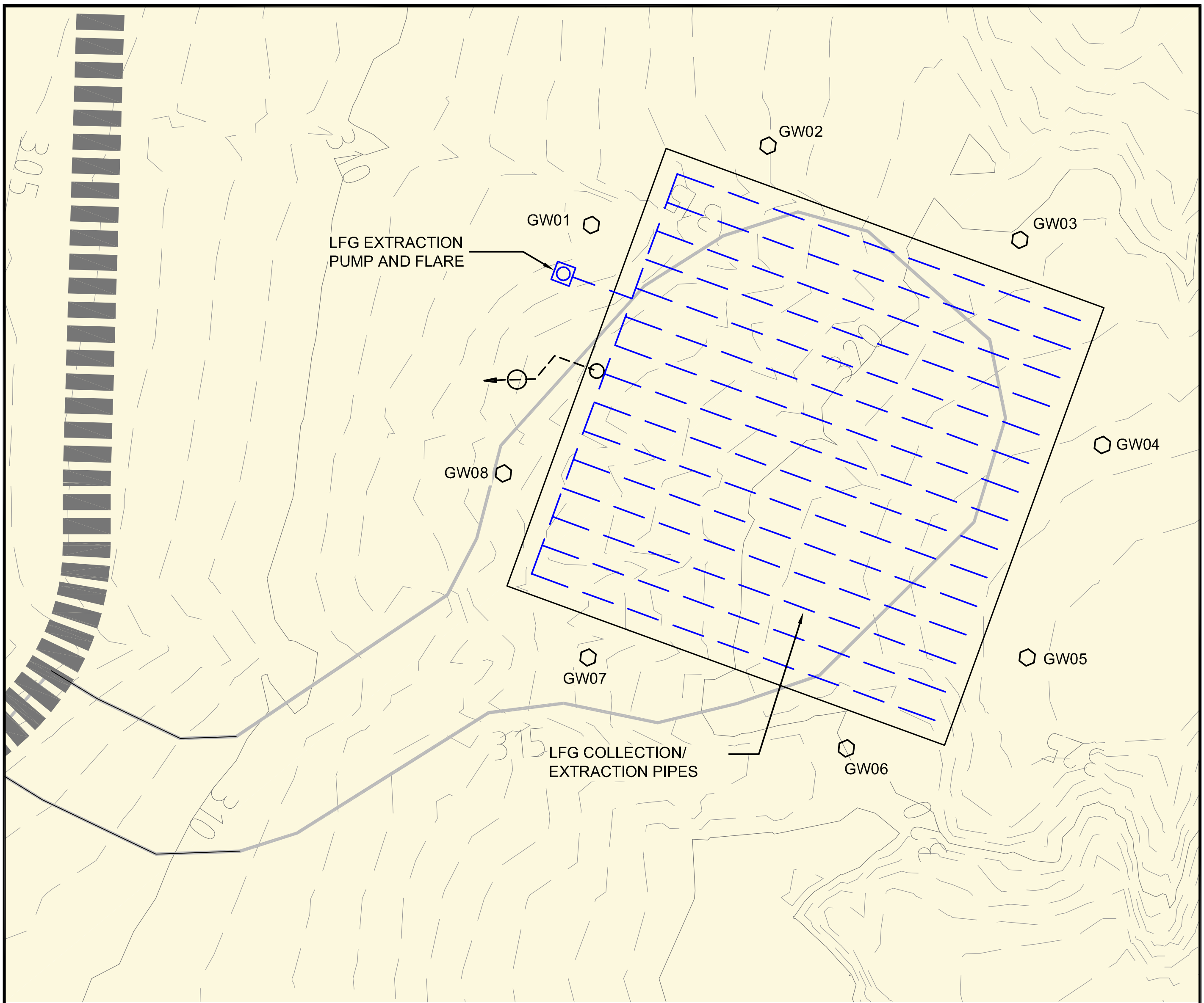
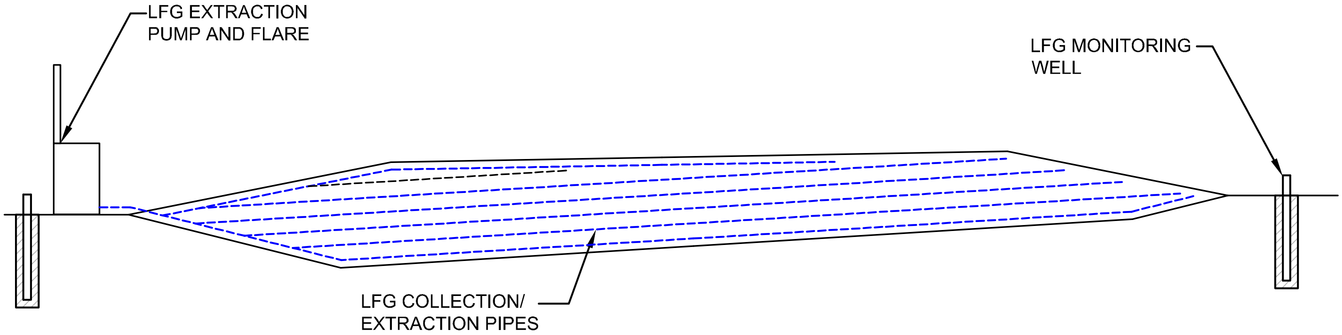
Figure: 16-3

File No: 42626000-g-1087.dwg





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LANDFILL GAS MANAGEMENT SYSTEM

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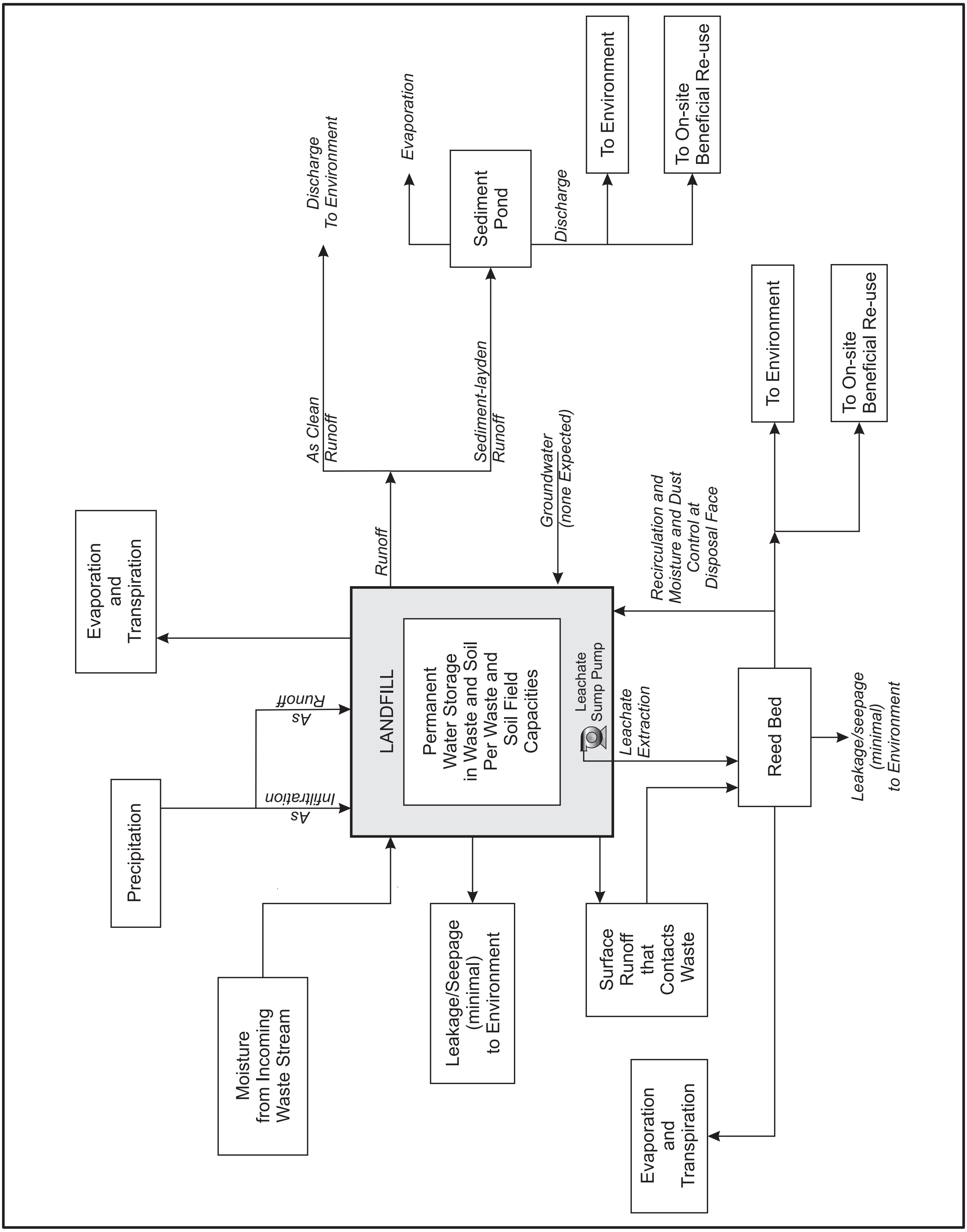
Date	12-09-2011

Figure: 16-4

File No: 42626000-g-1088.dwg



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Environmental Impact Statement

CONCEPTUAL LANDFILL
WATER BALANCE

Job Number 4262 6660
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Date 12-09-2011

Figure: 16-5

File No: 42626660-g-1089.cdr

16.9 Residual Impacts

After development and implementation of nominated waste minimisation and management measures, the residual impacts of waste generation and disposal on environmental values are expected to be very minimal.

Environmental monitoring will facilitate continuous improvement of waste avoidance, reduction and management measures throughout the Project.

Areas identified on-site as needing to be listed on DERM's EMR such as areas subjected to contaminating activities (existing or future) and a tyre disposal area will be identified, listed and remediated where possible.

Effective rehabilitation and appropriate management measures will be implemented to avoid residual impacts on environment values such as water quality and air quality as a result of construction and operation of a general solid waste landfill on site.

16.10 Cumulative Impacts

The Project will generate solid wastes, many of which will be reused, recycled or managed effectively on site. However, there will be some waste treated and disposed off site by licensed contractors or at local licensed waste management facilities.

It is reasonable to assume that other resource projects developed in the region will generate comparable waste types and quantities and adopt a similar management approach.

- All mining projects have the potential to generate large quantities of green waste as a result of land clearing, which can be reused on site for rehabilitation.
- All mining projects have the potential to produce waste overburden. However detailed mine planning and design will include a cut and fill balance for practical cost-effective management of soil resources retained on site. Some soils can be difficult to manage (due to either dispersive or "shrink/swell" properties) and, if not properly managed, may erode releasing sediment to waterways.
- Mining projects generally produce waste oil and oily waste. Waste oil recycling services are available through several major contractors operating in the surrounding region.
- Hazardous wastes such as acid-generating rock and tailings from mining activities will be managed within each mining lease.

Regional development would be likely to increase demand for collection, transport and recycling services for items such as waste oil, oil filters, tyres, drums etc. However, the demand is likely to stimulate a growth in services as a factor of market forces.

On the basis of Queensland's solid legislative framework and mature private sector waste management industry, it is expected that all wastes generated by projects in the region will be able to be managed within regulatory requirements.

It is expected that other locally proposed mining projects will adopt similar management and monitoring commitments to the Project; however it is possible that cumulative impacts on the surface and ground water environments may result if mining waste is not appropriately handled (refer to mine waste section).

Overall, cumulative impacts in relation to waste management are expected to be low, given a reasonable assessment of probability, duration, intensity, sensitivity of receiving environment.

16.11 Conclusions

The Project will adopt minimisation and management measures to effectively treat wastes generated by the construction, operation and decommissioning of the project.

Project-generated wastes will be effectively managed at suitably located waste segregation, recycling and disposal facilities on site or removed off-site by a licensed waste contractor for recycling or final disposal as appropriate for each waste type to minimise residual impacts on the environment.

Development and implementation of site-specific waste management plans and effective monitoring and reporting will ensure that the management of wastes associated with the construction, operation and decommissioning of the Project are consistent with relevant legislation and guidelines and good industry practice.

16.12 Mine Waste Management

16.12.1 Introduction

The Project waste generated through mining activities (overburden) and coal processing (coarse rejects and fine tailings) has been defined for the EIS as mining waste. Overburden is the waste rock material overlying the coal seams, which must be removed to access these seams during open cut mining. Material located in between the coal seams (interburden) is also called overburden in this report for the purposes of this discussion. When overburden has been disturbed through mining activities at coal mines it can also be called called spoil. Coarse and fine tailings materials are the uneconomic products of coal processing at the CHPP.

This section provides an a summary assessment of the geochemical characteristics of the Project mining wastes and the required management with detailed geochemical reports provided in Volume 2, Appendix Q1. A detailed description of mining and coal processing is provided in Volume 1, Section 2. In addition to the above mentioned waste materials, both raw and washed coal have been included in the geochemical assessment as these materials will be managed on site, albeit for only a relatively short time frame.

Coal is deposited within environments that may have some potential to produce sulphides within the sediments. The sedimentary genesis of these coal deposits and presence of carbonaceous materials in a reducing environment means that concentrations of sulphides elevated above background conditions are typically limited to some coal seams, partings and immediate roof and floor materials. Sulphides can also be present in uneconomic coal seams and some rock types closely associated with these units. In contrast, bulk overburden and interburden materials (such as sandstone and siltstone) generally have very low sulphide content.

Removal of the overburden materials and mining of coal can result in the oxidation of sulphides, when these materials exist and are exposed to air and water. This can lead to the generation of poor quality leachate, which can be acidic with elevated metal and sulphate salt concentrations. This is commonly referred to as acid and metalliferous drainage (AMD). Accordingly, a geochemical assessment of coal and mining waste materials includes the analysis of the sulphide content to determine the presence of any contained sulphides and whether these materials have the potential to oxidise and overcome any natural inherent buffering, commonly measured in the laboratory as Acid Neutralising Capacity (ANC).

The coal and mining waste materials, characterised as part of this EIS, are considered to be representative of the coal, overburden, and reject materials projected to be generated at the mine and thus allow a qualified assessment of any potential to generate poor quality leachate. There is also a substantial resource of additional geochemical data for similar materials at the adjacent Alpha coal deposit. Should the project progress, then the generated coal and mining waste materials will continue to be assessed to verify their geochemical characteristics and further validate the adopted management strategies including site rehabilitation. It is planned that following development of the initial open pit boxcut areas in Year 1, all coarse rejects will be stored within in-pit overburden emplacement facilities. Similarly, tailings will be stored in the mined out Northern pit void when storage becomes available, although tailings will need to be placed into an engineered out-of-pit tailings storage facility (TSF) for project start up and the first five to seven years of operation.

Initially, the overburden produced by mining the boxcut areas will be stored at out-of-pit overburden emplacement areas adjacent to the low walls of the Northern and Central open pit areas (refer to Figures 2-11 to 2-16 in Volume 1, Section 2). Some of the overburden has the potential to be saline and/or sodic and any out-of-pit overburden will be managed to ensure that saline and/or sodic materials report to the core of the overburden emplacement facilities and not to the final top and bench surfaces and batters. During the first year of operation, coarse rejects will be encapsulated in the out-of-pit overburden emplacement areas. This out-of-pit overburden emplacement area will comprise approximately 110 million tonnes of material mined from the box-cut and will cover an area of approximately 250 ha. When sufficient space is created within the open pit areas from Year 2, subsequent overburden will remain in the open pit.

Details of surface water and groundwater management issues associated with coal and mine wastes and stockpile/emplacement areas are provided in Volume1, Section 11; Volume 2, Appendix M; and Volume 1, Section 12, Volume 2, Appendix N, respectively. Air emissions associated with coal and mine wastes and stockpile/emplacement areas are provided in Volume 1, Section 13.

The objective of the Project geochemical assessment was to determine the following:

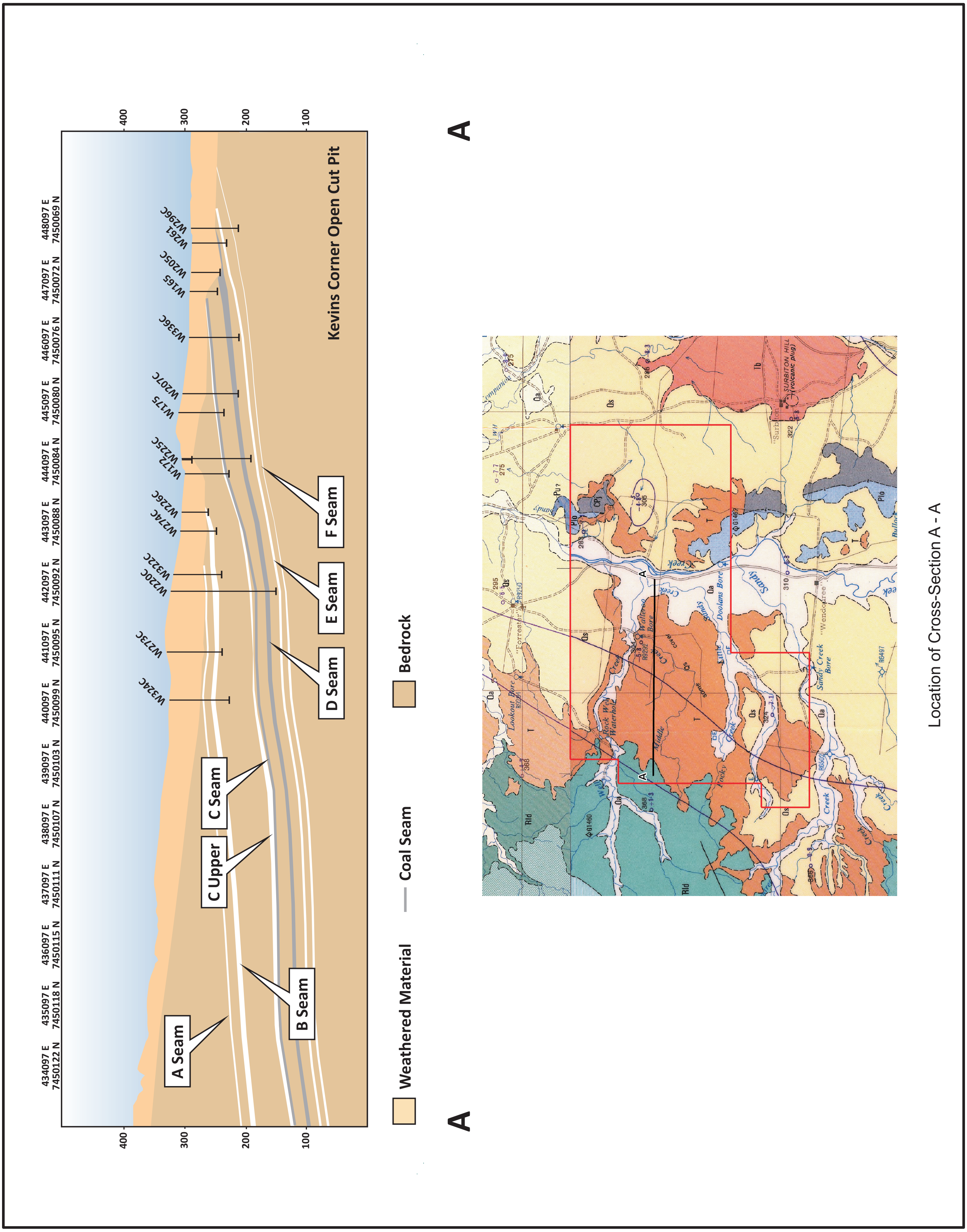
- The potential for AMD and salinity generation from coal and mining waste materials;
- The concentrations of trace metals in the coal and mining waste materials and potential for release to water resources; and
- The feasibility of utilising overburden materials for site rehabilitation.

16.12.2 Geology

The Kevin's Corner Cal Deposit (ML 333) occurs within the Galilee Basin, a sequence of Late Permian to Early Triassic sedimentary rocks, characterised by undeformed sediments 1 - 2 westward. These are structurally simple and have an absence of intrusions and significant faults. The site geology consists of gently westerly dipping sediments of Permian age, overlain by Tertiary and Quaternary sediments. The Tertiary strata and some of the Permian deposit contain mudstone, claystone and sandstone, which have a clayey matrix. Sections of the sequence are prone to slaking and thus often rapidly degrade on exposure to weathering conditions. Below these sections, the rock grades into more sandy and generally more competent rock types towards the top of the C Seam. The geology of the deposit reflects consistent, correlatable lithologies and is well understood having been characterised through extensive drilling, geological interpretation and then geological modelling as part of the Pre-Feasibility Study.

The genesis of the deposit follows a typical coal and sedimentary rock profile. Historical and recent borehole data shows that the thickness of Tertiary and Quaternary sediments varies from 5 m to 60 m (average 40 m) across MDL 333. In addition to the Tertiary and Quaternary sediments, a variable thickness of weathered Permian material is also commonly present. There are six coal seams in the project (mine) area designated as A, B, C, D, E, and F. A more detailed geology discussion is provided in Volume1, Section 4.

A schematic geological cross-section is presented in Figure 16-6 indicating the overburden materials and coal seams within the Project area. The site lithostratigraphy, including the site-specific coal seam information, is presented in Table 16-5.



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HANCOCK GALILEE PTY LTD

Kevin's Corner Project
Environmental Impact Statement

GEOLOGICAL WEST - EAST
CROSS-SECTION A - A THROUGH
MINING LEASE APPLICATION 70425

Job Number	4262 6660
Revision	B
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Figure: 16-6

File No: 42626660-g-1039.cdr

Table 16-5: Late Permian Coal Measure Stratigraphy - Galilee Basin

Age	Lithology	Stratigraphic Unit	Thickness	Comments
Quaternary	Sand, fine gravel, clay		Average 40 m	Alluvium
Tertiary	Saprolite, laterite and remanent red mudstone and white / beige sandstone		5 - 60 m	Clay-rich
Triassic	Green brown-purple mudstone, siltstone and labile sandstone	Rewan Formation	175 m[1]	In far west
Late Permian	Sandstone	Bandanna Formation	30–50 m	Increasingly argillaceous
	Coal Seam A. Seam contains thin stone bands that thicken from south to north		1 - 2.5 m	
	Labile sandstone, siltstone and mudstone		10 m	
	Coal Seam B. Seam contains numerous dirt bands that constitute between 15 and 30% of seam. Variable in quality.		6 - 8 m	
	Siltstone and mudstone		60–70 m	
		Colinlea Sandstone		Increasingly arenaceous
	Coal Seam C. Inferior C upper seam C Seam		 2 - 5 m 3 – 4 m	
	Siltstone and sandstone		2 – 20 m	
	Coal Seam D. Stone bands present with seam thickening westward, upper section splits off main seam to north west		4.5 - 6 m	
	Sandstone		30 m	
	Coal Seam E		0.5 m	
	Sandstone		15 – 20 m	
	Coal Seam F		1 - 3 m	
	Sandstone		Unknown	
Early Permian	Labile and quartz sandstone	Undefined	Transition to Joe Joe Formation	

[1] Typical thickness

16.13 Mining Waste

16.13.1 Coal and Mining Waste Quantities

As described in the Project Description (Volume 1, Section 2) and summarised in Table 16-6, the Project is expected to generate up to 30 Mtpa of ROM coal from both open cut and underground longwall operations, with a projected life of mine (LOM) of approximately 30 years. The majority of ROM coal (695.6 Mt or 79%) will be produced from the underground operations with 184.3Mt (21%) being produced from the open cut operations. The Central and Northern open pits would cover an area of approximately 21 km^2.

Approximately 3.15 billion tonnes of overburden is expected to be generated from the open pits over the life of mine. In addition, coal reject material would also be generated by the Project from the CHPP from coal sourced from both open pit and underground operations. The coarse reject comprises the larger pieces of overburden and poor quality coal that are not suitable for product sale. The tailings material is the fine component of this waste material. Both coarse rejects and tailings are segregated from the coal product in the CHPP. For every 100t of ROM coal approximately 75t of product coal, 17t of coarse reject and 8t of tailings will be produced. This amounts to approximately 150Mt of coarse reject and 70 Mt of fine reject (tailings), generated over the LOM. Both coarse reject and tailings will be stored at on-site emplacement facilities.

Table 16-6: Project annual and life of mine waste quantities

	Annual Production	Life of Mine (30 years)	Percentage of ROM coal
ROM Coal	30 Mtpa	870 Mt	
Overburden	110 Mtpa	3,150 Mt	
Coarse Rejects	5.2 Mtpa	150 Mt	17%
Fine Rejects (Tailings)	2.4 Mtpa	70 Mt	8%

The Project coal rejects (coarse and fine) are expected to comprise in the order of 7% of all mining waste produced by the Project. The proportion of coal rejects to overburden for the Project is comparable to similar coal mines in the nearby Bowen Basin, which typically average about 5% of mining waste. Details of the mining waste storage strategy are discussed in the following section; also refer to Volume 2, Appendix Q2. Plans showing the proposed location, site suitability and volume of overburden and coal reject emplacement areas and measures to ensure stability are described in the Project Description (Volume 1, Section 2).

16.14 Coal and Mining Waste Storage

16.14.1 Coal

Raw coal will be transferred from the open pits and underground operations to ROM facilities where, after primary crushing, it will be transported via conveyor to the CHPP where it will be processed (washed). It is expected that product coal will be stockpiled before being loaded into trains for transport to port facilities for export.

16.14.2 Overburden

At the mine, the overburden material will predominantly be stored within the open pit from Year 2, although an out-of-pit overburden emplacement area adjacent to the low walls of the Northern and Central open pit areas (refer to Figures 2-12 to 2-16 in Volume 1, Section 2) will accommodate material from the box-cut developed during the first year of mining. The out-of-pit overburden emplacement areas will comprise approximately 110 million tonnes (approximately 3.4%) of the total overburden mined over the 30 year mine life and will cover an area of approximately 250 ha. Mining will evolve into a dragline stripping operation with truck-shovel pre-strip.

16.14.3 Coarse Rejects

The coarse rejects generated from the CHPP will be dewatered and discharged onto the CHPP rejects conveyor, which reports to the rejects bin. During the first year of mining, the coarse rejects will be truck-hauled from the rejects bin and encapsulated with non-acid forming (NAF) overburden at the out-of-pit overburden emplacement areas.

From around Year 2 to the end of mine life, the coarse reject material will be placed in the in-pit voids between the dragline overburden/spoil. These placement areas are below the natural ground surface and extend to a depth of 10-20 m below ground level, which is above the predicted depth of the dewatered groundwater table both during and post mining. Truck-shovel pre-strip overburden materials will be used to progressively cover the reject areas with NAF overburden material as the working face progresses down dip.

Topsoil will be placed onto the re-profiled slopes. Details of the final landforms are contained within Volume 1, Section 26.

16.14.4 Tailings

Tailings will report to a purpose built TSF for the first five to seven years followed by in-pit disposal of tailings to the Northern Open Pit for the remaining life of the mine. Design concepts for the initial TSF structure and the in pit disposal of tailings are described in Volume 2, Appendix Q2. In addition, alternative TSF sites have been identified, should mining activities or technical issues limit the ability to utilise in pit tailings disposal. A site north of the Northern Open cut pit (TSF Site 1) was chosen as the preferred TSF location.

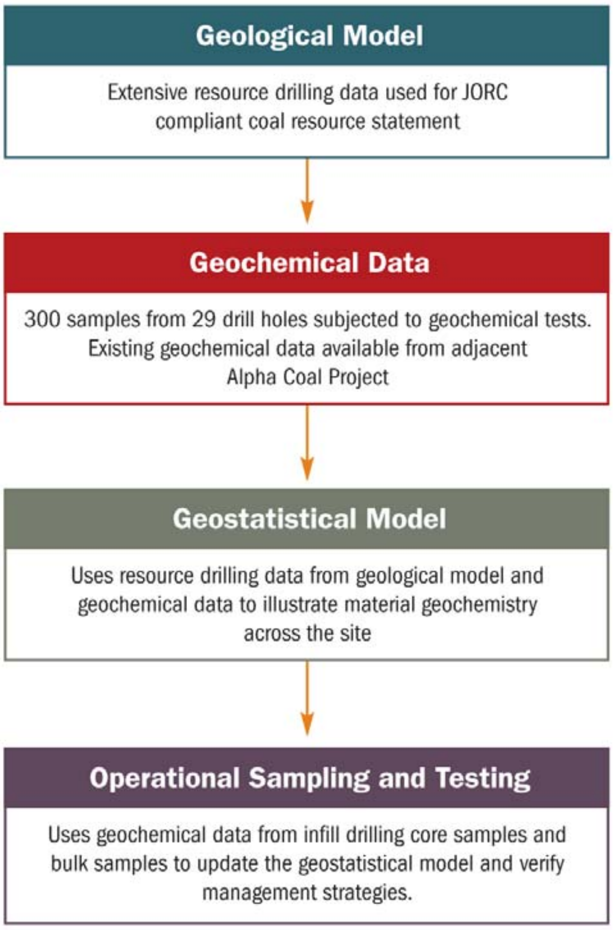
The placement of tailings material in-pit would significantly reduce the size of the required out-of-pit TSF footprint. Tailings will report to the TSF in a slurry form containing approximately 30% solids and excess water will be recycled from the TSF using a decant system for reuse at the CHPP. Given the semi-arid climate of the region, the tailings surface is expected to dry out relatively quickly and form a dense compact solid material, which will facilitate a cover placement and rehabilitation at the end of mine life. A cover system will be utilised for closure of the TSF and Northern Open Pit and topsoil will be placed onto the reprofiled final landform slopes. Information regarding the final landforms are provided in Volume 1 Section 26.

16.15 Approach to Coal and Mining Waste Characterisation

16.15.1 Overview of approach

The geochemical sampling and testing program was developed align with relevant Guidelines associated with proposed coal mining operations in Queensland, which include the Assessment and Management of Acid Drainage (DME, 1995), the Australian Leading Practice handbook (DITR, 2007) and Global Acid Rock Drainage (GARD) Guide (INAP, 2009). The following flow chart is reproduced from the 1995 DME guidelines as a graphic representation of the steps taken by the Project to understand and confirm the consistency of the site geology and the corresponding geochemical characteristics of the coal and mining waste materials (Figure 16-7).

Figure 16-7: Steps Taken by the Project for Geochemical Investigations



16.15.2 Geological Model

The Project geological model developed for the PFS has been independently audited, is compliant with the JORC Code (JORC, 2004) and provides a very good understanding of the Project geology/stratigraphy, which is similar to that of the adjacent Alpha Coal Project. The geological models for both projects describe a predictable coal and sedimentary rock genesis with little significant faulting. A detailed description of the Project site geology is presented in Volume 1, Section 4.

The mineralogy of 2,972 samples from 32 bores on site was also undertaken by the Proponent using visible, near infrared, short wavelength infrared (vis-NIR-SWIR) reflectance measurements using the HyChips system. The minerals observed included kaolinite, montmorillonite (Al smectite), nontronite (Fe smectite), and white mica, in a similar uniform stratigraphic profile as the Alpha Coal Project as illustrated at Figure 16-8.

16.15.3 Geochemical Data

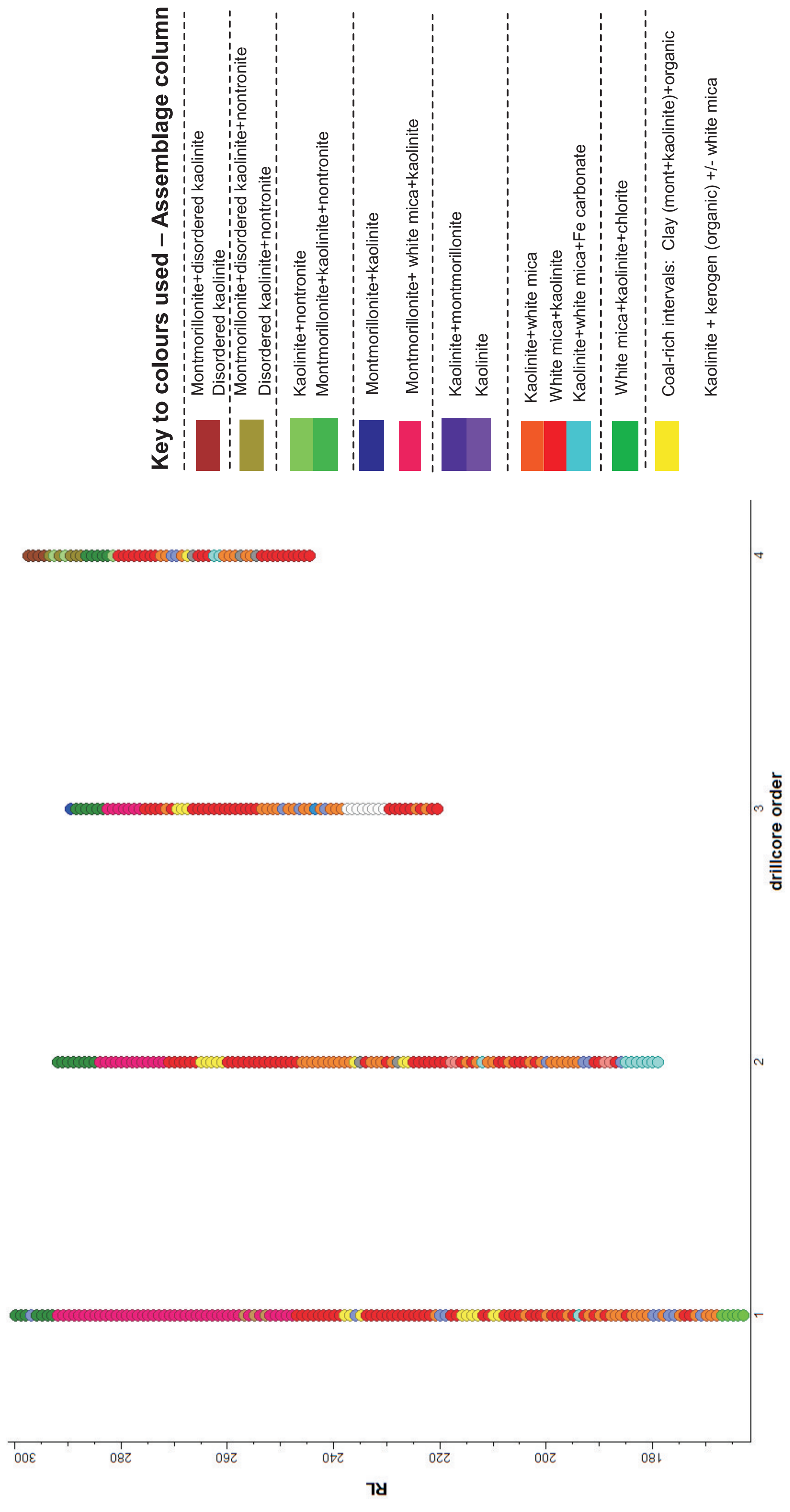
The sampling and testing program involved collecting a total of 300 drill core samples from 29 drill holes across the Project area for geochemical assessment. The samples represent coal, overburden, coal seam roof and floor materials and coal reject materials (coarse and fine). A representation of the lateral coverage of drill holes across the Project site for the 2010/11 EIS drilling, sampling and geochemical and lithological testing program is provided in Figure 16-9. The sampling program complements the existing geochemical and lithological database available from the geological model at the adjacent Alpha Coal Project as well as that of the Project. The number of samples and the drill hole intensity across the Project site is comparable with the sampling strategies used for recent EIS programs for approved coal mining operations in Queensland.

16.15.4 Geostatistical Modelling

The geostatistical modelling approach used by the Proponent for this project is described in detail at Volume 2, Appendix Q1. The model uses resource drilling data from the geological model and geochemical data to illustrate statistical relationships between material geochemistry and geology across the site. The geostatistical modelling approach undertaken for the Project provides an improved level of confidence that the occurrence and distribution of the coal and mining waste types likely to be generated at the Project have been adequately reflected in the sampling program and will be complemented by infill drilling programs and additional geochemical sampling and testing moving forward.

16.15.5 Operational Sampling and Testing

The Proponent will complete additional sampling and geochemical testing programs for representative samples of coal and mining waste materials as the Project progresses. The intention is to use geochemical data from infill drilling programs and bulk samples (where available) to update the geostatistical model and verify the adopted material management strategies. The Proponent has developed an additional infill drilling program focussed on sampling coal and mining waste materials from the area likely to be mined in the first five years of operation as well as over the life of mine as shown at Figure 16-10. Specific drill hole locations have been earmarked for geochemical sampling and testing at drill hole intervals of approximately 1 km (*ie*. that deemed adequate in the geostatistical modelling approach). It also aligns well with the uniformity of the underlying geology at the Project area and amount of existing geochemical information.



Plot showing mineral assemblage data for the Kevin's Corner holes. The legend shows the colour for the different assemblages. White in 1313C is where there was no sample.

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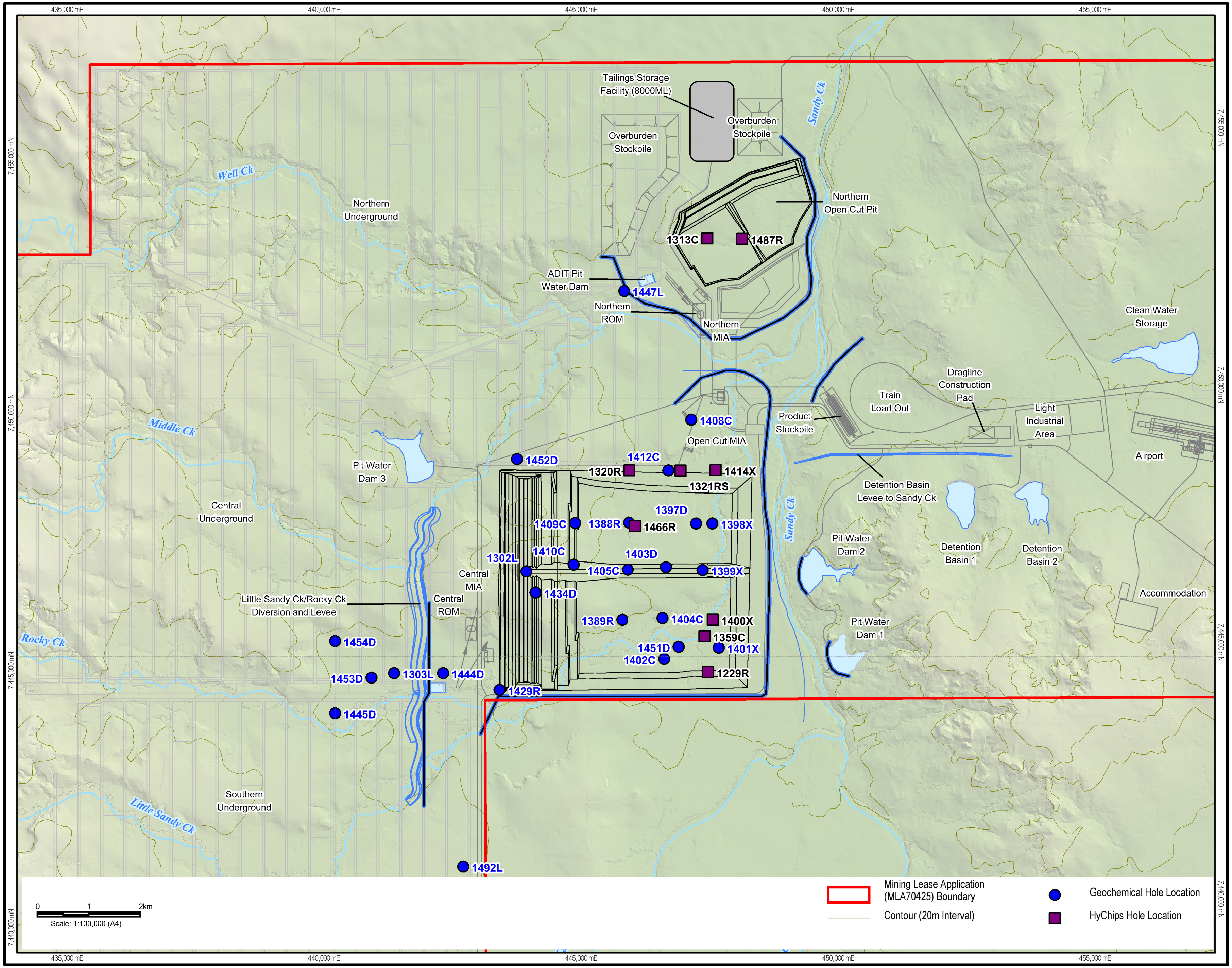
Kevin's Corner Project
Environmental Impact Statement

KEVINS CORNER COAL PROJECT (MINE)
MINERAL ASSEMBLAGES ACROSS
HYCHIP DRILL HOLES

Job Number	4262 6660
Revision	B
Date	12-09-2011

Figure: 16-8

File No: 42626660-g-1143.cdr



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Kevin's Corner Project
Environmental Impact Statement

KEVINS CORNER (MINE) DRILL HOLES USED TO PROVIDE LITHOLOGICAL AND GEOCHEMICAL INFORMATION IN EIS

Job Number	4262 6660
Revision	B
Date	12-09-2011

Figure: 16-9

Datum: GDA94, MGA Zone55

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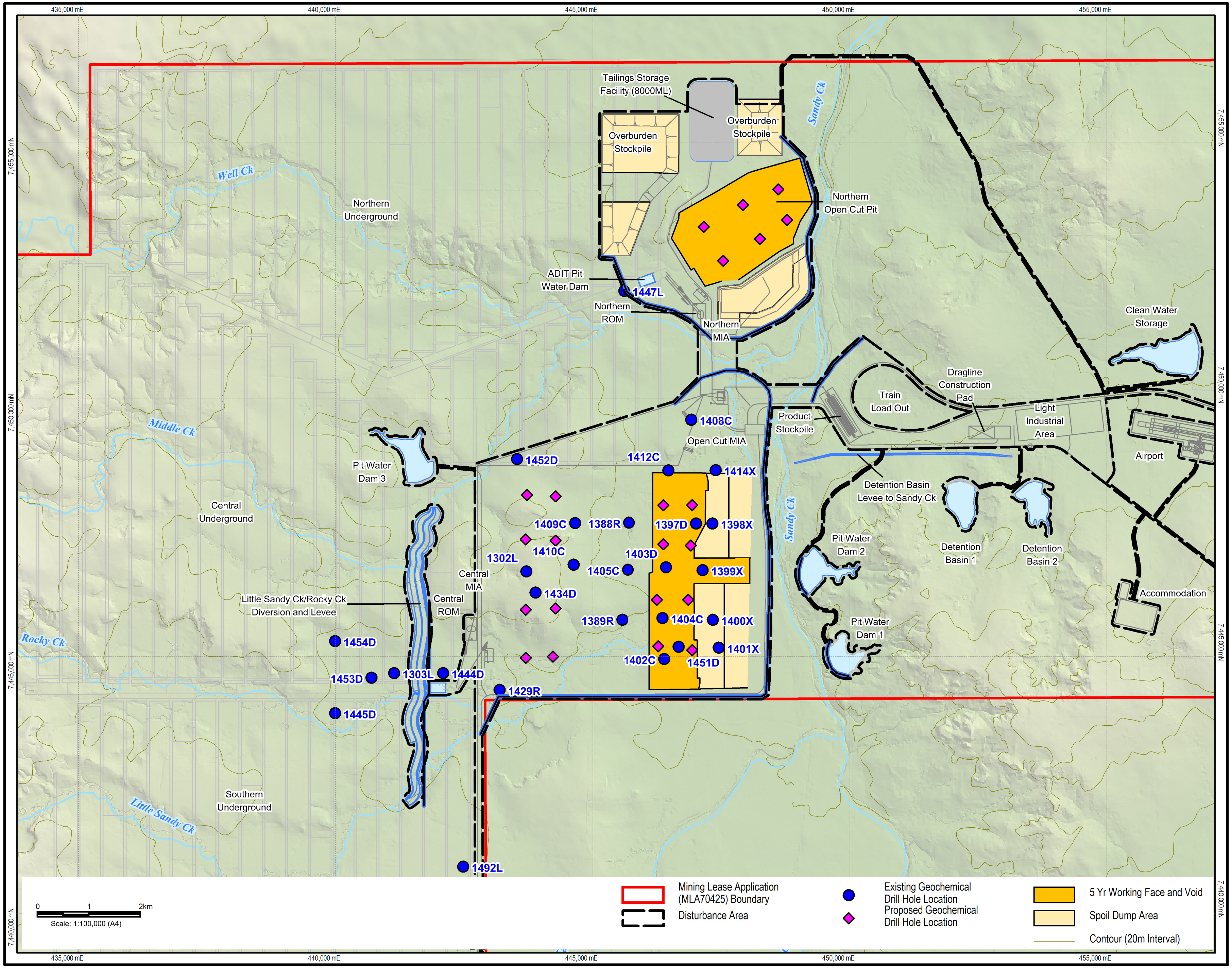

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Datum: GDA94, MGA Zone55

File No: 42626660-g-1141.wor

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Kevin's Corner Project
Environmental Impact Statement

PLANNED MINING AREA FOR FIRST FIVE YEARS AND LOCATION OF ADDITIONAL INFILL DRILL CORE HOLES FOR GEOCHEMICAL SAMPLING

Job Number	4262 6660
Revision	C
Date	12-09-2011

Figure: 16-10

Material Characterisation

The geochemical characterisation program for coal and mining waste materials from the Project is primarily based on the 1995 DME guidelines, as well as other Australian and internationally recognised methods (AMIRA (2002); INAP (2009); and Price (2009). All samples were screened for:

- Paste pH;
- Electrical Conductivity (EC);
- Total sulfur;
- ANC;
- Net Acid Producing Potential (NAPP); and
- Elemental Composition (Total metals).

Screening was undertaken at a National Association of Testing Authorities (NATA) certified laboratory in Brisbane (ALS Brisbane). In addition, a series of more specialised static geochemical tests were undertaken on selected samples to reflect more recent knowledge (ACARP, 2008) and Australian and International guidelines applicable to the Project (DITR, 2007 and INAP, 2009). These tests included:

- Net Acid Generation (NAG);
- Carbon and sulphur speciation;
- Acid Buffering Characterisation Curve (ABCC);
- Metal leachability;
- Effective cation exchange capacity (eCEC);
- Exchangeable sodium percentage (ESP); and
- Emmerson Aggregate tests.

Kinetic leach column (KLC) tests generally follow static tests on a small number of selected samples where there is potential risk of leaching of poor quality leachate. For the Project, it was decided to bring forward the KLC test program for selected coal, coal rejects and coal tailings materials to generate kinetic geochemical data for the Project EIS. This approach compares favourably with the geochemical testing strategies used for recent EIS programs for approved coal mining operations in Queensland. The Proponent has also commissioned additional KLC tests on selected overburden materials to further verify the geochemical approach used for material classification and adopted environmental management strategies.

Details of the overall geochemical sampling, testing and classification methodology utilised for coal and mining waste materials from the Project and results obtained are described in some detail in the EIS geochemical assessment technical reports (Volume 2, Appendix Q).

16.16 Geochemical Nature of Coal and Mining Waste Materials

16.16.1 Acid Generating Potential

The geochemical data on the coal and mining waste samples from the static and kinetic geochemical test programs is summarised in this section for specific material types. The acid generating potential is determined using a number of geochemical results, but ultimately the ability for a material to generate acid is a balance between a samples inherent capacity to generate acid (called the maximum potential acidity (MPA)) and neutralise acid (ANC) Acidity at mining projects is generated through the oxidation of sulphide minerals, such as pyrite, and neutralised by carbonate minerals, such as calcite and dolomite. Therefore, in very simple terms, an excess of MPA relative to ANC will generally lead to a positive net acid producing potential (NAPP and an excess of ANC relative to MPA will lead to a negative NAPP value.

Coal

Substantial existing data is available on the Project coal materials including total sulphur results for 310 raw and washed coal samples from drill holes across the deposit area (as described in Volume 1, Section 4). The total sulphur content of the target coal seams for the Project is typically around 0.6 %, which is similar to that found at the Alpha Coal Project for a larger number of samples. At the Alpha Coal Project approximately half of the total sulphur in samples was present as pyritic sulphur (ie. the pyritic sulphur content of samples was relatively low at about 0.27 %). For this Project, there appears to be a smaller proportion of total sulphur present as pyritic sulphur in the samples tested, although this will need to be confirmed by further sampling and testing of coal samples.

The ANC of the coal is also quite low (approximately 4 to 5 kg H2SO4/t) therefore there is some uncertainty regarding the overall acid generating nature of the coal material. Notwithstanding this, the low pyritic sulphur concentration of coal renders the capacity of coal materials to generate acid as being very low.

Raw and washed coal may be stored at the site for a relatively short period of time (weeks) compared to mining waste materials, which will be stored at the site in perpetuity. Management practices are therefore different for coal and for mining waste materials as described in this EIS at Section 16.19 and in the EMP.

Overburden

The results of the geochemical test program for overburden materials from this Project are provided in technical geochemical reports, which indicate that the bulk overburden material is NAF. This finding is illustrated (at Volume 2, Appendix Q2) in a series of cross-sections through the Central open pit area. Of the 266 overburden samples tested using the net potential ratio (NPR) screening method (Price, 2009), three samples are classified as Potentially Acid Forming (PAF) and six were classified as PAF-Low Capacity (PAF-LC). PAF-LC materials may generate acidity, however the amount of acid generated is expected to be low.

The ratio of ANC to MPA (ANC/MPA) of the overburden samples was calculated to provide an indication of the relative margin of safety within a material with regard to acid generation potential. An ANC/MPA ratio of 2 or greater is an indication a low potential for acid generation, according to

International guidelines (INAP, 2009). As a general rule, an ANC/MPA ratio of 2 or more signifies that there is a high factor of safety and a high probability that the material will remain circum-neutral in pH and thereby should not be problematic with respect to acid generation. The data illustrate that whilst the samples span a large range of ANC/MPA values from 0.005 to 555.1 and have a broad statistical distribution, the results clearly show that the bulk overburden materials will have ANC/MPA values between 4.5 (25th percentile and 39 (75th percentile). These results illustrate that the bulk overburden material at the Project is likely to have a high factor of safety and a low probability of acid generation.

Additional interpretation of the acquired data using material classification criteria described at Volume 2 Appendix Q2 indicates that the geochemical nature of the overburden materials can be summarised as described at Table 16-7.

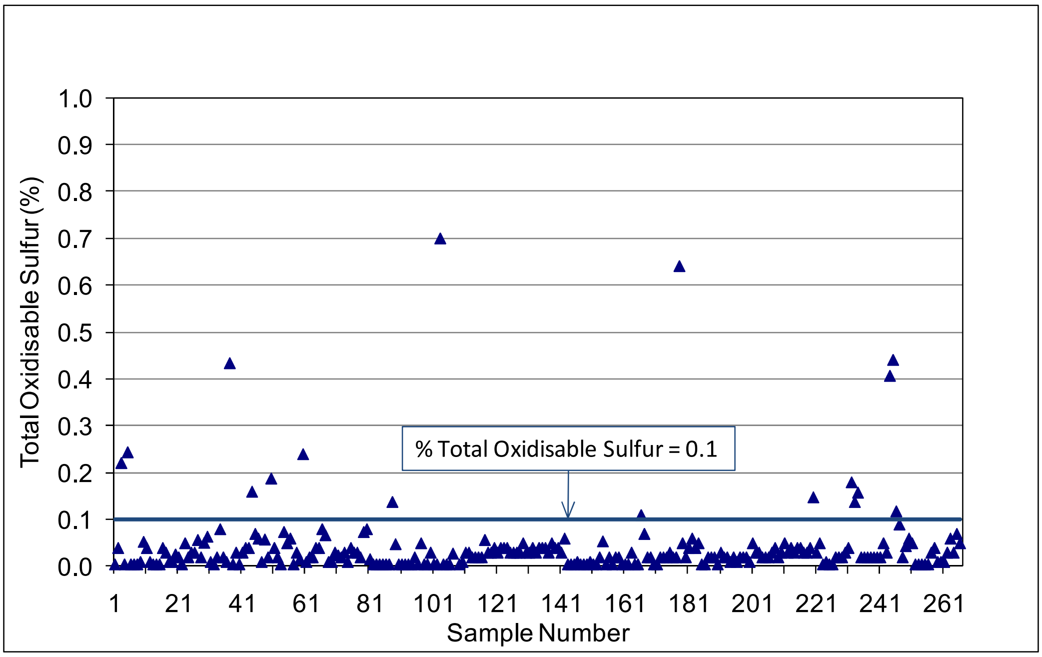
Table 16-7: Geochemical Nature of Overburden Materials

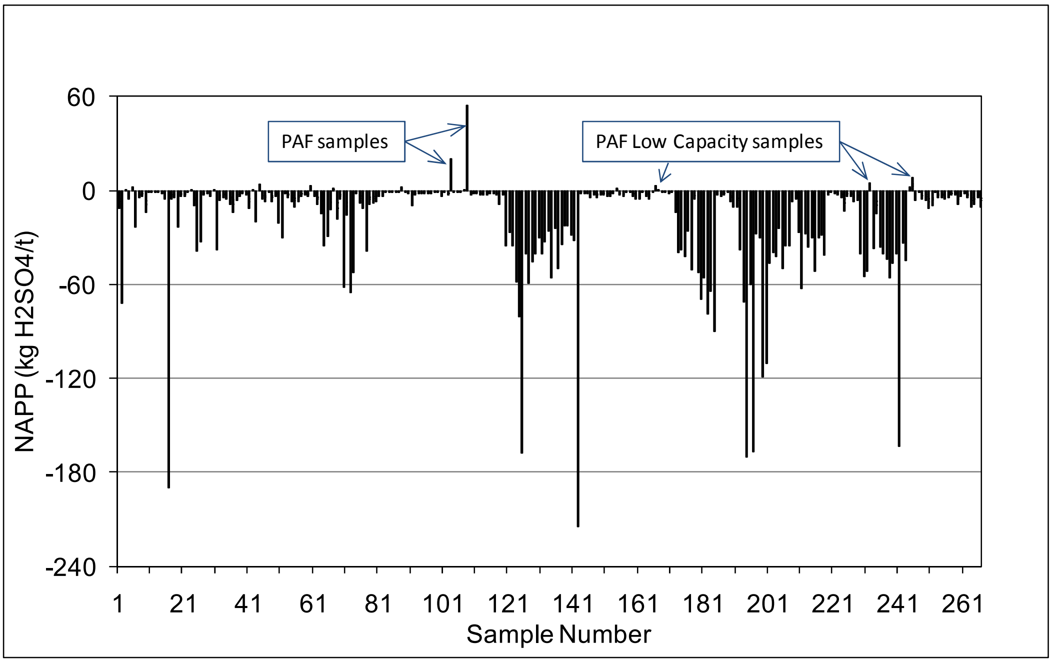
Material Type	No. of Samples	Percentage of Total (%)
NAF	253	95.1
Uncertain	7	3.0
PAF-LC	3	1.1
PAF	2	0.8

Most of the overburden samples have very low oxidisable sulphur content and are essentially barren of sulphur, as illustrated at Figure 16-11. This material characteristic coupled to excess ANC, means that the NAPP of the bulk overburden material is typically negative as shown at Figure 16-12. The two PAF samples and three PAF-LC samples are shown on the figure and provide a striking contrast with the negative NAPP values of the bulk overburden materials.

For the two samples identified as PAF, one is for clay material that is located directly above a coaly shale unit. The other PAF sample is for a sandstone material located at the roof of an undifferentiated coal unit. Clearly the bulk overburden material can be regarded as overwhelmingly NAF with a small amount of PAF material located close to some coal units. Management practices for overburden materials are described in this EIS at Section 16.19 and in the EMP.

Figure 16-11: Plot of total oxidisable sulphur value (top) and Plot of NAPP value (bottom) for overburden samples at Kevins Corner project





Roof and Floor Materials

Some immediate coal seam roof and floor materials will likely report (as dilution) with coal to the CHPP and therefore will ultimately become part of the coal reject stream. Hence, their inclusion in the geochemical assessment of potential mineral wastes. Based on the current geochemical dataset for the Project, some of the immediate roof and floor materials at the coal seams may have elevated total sulphur content, although all samples tested had sufficient ANC and are unlikely to pose a significant risk of developing acid conditions, especially if mixed with the NAF bulk overburden materials. However, based on previous Alpha Coal Project data, it is recognised that further drilling and testing will be required at the Project to fully delineate the presence of any PAF roof and floor material.

Coarse Reject

The results of the geochemical test program for coarse reject materials at the Project are provided in the technical geochemical reports at Volume 2, Appendix Q2. Currently two coarse reject samples from three drill holes have been tested in the static and kinetic geochemical test program, with a further three samples from another three drill holes in preparation at the coal quality laboratory. The two samples are sourced from the D coal seam, which comprises approximately 93% of the total coal produced from both open pit and underground operations (and therefore most of the coarse reject produced) over the LOM. These geochemical results are supplemented by existing data from the Alpha Coal Project where 17 coarse reject samples from 10 drill holes (derived from the C and D coal seams) were subjected to geochemical tests.

The available geochemical results indicate that coarse reject materials have an elevated oxidisable sulphur content, very little ANC and are likely to be PAF. Material represented by the samples is likely to generate acid conditions within a relatively short period of time (probably several weeks to a few months), and be a source of sulphate salts and some metals. Management practices for overburden materials are described at Section 16-19 and in the EMP.

Tailings

The results of the geochemical test program for tailings materials at the Project are provided in the technical geochemical reports at Volume 2, Appendix Q2. Currently two tailings samples from three drill holes have been tested in the static and kinetic geochemical test program, with a further three tailings samples in preparation at the coal quality laboratory. The two samples are sourced from the D coal seam, which comprises approximately 93% of the total coal produced from both open pit and underground operations (and therefore most of the tailings produced) over the life of mine. These geochemical results are supplemented by existing data from the Alpha Coal Project where 17 tailings samples from 10 drill holes (derived from the C and D coal seams) were subjected to geochemical tests.

The available geochemical results indicate that the tailings have a relatively low oxidisable sulphur content (approximately 0.27 %) and an ANC value of around 5 kg H_2SO_4/t, leading to a slightly positive NAPP value. There is, therefore, some uncertainty regarding the acid generating nature of the tailings material. Notwithstanding, the low NAPP value (less than 5 kg H_2SO_4/t) indicates that the capacity of tailings materials to generate acid is low. Management practices for overburden materials are described at Section 16-19 and in the EMP.

16.16.2 Elemental Composition and Water Quality

Elemental Composition

Quantitative elemental (total metals) analyses of samples of coal and mining waste materials were completed to determine the abundance of elements in the samples and details of the results are provided in the geochemical technical reports at Volume 2 Appendix Q1. Selected (29) samples were also leached with de-ionised water (solid:water ratio 1:3) and quantitative elemental analysis was conducted on the leachate to identify readily soluble elements that may be leached from the test material.

The geochemical results obtained indicate that most elements were not significantly enriched in the sample materials, although silver (Ag), arsenic (As), antimony (Sb) and selenium (Se) were enriched in a very small number of samples compared to average crustal abundance, whereas enrichment of Re (Rhenium) and Te (Tellurium) was more widespread. All of these enriched elements, apart from Se, were found to be sparingly soluble in leach tests. Se was slightly above applied livestock drinking water guideline concentrations (ANZECC, 2000) in 3 of the 29 samples tested.

Water quality

The vast majority of the samples tested had water quality values within the applied livestock drinking water guideline criteria. The main exceptions were for a few of the (mainly lower pH) samples where Al (1 sample), Ni (2 samples), Se (3 samples) and SO_4 (1 sample) were greater than the applied water quality guideline criteria (ANZECC, 2000). It should be noted that these analysis were completed on pulverised samples with a large surface area in contact with the leaching solution and represents an assumed 'worst case' scenario. Hence, in the field, metals in leachate from bulk coal and mining waste is unlikely to present any significant issues for surface runoff and seepage quality at the site. However, the solubility of many metals is closely linked to pH and should PAF materials such as coarse rejects be exposed to ongoing oxidising conditions and generate acidic leachate, dissolved metal and sulphate salt concentrations in surface runoff and seepage may increase significantly over time.

The pH of surface runoff and seepage from bulk overburden materials is expected to be circum-neutral in the range pH 7 to 8 as illustrated in Figure 16-13. Whilst the samples show a range of pH values, the median pH value is 7.9. The two samples with pH values less than 4 are the two PAF samples closely associated with coal units as described in Section 16.17.1. For the current dataset, coal seam roof and floor samples are expected to exhibit a similar pH to that of overburden samples. However, based on Alpha Coal Project data, it is recognised that further drilling and testing will be required to delineate the presence of any PAF roof and floor material at the site. For coal and tailings material, the pH of surface runoff and seepage is expected to be in the range pH 5.0 to 6.5 whereas for coarse reject, the initial pH is expected to be in the range pH 4.0 to 5.0, but is likely to reduce with continued exposure to oxidising conditions.

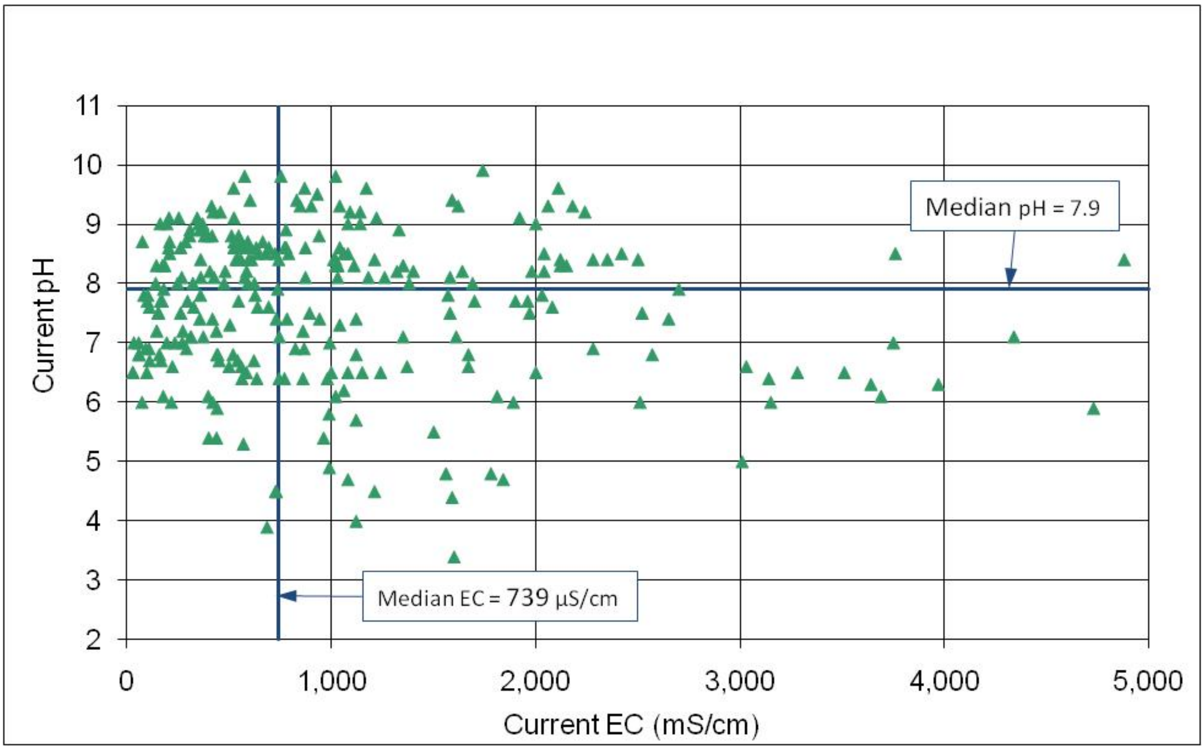
The salinity of leachate from overburden (as represented by EC value) is provided at Figure 16-13. The data illustrate that whilst there is a wide range of salinity values and some overburden materials are likely to be saline (*eg*. salinity values for some siltstone and clay materials tend to be more elevated than other rock types). The samples span a large range of EC values from 26 µS/cm to over 4,800 µS/cm; with a broad statistical distribution (25^{th} and 75^{th} percentile values of 382 and 1,345 µS/cm, respectively). Most samples are generally evenly distributed between the 'Low', 'Medium' and 'High' salinity categories as described in Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (DME, 1995), reproduced at Table 16-8. Approximately 14% of overburden samples are classified as being in the 'Very High" salinity category.

Table 16-8 Salinity Criteria for Mine Waste Assessment

Test	Very Low	Low	Medium	High	Very High
EC (1:5 sample:water) (µS/cm)	<150	150 - 450	450 - 900	900 – 2,000	>2,000

Again, these analysis were completed on pulverised samples with a large surface area in contact with the leaching solution and represent an assumed 'worst case' scenario. It should also be noted that the guidelines are for EC values obtained for a 1:5 (sample:water) extract, whereas the overburden EC results were obtained for a more concentrated 1:3 (sample:water) extract. It is also expected that the salinity of leachate from overburden materials will diminish with time as salts are flushed from the rock matrix until a state of equilibrium develops and the salinity of seepage/runoff stabilises at a lower asymptotic concentration relative to the weathering/erosion of the materials. The salinity of surface runoff and seepage from roof and floor materials is expected to be similar to overburden materials based on the samples tested to date. Salinity in surface runoff/seepage will be managed at the site by avoiding placing overburden materials with elevated salinity at the final surface and outer slopes and batters of overburden emplacement facilities. A water management system, including surface drainage controls and sediment control ponds will also be used to capture surface runoff/seepage from these facilities.

Figure 16-12: : Plot of pH versus EC for overburden samples at Kevin's Corner project



The salinity of leachate from coal and tailings materials is expected to be similar to that of overburden materials however for coarse rejects, salinity values are expected to be in the 'High' range and could progress into the 'Very High' range if these materials are exposed to oxidising conditions for more than several weeks and generate significant quantities of soluble sulphate salts. The salinity of leachate from coarse reject materials is expected to be in the 'Very High' range.

16.17 Comparison with Similar Mining Operations

In line with the 1995 DME guidelines, the Proponent has also completed a comparison of the Project with mining projects with similar case histories which *"is more applicable to stratigraphically continuous coal mines in sedimentary sequence than to non-coal operations*". This statement reflects the fact that most coal mines in the Bowen, Galilee and Surat Basins in Queensland have relatively uniform stratigraphic profiles, with potentially sulphidic materials generally located close to or within coal seams (including uneconomic seams).

In the nearest comparable operating coal fields of the Bowen Basin in Queensland, most overburden is typically NAF, but can potentially be saline and/or sodic. These material properties are addressed through appropriate material management and rehabilitation strategies (BMA, 2008). At some coal mines in the Bowen Basin, some coal reject and tailings materials have some capacity to generate acid, salts and metals; ie. the majority of coal mines in the Bowen Basin do not have significant AMD issues. Coal reject and tailings materials are generally managed in above ground containment facilities, although more recently the trend has been to store these materials in final voids where there can be a lower risk of resource sterilisation (a requirement of the mining licence conditions) and surface and groundwater impacts.

On the Project, the aim is to store coal reject and tailings materials in below ground in-pit storage facilities as soon as sufficient capacity becomes available to achieve this outcome. Material compaction, lime amendment and encapsulation within a set time period will be used to manage these materials and generate an improved environmental outcome. Again, this approach is comparable with the management strategies proposed to manage coal rejects and tailings materials contained in EIS programs for approved coal mining operations in Queensland.

In recent years there have not been major issues with acid leaching from coal mine tailings dams in Queensland containing low concentrations of pyritic sulphur. Most Bowen Basin coal mines have low total sulphur content coals (< 0.7%) and the Project is no exception (0.6%). In addition, the proportion of organic and sulphate sulphur in the Project coal, and subsequently tailings, is relatively high (approximately 50%), which will also significantly limit the risk of acid generation from coal and tailings materials.

16.18 Management Measures for Coal and Mining Waste Materials

Management measures for coal and mining waste materials are summarised in this section and also contained in the EMP. These measures and associated ongoing sampling/testing and monitoring activities will also be detailed in a Mining Waste Management Plan (MWMP) completed prior to the construction phase of the Project. The management measures are summarised in Table 16-9 and discussed for each waste type in the following sections.

Table 16-9: Summary of Management Measures for Coal and Mining Waste Materials

Material Type	Seepage and Drainage Water Quality Management
Coal	• Contact water contained and segregated from clean site water; • Acidic contact water (trigger value = pH 5) will undergo lime treatment to control pH
Material Type	**Management Strategy**
Bulk overburden: • NAF; and • Non-saline and/or non-sodic	In-pit and out-of-pit overburden emplacement facilities. No specialised geochemical management required.
Bulk overburden: • NAF; and • Saline and/or sodic	Report to core (internal) of storage facilities. Avoid placement at the final top surface and final surface of the outer slopes and batters.
Uneconomic coal close to economic coal units: • Coal ply partings <30 cm thick • Coal seam roof and floor	Report to CHPP for processing and becomes part of coarse rejects and tailings material streams
Uneconomic coal away from economic coal units: • Coal ply partings >30 cm thick: o NAF o PAF-LC	Remain at floor of pit (if pit floor capacity is available) and cover with NAF overburden within 4 weeks. If capacity is unavailable at pit floor, will report to an alternative in-pit storage location or report to coarse reject storage area
Uneconomic coal away from economic coal units: • Coal ply partings >30 cm thick: o PAF	Delineation of PAF units through geological control and ongoing geochemical sampling and testing. Selectively handled, then report to: • Year 1: Out-of-pit coarse reject storage areas; • Year 2+: In-pit coarse reject storage areas.
Coarse rejects during Year 1	• Report to core of out-of-pit overburden emplacement facility (coarse reject storage areas); • Compacted in approximate 1 to 2 m layers using dozing and vibrating or square roller equipment; then • Covered with reduced permeability NAF overburden within 4 weeks; then • Encapsulated with a thick layer of NAF overburden within 3 months. • Cap with truck-shovel pre-strip overburden and topsoil materials

Material Type	Seepage and Drainage Water Quality Management
Coarse rejects from Year 2+	• Report to in-pit voids (coarse reject storage areas); • Compacted in approximate 1 to 2 m layers using dozing and vibrating or square roller equipment; • Covered with reduced permeability NAF overburden within 4 weeks; then • Encapsulated with a thick layer of NAF overburden within 3 months. • Cap with truck-shovel pre-strip overburden and topsoil materials.
Tailings	Placement as a piped slurry into the TSF. If there is an increase in AMD due to issues such as greater than predicted PAF quantities or lower than predicted tailings PH levels, additional risk management methods with be considered, such as selective placement, early encapsulation or lime amendment.

16.18.1 Coal

As a precautionary measure, contact water from raw and product coal stockpiles materials will be contained to avoid interaction with clean site waters. Lime or an alternative alkaline amendment may be required from time to time to control the pH of any contact water contained in coal stockpile drainage/seepage collection ponds. The dosage of alkaline amendment will dependent upon ongoing geochemical and water quality monitoring test data, and a trigger pH value of 5.

16.18.2 Overburden

The bulk overburden materials at the Project are expected to be NAF and, from an acid generating potential perspective, this makes management of bulk overburden materials relatively straightforward with no selective handling required away from coal units. However, a small amount of overburden typically associated with economic and uneconomic coal seams may be PAF, with most PAF materials expected to have a low capacity to generate acid. PAF materials with a significant capacity to generate acid will be further delineated in future planned infill drilling programs as described earlier in this section.

Any overburden associated with coal units such as coal ply partings less than 30 cm in thickness and some roof and floor materials will report with coal to the CHPP and will therefore report as coarse reject. Any PAF uneconomic coal that is mined but nor processed will also report directly to coarse reject storage facilities.

Any coal ply parting greater than 30 cm thickness that is NAF or low capacity PAF will be selectively left at the floor of the pit (or if storage capacity is unavailable at the pit floor, will report to an alternative in-pit storage location) and be covered within four weeks with reduced permeability NAF overburden material. If there are any PAF parting or roof and floor materials of greater capacity, these will be selectively handled and report to either out-of pit (during Year 1) or in-pit coarse reject storage areas (after Year 1). It is expected that open-pit mining geological control coupled with pre-mining and

ongoing geochemical sampling and testing of these materials can be used to delineate the extent of any PAF materials and ensure that these are selectively handled and managed in a similar manner to PAF coarse coal reject materials There will be an infill drilling program dedicated to geochemical sampling and testing to help to delineate any PAF materials of greater capacity and make sure that these are selectively mined and stored with coarse rejects.
Some overburden has the potential to be saline and/or sodic (as described in Volume 2 Appendix Q1) and any out-of-pit overburden will be managed to ensure that saline and/or sodic materials report to the core of storage facilities. Precautions will be taken to prevent water flow over the dispersive materials of overburden dumps by avoiding placement at the final top surface and final surface of the outer slopes and batters.

Consideration of placement of coarser overburden material at the base of the emplacement area will be given to assist in overburden drainage. Some rock mulching may be required on final batters to limit potential erosion from surface runoff and any requirement for this approach will be assessed during rehabilitation field trials. Information on the project rehabilitation strategy is presented in Volume 1, Section 26.

16.18.3 Coarse Rejects

All coarse reject materials will be paddock dumped and compacted in approximate 1-2 m layers using dozing and vibrating or square roller equipment. During the first year of mining, coarse rejects placed at the low wall edge of the boxcut area will be isolated with reduced permeability NAF overburden within 4 weeks before being encapsulated with a thick layer of NAF overburden within 3 months.

From Year 2 to end of mine life, the coarse reject material will be placed in the in-pit voids between the dragline overburden (spoil). Again compaction, lime dosing, preliminary isolation with reduced permeability material within 4 weeks and encapsulation with a thick layer of NAF overburden within 3 months will be utilised to manage the potential for AMD. These placement areas are below the natural ground surface and extend to a depth of 10-20 m below ground level, which is above the predicted depth of the recovered groundwater table. Truck-shovel pre-strip overburden materials will be used to cap the reject areas. Coarse reject placement will be sequenced such that capping of the rejects will be completed progressively as the working face progresses down dip. Topsoil will be placed onto the re-profiled slopes. Details of the final landforms are contained within Volume 1, Section 26.

16.18.4 Tailings

Geochemical test results indicate that some tailings may have a low capacity to generate acid. The Proponent will consider lime amendment of PAF tailings materials if their occurrence is more widespread than currently predicted and tailings materials generate pH values less than five. The TSF will be designed to ensure that risk of seepage to the underlying sediments is minimised.

The geochemical characteristics of tailings will also depend on variations in raw coal, processing methods and potential reactions upon exposure to water and/or air. Hence, during operations small scale field tests on tailings materials will be carried out under actual site conditions to determine the any requirement for operational lime amendment of tailings. The potential merits of lime amendment of tailings reporting to the TSF will also be assessed by ongoing monitoring of the tailings geochemical characteristics, TSF decant water quality and any collected seepage water quality.

Given the semi-arid climate of the region, the tailings surface is expected to dry out relatively quickly and form a dense compact solid material, which will facilitate a cover placement and rehabilitation at the end of mine life. A cover system will be utilised for TSF closure and topsoil will be placed onto the re-profiled final landform slopes.

16.19 Ongoing Sampling and Monitoring

16.19.1 Geochemical Sampling

The distribution of drill holes used for geochemical sampling (see Figure 16-9) shows that the geochemical information to date provides good coverage of the proposed open pit areas. Geostatistical modelling has found that the uniform geology and stratigraphy at the Project site is reflected by the predictable geochemical characteristics of materials at the Project site.

The geochemical characteristics of the coal and mining waste materials are adequately characterised by the existing geochemical testing program data for the EIS stage of a project. The Proponent will, however, continue ongoing infill drilling programs and operational geochemical characterisation of coal and mining waste materials from the Project area to verify the predicted geochemical characteristics of these materials (the infill drilling program earmarked for geochemical sampling and testing is described at Section 16.15.5 and illustrated at Figures 16-10 and 16-11).

Acquired geochemical data will be used to refine the management strategies adopted for coal and mining waste materials. For future work, in addition to standard acid-base and metals testing (static tests) and kinetic leach column tests, geochemical characterisation of overburden materials will include assessing the general soil properties (sodicity, exchangeable cations) of selected mined waste materials to confirm their suitability for use in surface revegetation and rehabilitation activities.

16.19.2 Water Quality Management and Monitoring

Surface water and leachate derived from, or in contact with, coal and mining waste materials will be monitored to ensure that water quality is being managed and not significantly compromised by proposed site management practices. Potentially impacted surface waters will be primarily managed by retaining water on-site. This water will be reused in the site water management system. This will be particularly important in the CHPP and open pit areas where stored materials may produce brackish run-off water.

Management of any poor quality runoff and seepage from overburden emplacements, open pits, coal stockpiles, coarse reject storage areas, the TSF, and disturbed areas is detailed in Volume 1 Section 11 and Section 16 and the EMP.

The potential for the PAF materials at the Project to impact on surface water and regional groundwater quality is relatively low as they are encapsulated with NAF overburden and groundwater flow will be toward the pits, with the potential for any AMD to migrate off site being low. The Proponent will undertake ongoing operational geochemical characterisation of coal and mining waste materials from the Project area to confirm the predicted geochemical characteristics of these materials. This data will be used to optimise the management strategies of coal and mining waste materials.

Coal and mining waste materials will be monitored for geochemical characteristics (pH, EC, acidity, alkalinity, sulphur species (total and sulphide) and ANC) on a monthly basis until such time as the variability of the geochemical characteristics of these materials is well defined (approximately 12 months).

Surface and seepage water at coal and mining waste storage areas will also be monitored on a monthly basis (as well as opportunistically during rainfall events when access is available) and tested for pH, EC, Total Dissolved Solids (TDS), acidity and alkalinity, major anions (sulphate (SO4), chloride (Cl), fluoride (F)), major cations (calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K)) and trace metals (aluminium(Al), arsenic (As), antimony (Sb), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), uranium (U), vanadium (V) and zinc (Zn)) will be included in the range of parameters tested in these water samples, initially on a quarterly basis (for 12 months) and then on an annual basis throughout the life of mine. On a 95th percentile basis, should the pH of the TSF seepage water decrease below pH 5 or the EC increase by more than 100% from typical background values, the full range of parameters described above will be included in the test suite.

16.20 Conclusions

The Project will adopt material characterisation and management measures to effectively manage coal and mining wastes generated by the construction, operation and decommissioning of the project.

Coal and mining wastes will be effectively managed by material type to minimise operational and longer term residual impacts on the environment.

Development and implementation of a site-specific MWMP and effective monitoring and reporting will ensure that the management of coal and mining wastes at the Project are consistent with relevant legislation and guidelines and leading industry practice.