REVISED ENVIRONMENTAL REVIEW

SORBY HILLS SILVER LEAD ZINC PROJECT

EAST KIMBERLEY, WESTERN AUSTRALIA

SORBY MANAGEMENT PTY LTD

September 2013

REVISED ENVIRONMENTAL REVIEW FOR THE CONSTRUCTION AND OPERATION OF THE SORBY HILLS SILVER LEAD ZINC PROJECT MINE SITE

Tenements M80/197 & M80/286

Environmental Protection Authority Assessment Number: 1920

VOLUME 1

KBL Mining Limited

Prepared by Sorby Management Pty Ltd with the assistance of Animal Plant Mineral Pty Ltd

DOCUMENT HISTORY AND STATUS

Reviewed by	Approved by	Date approved	Revision type
			Internal draft
Mitchell Ladyman	Sharon Arena	15 November 2012	OEPA draft
Mitchell Ladyman	Sharon Arena	07 December 2012	Draft for DMAs
Mitchell Ladyman	Sharon Arena	12 February 2013	Final OEPA Draft
OEPA	OEPA	05 March 2013	Final Public Release
OEPA	OEPA	18 September 2013	Revised Environmental Review

DISTRIBUTION OF COPIES

Revision	Quantity	Issued to
Drafts for DMAs	14	DMAs
Final OEPA Draft	1	OEPA
Final Public Release	As required	Public
Revised Environmental Review	1 electronic	OEPA

Released:	18 September 2013
Author:	Corinne Chambers
Name of Organisation:	Sorby Management Pty Ltd
Name of Project:	Sorby Hills Silver Lead Zinc Project
Name of Document:	Revised Environmental Review - Sorby Hills Silver Lead Zinc Project
Document version:	Revised Environmental Review
Project number:	KBL014

EXECUTIVE SUMMARY

The Project

Sorby Management Proprietary (Pty) Limited (Ltd) (SMPL) is seeking to develop a new Silver Lead Zinc (Ag Pb Zn) mine at Sorby Hills 50 kilometres (km) north of Kununurra in the east Kimberley Region of Western Australia (WA). The primary Lead mineral is Galena (Lead Sulphide).

The Sorby Hills mining tenements M80/196, M80/197, M80/285, M80/286, and M80/287 cover a total area of 12,612.40 hectares (ha). The proposed Sorby Hills Project (the Project) is contained within two of these leases, M80/197 and M80/286, which cover an area of 1,782.27 ha. SMPL will initially target three mineralised ore pods which are to be mined sequentially as separate entities. As mining progresses two of the three ore bodies will be contained within one larger pit; the focus will be on resources within 70 metres (m) of the surface.

Between 400,000 and 600,000 tonnes per annum (tpa) of ore will be excavated from the open pits and processed through the facility to produce 45,000 tpa of concentrate for export. Processing discharge will require the storage of up to 355,000 tpa of tailings. The expected project life is approximately 14 years, with 10 years anticipated for production and the additional 4 years accounting for the construction and closure phases.

The Project will consist of a number of operational components including:

- Mine site infrastructure such as run of mine (ROM) pad, haul roads, a mill and concentrator, laboratory, tailings storage facility (TSF) and associated TSF evaporation basin, dewatering evaporation basin, access road, power generation, hardstand area, diesel storage and refuelling area, workshop, site office, explosives magazine, potable water storage tank, bioremediation facility, landfill site, fire breaks and perimeter fence
- Transport of concentrate to Wyndham Port *via* road train
- Short term storage and export of concentrate from Wyndham Port

The Project is being developed by the Sorby Hills Joint Venture partners KBL Mining Ltd (KBL) (formerly Kimberley Metals Ltd) of Australia (75 %) and Yuguang (Australia) Pty Ltd, a wholly owned subsidiary of China's largest lead producer, Henan Yuguang Gold and Lead Co., Ltd (HYG&L) (25 %). The Manager of the Joint Venture is SMPL, which is 100 % owned by KBL.

Impact Assessment and Management

The primary purpose of a Public Environmental Review (PER) is to present an Environmental Impact Assessment (EIA) of the proposed Project to all stakeholders with the aim of emphasising how the Project may impact on key environmental factors and how these impacts may be mitigated and managed so as to be environmentally acceptable.

SMPL is committed to the responsible development of the Project and will endeavour to develop the Project to meet the environmental expectations of current and future stakeholders.

This Revised Environmental Review (RER) document is a revised version of SMPL's original PER based on public submissions and feedback from the OEPA.

Summary of Key Preliminary Environmental Factors and Environmental Management

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
Biophysical Factors				
Flora and Vegetation – Relevant to the Victoria Bonaparte Bioregion, with emphasis on the Project Area and immediate surrounds				
• Maintain the abundance, diversity, geographic distribution and productivity of flora species and ecosystem levels and the vegetation units in which they occur through the avoidance or management of adverse impacts and improvement in knowledge	• The Project Area supports eight vegetation units; the condition of the vegetation ranges from Excellent to Completely Degraded • The Project tenements support two areas that may be classified as the 'Monsoon vine thickets of limestone ranges' which are a Priority 1 Priority Ecological Community (PEC) • A total of 334 taxa (species, subspecies and varieties) from 69 families and 201 genera have been recorded in the Project Area • No Declared Rare Flora (DRF) were located, however 16 flora of conservation significance are known to occur	• Clearing of 573 ha of native vegetation • Loss of a proportion of flora species of conservation significance • Vehicle and earth movements could potentially introduce or spread weeds which may result in competition for resources with native flora, cause degradation of habitats and reduce rehabilitation success • Mine development and operation has the potential to increase the number of ignition sources which may increase fire frequency/intensity and, as a result, favour the establishment of weeds and prevent the regeneration of native species • Dust settling on soil and vegetation foliage may result in physical effects such as stomata blockage causing plant death and altered soil chemistry	• All disturbance areas have been subjected to biological surveys and have been selected at the design phase to minimise impacts to flora and vegetation of conservation significance • Where possible, infrastructure is located on pre-cleared/disturbed areas • Creation of a self-imposed Development Exclusion Boundary to maintain biological diversity and preserve the two areas of the Priority 1 PEC 'Monsoon vine thickets of limestone ranges' • Internal clearing procedure will be implemented • Progressive rehabilitation will be conducted throughout the Project life and revegetation continued after cessation of production • Weed mapping will be undertaken and a weed inventory will be maintained • Implementation of weed hygiene and management procedures • Appropriate firebreaks will be created and maintained • Procedure and permitting process for all hot work	• The removal of 573 ha of native vegetation over the life of the Project and the subsequent progressive rehabilitation of that same area of land • Implementation of environmental management plans and strategies will help to avoid or minimise impacts to flora and vegetation • No significant impact to the Priority 1 PEC 'Monsoon vine thickets of limestone ranges' due to implementation of the Development Exclusion Zone • No significant impact to the majority of flora taxa of conservation significance due to strategic placement of impact footprint and implementation of the Development Exclusion Zone • Avoidance of the introduction and spread of weeds • No increase in frequency, and a reduction in size and intensity of wild fires

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
		• Vegetation scalding or death from use of brackish water for dust suppression • Changes in surface hydrology due to infrastructure could impact flora and vegetation that are adapted to the natural surface water fluctuations	• Implementation of safe smoking practices and appropriate disposal of cigarette butts • All fires will be investigated • Implementation of dust management strategies and procedures • Water sprayed onto haul roads will be contained within bunding • Equipment suitable for the task will be utilised for dust suppression • Water will be applied at an appropriate rate • Any saline water spills or leaks will be contained and cleaned up • Installation of appropriately designed and located culverts to minimise potential for water ponding • Collection and storage of seed from flora species of conservation significance for replanting at the rehabilitation stage • Stock for replanting flora species of conservation significance can be collected from topsoil at the time of land clearing	• No noticeable evidence of dust accumulation on roadside vegetation following the wet season • Any accumulated saline residue from dust suppression will not impact vegetation • No surface water to accumulate in areas other than those that naturally occur or those that have been engineered into the Project design
Fauna – Relevant to the Victoria Bonaparte Bioregion, with emphasis on the Project Area and immediate surrounds				
• Maintain the abundance, diversity, geographic distribution and productivity of fauna	• There is potential for 12 ground dwelling fauna species of conservation significance to occur in the Project Area	• Vegetation clearing will directly disturb fauna habitat and may result in the loss or displacement of individuals	• All disturbance areas have been subjected to biological surveys and have been designed to minimise impacts to fauna of conservation significance	• The Project will result in the loss of approximately 573 ha of native vegetation and fauna habitat, however, high value fauna habitat will be retained

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge	• Ornithological surveys in the region found five *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act)* species of conservation significance within the vicinity of the Project Area and 2 species listed as Priority 4 by the Department of Parks and Wildlife (DPaW), formerly the Department of Environment and Conservation (DEC)	• Activities associated with the Project such as increased movement of personnel and machinery may result in disturbance to, or the loss or displacement of fauna • Secondary impacts, such as altered fire regimes, increased light and noise, and dust deposition over the life of the Project, may reduce the value of fauna habitat that remains after clearing • The Project may potentially increase the presence of feral animals in the area which could result in competition, predation and/or habitat degradation	• Infrastructure located on pre-cleared/disturbed areas • Development Exclusion Boundary implemented to maintain biological diversity, ecological function and the most valuable habitats for threatened species such as the Gouldian Finch • Internal clearing procedure will be implemented • Cleared areas will be rehabilitated as soon as practicable. This will include replacing vegetation as this provides refuge for fauna and the construction of Gouldian Finch artificial nest boxes, these strategies will help offset the impacts of clearing • All habitats identified as the Priority 1 PEC 'Monsoon vine thickets of limestone ranges' are to be avoided (i.e. Development Exclusion Boundary) • Implement dust management strategies and procedures • Management of fire directly associated with construction and operations will focus primarily on prevention and control • Destocking of the Project Area • Implementation of management controls for feral fauna • Implementation of good housekeeping and waste control • Speed limits will apply to all vehicles on	due to implementation of the Development Exclusion Zone • Implementation of environmental management plans and strategies will help to avoid or minimise impacts to fauna • No significant impact to fauna habitat of high conservation significance • No significant impact to fauna occupying the Priority 1 PEC 'Monsoon vine thickets of limestone ranges' due to implementation of the Development Exclusion Zone • No significant impact to fauna of conservation significance due to strategic placement of impact footprint and implementation of the Development Exclusion Zone • No increase in frequency, and a reduction in size and intensity of wild fires • No noticeable evidence of dust accumulation causing a decline in vegetation health and the subsequent decrease of fauna habitat values • No surface water to accumulate in areas other than those that naturally occur or

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			site to reduce the potential for impacts to fauna on site roads • Site personnel will be discouraged from feeding wildlife	those that have been engineered into the Project design
Short Range Endemic (SRE) Fauna – Relevant to the Project Area and immediate surrounds				
• Maintain the abundance, diversity, geographic distribution and productivity of fauna species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge	• Habitats likely to promote short range endemism do not occur in the Project Development Envelope of the Project Area	• It is considered that there is little or no potential for the Project to impact on SRE fauna	• Given the assessment that habitats likely to promote short range endemism do not occur in the Project Area, no management strategies are proposed	• No significant impact to SRE fauna
Subterranean Fauna (Stygofauna and Troglofauna) – Relevant to the Project Area where it is subject to below ground level disturbance and the Project's zone of hydrological influence				
• Maintain the abundance, diversity, geographic distribution and productivity of fauna species and ecosystem levels through the avoidance or management of adverse impacts and	• Within the proposed impact area, the occurrence of very fine grained alluvial sediments unlikely to contain extensive interconnected voids, the generally shallow water table and seasonal inundation suggest that there is no suitable habitat for troglofauna to occupy; therefore it is unlikely that troglofauna occur	• As the habitat present in the Project Area is not favourable for troglofauna and is unlikely to contain significant troglofauna communities it is considered that there is little or no potential for the Project to impact on troglofauna • It is possible that the Project may impact local populations of	• Given the findings of the subterranean fauna assessment, no management strategies are proposed, SMPL will however minimise pit disturbance areas and dewatering activities wherever possible	• No significant impacts to troglofauna are anticipated • No significant impacts are anticipated to local populations of stygofauna through the excavation of ore and dewatering activities

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
improvement in knowledge	in the Project Area • Stygofauna are known to occur in the area and a subterranean fauna assessment carried out for the Project identified the presence of ten species. All of the species were new to science and therefore none are currently listed as specially protected under either Commonwealth or Western Australian legislative or policy frameworks. Of the ten species, all but one was collected outside of the proposed Primary Impact Footprint. The single species known only from the Primary Impact Footprint was collected as a single valve and is considered to be a surface water species with a range likely to be orders of magnitude greater than the Primary Impact Footprint	stygofauna through the excavation of ore and dewatering activities, however based on the findings of the subterranean fauna assessment it is considered unlikely that the localised impact will have a significant effect on regional populations or threaten the persistence of any stygofauna species		
Conservation Areas – Relevant to the proposed Goomig Range Conservation Park (GRCP)				
• Protect the environmental values of areas identified as having significant environmental attributes	• The proposed GRCP is located immediately adjacent to the Project Area. The GRCP covers 17,900 ha and contains the Pincombe and Cave Spring Ranges. The ranges trend north east to south west and form a	• Dust from mining activities in the Project Area may result in increased dust levels in the GRCP which may physically effect vegetation • Increased fire frequency/intensity due to	• Self-imposed Development Exclusion Boundary which provides a buffer zone between the GRCP and the area to be directly impacted by the Project. This will lessen the intensity or severity of impacts associated with vibration, noise and odour	• Implementation of environmental management plans and strategies will help to avoid or minimise indirect impacts to the GRCP • Active environmental management by DPaW will

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
	series of parallel ridges • The GRCP is dominated by open woodland composed of *Corymbia dichromophloia* (Variable-barked Bloodwood), *Eucalyptus miniata* (Darwin Woollybutt) and *Eucalyptus tetrodonta* (Darwin Stringybark) with *Triodia bitextura* (Curly Spinifex) and sorghum grasses	Project activities may favour the establishment of weeds and prevent the regeneration of native species in the GRCP • Fauna displaced due to clearing in the Project Area may increase resource competition in the GRCP • Increased noise and vibration levels due to blasting and use of vehicles and machinery may impact fauna in the GRCP or contribute to the displacement of fauna from the Project Area to the adjacent GRCP, subsequently increasing ecological pressure on those species that already occur in GRCP • Increased traffic and personnel may contribute to weed encroachment • Restriction of public access to the GRCP due to closure of informal GRCP access tracks within the Project tenements may reduce recreational value of the GRCP	• Implementation of management controls for fire and emissions such as noise, light, vibration, dust and odour • Improved public access to the GRCP through DPaW managed roads, day use areas and camp grounds	likely combine to stabilise, if not enhance, the conservation values of the GRCP • No significant impacts to the GRCP anticipated • Carefully monitored noise and vibration levels due to blasting and use of vehicles and machinery, minimal impact on fauna in the GRCP or displacement of fauna from the Project to the GRCP • No increase in weed abundance from increased traffic and personnel • Closure of informal GRCP access tracks within the tenement will have little impact to public access and recreational value

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
Physical Factors				
Surface Water – Relevant to the Project site and immediate surrounds				
• Maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected • Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	• The Project Area is located in the upper portions of the Knox Creek and Keep River catchments; all surface flows within the Project Area tend south east towards these watercourses. No significant creeks or defined drainage systems occur within the Project Area; the ephemeral Border and Knox Creeks are located 3.5 km to the north and south respectively, and the Keep River (which Knox Creek flows into) is situated 4.6 km to the south east • Throughout the wet season the Project Area is subject to waterlogging and surface flooding conditions. During intense rainfall events (i.e. a 1 in 100 year, 72 hour flood event) the water level is likely to rise approximately 1 m above ground level and remain for extended periods	• Localised modification of flow paths due to diversionary works to protect site infrastructure • Ponding of water upstream of infrastructure • Changes to surface hydrology resulting from creation of the dewatering evaporation basin for containment of runoff and dewatering • Increased erosion due to alterations of natural flow paths • Sedimentation or contamination of surface water due to Project activities or design • Pollution of surface water due to the inappropriate storage of hydrocarbons, process chemicals and other dangerous goods	• All infrastructure situated in areas where flooding of water is likely will be raised to a height of at least 1 m above the floodplain level to withstand 1 in 100 year, 72 hour flood events • Runoff from the upstream catchment will be diverted around critical infrastructure by the site enveloping alignment of the haul road. The haul road has been designed to function as a surface water diversion bund and will offer a 2.8 m flood protection barrier which will minimise the potential of overtopping during a flood in excess of the 1 in 100 year, 72 hour flood event • The TSF is designed to accommodate at least a 1 in 100 year, 72 hour flood event, nevertheless the associated TSF evaporation basin has been sized to contain water from the TSF generated during a 1 in 100 year, 72 hour flood event • Creation of the dewatering evaporation basin for the capture and storage of runoff from within the haul road envelope and dewatering not required for processing. • Stockpiles will be placed to act as surface water diversion bunds	• Project designed to minimise impacts to surface water • Implementation of environmental management plans and strategies will help to avoid or minimise impacts • No significant impact to surface water quantity or quality as a result of Project operations • No predicted increase in erosion • No anticipated sedimentation or contamination of surface water due to Project activities • No or only minor spills of hydrocarbons, process chemicals and other dangerous goods may occur, therefore, greatly reducing the risk of environmental harm

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			• Flood bunds will be constructed around site infrastructure such as the landfill facility to divert clean water away and contain any potentially sediment laden or contaminated surface waters within the work area • Haul road envelope and surface water diversion bunding will divert clean runoff from the surrounding environment away from the internal infrastructure areas to ensure this water does not become sediment laden or contaminated • Installation of appropriately designed and located culverts to minimise potential for water ponding • Appropriately designed and located sediment trapping devices will be installed to ensure that sediment laden waters do not enter the adjacent environment • Water from the ROM pad and plant site will drain into collection sumps and be transferred to the process circuit • Potentially contaminated surface water (e.g. from workshop wash down facilities) will pass through a treatment system such as a triple interceptor or coalescing plate separator • Implementation of management controls for the handling and storage of hydrocarbons and process chemicals • Surface water monitoring program; quality will be assessed in relation to	

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			guideline trigger values and baseline data	
Groundwater – Relevant to the Project site and immediate surrounds				
• Maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected • Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	• Within the Project Area two aquifers have been found to occur, variability in hydraulic conductivity suggests that these are faulted/fractured rock aquifers • Groundwater levels are highest at the southern end of the Project tenements where they range from 14.4 m Australian Height Datum (AHD) to 8.2 m AHD adjacent to Knox Creek • Groundwater is generally neutral pH and brackish. The cation/anion balance of the groundwater shows no dominant water type other than an overall predominance associated with sodium, magnesium, calcium, sulphate and bicarbonate • The groundwater flow gradient beneath the Project Area is towards Border Creek. Therefore groundwater from the Project Area will not flow towards the Ord River Irrigation Area – Weaber Plains Development Project (ORIA –	• Pollution of groundwater due to the inappropriate storage of hydrocarbons and process chemicals • Contamination of groundwater due to Project activities or design • Contamination of groundwater due to inadequate closure planning for mine voids and TSF • Unsustainable abstraction of groundwater • Excessive dewatering drawdowns outside of the Project Area • Possible impacts to groundwater dependant ecosystems	• Implementation of management controls for the handling and storage of hydrocarbons and process chemicals • Implementation of TSF management and monitoring strategies • Ensure appropriate licences are obtained for water abstraction on the site. • No extraction of groundwater beyond that permitted under the water licence. • A monthly monitoring programme will be carried out to assess water levels associated with the production bores and vegetation health in proximity; data to be reported in Annual Environmental Report (AER) • Report annual water use to the appropriate regulatory authority • Water demands to be offset through use of water from dewatering activities for processing and the recycling of process waters • Minimisation techniques for water use incorporated into the Project's Operational Environmental Management Plan (OEMP) • Bores and associated pipelines will be inspected regularly to ensure any leaks are detected and repaired promptly	• Appropriate storage of hydrocarbons and process chemicals, will reduce the risk of groundwater pollution • Implementation of environmental management plans and strategies will help to avoid or minimise impacts • Drawdown is not anticipated to be extensive with the drawdown impact area limited to the immediate vicinity of the pits • The groundwater aquifers are rainfall recharged and therefore not anticipated to be affected by long term water extraction • No impacts to groundwater dependent ecosystems are anticipated as it is unlikely that troglofauna will occur and regional representation of stygofauna is not likely to be threatened by the localised impact of the Project • No impacts to flora and vegetation are anticipated as drawdown will be limited to

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
	Weaber Plains Project)		• Development of comprehensive closure strategies for the TSF and pit voids • Establish a groundwater monitoring program; quality will be assessed in relation to guideline trigger values and baseline data	the immediate vicinity of the pits • There is expected to be no significant impact on regional groundwater resources or groundwater quality as a result of Project operations
Pollution and Emissions Management				
Mining Waste and Potential Contaminants – Relevant to the Project site				
• Ensure that mining waste is suitably managed such that it does not adversely affect environmental values or the health, welfare and amenity of people and land uses in the vicinity of the Project	Geochemical characterisation has identified that: • The majority of the waste rock can be classified as Non-acid Forming (NAF) with a low potential to produce Acid Rock Drainage (ARD) • There is a localised presence of Potentially Acid Forming (PAF) materials within the proposed mine voids • There is a low risk of Metalliferous Drainage (MD)	Contamination of soils, surface water and groundwater through: • Generation of ARD • Release of suspended sediment laden runoff into the environment	• Block modelling and scheduling carried out to enable NAF and PAF materials to be successfully delineated and segregated during mining and subsequently managed • On site Net Acid Generation pH (NAGpH) testing carried out as part of grade control and visual inspection of drill chips and blasted ground conducted to determine expected PAF intersection • Ensure expected intersection with PAF materials is communicated to appropriate personnel • PAF waste will either be placed into an in-pit waste dump or in-pit sump specifically designed for that purpose • Kinetic test work will be undertaken to confirm NAF waste rock characterisation remains the same as operations progress • Sufficient volume of competent NAF dolomite will be segregated for later use	• Implementation of environmental management plans and strategies and correct handling techniques for PAF materials will help to avoid or minimise impacts • No significant impacts are anticipated as a result of mining wastes at the Project

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			in rehabilitation to stabilise the post-mine land surfaces • Appropriately designed and located sediment trapping devices will be installed to ensure that sediment laden waters do not enter the adjacent environment • Surface water monitoring program; water quality will be assessed against guideline trigger values and baseline data	
Tailings Characterisation and Storage (TSF Design, Construction and Management) – Relevant to the Project site				
• Ensure that processing waste is suitably managed such that it does not adversely affect environmental values or the health, welfare and amenity of people and land uses in the vicinity of the Project	• Tailings will be discharged and stored within a purposed built above ground paddock style TSF • Geochemical characterisation classified the tailings as NAF, with elevated carbonate content and a highly alkaline pH. This together with the low content of available oxyanions metals and metalloids, results in a low potential for ARD or MD to occur. Analysis of the tailings materials also identified Thallium (Tl)	• Contamination of soils, surface water or groundwater through: ▪ Tailings seepage ▪ Leaching of poor quality water and subsequent indirect effects on the surface environment manifested as vegetation stress or death due to changes in soil chemistry and groundwater quality ▪ Accidental release (e.g. overtopping) of poor quality water/tailings slurry • Fauna utilising the TSF and associated TSF evaporation basin as a water source	• Implement appropriate design, planning and management measures • TSF designed in accordance with the Department of Mines and Petroleum (DMP) *Guidelines on the Safe Design and Operating Standards for Tailings Storage (1999)* and assigned a hazard rating of Low, Category 2, with the probability of embankment failure assessed as low • TSF design and construction materials will minimise the potential for seepage; the flow volume from the facility is expected to be less than 5 cubic metres per day (m^3/d) • Kinetic test work will be undertaken to confirm tailings characterisation remains the same as operations progress • Prior to TSF construction, remnant sterilisation drill holes will be sealed with bentonite to prevent flow from the TSF	• Tailings materials contain elevated carbonate content and are classified as NAF; as such ARD seepage is not anticipated • Metalliferous seepage is not anticipated as the source rocks do not contain mobile enriched metals and the subsequent risk of elevated metals content within the tailings solution is low • Tl levels are within limits that will allow material to be effectively managed within the TSF and avoid any hazard to the environment or human health • Overflow risk assessment suggests that it is only the process chemicals sodium

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			into the subsurface geology through preferential pathways • TSF positioned within the haul road envelope which will act as flood diversion bunding to protect the TSF from the potentially damaging effects of stormwater runoff • Pipelines will be located within the haul road safety bunding which will serve to contain spills or leaks • The TSF will not be used for water storage; water will be removed via decant structures and pumped into the adjacent TSF evaporation basin. Both the TSF and associated TSF evaporation basin will have the capacity to cater for a 1 in 100 year, 72 hour flood event • Risk assessment carried out into the potential environmental effects in the unlikely event of a significant overflow from the TSF • Implement comprehensive monitoring and inspection program • Avifauna will be discouraged from utilising the TSF using 'Scare Guns' (blast cannons) and reflective material placed around the periphery • Analysis of bird feathers collected from TSF for traces of heavy metals • Fencing will be erected around the Project Development Envelope (following the firebreaks) as part of the destocking process which will keep macro fauna	hydrogen sulphide and xanthates that may impact organisms and then only when the overflow is minimally diluted in proximity of the TSF • Implementation of environmental management plans and strategies will help to avoid or minimise impacts • No significant impacts are anticipated as a result of tailings storage

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			away from the TSF. Barbed wire will not be used	
Concentrate Emissions – Relevant to the Project site and immediate surrounds, Wyndham Port and the community of Wyndham				
• Ensure emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	• The Project will produce approximately 45,000 tpa of concentrate for export. Concentrate will be transported from the Project site to Wyndham Port in sealed containers via road train; there will be an average of 12 return truck movements per week. Shipping will occur once per month • The concentrate to be produced by the Project is of Ag Pb Zn composition with a lead grade of around 64 % • The concentrate will be transported as a Class 6.1 lead compound, soluble, N.O.S. (UN 2291, packaging group III) with a subsidiary environmental hazard (Class 9) classification for marine transport	Impacts at the Project site and/or Wyndham Port include: • Adverse effects to human health • Pollution of the terrestrial and/or marine environments • Degradation of terrestrial and/or marine habitats • Loss of terrestrial and/or marine flora and fauna	• A range of rules and procedures will be implemented at all stages of the concentrate handling process • Minimal direct handling of concentrate by utilising a predominantly mechanised system • Storage and handling of concentrate will comply with relevant regulations • SMPL propose to use "Rotabox" (or similar) shipping containers for the collection, storage and transport of concentrate; there will be no requirement for internal bags or packaging • "Rotabox" containers are purpose built, stackable, bulk ore containers that can be fully sealed with lockable lids that include a weather resistant seal • Use of containers eliminates the requirement for stockpiling of concentrate both at the Project site and Wyndham Port • Container design has taken into account the key material handling characteristics of the concentrate and the containers are built to comply with International Standards Organisation (ISO) 1496-1:1990 *Series 1 Freight Containers*	• Avoidance of open concentrate stockpiles • Use of containerised system and implementation of environmental management plans and strategies will help to avoid or minimise impacts • No adverse effects to human health are anticipated • No predicted pollution or degradation of terrestrial and/or marine environments • No predicted loss of terrestrial and/or marine flora and fauna • No significant impacts are anticipated as a result of concentrate storage and handling

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			Specification and Testing (Part 1) • Concentrate will be loaded directly into containers – the loading system will be integrated in to the final stage of the production process • Container loading dock will be situated within a covered concrete bunker • Containers will be inspected prior to leaving the Project site and upon arrival at Wyndham Port • Concentrate will be transferred directly into the ships hold using a container rotation system specifically designed to minimise the chance of spillage and fugitive dust emissions • Locks and lids will only be removed from the containers immediately prior to unloading of the concentrate • Shipping will be carried out to current world standards • Produce and implement Port Operations Environmental Management Plan (POEMP)	
Marine Environment – Relevant to marine environment in the vicinity of Wyndham Port				
• Ensure emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses	• Wyndham port is situated on the eastern bank of the West Arm Estuary of the Cambridge Gulf • Wyndham port is fully operational; no new	• Pollution of the marine environment and degradation of marine habitats • Loss of marine flora and fauna • Pollution of the terrestrial environment and degradation	• All relevant actions undertaken at Wyndham Port must comply with the *Dangerous Goods Safety Act 2004*, specifically the *Dangerous Goods Safety (Goods in Ports) Regulations 2007* • The *Dangerous Goods Safety (Goods in*	• Avoidance of open concentrate stockpiles • Use of containerised system and implementation of environmental management plans and strategies will help to

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
by meeting statutory requirements and acceptable standards	infrastructure will be required to facilitate SMPL operations and current dredging schedules will not need to be altered • Wyndham Port is currently listed as a contaminated site under the *Contaminated Sites Act 2003* however the land is deemed suitable for industrial or commercial use and is not in the vicinity of Project operations • The waters surrounding Wyndham Port have a high turbidity which limits the number of species that can utilise the environment. An appraisal of the Commonwealth and Western Australian legislation in conjunction with an assessment of available habitat revealed that 36 protected species have the potential to occur; of these only 16 have actually been recorded in the area	of habitat in proximity to Wyndham Port • Loss of terrestrial flora and fauna	*Ports) Regulations 2007* require port operators to comply with Australian Standard (AS) 3846-2005 *The Handling and Transport of Dangerous Cargoes in Port Areas* • A range of rules and procedures will be implemented at all stages of the concentrate handling process • Utilisation of a container system which is predominantly mechanised eliminates the requirement for stockpiling of concentrate at Wyndham Port • Concentrate will be transferred directly into the ships hold using a container rotation system specifically designed to minimise the chance of spillage and fugitive dust emissions • Moisture content levels in the concentrate will be monitored to ensure optimum conditions for dust control during ship loading • Quarterly monitoring of soil and marine sediments at Wyndham Port for Ag, Pb and Zn • Shipping will be carried out to current world standards	avoid or minimise impacts • No significant impacts are anticipated as a result of concentrate storage, handling and ship loading • There is little threat posed to the marine environment through pollution • Marine flora and fauna are not predicted to decline • The terrestrial environment in the vicinity of Wyndham Port is not expected to become polluted
Dust Emissions – Relevant to the Project site and immediate surrounds, Wyndham Port and the community of Wyndham				
• Ensure emissions do not adversely affect environmental values or the health, welfare	• Dust may be generated by the Project in a number of ways during construction and ongoing operations. Key	• Fauna, flora and vegetation on site and in the immediate vicinity may be adversely affected by an increase in dusty	• Onsite dust sampling program established to measure baseline dust fall • Comprehensive dust monitoring program	• Implementation of environmental management plans and strategies will help to

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
and amenity of people and land uses by meeting statutory requirements and acceptable standards	emission sources will include: ▪ Vegetation and topsoil removal ▪ Earthworks ▪ Wind erosion of cleared areas and stockpiles ▪ Wheel generated dust from travelling on unsealed roads ▪ Drilling and blasting activities ▪ Extraction, transfer and crushing of ore ▪ Road side dust mobilisation from concentrate haulage trucks	conditions • Adverse health impacts for the workforce on site and at Wyndham Port if staff are exposed to unacceptable levels of dust • Road side dust mobilisation as a result of ore haulage through the community of Wyndham may become a health risk, cause annoyance and reduce the amenity of the township • Potential impacts to adjacent sensitive receptors	will be implemented upon commencement of construction • Visual monitoring of dust will be regularly conducted and activities will be halted if adverse conditions result in excessive dust generation • Photographic monitoring points of vegetation adjacent to high dust generating sources will be established • Weather conditions will be assessed prior to blasting and blasting will not be undertaken during unfavourable conditions • Utilisation of a water cart for dust suppression of roads, stockpiles etc. • Dust suppression systems on the crusher, process conveyors and all ore transfer points • Water, or where appropriate dust suppressants, will be used to minimise dust generation from cleared areas where fugitive dust is recognised as a problem • All vehicles on site will be confined to designated routes with speed limits enforced • All road edges will be clearly defined to control their locations • Speed restrictions will apply to all concentrate haulage trucks whilst travelling on site, through the township of Wyndham and whilst at Wyndham	avoid or minimise • No significant dust impacts are anticipated as a result of Project operations • Dust is not considered likely to cause health or amenity issues to neighbouring residents, agricultural land or conservation reserves

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			Port • In the event that airborne dust cannot be managed to an acceptable level in a particular work area, personal protective equipment (PPE) requirements will be adopted and enforced	
Hydrocarbons, Process Chemicals and other Dangerous Goods – Relevant to the Project site				
• Manage hydrocarbons, process chemicals and other dangerous goods in a manner that minimises environmental impacts to ensure affects to soil, groundwater or surface water quality are avoided	• Substances required for the operation of the Project will include: ▪ Diesel fuel ▪ Oil ▪ Lubricants ▪ Gasses, reagents and process chemicals ▪ Explosives ▪ Radiation	• Contamination of soils, surface water or groundwater • Adverse effects to fauna and fauna habitats	• All hydrocarbon storage areas will be designed in accordance with Australian Standard/New Zealand Standard (AS/NZS) *1940:2004 –Storage and Handling of Flammable and* Combustible *Liquids* and have Material Safety Data Sheets (MSDS's) located at storage sites • Self-bunded fuel storage tanks to be installed • Oils and lubricants will be stored in a weatherproof sea container • Provide a suitable level of training to staff and contractors identified to be involved in hydrocarbon management to ensure they are aware of SMPL's requirements for use, storage and disposal • Ensure spill response equipment is available and procedures are communicated effectively • Bioremediation facility will be established to treat contaminated soil in situ	• As a result of the implementation of management measures, no adverse effects to faunal habitats or contamination of soils, surface water or groundwater is anticipated as a result of hydrocarbons, process chemicals or other dangerous goods

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			• Appropriate licences and requirements of the *Dangerous Goods Safety Act 2004* will be implemented wherever necessary • Bunded, purpose built storage and reagent handling facilities will be incorporated into the process plant and specific handling, storage and spill response procedures will be implemented • Explosives will be stored in a dedicated explosives magazine in compliance with the *Dangerous Goods Safety Act 2004*, the *Dangerous Goods Safety (Explosives) Regulations 2007* and *AS 2187.1:1998, Explosives – Storage, transport and use, Part 1* • Disposal of dangerous goods will be in accordance with MSDS's and any requirements from the Department of Environment Regulation (DER)	
Non-mineral Waste – Relevant to the Project site				
• Manage non-mineral wastes generated by the Project in a manner that minimises environmental impacts to ensure that wastes do not affect groundwater or surface water quality, nor result in soil	Various forms of non-mining or process wastes will be produced: • Putrescibles, plastics, glass and aluminium from the office and crib room facilities • General litter from human presence • Paper and cardboard from office and warehouse activities	• Contamination of soils, surface water or groundwater • Faunal habitats could be adversely affected • Encourage feral species and increase pest activity	• Waste streams have been identified and appropriate segregation and disposal methods will be adopted • Due to the relatively remote location of the Project site full recycling programs may be inhibited, however recycling is a preference and all options will be explored • The "Reduce, Reuse, Recycle and Recover" principles will be employed to	• Implementation of environmental management plans and strategies will help to avoid or minimise impacts • No significant impacts are anticipated as a result of non-mineral waste

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
contamination	• Scrap metal • Tyres • Wood from pellets and packaging • Hydrocarbon wastes, particularly waste oil • Chemical packaging products • Laboratory wastes • Medical wastes • Sewage related wastes		minimise disposal requirements • Good housekeeping and rubbish disposal practices will be established to avoid attracting feral animals, pests and other wildlife throughout operation of the Project • Waste storage areas will be appropriately signposted, regularly inspected and kept clean. • A 'no littering' policy will be implemented • For wastes which cannot be recycled, a landfill facility will be established on site. The landfill will be constructed and managed in accordance with DER licence conditions • Construct and manage bioremediation facility in accordance with the *Contaminated Sites Management Series Guideline for Bioremediation of Hydrocarbon Contaminated Soils in Western Australia (DEC 2004)* • Sewage will be treated using a bio-sewage system that will conform to the standards of the Shire of Wyndham East Kimberley (SWEK) and any Department of Health (DoH) requirements	
Greenhouse Gas (GHG) Emissions – Relevant to the Kimberley Region				
• To minimise emissions to levels as low as practicable on	GHG emissions will be generated by the Project in a number of ways during construction and ongoing	• Over the duration of the Project life from 2013 to 2027, it is estimated that the Project	• GHG emissions will be kept as low as practicable at all times in accordance with the objectives outlined in *EPA*	• Given the low GHG emissions expected from the annual operation of the Project and

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
an on-going basis and consider offsets to further reduce cumulative emissions	operations; the key emission sources will include: • Land clearing • Combustion of fuel by diesel powered generators, machinery, equipment and vehicles	will emit up to 596,104 t CO2-e (tonnes carbon dioxide equivalent) of emissions • Overall, Australia's total direct annual emissions for 2009/2010 were 560.8 Mt (million tonnes) t CO2-e and Australia's direct annual emissions from the mining sector in 2009/2010 were 65.1 Mt t CO2-e. By comparison, the annual operation of the Project mine is projected to represent approximately 0.005 % of Australia's total emissions and 0.9 % of Australia's total direct mining emissions respectively	*Guidance Statement No. 12: Minimising Greenhouse Gases (2002)* • Disturbance footprint and vegetation clearing minimised • Site layout designed for maximum efficiency • Implement management strategies for procurement • Maintenance of all vehicles, plant and equipment will be in accordance with manufacturers' specifications and relevant standards to retain high levels of energy efficiency • Exhaust controls will be fitted to equipment in keeping with Australian design rules and good industry practice • Energy efficient equipment will be incorporated into the processing plant • Controlled regrowth of low vegetation will be allowed in areas where it will not cause adverse operational safety impacts in order to absorb and compensate for carbon dioxide (CO_2) emitted from vegetation clearing • Development of key performance indicators for efficiency and GHG intensity • Regular monitoring, auditing and reporting on energy and resource usage and GHG emissions from all relevant activities with a view to progressively improving energy efficiency and investigation of renewable sources (e.g.	the mitigating measures described, no significant impacts from GHG emissions are anticipated

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			solar generation) where feasible • Continual evaluation of the success of any abatement measure undertaken, and investigation and adoption of new opportunities as they become available	
Other Emissions (Noise, Vibration, Light and Odour) – Relevant to the Project site and immediate surrounds, Wyndham Port Facility and the community of Wyndham				
• To protect the amenity of nearby residents from noise impacts resulting from activities associated with the Project by ensuring noise levels meet statutory requirements and acceptable standards • To avoid or manage potential impacts from light overspill and comply with acceptable standards • To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and	• The Project Area and surrounds are currently largely undisturbed with most noise sources being natural with very occasional vehicle noise from the Weaber Plain Road. There is no artificial lighting aside from a few scattered lights for agricultural purposes outside of the Project Area • Noise, vibrations, light and odour may be generated by the Project in a number of ways during construction and ongoing operations, the key emission sources will include: ▪ Project construction ▪ Drilling and blasting activities ▪ Extraction, transfer, crushing and processing of ore. ▪ Transportation of concentrate ▪ On site landfill facility ▪ Lighting required for the 24	• Fauna on site and in the immediate vicinity may be adversely affected by an increase in noise, vibration, odour and light emissions • Noise and vibration emissions may lead to occupational health and safety impacts for the workforce on site and at Wyndham Port • Noise and vibration emissions may impact on the Wyndham community as a result of ore haulage trucks passing through the town • Light emissions may impact on users of the Weaber Plain Road during hours of darkness as a result of the 24 hour operation of the crushing and processing facilities • Odour emissions from the processing plant and landfill may result in occupational health and safety impacts for	• Concentrate haulage trucks will only operate during daylight hours • Speed restrictions will be enforced and a ban on exhaust braking will be applied for concentrate haulage trucks whilst travelling through Wyndham township • Trucks will be serviced and maintained to system requirements and relevant standards to retain an appropriate sound power level • All complaints regarding noise emissions will be investigated and mitigating measures implemented where required • Blasting will be designed to minimise noise projection and comply with noise standards • Blasting will only occur during daylight hours • Construction activities will be carried out in accordance with *AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites* • Operational activities will comply with the standards for operational noise set	• Impacts during construction and operations are not anticipated to be significant as the nearest fixed sensitive receptor (residential) is approximately 25 km away from the Project site and the Weaber Plain Road experiences only very occasional use by pastoralists or members of the public for recreational purposes • Hauling concentrate only during the daylight hours will result in no significant impact of vehicles on fauna • Little effect will be experienced by communities as haulage trucks will travel common haulage routes • Management plans will be in place to prevent odour emissions from the processing plant and landfill

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
acceptable standards	hour operation of the processing plant	the workforce on site	by the *Environmental Protection (Noise) Regulations 1997* • New generators will be used and they will have modern noise suppression devices attached • Vehicles, plant, equipment and generators will be serviced and maintained to system requirements to retain an appropriate sound power level • Mechanical plant will be fitted with noise suppression devices maintained to manufacturers specifications. Internal combustion engines will be fitted with a suitable muffler in good repair • Where necessary, mitigation measures such as earthen bunds and noise walls will be used • Wearing of appropriate PPE will be enforced to reduce noise impacts on workers • Frequency modulated reversing alarms will be installed on all relevant equipment • Consideration will be given to the location of fixed and mobile lighting such that light overspill is limited where practicable • All lighting will be directed inwards at the site to result in a “glow” being visible from the Weaber Plain Road rather than direct light • ‘Bug Yellow’ fluorescent lighting (or similar) will be used to limit attraction of	

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			flying insects to permanently lit areas • Shrouding will be used where practicable to reduce light overspill • Site speed limits will be adjusted to suit conditions during the hours of darkness to provide increased driver reaction time should fauna be "stunned" in vehicle head lights • Waste material at the landfill will be covered in accordance with the DER licence to reduce odour emissions	
Social Surroundings				
Visual Amenity – Relevant to the Project site and immediate surrounds				
• To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as practical	The assessment of visual amenity is subjective in that each person has a different perspective on what is, or what is not, visually appealing. The visibility and appearance of a development can be assessed by considering: • Visual magnitude • Visual contrast • Duration	The alteration of the landscape associated with development of the Project may detract from the visual amenity of the area. The potential visual amenity impacts could result from: • Creation of the mine pit voids, stockpiles and TSF • Clearing of native vegetation and ground disturbance associated with construction and mine site infrastructure development • Dust generation during construction and mining operations • Light generation for 24 hour operation of the processing	• Vegetation clearing during construction and operations will be minimised by appropriate planning, design and layout of infrastructure. There will be strict controls and clear delineation of development boundaries • The Project has been designed to maximise the use of pre-cleared and disturbed areas to minimise clearing of vegetation • Where practical infrastructure will be placed such that it is screened by existing vegetation or topographic features to minimise visual intrusion on the landscape • Vegetation screening will be planted	• As a result of the management measures described and given the relative remoteness of the Project Area and comparatively small scale of the operation, no significant impacts to visual amenity are anticipated • Once Project closure occurs, land will be rehabilitated restoring visual amenity • Dust will be kept to a minimum through the use of dust suppressants and water carts • The processing facility will not be visible from the road

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
		facility	where appropriate • Landform heights and slopes designed to ultimately blend into the surrounding landscape • Access road to the site will be curved so the Project will not be directly visible from the Weaber Plain Road • Progressive rehabilitation and revegetation will be undertaken with the aim of re-establishing suitable local vegetation communities to blend into the landscape • Rehabilitation and closure concepts will consider visual amenity • Backfilling of pit voids wherever possible	
Aboriginal Heritage – Relevant to the Project site and immediate surrounds				
• To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation	• No heritage sites have been identified within the Project Area to date and the Traditional Owners (TO's) and Miriuwung Gajerrong (MG) Corporation approve the development of the Project • Although the Project impact footprint has been cleared by extensive heritage assessments there remains the potential for unknown sites of significance or value to be located in the area	• Disturbance to Aboriginal heritage sites and values through physical development of the Project • Impacts to water sources used by indigenous groups in the immediate area and downstream as a result of dewatering activities	• Project footprint altered following ethnographic survey to avoid a limestone hill of Aboriginal heritage significance • Aboriginal heritage assessments will be undertaken prior to any future developments in areas outside of the Project's Aboriginal heritage clearance area • All employees and contractors will be inducted regarding cultural awareness; this will inform personnel of their legal obligations with regards to heritage sites, provide instruction on their duty to look out for cultural heritage material and the	• No significant impacts to Aboriginal heritage are anticipated given the extensive heritage assessments carried out and management measures that will be implemented • No impact to indigenous water sources are anticipated due to Project activities as no natural standing water bodies are present in the Project Area. Additionally, drawdown as a result of dewatering is not expected to extend beyond the Project tenements or have any

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			appropriate course of action to be followed if new sites are identified • Aboriginal Cultural Heritage Management Plan (ACHMP) developed to allow adequate management of known and unknown heritage values which may be located in the Project Area • Development of a Memorandum of Understanding (MOU) with the MG Corporation whose traditional lands the Project site lies within • Ensure clearing only occurs in areas that have been surveyed for Aboriginal heritage significance by competent personnel • Aboriginal heritage will be included in the Environmental Clearance Permit (ECP) process	lasting effect on the groundwater aquifers
Other				
Closure and Rehabilitation – Relevant to the Project site and immediate surrounds				
• To ensure as far as practicable that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values	• SMPL intends to leave the site upon cessation of the Project in a safe and stable condition such that the tenements can be relinquished without any future liability for the company or the community	• Adverse impacts to flora, fauna, soil quality, ground and surface water quality and quantity, visual amenity and economic and social impacts due to poor rehabilitation • Adverse impacts to rehabilitation efforts due to poor quality soil • Poor closure planning resulting	• Mine closure planning has been initiated and a framework of concepts, targets and predicted outcomes has been produced • A Mine Closure Plan (MCP) will be developed in accordance with the DMP/EPA *'Guidelines for Preparing Mine Closure Plans'* (June 2011) • Where appropriate rehabilitation will occur progressively throughout the life of	• Given the closure and rehabilitation concepts, the proposed development of a MCP and the potential for future use of the site following mine closure, SMPL consider the residual impacts of the mining operation to be suitably acceptable over the long term • No predicted adverse impacts

Environmental Protection Authority (EPA) Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
		in the insufficient allocation of funds and/or resources for closure, particularly in the event of unforseen closure	the Project • Implementation of soil management strategies from commencement of land clearing operations	are expected on flora, fauna, soil quality, ground and surface water quality and quantity, visual amenity and economic and social impacts due to poor rehabilitation • Poor soil quality is unlikely to impact on rehabilitation efforts • Sufficient funds and/or resources will be allocated for closure and unforseen closure

Key Environmental Factors and Environmental Management

SMPL is committed to maintaining the ecological integrity of the Project Area and immediate surrounds that are not directly impacted during construction and contributing to other aspects of ecological management relevant to the Project that will result in a net positive environmental impact.

Biophysical Factors

Vegetation, Flora and Fauna

The principal objectives for the management of flora and vegetation are to maintain the abundance, diversity, geographic distribution and productivity of flora species and ecosystem levels through the avoidance or management of adverse impacts and with improvement in knowledge.

A flora and vegetation assessment for the Project identified eight vegetation units within the Project Area; the condition of the vegetation ranged from Excellent to Completely Degraded. The Project tenements support two areas that may be classified as the Priority 1 PEC 'Monsoon vine thickets of limestone ranges'. A total of 334 taxa (species, subspecies and varieties) from 69 families and 201 genera have been recorded in the Project Area. No DRF were located, however 16 flora of conservation significance are known to occur.

Approximately 573 ha of native vegetation will be cleared to accommodate Project infrastructure such as open pits, plant site, TSF, roads, ROM pad and evaporation basins. Potential impacts resulting from this clearing include the loss of a proportion of flora species of conservation significance, loss of sections of vegetation communities and the degradation of various flora and vegetation habitats.

Development of management strategies has focused primarily on avoiding impacts to flora and vegetation through site selection and then on mitigating and managing unavoidable impacts. All disturbance areas have been subjected to biological surveys and have been selected at the design phase to minimise impacts to flora and vegetation of conservation significance. Where possible, infrastructure is located on pre-cleared/disturbed areas. A self-imposed Development Exclusion Boundary will be created to maintain biological diversity and preserve the two areas of the Priority 1 PEC 'Monsoon vine thickets of limestone ranges'. Progressive rehabilitation will be conducted throughout the Project life and revegetation continued after cessation of production.

Increased human activities including vegetation clearing and the introduction of vehicles, machinery and equipment for construction and operations could potentially introduce or spread weeds which may result in competition for resources with native flora, cause degradation of habitats and reduce rehabilitation success. To assist in minimising the potential sources of weed infestations and containing, controlling and/or eradicating target weeds species from the Project Area weed mapping will be undertaken, a weed inventory will be maintained and weed hygiene and management procedures will be implemented.

Implementation of these management strategies will ensure that there will be no significant impact to flora of conservation significance or to the Priority 1 PEC 'Monsoon vine thickets of limestone ranges' and that the impact on the general flora and vegetation will be minimal.

A terrestrial fauna survey for the Project revealed the potential for 12 ground dwelling fauna species of conservation significance to occur in the Project Area, while ornithological surveys in the region found five *EPBC Act* species of conservation significance within the vicinity of the Project Area and two species listed as Priority 4 by the DPaW.

The clearing of native vegetation will directly impact local populations of terrestrial fauna. In addition to the individuals lost during clearing, loss of habitat and displacement of individuals may cause secondary fauna deaths.

All disturbance areas have been subjected to biological surveys and have been designed to minimise impacts to fauna of conservation significance. Infrastructure will be located on pre-cleared/disturbed areas and an exclusion boundary will be developed to maintain biological diversity, ecological function, unique habitat such as the Priority 1 PEC 'Monsoon vine thickets on limestone ranges' and the most valuable habitats for threatened species such as the Gouldian Finch. Subsequently, cleared areas will be rehabilitated as soon as practicable. This will include replacing vegetation, as this provides refuge for fauna, and the construction of nest boxes for Gouldian Finches; these strategies will help to offset the impacts of clearing.

Due to the strategic placement of the impact footprint and the implementation of the Development Exclusion Zone there will be no significant impact to fauna and fauna habitat of conservation significance.

No habitats or landforms likely to promote endemism occur within the Project Area. Therefore it has been determined that there is little or no potential for impact on SRE Fauna.

Secondary impacts, such as dust deposition, light emissions, noise and vibration disturbance and altered fire regimes, may adversely impact vegetation, flora and fauna. SMPL will aim to minimise the potential for dust, light, noise and vibration emissions through appropriate planning and control and will implement management measures to mitigate any potential impacts to the surrounding environment.

To enhance the habitat value of areas within the Project Area that are not directly impacted by construction, SMPL commit to destocking the tenements and managing wild fire.

Conservation Areas

Project activities have the potential to indirectly impact the environmental values of the proposed GRCP if these activities are not actively managed. The proposed GRCP is located adjacent to the Project Area and covers 17,900 ha.

SMPL has established a self-imposed Development Exclusion Boundary which will provide a buffer zone between the GRCP and the area to be directly impacted by the Project. Additionally, implementation of management controls for fire and emissions such as noise, vibration, dust and odour will minimise or even completely avoid impacts to the flora of the GRCP.

Due to the closure of informal GRCP access tracks within the Project tenements public access will be restricted which may reduce recreational value of the GRCP. However DPaW has suggested the potential for creating a loop scenic drive as well as day use areas and camping grounds in the southern area of the ranges. This will allow for improved public access and management of public use of the GRCP.

Subterranean Fauna

Within the proposed Project Area the generally shallow water table and seasonal inundation, suggest that there is no suitable habitat for troglofauna to occupy and therefore there is little or no potential for the Project to impact on troglofauna.

Stygofauna are known to occur in the area and a subterranean fauna assessment carried out for the Project identified the presence of ten species. All of the species were new to science and therefore none are currently listed as specially protected under either Commonwealth or Western Australian legislative or policy frameworks. Of the ten species, all but one was also collected outside of the proposed Primary Impact Footprint. The single species known only from the Primary Impact Footprint was collected as a single valve and is considered to be a surface water species with a range likely to be orders of magnitude greater than the Primary Impact Footprint.

It is possible that the Project may impact local populations of stygofauna through the excavation of ore and dewatering activities, however, based on the findings of a subterranean fauna assessment it is considered unlikely that the localised impact will have a significant effect on regional populations or threaten the persistence of any stygofauna species.

Physical Factors

Surface Water

The principal objectives for the management of surface water are to maintain surface water quality and flow regimes as well as practicable to ensure that existing and potential environmental values, including ecosystem maintenance, are protected. SMPL are committed to ensuring that surface water discharge from the Project does not adversely affect environmental values or the health, welfare and amenity of people and land uses by complying with statutory requirements and meeting acceptable standards.

The Project Area is located in the upper portions of the Knox Creek and Keep River Catchments; all surface flows within the Project Area tend south east towards these watercourses. No significant creeks or defined drainage systems occur within the Project Area; the ephemeral Border and Knox Creeks are located 3.5 km to the north and south respectively, and the Keep River (which Knox Creek flows into) is situated 4.6 km to the south east.

Throughout the wet season the Project Area is subject to waterlogging and surface flooding conditions. During intense rainfall events (i.e. a 1 in 100 year, 72 hour flood event) the water level is likely to rise approximately 1 m above ground level and remain for extended periods.

Infrastructure will be elevated to a height of at least 1 m above the floodplain level to withstand 1 in 100 year, 72 hour flood events. The haul road has been designed to function as a surface water diversion bund and will offer a 2.8 m flood protection barrier. To minimise the potential for increased ponding of water and to reduce disruption to natural flow paths appropriately located and designed culverts will be installed.

A dewatering evaporation basin will be created for the capture and storage of water from pit dewatering that is not required for processing and runoff from within the haul road envelope.

Strict control of sedimentation and management of potentially contaminated water flow will be implemented to maintain surface water quality. The haul road envelope and surface water diversion bunding will divert clean runoff from the surrounding environment away from the internal infrastructure areas to ensure this water does not become sediment laden or contaminated. Appropriately designed and located sediment trapping devices will be installed to ensure that sediment laden waters do not enter the adjacent environment.

Surface water contamination risk predominantly relates to hydrocarbon and process chemical storage, handling and disposal, and management of the TSF. Therefore, management controls for the handling and storage of hydrocarbons and process chemicals will be implemented and infrastructure will be designed to prevent discharge of contaminated surface water into the environment. To achieve this, water from the ROM pad and plant site will drain into collection sumps and be transferred to the process circuit, and the TSF with associated TSF evaporation basin have been designed to accommodate at least a 1 in 100 year, 72 hour flood event to prevent overtopping.

A surface water monitoring program will be established using automated data collection devices with alarm trigger levels and flow retarding devices. Monitoring will continue throughout the life of the Project.

Groundwater

Within the Project Area two aquifers have been found to occur with variability in hydraulic conductivity suggesting that these are faulted/fractured rock aquifers. Groundwater levels are highest at the southern end of the Project tenements where they range from 14.4 m AHD to 8.2 m AHD adjacent to Knox Creek. The groundwater is generally neutral pH and brackish. The cation/anion balance of the groundwater shows no dominant water type other than an overall predominance associated with sodium, magnesium, calcium, sulphate and bicarbonate.

Project activities have the potential to pollute the groundwater by inappropriate storage of hydrocarbons and process chemicals, inadequate Project design or inadequate closure planning for mine voids and the TSF. SMPL will implement management controls for the handling and storage of hydrocarbons and process chemicals. The TSF will have management and monitoring strategies and comprehensive closure strategies will be developed for the TSF and pit voids. A groundwater monitoring program has been established that will continue throughout the life of the Project. The implementation of these environmental management plans and strategies will help to avoid or minimise impacts on groundwater quality.

Extraction of groundwater through dewatering has the potential to reduce pressure and groundwater flow in affected aquifers. Drawdown is not anticipated to be extensive with the impact area limited to the immediate vicinity of the pits. Additionally, the groundwater aquifers that will be dewatered are rainfall recharged and are therefore not anticipated to be affected by long term water extraction. Therefore no significant impact to be expected on regional groundwater resources. Management strategies, however, will be implemented to minimise impacts resulting from abstraction at the Project site and appropriate licenses for water abstraction will be obtained with annual reporting to the appropriate regulatory authority.

A monthly monitoring programme will be carried out to assess water levels associated with the production bores and the health of the surrounding vegetation. In addition, water demands to be offset through use of water from dewatering activities for processing and the recycling of process waters from the TSF and associated TSF evaporation basin.

Pollution and Emissions Management

Mining Waste and Potential Contaminants

SMPL is committed to ensuring that mining waste is suitably managed such that it does not adversely affect environmental values or the health, welfare and amenity of people and land uses in the vicinity of the Project.

Geochemical characterisation has identified that the majority of the waste rock can be classified as NAF with a low potential to produce ARD, that there is a localised presence of PAF materials within the proposed mine voids and that there is a low risk of MD. Kinetic test work will be undertaken to confirm that NAF waste rock characterisation remains the same as operations progress.

Block modelling and mine scheduling has been carried out to enable NAF and PAF materials to be successfully delineated and segregated during mining. On site NAGpH testing will be conducted to determine expected PAF intersection's prior to them being encountered. Two management options exist for the PAF waste material that will be generated by the Project; PAF material will either be placed into a specifically designed in-pit waste dump or in-pit sump. During mining, NAF materials not used in the construction of infrastructure will be utilised to prepare the in-pit waste dump if this is the preferred option following the Mining Proposal approval process. Towards the end of the mine life stockpiled NAF waste will be used in rehabilitation to stabilise post-mine land surfaces.

Appropriately designed and located sediment trapping devices will be installed to ensure that sediment laden waters do not enter the adjacent environment.

Implementation of these environmental management plans and strategies and correct handling techniques for PAF materials will help to avoid or minimise impacts to the environment.

Tailings Characterisation and Storage

Tailings will be discharged and stored within a purposed built above ground paddock style TSF. Geochemical characterisation classified the tailings as NAF, with elevated carbonate content and a highly alkaline pH. This, together with the low content of available oxyanions, metals and metalloids, results in a low potential for ARD or MD to occur. Analysis of the tailings materials also identified Tl, however Tl forms cation-hydrolysis complexes in solution (i.e. positively charged species) and hence any Tl released into the TSF will be rapidly adsorbed onto mineral surfaces. Absorption of Tl will significantly minimise its mobility and potential for release into the environment. Furthermore, the reducing properties of the TSF will cause Tl to form insoluble complexes, come out of solution and be retained in the TSF. Kinetic test work will be undertaken to confirm tailings characterisation remains the same as the operation progresses.

Appropriate design, planning and management measures will be implemented to ensure the potential impacts from TSF operation are minimised. Prior to construction, remnant sterilisation drill holes will be sealed with bentonite to prevent flow from the storage facility into the subsurface geology through preferential pathways. The TSF will be positioned within the haul road envelope which will act as flood diversion bunding to protect it from the potentially damaging effects of stormwater runoff. Additionally, pipelines will be located within the haul road safety bunding which will serve to contain potential spills or leaks. Both the TSF and associated TSF evaporation basin will have the capacity to cater for a 1 in 100 year, 72 hour flood event.

Supernatant solution on the surface of the TSF will be removed via decant structures and pumped into the adjacent TSF evaporation basin.

The TSF has the potential to become a target for foraging waders and shore birds that seasonally occupy the Project Area. To detract the birds from using the TSF scaring devices, such as 'Scare Guns' (blast cannons), will be positioned around the facility. Fencing (not barbed wire) will keep macro fauna away from the TSF. To monitor the health of birds utilising the Project Area, bird feathers will be collected from the TSF tested for traces of heavy metals.

Overall the TSF is not expected to have a significant impact on the environment or human health due to:

- The tailings materials contain elevated carbonate content and are classified as NAF; as such ARD seepage is not anticipated
- Tl levels are within limits that will allow material to be effectively managed within the TSF and avoid any hazard to the environment or human health
- Metalliferous seepage is not anticipated as the source rocks do not contain mobile enriched metals and the subsequent risk of elevated metals content within the tailings solution is low
- Overflow risk assessment suggests that it is only the process chemicals sodium hydrogen sulphide and xanthates that may impact organisms and then only when the overflow is minimally diluted in close proximity of the TSF. Relative to the entire floodplain this is a very small area and is an area in which the ecosystem is likely to already be affected by construction and maintenance activities for the TSF

Concentrate Emissions

The Project will produce approximately 45,000 tpa of concentrate for export. Concentrate will be transported from the Project site to Wyndham Port in sealed containers via road train; there will be an average of 12 return truck movements per week. Shipping will occur once per month. The concentrate to be produced by the Project is of Ag Pb Zn composition with a lead grade of around 64 %. The concentrate will be transported as a Class 6.1 lead compound, soluble, N.O.S. (UN 2291, packaging group III) with a subsidiary environmental hazard (Class 9) classification for marine transport.

Wyndham Port is situated on the eastern bank of the West Arm Estuary of the Cambridge Gulf near the town of Wyndham. The Port is fully operational; no new infrastructure will be required to facilitate SMPL operations and current dredging schedules will not need to be altered. A portion of Wyndham Port is currently listed as a contaminated site under the *Contaminated Sites Act 2003* however the land is deemed suitable for industrial or commercial use and the contamination is not in the vicinity of anticipated Project operations.

The waters surrounding the Port have a high turbidity which limits the number of species that can utilise the environment. An appraisal of the Commonwealth and Western Australian legislation in conjunction with an assessment of available habitat revealed that 36 protected species have the potential to occur in the estuary; of these only 16 have actually been recorded in the area. There is no anticipated significant impact on these 16 species, should they actually occur around the Port of Wyndham.

Inappropriate handling, storage and management of concentrate could result in exposure of personnel, members of the public and the environment. Potential impacts at the Project site and/or Wyndham Port include adverse effects to human health, the pollution of the marine environment and degradation of marine habitats, the pollution of the terrestrial environment and degradation of habitat in proximity to Wyndham Port and the loss of terrestrial and marine flora and fauna.

SMPL will endeavour to achieve minimal direct handling of concentrate by utilising a predominantly mechanised system and a range of rules and procedures will be implemented at all stages of the concentrate handling process to minimise potential for accidental release into the environment. SMPL propose to use "Rotabox" (or similar) shipping containers for the collection, storage and transport of concentrate. These containers are fully sealed and lockable. Concentrate will be loaded directly into the containers on site and they will be transferred directly into the ships hold using a container rotation system. This negates the requirement for open concentrate stockpiles.

Due to the use of a containerised system and implementation of environmental management plans and strategies no significant impacts are anticipated.

Dust Emissions

Dust may be generated by the Project in a number of ways during construction and ongoing operations. Key emission sources will include earthworks, wind erosion, blasting and wheel generated dust from haulage trucks.

The potential impacts that may arise from dust generation during Project operations include adverse effects on fauna, flora and vegetation on site. Adverse health impacts for the workforce on site and at Wyndham Port may occur if employees are exposed to unacceptable levels of dust. Road side dust mobilisation as a result of ore haulage through Wyndham may become a health risk, cause annoyance and reduce the amenity of the town.

However, the increased traffic equates to only 12 return truck movements per week through Wyndham and the transport route avoids the town of Kununurra, entirely. The Project is located more than 50 km from the nearest town (Kununurra) and wind speed and direction suggests very little potential for dust disturbance.

To monitor dust emissions a comprehensive dust monitoring program will be implemented upon commencement of operations. Visual monitoring of dust will be regularly conducted and activities will be halted if adverse conditions result in excessive dust generation. Photographic monitoring points of vegetation adjacent to high dust generating sources will be established.

To minimise dust emissions weather conditions will be assessed prior to blasting and blasting will not be undertaken during unfavourable conditions. Dust suppression systems will be installed on the crusher, process conveyors and all ore transfer points. A water cart will be used to supress dust on stockpiles, cleared areas and roads; additionally speed restrictions will apply to all concentrate haulage trucks whilst travelling on site, through the town of Wyndham and whilst at Wyndham Port.

Initial baseline data collection has commenced and SMPL endeavour to source data on dust emissions arising from use of the Rotobox system elsewhere in Australia. To date, no quantitative data has been made available by regulators or industry peers. SMPL engaged a suitably qualified air emissions consultant to develop a Port Operations Environmental Management Plan specific for ship loading activities at Wyndham Port.

Hydrocarbons, Process Chemicals and other Dangerous Goods

Substances required for the operation of the Project will include diesel fuel, oil, lubricants, gasses, reagents and process chemicals, explosives and radiation devices. Where relevant, these substances will be stored according to national standards. Staff and contractors involved in hydrocarbon management will be made aware of SMPL's requirements for use, storage and disposal. The disposal of dangerous goods will be in accordance with MSDS's and any requirements from DER. Potential impacts that may arise from inappropriate storage and management of hydrocarbons, process chemicals and other dangerous goods at the Project include contamination of soils, surface water or groundwater and adverse effects to faunal habitats. A bioremediation facility will be created to treat contaminated soil in situ.

As a result of the implementation of management measures, no adverse effects to faunal habitats or contamination of soils, surface water or groundwater is anticipated.

Non-mineral Waste

During the life of the mine various forms of non-mining or process wastes will be produced including general litter from human presence, scrap metal, hydrocarbon wastes, chemical packaging products, chemical waste and sewage related wastes. The inappropriate storage and management of non-mineral wastes may lead to the contamination of soils, surface water or groundwater, the degradation of fauna habitat and the increased activity of feral species.

Due to the relatively remote location of the Project site and the limited recycling opportunities in Kununurra and Wyndham, a full recycling program may be inhibited. However, where practicable recycling is a preference and all options will be explored. The "Reduce, Reuse, Recycle and Recover" principles will be employed to minimise disposal requirements. Good housekeeping and rubbish disposal practices will be established to avoid attracting feral animals, pests and other wildlife throughout operation of the Project.

For wastes which cannot be recycled, a landfill facility and a bioremediation facility will be established on site. Sewage will be treated using a bio-sewage system that will conform to the standards of the SWEK and DoH requirements.

GHG Emissions

SMPL is committed to reducing GHG emissions to levels as low as practicable on an on-going basis.

The key emission sources will include land clearing and combustion of fuel by diesel powered generators, machinery, equipment and vehicles. Over the duration of the Project life from 2013 to 2027, it is estimated that the Project will emit up to 596,104 t CO_2-e of emissions. Overall, Australia's total direct annual emissions for 2009/2010 were 560.8 Mt t CO_2-e and Australia's direct annual emissions from the mining sector in 2009/2010 were 65.1 Mt t CO_2-e. By comparison, the annual operation of the Project mine is projected to represent approximately 0.005 % of Australia's total emissions and 0.9 % of Australia's total direct mining emissions respectively.

Appropriate maintenance of equipment and the promotion of a culture of operating equipment efficiently will reduce GHG emissions, as with the minimising of land clearing to that which is essential. Emissions monitoring, auditing and reporting, including energy and resource usage will be undertaken regularly and the data will be submitted to the national inventories.

No significant impacts from GHG emissions are anticipated.

Other Emissions (Noise, Vibration, Light and Odour)

There are three principal objectives for the management of noise, vibration, light and odour emissions:

- To protect the amenity of nearby receptors from noise impacts resulting from activities associated with the Project by ensuring noise levels meet statutory requirements and acceptable standards
- To avoid or manage potential impacts from light overspill and comply with acceptable standards
- To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards

To reduce any potential noise impacts operational activities will comply with the standards for operational noise set by the *Environmental Protection (Noise) Regulations 1997*, new equipment will be used and noise suppression devices will be implemented. To reduce the odour emissions on sight all waste material at the landfill will be covered in accordance with the schedule identified in the DER licence.

Emissions impacts during construction and operations are not anticipated to be significant as the nearest fixed sensitive receptor (residential) is approximately 25 km away from the Project site and the Weaber Plain Road experiences only very occasional use by pastoralists or members of the public for recreational purposes. However, adverse impacts on the workforce or the population of Wyndham may occur during operations.

Noise and vibration emissions may impact on the Wyndham community as a result of ore haulage trucks passing through the township. To mediate this effect concentrate haulage trucks will only operate during daylight hours, speed restrictions will be enforced and a ban on exhaust braking will be applied for concentrate haulage trucks whilst travelling through the township. All complaints regarding noise emissions will be investigated and mitigating measures implemented where required.

Social Surroundings

Visual Amenity

The visibility and appearance of a development can be assessed by considering visual magnitude, visual contrast and duration.

The alteration of the landscape associated with the Project development may detract from the visual amenity of the area. The potential visual amenity impacts could result from the creation of mine pit voids, stockpiles and TSF, dust and light generation or clearing of native vegetation and ground disturbance associated with construction and mine site infrastructure development.

Given the relative remoteness of the Project Area and the comparatively small scale of the operation, visual amenity impacts are not expected to be significant. During the planning stage the Project has been designed to maximise the use of pre-cleared and disturbed areas to minimise clearing of vegetation.

At closure the mine the pit voids will be backfilled where possible; a pit lake will form in the C pod pit void.

Throughout the operation of the mine progressive rehabilitation and revegetation will be undertaken with the aim of re-establishing suitable local vegetation communities to blend into the landscape.

Aboriginal Heritage

SMPL is committed to building relationships and working cooperatively with local indigenous groups throughout the life of the Project. The principal objectives for the management of Aboriginal heritage are to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

The original Project impact footprint was altered following ethnographic survey work to avoid a limestone hill that is of Aboriginal heritage significance. To date no heritage sites have been identified within the new Project Area and the TO's and MG Corporation approve the development.

Although the Project impact footprint has been cleared by extensive heritage assessments there remains the potential for unknown sites of significance or value to be located in the area during future operations.

Aboriginal heritage assessments will be undertaken prior to any future developments in areas outside of the Project's Aboriginal heritage clearance area and clearing will only occur in areas that have been surveyed for Aboriginal heritage significance by competent personnel.

All employees and contractors will be inducted regarding cultural awareness; this will inform personnel of their legal obligations with regards to heritage site, provide instruction on their duty to look out for cultural heritage material and the appropriate course of action to be followed if new sites are identified.

Additionally, an ACHMP has been produced and a MOU with the MG Corporation, whose traditional lands the Project site lies within, will be developed.

Other

Closure and Rehabilitation

SMPL is committed to the successful rehabilitation of all mining related disturbances on the Project site and intends to leave the site in a safe and stable condition such that the tenements can be relinquished without any future liability for the company or the community. To achieve this mine closure planning has been initiated and a framework of concepts, targets and predicted outcomes has been produced. Rehabilitation of the site will start as soon as possible and will occur progressively throughout the life of the Project. The proposed end land use is pastoralism, although interest has been expressed in agricultural uses; this option will be further explored as the mine progresses.

Given the closure and rehabilitation concepts, the development of a MCP and the potential for future use of the site following mine closure, SMPL consider the residual impacts of the mining operation to be suitably acceptable over the long term.

Commitments

SMPL's key objectives are to implement the Project in a sustainable manner and mitigate environmental impacts to the extent reasonably practicable by the application of appropriate management measures over the life of the Project. Fulfilment of these objectives depends upon sound environmental knowledge of the Project Area and surrounds. Environmental studies undertaken for the Project have provided a good understanding of the distribution, diversity and abundance of biological taxa and conservation values. The findings have contributed to Project planning and design and will continue to contribute to ongoing operations, rehabilitation and ultimately decommissioning and closure.

SMPL's commitment to sound environmental management is reflected in the following formal commitments for the Project:

Commitment 1: Environmental Management System

SMPL will develop a Safety, Health Environmental and Community Management System (SHECMS) to ensure environmental management is effectively integrated into Project operations and that planning, implementation and review processes achieve continuous improvement. The SHECMS will be developed in accordance with the principles of *AS/NZS ISO14001:2004* and *AS/NZS 4801:2001*, and will provide a structured approach to managing risks and potential impacts arising from the Project.

Commitment 2: Environmental Management Plans

Documented management plans will be established, maintained and incorporated into the Project's environmental management system to ensure the desired environmental outcomes are achieved. The following management plans have been identified as required:

- Construction Environmental Management Plan
- Operational Environmental Management Plan
- Port Operations Environmental Management Plan
- Gouldian Finch Environmental Management Plan
- Aboriginal Cultural Heritage Management Plan

Commitment 3: Ongoing Consultation with Key Stakeholders

Stakeholder consultation has been an important aspect of the Project to date and will continue to be an integral factor in the overall environmental management. SMPL will endeavour to update the public and key stakeholders on the progress of the development throughout the life of the Project.

Commitment 4: Rehabilitation and Closure Strategy

Planning for mine closure is a critical component of environmental management for the Project. A MCP will be developed in accordance with the DMP/EPA '*Guidelines for Preparing Mine Closure Plans*' (June 2011). The MCP will be regularly reviewed and revised throughout the life of the Project to allow for incorporation of new information.

Environmental Outcome

SMPL has made a range of environmental commitments with respect to all aspects of the Project to show their commitment to constructing and operating the Project in an environmentally responsible and sustainable manner. The Project will be undertaken in accordance with the Principles of Environment Protection as set out by Section 4A of the *Environmental Protection Act 1986*.

SMPL is dedicated to minimising and mitigating environmental impacts associated with construction and operation the Project that cannot be practicably avoided. SMPL will consult and comply with relevant authorities where applicable to ensure environmental standards are achieved.

Through the findings of surveys and assessments and the implementation of comprehensive management plans it is anticipated that the Project will provide environmental benefits to the area, including:

- Increased scientific knowledge, particularly related to poorly known or collected flora taxa
- Improved fire, feral and stock management in and around the Project Area that will increase habitat value in areas not cleared for construction and operation
- Retention of valuable habitat for species of conservation significance such as the Gouldian Finch and other Threatened and Migratory bird species

Additionally, the Project will provide social and economic benefits locally and state wide through:

- A significant positive influence on the economy of the Kimberley Region and considerable localised positive impact on business
- Employment opportunities for residents of Kununurra and Wyndham that are not based on seasonal operations such as tourism and agriculture
- Greater diversity of employment opportunities for local indigenous communities
- Provision of social support for local communities
- Increased government revenue locally and State wide

It is SMPL's intent that the application of the management and mitigation strategies described in this RER will enable development of the Project with no significant adverse effect to the environment. SMPL believe that this will be achieved by ensuring protection of environmental values through comprehensive environmental management.

SMPL considers that development of the Project in the environmentally responsible manner described will not only ensure environmental protection but also deliver net environmental, economic and social benefits to the local and regional community and State as a whole.

CONTENTS: VOLUME 1

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

CONTENTS: VOLUME 2

CONTENTS: VOLUME 3

CONTENTS: VOLUME 4

PROJECT TERMINOLGY, ABBREVIATIONS, SYMBOLS AND UNITS

Project Terminology	Meaning
The Project	Sorby Hills Silver Lead Zinc Project
Project Area	Tenements M80/197 and M80/286
Project Development Envelope	The area surrounding the Primary and Secondary Impact Footprints; defined by the Project's firebreaks
Primary Impact Footprint	Area that will be disturbed by the construction of infrastructure, placement of stockpiles and extraction of ore from open cut pits
Secondary Impact Footprint	Areas that will not be directly disturbed but which are situated immediately adjacent to infrastructure, stockpiles and open cut pits and might be indirectly impacted over the life of the Project
Baseline Biological Survey Area	Area within tenements M80/197 and M80/286 extending from the northern extent of the tenements to just south of the Primary Impact Footprint
Development Exclusion Boundary	Self-imposed boundary which delineates the western extent of the Project
Development Exclusion Zone	Area situated to the west of a self-imposed Development Exclusion Boundary

<table>
<tr><th>Official SMPL Terminology</th><th>Specialist Consultant Terminology</th><th>Relevant Report</th><th>Appendix and Volume</th></tr>
<tr><td rowspan="5">Primary Impact Footprint</td><td>Disturbance Area</td><td>Sorby Hills Deposit Pre-mine Soils Characterisation</td><td>Appendix 4, Volume 3</td></tr>
<tr><td>Sorby Hills Deposit</td><td>Sorby Hills Geochemical Characterisation</td><td>Appendix 5, Volume 3</td></tr>
<tr><td>Disturbance Footprint</td><td>Mining Proposal Infrastructure Sorby Hills Silver Lead Zinc Mine</td><td>Appendix 9, Volume 3</td></tr>
<tr><td>Onsite infrastructure</td><td>Sorby Hills Deposit Flow Analysis</td><td>Appendix 10, Volume 3</td></tr>
<tr><td>Pods and Site Infrastructure</td><td>Sorby Hill Proposed Silver Lead Zinc Mine Flora and Vegetation Assessment</td><td>Appendix 22, Volume 3</td></tr>
<tr><td rowspan="2">Project Development Envelope</td><td rowspan="2">Development Envelope</td><td>Conservation Significant Flora Assessment</td><td>Appendix 23, Volume 3</td></tr>
<tr><td colspan="2">Appendices 1 – 6, Volume 3</td></tr>
</table>

Abbreviation	Meaning
ACHMP	Aboriginal Cultural Heritage Management Plan
ADG	Australian Dangerous Goods
ADGC	Australian Dangerous Goods Code
AER	Annual Environmental Report
AGEC	Australasian Groundwater and Environmental Consultants Proprietary Limited
AHD	Australian Height Datum
AMD	Acid Mine Drainage
AMIRA	Australian Mineral Industry Research Association
ANZECC	Australian and New Zealand Environment and Conservation Council
APM	Animal Plant Mineral Proprietary Limited
ARD	Acid Rock Drainage
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standard

Abbreviation	Meaning
BGL	Below Ground Level
BGRIMM	Beijing Research Institute of Mining and Metallurgy
BLF	Barge Loading Facility
BoM	Bureau of Meteorology
BS	British Standard
CBH	CBH Resources Limited
CEMP	Construction Environmental Management Plan
CGL	Cambridge Gulf Limited
CME	Chamber of Minerals and Energy
Coffey	Coffey Mining Proprietary Limited
CoPC	Chemicals of Potential Concern
CSA	CSA Global Proprietary Limited
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation
DEM	Digital Elevation Model
DER	Department of Environment Regulation (formerly Department of Environment and Conservation)
DIA	Department of Indigenous Affairs
DMP	Department of Mines and Petroleum
DMP-RS	Department of Mines and Petroleum - Resource Safety
DoA	Department of Agriculture
DoH	Department of Health
DoIT	Department of Infrastructure and Transport
DoT	Department of Transport
DoW	Department of Water
DPaW	Department of Parks and Wildlife (formerly Department of Environment and Conservation)
DRDL	Department of Regional Development and Lands
DRF	Declared Rare Flora
DSD	Department of State Development
EAD	Equivalent Aerodynamic Diameter
EC	Electrical conductivity
ECP	Environmental Clearing Permit
EIA	Environmental Impact Assessment
EK	Environs Kimberley
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESD	Environmental Scoping Document
FIFO	Fly-in Fly-out
GHG	Greenhouse Gas
GRCP	Goomig Range Conservation Park

Abbreviation	Meaning
GST	Goods and Services Tax
HFCs	Hydrofluorocarbons
HLA	HLA Envirosciences
HYG&L	Henan Yuguang Gold and Lead
H&S	H&S Consultants Proprietary Limited
IBRA	Interim Biogeographic Regionalisation for Australia
ICMM	International Council on Mining and Metals
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
ISO	International Standards Organisation
JORC	Joint Ore Reserves Committee
JSEA	Job Safety and Environment Analysis
KBL	KBL Mining Limited (formerly Kimberley Metals Limited)
KLC	Kimberley Land Council
KMG	Kimberley Metals Group Proprietary Limited
LAS	Land Access Solutions
Ltd	Limited
LPG	Liquefied Petroleum Gas
MCA	Minerals Council of Australia
MCP	Mine Closure Plan
MD	Metalliferous Drainage
MG Corporation	Miriuwung Gajerrong Corporation
MIM	Mount Isa Mines Proprietary Limited
MMU	Mobile Manufacturing Unit
MNES	Matters of National Environmental Significance
MOU	Memorandum of Understanding
MRWA	Main Roads Western Australia
MSDS	Material Safety Data Sheets
NAF	Non-acid Forming
NAG	Net Acid Generation
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
NOHSC	National Occupational Health and Safety Commission
NSW	New South Wales
NT	Northern Territory
NZS	New Zealand Standard
OEMP	Operational Environmental Management Plan
ORIA	Ord River Irrigation Area
ORIA – Weaber Plains Project	Ord River Irrigation Area – Weaber Plains Development Project
P	Priority
PAF	Potentially Acid Forming
PB	Parsons Brinkerhoff Australia Proprietary Limited
PEC	Priority Ecological Community

Abbreviation	Meaning
PER	Public Environmental Review
PFC	Perfluorocarbons
PM	Particulate Matter
PM_{10}	Particulate Matter with a Diameter ≤10 µm
$PM_{2.5}$	Particulate Matter with a Diameter ≤2.5 µm
PMP	Project Management Plan
PNT	Possible New Taxa
POAGS	POAGS Bulk Logistics
POEMP	Port Operations Environmental Management Plan
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
PoW	Program of Works
Pty	Proprietary
QLD	Queensland
RC	Reverse Circulation
RE	Range Extension
RER	Revised Environmental Review
RL	Relative Level
ROM	Run-of-Mine
SAG	Semi-Autogenous Grinding
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
SG	Specific Gravity
SHECMS	Safety, Health Environmental and Community Management System
SMPL	Sorby Management Proprietary Limited
SMU	Soil Mapping Unit
SRE	Short Range Endemic
SWC	Soil Water Consultants
SWEK	Shire of Wyndham East Kimberley
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
TO	Traditional Owner
TOPAZ	TOpographical PArameteriZation
ToxConsult	ToxConsult Proprietary Limited
TSF	Tailings Storage Facility
TSP	Total Suspended Particles
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
VOIP	Voice Over Internet Protocol
WA	Western Australia
WHO	World Health Organisation
WRC	Water and Rivers Commission

Symbols and Units	Meaning
%	Percentage
°	Degree
°C	Degrees celsius
µg/L	Micrograms per litre
µm	Micrometres
µS/cm	Microsiemens per centimetre
Ag	Silver
Al	Aluminium
As	Arsenic
B	Boron
Ba	Barium
Be	Beryllium
Ca	Calcium
Cd	Cadmium
CH_4	Methane
Cl^-	Chloride
Cm	Curium
Co	Cobalt
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
CO_3	Carbonate
Cr	Chromium
Cu	Copper
dB(L)	Decibel linear
Fe	Iron
g/m^2/mth	Grams per square metre per month
g/t	Grams per tonne
ha	Hectare
HCO_3	Bicarbonate
Hg	Mercury
hr	Hour
K	Potassium
kg	Kilogram
kg/m^3	Kilograms per metre cubed
kL	Kilolitre
km	Kilometre
kph	Kilometres per hour
kT	Kilotonnes
kV	Kilovolt
kW	Kilowatt
L	Litre
m	Metre
m^3	Cubic metres
m^3/day	Cubic metres per day

Symbols and Units	Meaning
$m^3/d/m$	Cubic metres per day per metre
Mg	Magnesium
mg/L	Milligrams per litre
ML	Megalitre
ML/day	Megalitre per day
mm	Millimetre
mm/hr	Millimetres per hour
mm/s	Millimetres per second
Mn	Manganese
Mo	Molybdenum
Moz	Million ounce
mS/m	Millisiemens per metre
Mt	Million tonnes
MWHrsPa	Megawatt hours per annum
N	Nitrogen
N_2O	Nitrous oxide
Na	Sodium
Ni	Nickel
NO_2	Nitrite
NO_3	Nitrate
P	Phosphorus
Pb	Lead
pH	A measure of the degree of acidity or alkalinity of a solution; expressed numerically (logarithmically) on a scale of 1 to 14, on which 1 is most acid, 7 is neutral and 14 is most basic (alkaline)
ppm	Parts per million
S	Sulphur
Se	Selenium
SF_6	Sulphur hexafluoride
Si	Silicon
SO_4	Sulphate
t	Tonne (1000 kilograms)
t CO_2-e	Tonnes of carbon dioxide equivalent
Tl	Thallium
Tpa	Tonnes per annum
V	Vanadium
Zn	Zinc

1 INTRODUCTION

1.1 PROJECT OVERVIEW

SMPL is seeking to develop a new Ag Pb Zn mine at Sorby Hills 50 km north of Kununurra in the east Kimberley Region of WA. A location map is provided as Figure 1-1.

Sorby Hills is a major undeveloped Ag Pb Zn deposit; the primary Lead mineral is Galena (Lead Sulphide). The Sorby Hills mining tenements M80/196, M80/197, M80/285, M80/286, and M80/287 cover a total area of 12,612.40 ha. Within these tenements, a total of 13 individual mineralised pods have been delineated by exploration within the platform carbonate rocks of the Burt Range Formation in the Bonaparte Basin. The ore pods form a linear belt (trending north-south) over an 8 km long and up to 1 km wide strike length on the eastern margin of the Pincombe Inlier.

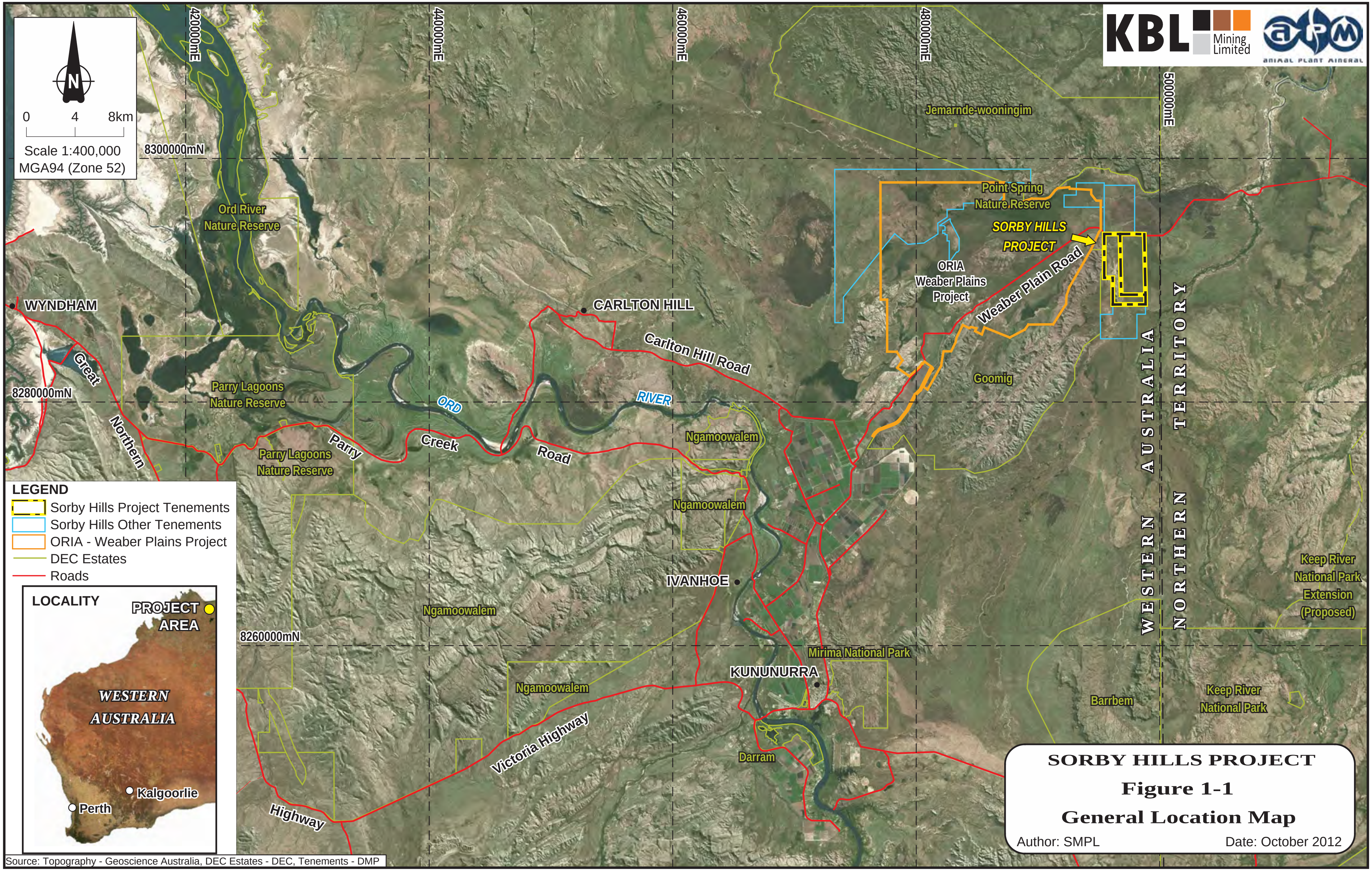
The proposed Project is contained within two of these leases, M80/197 and M80/286, which cover an area of 1,782.27 ha. The Project will initially target three of the mineralised ore pods, C, D and E, which are to be mined sequentially as separate entities. As mining progresses two of the three ore bodies (D and E pods) will be contained within one larger pit; the focus will be on resources within 70 m of the surface.

The current resource for the Sorby Hills mining tenements totals 16.662 Mt at a grade of 4.5 % Pb, 0.7 % Zn and 52 grams per tonne (g/t) Ag at a 2.5 % Pb cut-off. The resource for the Project has been calculated using an updated resource estimation which includes 2011 drill data and uses a cut-off of 1 % Pb for the D and E deposits. The current Project resource totals 8.712 Mt at a grade of 3.13 % Pb, 0.37 % Zn and 36.7 g/t Ag.

Ore will be processed by flotation and a concentrate produced for export through the Port of Wyndham. In addition to the open cut pits, the Project will consist of a ROM pad, haul and access roads, a mill and concentrator, laboratory, road train loading area, TSF and associated TSF evaporation basin, dewatering evaporation basin, workshop and site office at the Mine Site, as well as laydown facilities at Wyndham Port.

Between 400,000 and 600,000 tpa of ore will be excavated from the open pits and processed through the facility to produce 45,000 tpa of concentrate for export. Concentrate will be transported to Wyndham Port via an existing road network, utilising road trains. SMPL are planning to utilise existing Wyndham Port facilities and ship once a month for 11 months each year. Shipping consignments will contain approximately 4,000 t of concentrate. The expected Project life is approximately 14 years, with 10 years anticipated for production and the additional 4 years accounting for the construction and closure phases.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S1_101.dgn



Source: Topography - Geoscience Australia, DEC Estates - DEC, Tenements - DMP

1.2 PROJECT PROPONENT

The Project is being developed by the Sorby Hills Joint Venture partners KBL of Australia (75 %) and Yuguang (Australia) Pty Ltd a wholly owned subsidiary of China's largest lead producer, HYG&L (25 %). The Manager of the Joint Venture is SMPL, which is 100 % owned by KBL.

The tenements associated with the Project are currently held by KBL. Transfers of a 25 % interest in these tenements have been executed by KBL in favour of Yuguang (Australia) Pty Ltd and these are currently with the Office of State Revenue for stamping.

A summary of the key contacts and tenement information associated with the Project is presented below; the tenement boundaries are illustrated in Figure 1-1.

Proponent:	Sorby Management Pty Ltd
Address:	Level 3, 2 Elizabeth Plaza North Sydney, NSW, 2060
Joint Venture Partners:	KBL Mining Ltd and Yuguang (Australia) Pty Ltd
Tenement Holders:	KBL Mining Ltd. pending transfers to KBL Mining Ltd (75 %) and Yuguang (Australia) Pty Ltd (25 %)
Key Contact:	Edgar Newman Project Manager – Sorby Management Pty Ltd Phone: (02) 9927 2006 Fax: (02) 9927 2050 Mobile: 0458 881 445 Email: ednewman@kblmining.com.au
Tenements Held:	M80/196; M80/197; M80/285; M80/286; M80/287; E80/1187

The proposed Project relates to activities on tenements M80/197 and M80/286.

1.3 DOCUMENT PURPOSE AND STRUCTURE

The Project proposal was referred to the EPA under Section 38 of the *Environmental Protection Act 1986* (*EP Act*) on December 14th 2011. As there is likely to be public interest in the proposed Project due to the commodities that will be mined and transported (in particular Lead Sulphides), the proximity of the Project to the current ORIA and proposed ORIA – Weaber Plains Project, and the presence of conservation significant flora and fauna in the area the EPA set the level of assessment for the Project at PER with a 4 week public review period. This determination was made on February 8th 2012.

A PER is required for projects of local or regional significance that raise a number of significant environmental factors. The primary purpose of the environmental review is to present an EIA of the proposed Project with the aim of emphasising how the Project may impact on key environmental factors and how these impacts may be mitigated and managed so as to be environmentally acceptable. Following a four week public review period of the PER, the EPA assesses the proposal and provides recommendations to the Minister for the Environment for a final decision.

This PER document outlines the potential environmental impacts related to construction and operation of the Project and details the relevant management measures to eliminate or minimise these impacts.

The Project's PER document was prepared in accordance with the EPA *Guidelines for Preparing a Public Environmental Review/Environmental Review and Management Programme (2009)*. The objectives stated in the guidelines are to:

- Place the proposal in the context of the local and regional environment
- Adequately describe all components of the proposal so that the Minister for the Environment can consider approval of a well-defined project
- Provide the basis of the proponent's environmental management program which shows that the environmental impacts resulting from the proposal, including cumulative impacts, are minimised and can be acceptably managed
- Communicate clearly with stakeholders (including the public and government agencies) so that the EPA can obtain informed comment to assist in providing advice to government
- Provide a document which clearly sets out the reasons why the proposal should be judged by the EPA and the Minister for the Environment to be environmentally acceptable

This document is the RER which is a revised document based on public submissions and OEPA feedback relating to the Project's original PER document.

This RER is structured as follows:

- ***Volume 1:*** comprising the main report (containing 11 Sections), which is intended to be independently understood without reference to supporting technical reports
- ***Volume 2:*** details environmental management for the Project and contains the Project Environmental Management Plans (EMP's)

- ***Volume 3:*** containing the appendices which comprise a series of supporting technical studies and other applicable information, the key elements of which are summarised in the main report (Volume 1) as relevant

- ***Volume 4:*** contains the final Environmental Scoping Document (ESD) for the Project

1.4 LEGISLATIVE APPROVALS AND POLICY FRAMEWORK

A range of legislation, standards, guidelines and codes of practice will have relevance to the assessment and management of the proposed Project and related environmental factors as outlined in Table 1-1.

Table 1-1: Legislation, Standards, Guidelines and Codes of Practice Relevant to the Project

State Government Legislation	
Environmental Protection Act 1986	*Dangerous Goods Safety Act 2004*
Rights in Water and Irrigation Act 1914	*Health Act 1911*
Mining Act 1978	*Mine Safety and Inspection Act 1994*
Occupational Safety and Health Act 1984	*Waterways Conservation Act 1976*
Wildlife Conservation Act 1950	*Contaminated Sites Act 2003*
Aboriginal Heritage Act 1972	*Bush Fires Act 1954*
Soil and Land Conservation Act 1945	*Conservation and Land Management Act 1984*
Commonwealth Government Legislation	
National Environment Protection Council Act 1994	*Native Title (State Provisions) Act 1999*
Environment Protection and Biodiversity Conservation Act 1999	
EPA Documents	
Guide to EIA Environmental Principles Factors and Objectives (2009)	
Environmental Protection Bulletin 1: Environmental Offsets – Biodiversity (2008)	
Position Statement 2: Environmental Protection of Native Vegetation in Western Australia (2000)	
Position Statement 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (2002)	
Position Statement 7: Principles of Environmental Protection (2004)	
Position Statement 9: Environmental Offsets (2006)	
Guidance Statement 6: Rehabilitation of Terrestrial Ecosystems (2006)	
Guidance Statement 8 (draft): Environmental Noise (2007)	
Guidance Statement 12: Minimising Greenhouse Gases (2002)	
Guidance Statement 18: Prevention of Air Quality Impacts from Land Development Sites (2000)	
Guidance Statement 19: Environmental Offsets – Biodiversity (2008)	
Guidance Statement 20: Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia (2009)	
Guidance Statement 41: Assessment of Aboriginal Heritage (2004)	
Guidance Statement 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (2004)	
Guidance Statement 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (2003)	
Guidance Statement 54a (draft): Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia (2007)	
Guidance Statement 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (2004)	
Environmental Assessment Guideline No. 3: Protection of Benthic Primary Producer Habitats in Western Australia's Marine Environment (2009)	

Standards
AS/NZS 4360:2004 - Risk Management
AS 3846-2005 - The Handling and Transport of Dangerous Cargoes in Port Areas
AS/NZS 5667.1:1998 – Water Quality – Sampling – Guidance on the Design of Water Sampling Programs, Sampling Techniques and Preservation and Handling of Samples
AS 3640 – 1989 – Method for Sampling and Gravimetric Determination of Inspirable Dust
AS 2985 – 1987 – Method for Sampling and Gravimetric Determination of Respirable Dust
AS/NZS 3580.9.6:2003 – Methods for Sampling and Analysis of Ambient Air – Determination of Suspended Particulate Matter – PM_{10} High Volume Sampler with Size Selective Inlet – Gravimetric Method
AS/NZS 3580.9.3:2003 – Methods for Sampling and Analysis of Ambient Air – Determination of Suspended Particulate Matter – Total Suspended Particulate Matter (TSP) – High Volume Sampler Gravimetric Method
AS/NZS 3580.1.1:2007 – Methods for the Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment
AS 2800 – 1985 – Ambient Air – Determination of Particulate Lead
AS 2923 – 1987 – Ambient Air – Guide for Measurement of Horizontal Wind for Air Quality Applications
AS 2922 – 1987 - Ambient Air – Guide to the Siting of Sampling Units
AS 4482 – 1997 – Guide to Sampling and Investigation of Potentially Contaminated Soil Part 1
AS 4874 – 2000 – Guide to the Investigation of Potentially Contaminated Soil and Deposited Dust as a Source of Lead Available to Humans
AS 1716 – 2003 - Respiratory Protective Devices
AS 4282-1997 - Control of the Obtrusive Effects of Outdoor Lighting
AS 4452 – 1997 – The Storage and Handling of Toxic Substances
AS 1940-2004 – Storage and Handling of Flammable and Combustible Liquids
NOHSC:1012(1994) – National Standard for the Control of Inorganic Lead at Work
ISO 14001:2004 - Environmental Management Systems
ISO 1496-1:1990 – Series 1 Freight Containers Specification and Testing Part 1: General Cargo Containers for General Purposes
Guidelines
Guidelines for preparing Mine Closure Plans (DMP & EPA 2011)
Guidelines for Environmentally Responsible Mineral Exploration and Prospecting in Western Australia (DMP 2012)
Guidelines for Mining Proposals in Western Australia (DMP 2006)
Guidelines for Safe Design and Operating Standards for Tailings Storage (DMP 1999)
Guidelines on the Development of an Operating Manual for Tailings Storage (DMP 1998)
Environmental Notes on Mining – Acid Mine Drainage (DMP 2009)
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Environment and Conservation Council (ANZECC) 2000)
A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities (DER 2011)
National Environment Protection (Ambient Air Quality) Measure (National Environment Protection Council (NEPC) 1998)
Water Quality Protection Guidelines – Water Quality Management in Mining and Minerals Processing Series (Water and Rivers Commission (WRC) 2000)
Adjustment of Exposure Standards for Extended Work Shifts (DMP 1999)
Guide to Health surveillance System for Mining Employees (DMP 2010)
Safety and Health Risk Management (DMP 1999)
A Guideline for the Development and Implementation of a Dust Management Program (DER 2008)

Codes of Practice
Code of Environmental Practice for Mineral Exploration in WA (Chambers of Minerals and Energy (CME) 2010)
Australian Dangerous Goods and Explosives Code 7th Edition (Department of Infrastructure and Transport (DoIT) 2010)
NOHSC:2015 (1994) – National Code of Practice for the Control and Safe Use of Inorganic Lead at Work
NOHSC:2007 (1994) – National Code of Practice for the Control of Workplace Hazardous Substances

1.4.1 *Western Australian Environmental Protection Act 1986*

The *EP Act* is the primary legislation that governs environmental impact assessment and protection in WA. Approvals can be required under Part IV and Part V of the *EP Act*. Projects with the potential to significantly impact on the environment are assessed under Part IV, while prescribed premises (as listed under Schedule 1 of the *Environmental Protection Regulations 1987*) are assessed under Part V. This Project requires assessment and approval under both parts of the *EP Act*.

1.4.1.1 Environmental Impact Assessment under Part IV of the *EP Act*

Part IV of the *EP Act* relates to the environmental assessment of proposals that have the potential to have significant impact on the environment. The EPA can adopt one of two levels of formal assessment for a proposal. The level of assessment is determined by the potential for environmental impacts and their significance, and the predicted extent of public interest in the project.

As previously explained in Section 1.3 the EPA determined that this Project is to be assessed at the level of PER.

Proponent requirements at the PER level of assessment are to:

- Prepare and obtain approval from the EPA for an ESD to outline the proposed scope of work for environmental and social impact assessment studies, incorporating the advice of other decision making authorities
- Undertake the relevant studies and investigations
- Prepare a PER document which outlines the project, its potential impacts and proposed management measures to eliminate, minimise or mitigate these impacts
- Make the document available for a public review period (after the EPA is satisfied that it is adequate for public release)
- Respond to issues raised in public submissions

The Sorby Hills Project ESD was approved by the EPA Chairman on September 19th 2012.

1.4.1.2 Environmental Assessment under Part V of the *EP Act*

Under Part V of the *EP Act*, premises listed as ‘prescribed’ under Schedule 1 of the *Environmental Protection Regulations 1987* require a DER Works Approval for construction. The Works Approval is issued by the DER after the environmental impact assessment is completed by the EPA under Part IV of the *EP Act* and after the Minister has approved the Proposal. Works Approvals will be required for the following prescribed categories proposed for the Project:

- Ore crushing and processing/beneficiation facilities
- TSF
- Putrescible Landfill Facility
- Hydrocarbon storage
- Mine dewatering

In addition to the Works Approvals required for construction, a Licence will be necessary for the operation of the Project. On completion of construction and following an application from SMPL, the DER will issue an operating Licence provided all conditions outlined in the Project's Works Approvals have been satisfied.

1.4.2 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *EPBC Act* is administered by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). If the project has the potential to significantly impact on a matter of national environmental significance (MNES), the project is to be referred to the Commonwealth for determination on whether the matter is a 'controlled action' (therefore requiring assessment).

The Project was referred to SEWPaC under the *EPBC Act* in December 2011; SEWPaC provided comments on review of the Project in February 2012. In response SMPL submitted a revised document to SEWPaC in August 2012. The referral decision was made by SEWPaC in January 2013 and the proposed Sorby Hills Project has been assessed as 'not a controlled action' provided it is undertaken in the manner specified by SEWPaC; the Project description and management strategies described in this RER document satisfy the SEWPaC conditions.

1.4.3 Other Approvals and Licences

In order to ensure that all aspects of the Project are considered, and for the Project to proceed, SMPL recognises that a number of other environmental and non-environmental approvals, licences and permits are required, as outlined in Table 1-2.

Table 1-2: Required Approvals and Licences

Agency/Authority	Approval required
DMP	Mining Proposal
	Project Management Plan (PMP)
	Dangerous Goods Site Licence
	Explosives Storage Licence
	Program of Works (PoW)
Department of Water (DoW)	5C Licence to take Groundwater
	26D Licence for Bore Construction
SWEK	Building Licence
	Application to Construct or Install an Apparatus for the Treatment of Sewage
Main Roads WA (MRWA) and Department of Transport (DoT)	Permission to Transport
DoH	Licence to Operate or use Irradiating Apparatus or Electronic Products

2 PROJECT DESCRIPTION

2.1 PROJECT SUMMARY

2.1.1 Project Location

Sorby Hills is situated in the north east Kimberley Region of WA close to the Northern Territory (NT) border. The Sorby Hills Mine Site is located approximately 50 km by road north east from the regional centre of Kununurra. The relevant Project tenements lie to the south east of the currently proposed ORIA – Weaber Plains Project. The south eastern corner of the ORIA – Weaber Plains Project is common with the north western corner of Mining lease M80/286. The nearest developed agricultural land and the closest residence to the Project site lie 21 km and 25 km to the south west respectively. A Project location map is provided as Figure 1-1.

Entry to the Project site will be via the existing access road from the Weaber Plain Road. The intersection with Weaber Plain Road will be widened and upgraded in line with MRWA specifications.

2.1.2 Project Overview

The Project will consist of a number of operational components as listed below:

- Excavation of up to 600,000 tpa of ore from the C, D and E pods
- Processing of ore by flotation to produce 45,000 tpa of Ag Pb Zn concentrate
- Discharge and storage of up to 355,000 tpa tailings within a designated TSF
- Mine site infrastructure such as ROM pad, haul roads, a mill and concentrator, laboratory, evaporation basins, access road, power generation, hardstand area, diesel storage and refuelling area, workshop, site office, explosives magazine, potable water storage tank, bioremediation facility, landfill site, fire breaks and perimeter fence
- Transport of concentrate to Wyndham Port via road train
- Short term storage and export of concentrate from Wyndham Port

The above elements are described in detail in the following sections. A summary of the key characteristics for the Project is provided in Table 2-1.

A detailed site layout plan for the Project Site is provided as Figure 2-1. This plan illustrates the location and scale of site infrastructure (overlaid on topographic data and aerial photography), along with key aspects of the existing environment such as vegetation communities, creeks and drainage lines and major topographic features.

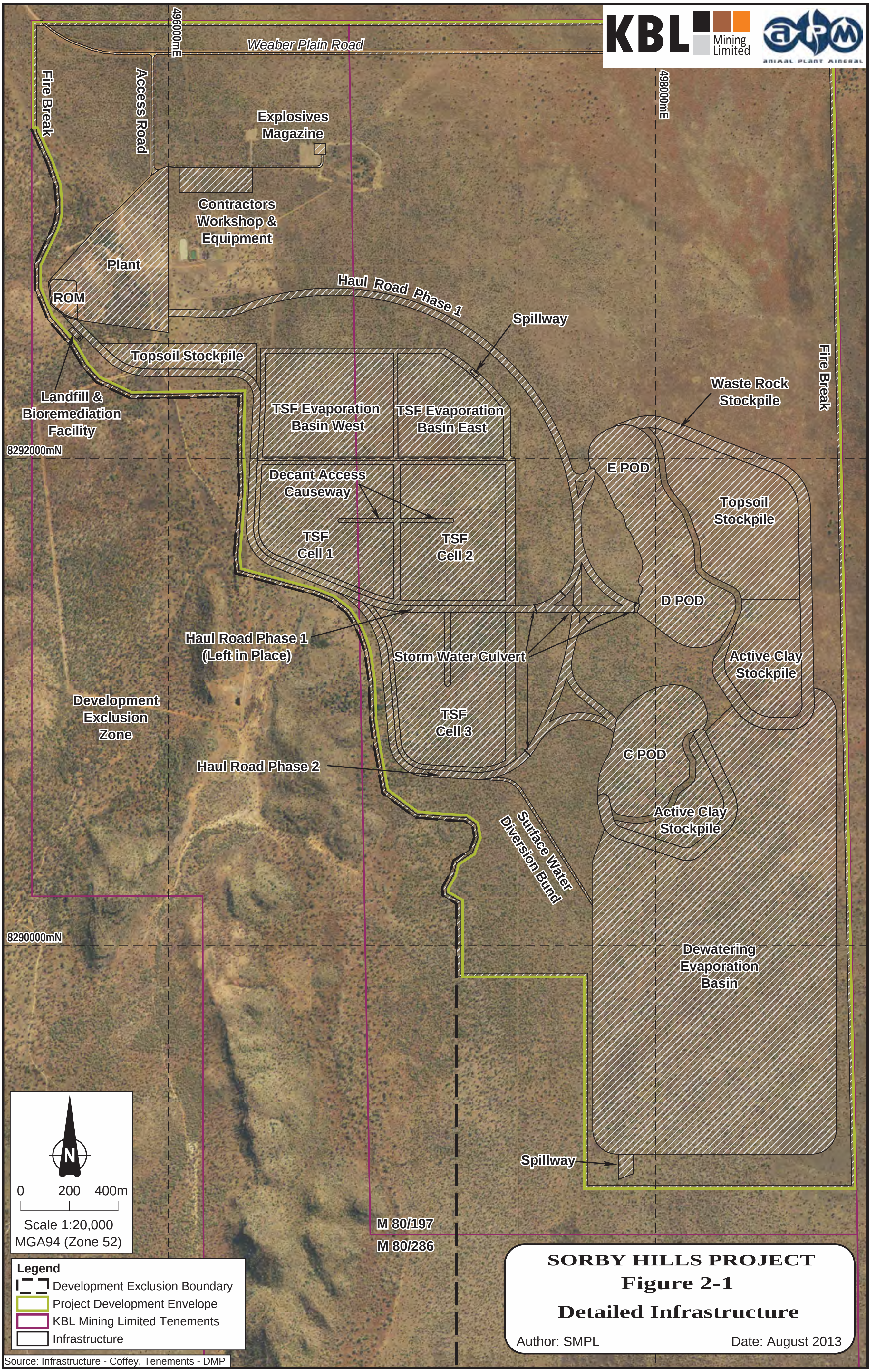
Table 2-1: Key Project Characteristics

Summary of the Proposal	
Proposal Title	Sorby Hills Silver Lead Zinc Project
Proponent Name	Sorby Management Proprietary Limited
Short Description	This proposal is to develop a silver, lead and zinc mine and processing facility approximately 50 km north of Kununurra in the Kimberley Region of WA, including the construction of associated mine infrastructure (ROM pad, haul roads, laboratory, evaporation basins, access road, power generation, hardstand area, diesel storage and refuelling area, workshop, site office, explosives magazine, potable water storage tank, bioremediation facility, landfill site, fire breaks and perimeter fence), discharge of waste to a TSF and road train transport of the concentrate produced to Wyndham Port for export.

Physical Elements		
Element	***Location***	***Extent***
Total Clearing	Figure 2-1	Up to 573 ha within the 1045 ha Project Development Envelope.
Mine Pits	Figure 2-1	Clearing not more than 40 ha within a 1045 ha Project Development Envelope and a pit depth of not more than 70 m.
TSF and associated TSF Evaporation Basin	Centre Coordinates (MGA 94, UTM Zone 52) 8,291,725N, 496,950E	Clearing not more than 135 ha within the 1045 ha Project Development Envelope.
Other Infrastructure		Clearing not more than 398 ha within the 1045 ha Project Development Envelope.

Operational Elements		
Element	***Location***	***Extent***
Mining		
Depth of Mine	-	Up to 70 m.
Mineralised Waste Materials (Maximum)	-	21.56 Mt total. The majority of waste will be consumed during development and construction of the TSF, haul roads and evaporation basins. Waste unsuitable for construction will be placed in temporary stockpiles to the east of the pits. As mining progresses waste material will be backfilled into exhausted pits. On completion of mining, stockpiled waste will be used for pit backfill and for capping of the TSF during rehabilitation. Therefore

Operational Elements		
Element	***Location***	***Extent***
		no permanent waste dumps will be required for the Project.
Processing		
Tailings Storage	Centre Coordinates (MGA 94, UTM Zone 52) 8,291,725 N, 496,950 E	355,000 t of solid per annum in an above ground paddock style TSF.
Transportation		
Transport Method	-	Sealed "Rotabox" (or similar) containers.
Truck Movements	-	Average of 12 per week.
Export	-	Shipping will occur once per month for 11 months of the year.
Water		
Dewatering	-	A maximum of 977.47 Mega litre (ML) per annum will be extracted from pit dewatering.



SORBY HILLS PROJECT
Figure 2-1
Detailed Infrastructure
Author: SMPL Date: August 2013

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_EPA_S2_201b.dgn

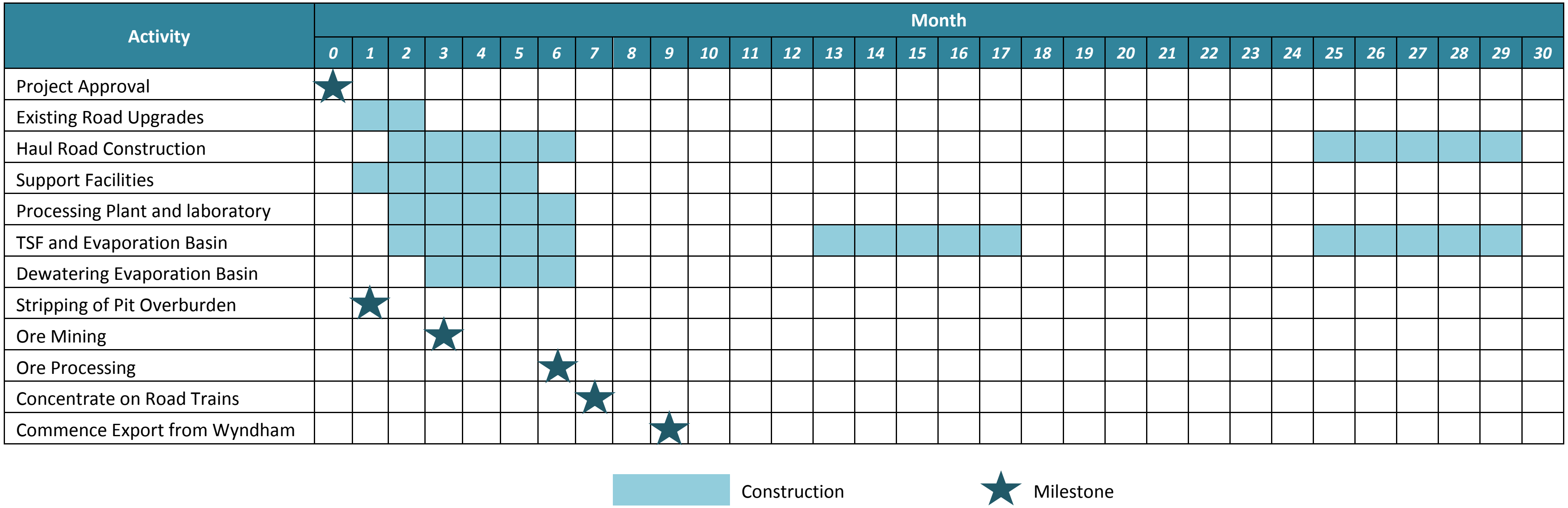
2.1.3 Timing

Provided all relevant approvals are obtained for the Project, construction at the site is scheduled to commence in the third quarter of 2013 with the Project becoming operational in early 2014. A schedule for the Project is provided in Table 2-2. The operational life of the mine is dependent on a number of factors including achievement of expected production rates, results of any exploration and market conditions; based on current resources and reserves it is expected that the Project will be operational for 10 years with a full Project life of 14 years, including construction and closure.

2.1.4 Tenure

The Project is located within the SWEK; tenements related to the Project Mine Site (M80/197 and M80/286) are situated on unallocated Crown Land Lot 373 on Deposited Plan 51355 and illustrated in Figure 1-1. This land was previously covered by a pastoral lease and is currently stocked under a grazing permit issued by the Department of Regional Development and Lands (DRDL). Prior to the commencement of mining activities, the grazing licence will be rescinded and the land de-stocked.

Table 2-2: Project Schedule



2.1.5 Project History

The Sorby Hills deposit was discovered in 1971 by Elf Aquitaine. Aquitaine extensively and systematically explored the Project Area for carbonate hosted Ag, Pb and Zn deposits during the 1970s and 1980s with various joint venture partners. The exploration focused on delineating economic Ag, Pb and Zn resources within the platform carbonate lithologies of the Bonaparte Basin. Exploration consisted of geochemical surveys, various geophysical surveys and extensive drilling. Base of overburden geochemical sampling by auger or rotary air blast drilling was used very effectively over most of the Project Area; the programs targeted the prospective stratigraphy along the main Sorby trend in all of the current mining leases to some extent. Geophysical surveys were used comprehensively. The most effective methods for delineating mineralisation and structure were gradient array and dipole-dipole Induced Polarisation surveys, of which there is complete coverage over the main Sorby trend. Drilling programs at the Project have been quite intensive and comprehensive; approximately 888 holes were completed for approximately 95,000 m from 1972 to 1988 and of these drill holes approximately 374 were diamond holes.

Post 1990 little exploration work was completed and the Project was suspended in the late 1990s due to uncertainty of tenure brought about by the surrounding ORIA – Weaber Plains Project. CBH Resources Ltd (CBH) acquired the Project in 2006 and after guarantees were given of the continuing mining tenure the Project was reactivated. In 2007 CBH commissioned a review of the economic potential of the Sorby Hills deposits which suggested that the deposits had potential for economic extraction. This led to a new phase of exploration which included a desktop review of historic data, a small scale diamond drilling program (13 holes), construction of a wireframe resource model and conceptual mining study. KBL acquired the Project from CBH in 2008 and entered into a Joint Venture Agreement with HYG&L’s Australian subsidiary, Yuguang (Australia) Pty Ltd for the project in 2010. In late 2010 a 99 hole Reverse Circulation (RC) and Diamond Drilling program was completed and in 2011 a further 72 hole RC resource and sterilisation drilling program was conducted.

The Project Area is situated on land that was once covered by pastoral leases and as such pastoral tracks, cattle yards and other limited infrastructure is present on the tenements. At present cattle graze in the Project Area but the land covered by this proposal will be de-stocked prior to mining.

2.1.6 Existing Facilities

There is little infrastructure currently on site. There is an access road linking the Project Mine Site to the Weaber Plain Road, as well as pastoral and exploration tracks across the tenements. The limited infrastructure includes cattle yards, a dam, water and production bores, a small cattle loading ramp, a diesel pump, a core storage site and some remnant disturbed areas and pads resulting from previous exploration. It is planned to utilise these existing degraded areas for the Project’s plant site and other support infrastructure.

SMPL plan to utilise the Weaber Plain Road, Mills Road, Ivanhoe Road, Victoria Highway and Great Northern Highway to haul concentrate from the Project Mine Site to the laydown facilities at Wyndham Port. The port was founded in 1885 and gazetted in 1886; it was established to service the east Kimberley cattle industry and today has an important role in the mining, pastoral and general freight industries. Wyndham Port is the only deep-water port between Broome and Darwin. The Wyndham Port facility is owned and controlled under the Western Australian Port Authority (DoT) and managed and operated by Cambridge Gulf Ltd (CGL). The port has been undergoing major upgrading works since 2010. Key upgrade features include replacement of the jetty fender system, a new jetty steel cathodic protection system, reconstruction of the container hardstand and new jetty amenities and ablutions.

No changes to infrastructure or dredging schedules will be required to facilitate SMPL operations at Wyndham Port.

2.2 RESOURCES TO BE MINED AND MANAGED

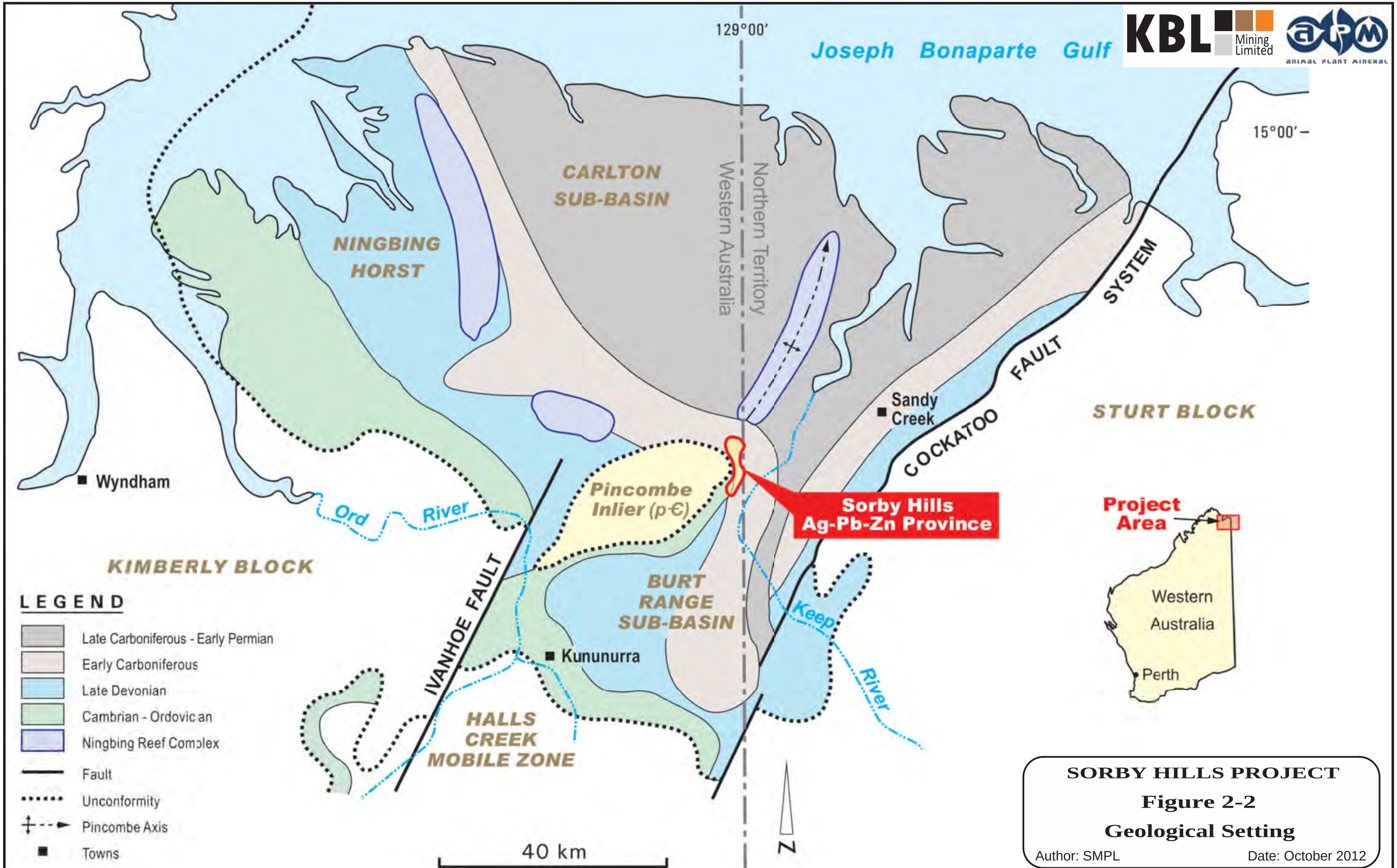
2.2.1 Mineral Resource

The Sorby Hills mineralisation consists of 13 discrete carbonate hosted Ag Pb Zn deposits (pods), Pods A – J, Beta Pod East, Beta Pod West and Alpha pod. The pods form a linear north-south belt extending over 8 km, sub parallel to the eastern margin of the Pincombe Inlier and within the Burt Range Formation of the Bonaparte Basin (Figure 2-2).

The carbonate sequences of the Burt Range Formation are pervasively dolomitised in the area of the Sorby Hills deposits. Dolomitisation has been described to both precede and accompany mineralisation. The pods are dominantly shallow dipping stratabound lenses within dolomitic intraclastic and tectonic breccias of the Burt Range Formation. The lenses average 7-10 m in thickness, are generally less than 1 km long and are 100 m-500 m wide. There is structural control to the mineralisation, with higher grade zones associated with faulting. The Sorby Hills mineralisation is typically Galena (Pb sulphide) rich with moderate to high pyrite (up to 5 %) content and generally low amounts of sphalerite (Zn sulphide).

A detailed description of the Sorby Hills mineralisation and the local and regional geology is available in the 2008 Annual Report for M80/197 compiled by CSA Australia Pty Ltd.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_202.dgn



Source: Geology - KBL Mining

SORBY HILLS PROJECT

Figure 2-2

Geological Setting

Author: SMPL Date: October 2012

2.2.1.1 Resource Estimate

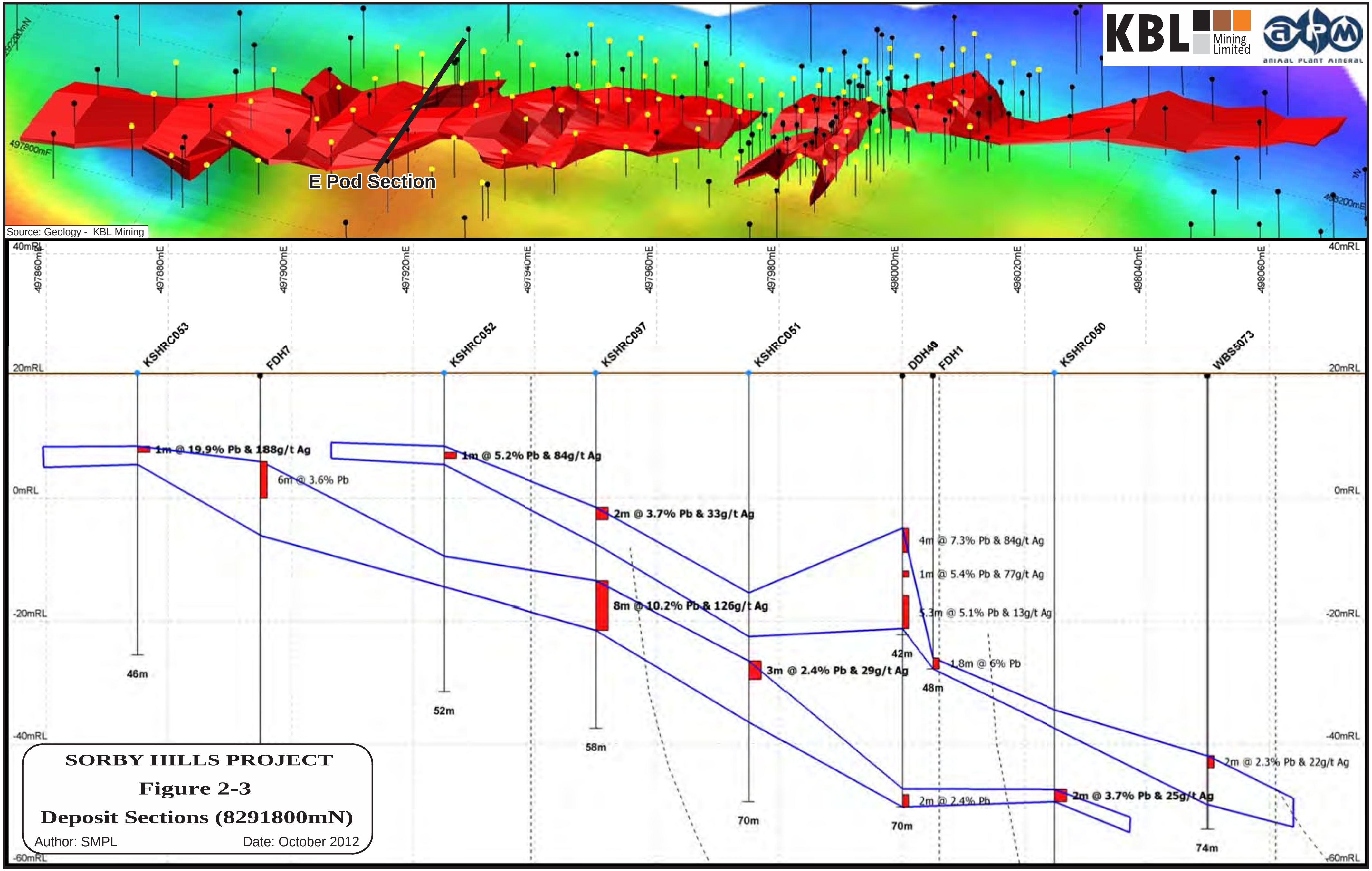
Three of the 13 ore pods have been targeted for sequential mining by SMPL; these are the C, D and E pods. These pods were selected as they represent near surface mineralisation that is amenable to an open cut mining operation with minimal removal of waste material required. Geological cross sections are presented in Figure 2-3 and Appendix 1 (Volume 3).

SMPL commissioned CSA Global Pty Ltd (CSA) to undertake a resource estimate for the C, D and E pods of the Sorby Hills deposit in early 2011 based on historic (888 holes) and 2010 drill holes (99 holes. The 2010 drill program specifically targeted the C, D and E pods in order to increase the confidence level of the resource. A further program for resource and sterilisation drilling was completed in 2011; drill hole locations are illustrated in Figure 2-4 and associated geological cross sections are provided in Appendix 1 (Volume 3). An updated resource and reserve estimate for the D and E deposits, including the 2011 drilling, was completed by H&S Consultants Pty Ltd (H&S) in June 2012.

The mineral resources for the C, D and E pods are classified as Indicated and Inferred totalling 8.712 Mt at a grade of 3.13 % Pb, 0.37 % Zn and 36.7 g/t Ag. This is based on confidence in the geological interpretation and continuity from the results of the drilling and exploration campaigns, drilling density and statistical confidence in the mineral resource estimate. Results of the mineral resource estimates for the C, D and E pods are presented in Table 2-3 and Table 2-4.

The resource and reserve estimates prepared by CSA and H&S are in accordance with the Joint Ore Reserves Committee (JORC) code.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_203.dgn

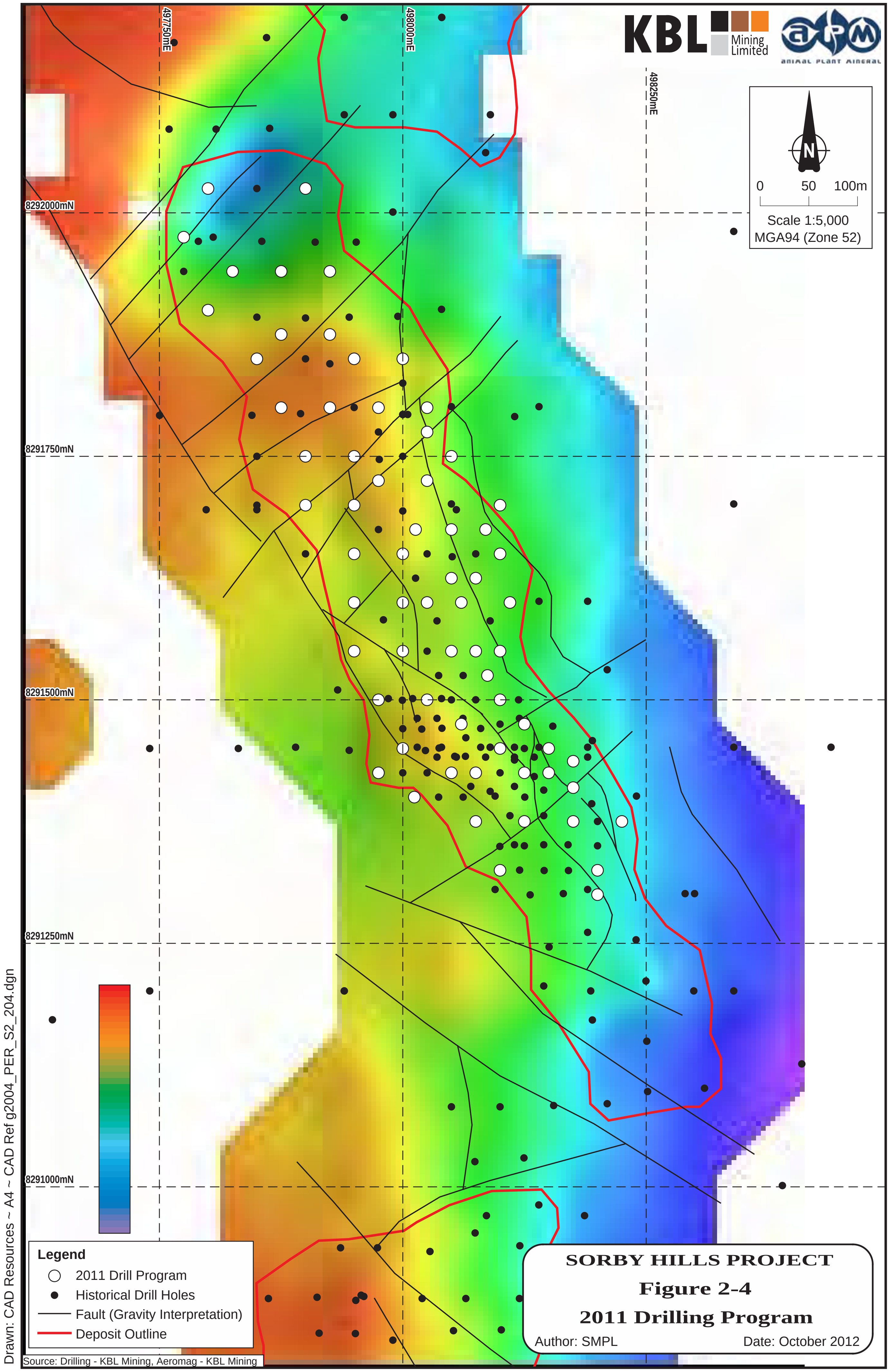


SORBY HILLS PROJECT

Figure 2-3

Deposit Sections (8291800mN)

Author: SMPL Date: October 2012



SORBY HILLS PROJECT

Figure 2-4

2011 Drilling Program

Author: SMPL

Date: October 2012

Table 2-3: Mineral Resource Estimate for Sorby Hills D and E Pods

Classification	Oxidation	Kilotonnes (kT)	Pb (%)	Zn (%)	Ag (g/t)
Indicated	Oxidised	1,462	2.6	0.24	30
	Transitional	816	2.8	0.25	32
	Fresh	3,371	3.6	0.44	49
	Total	*5,649*	*3.3*	*0.36*	*41*
Inferred	Oxidised	141	2.0	0.15	24
	Transitional	68	2.0	0.15	24
	Fresh	1,333	2.8	0.39	35
	Total	*1,543*	*2.7*	*0.36*	*34*
Totals	Oxidised	1,603	2.5	0.23	30
	Transitional	884	2.8	0.25	31
	Fresh	4,705	3.4	0.42	45
	Grand Total	***7,192***	***3.1***	***0.36***	***40***

Indicated and Inferred resource estimate for the D and E Pods at 1% Pb cut-off

Table 2-4: Mineral Resource Estimate for Sorby Hills C Pod

Classification	Oxidation	Kilotonnes (kT)	Pb (%)	Zn (%)	Ag (ppm)
Indicated	Oxidised	140	3.3	0.2	22
	Fresh	540	3.4	0.5	18
	Total	*680*	*3.4*	*0.4*	*18*
Inferred	Oxidised	80	3.1	0.3	19
	Fresh	750	3.2	0.4	23
	Total	*840*	*3.2*	*0.4*	*22*
Grand Total		***1,520***	***3.3***	***0.4***	***21***

Indicated and Inferred resource estimate for C Pod at 2.5% Pb cut-off

2.2.2 Geotechnical Assessment

A detailed rock mechanics analysis of the Project Area was undertaken in 1979 for a preliminary feasibility study. Although this analysis was aimed largely at an underground venture for I pod the deposits are fairly uniform across the Project and the results are also applicable to open cut proposals; the original report, completed by Mount Isa Mines Pty Ltd (MIM), is included as Appendix 2 (Volume 3). To further advance the geotechnical understanding for the Project an additional assessment of the geotechnical characteristics of the material to be mined and used in construction of infrastructure was made by Soil Water Consultants (SWC) (Appendices 3 and 4, Volume 3).

2.2.3 Overburden and Mining Waste

Extraction of mineralised ore will require the removal of overburden (surficial soils and waste rock) and waste rock surrounding the mineralised deposits. Materials and waste rock stripped from development areas will be an important resource for the construction of some Project elements. To enable SMPL to gain an understanding of the physical and chemical nature of these materials and to identify any key issues for handling and management during mining and rehabilitation SWC were commissioned to complete a pre-mine soils characterisation for the Project Area (Appendix 3, Volume 3) and a geochemical characterisation of the Project waste materials (Appendix 5, Volume 3).

The soils of the Project Area were found to comprise a surface layer of greyish brown active clay to a depth of approximately 80 cm which is underlain by a deep layer of brown inactive clay to approximately 18 m. The surficial soils have low shear strength, high plasticity, high activity and a dispersive nature which renders them unsuitable for use in construction; however suitability changes with depth and increasingly suitable soils are encountered from depths of 6 m. The upper 80 cm of clay (i.e. the greyish brown active clay) is expansive and is therefore also unsuitable as foundation material for infrastructure. The characterisation of the Project Area soils is discussed further in Section 6.1.6.

Geochemical characterisation of the Project waste materials has indicated that the majority of waste rock can be classified as NAF with a low potential to produce ARD. However there is a potential for a localised presence of PAF materials within the proposed mine voids. Comprehensive management strategies will be in place to avoid any risks associated with these PAF materials and their potential to produce acid mine drainage (AMD); the geochemical characterisation and proposed environmental management strategies are discussed in detail in Sections 6.1.7 and 7.2.7 respectively.

Overburden will be removed using a combination of scrapers and a load and haul operation consisting of excavators and articulated trucks. Waste material identified as suitable for construction will be used in the assembly of the haul road, TSF and evaporation basins. Unsuitable waste will be hauled to designated temporary active clay and waste rock stockpiles; these stockpiles will comprise material from the excavation of pit overburden as well as active clay removed in the foundation excavation for the haul roads, TSF embankments and evaporation basin embankments. These waste materials will be used for pit backfill upon completion of mining. Sufficient suitable waste material (NAF dolomites) will be stored and used for capping of the TSF during rehabilitation.

The three ore bodies will be mined in succession starting with D pod; as such the waste stockpiles have been sized to accommodate waste removed from infrastructure foundation excavations and the mining of D pod. Waste material generated through the development of the subsequent pits (E and C pods) will be used to backfill the exhausted pits and will therefore not require stockpiling. The proposed mining sequence is further described in Section 2.3.2.

The total volumes of clay and rock to be stockpiled are summarised in Table 2-5. The active clay and waste rock stockpiles will be located to the east of the mine pits as shown by Figure 2-1. The rock stockpiles will be located along the perimeter of the clay and topsoil stockpiles, thereby providing erosion protection; there is sufficient waste rock to form rock armouring some 60 m in width.

Table 2-5: Clay and Rock Stockpile Volumes

Source	Clay Volume (m^3)	Rock Volume (m^3)
Haul Road	165,000	0
TSF	495,000	0
TSF Evaporation Basin	30,000	0
Pits	3,390,000	790,000
Total	***4,080,000***	***790,000***

2.2.4 Topsoil Resource

Generally the soils of the Project Area were found to be nutrient poor however mineral nitrogen is slightly elevated in the top 20 cm of the soil profile. Nevertheless topsoil stripped from the development areas will be an important resource for future rehabilitation works. Topsoil will therefore be segregated and stockpiled for future redistribution as mine closure progresses. Topsoil stockpiles will comprise the organic material from the upper 25 cm of the areas stripped for development of pits and infrastructure, the resultant topsoil volumes are summarised in Table 2-6.

Topsoil will primarily be stockpiled to the east of the pits with a small area adjacent to the TSF evaporation basin also being used as shown in Figure 2-1. The topsoil stockpile to the east of the pits is adjacent to a surface water diversion structure, however the topsoil will be protected by 60 m wide waste rock stockpile armouring as shown in Figure 2-1, therefore the topsoil viability will not be compromised. The footprint of the topsoil stockpiles has been determined using a height of 1.8 m and the estimated volume of material required for stockpiling. Proposed environmental management strategies for topsoil are discussed in detail in Section 7.2.18.

Table 2-6: Topsoil Stockpile Volumes

Topsoil Source	Topsoil Volume (m^3)
Haul Road	75,000
TSF	225,000
TSF Evaporation Basin	115,000
Dewatering Evaporation Basin	150,000*
Pits	88,000
Total	***653,000***

* If vegetation is retained within the footprint of the dewatering evaporation basin then topsoil stockpile volumes will be significantly less.

2.3 MINING OPERATIONS

The mining technique for the Project will be consistent with a typical open cut, drill and blast, loading and haulage operation. The pits will be linked to the ROM by haul roads; the spatial arrangement of the pits, haul roads and ROM pad is illustrated in Figure 2-1.

2.3.1 Mining Rate

The Sorby Hills mining operation for the C, D and E pods is planned over a period of 10 years at an ore production rate of 400,000 tpa to 600,000 tpa.

Mining will be carried out predominantly during dayshift, with some night operations occurring.

Mining will also be influenced by seasonal conditions and may be limited during periods of heavy rainfall during the wet season however all-weather haul roads will reduce this down time.

2.3.2 Sequence and Pit Design

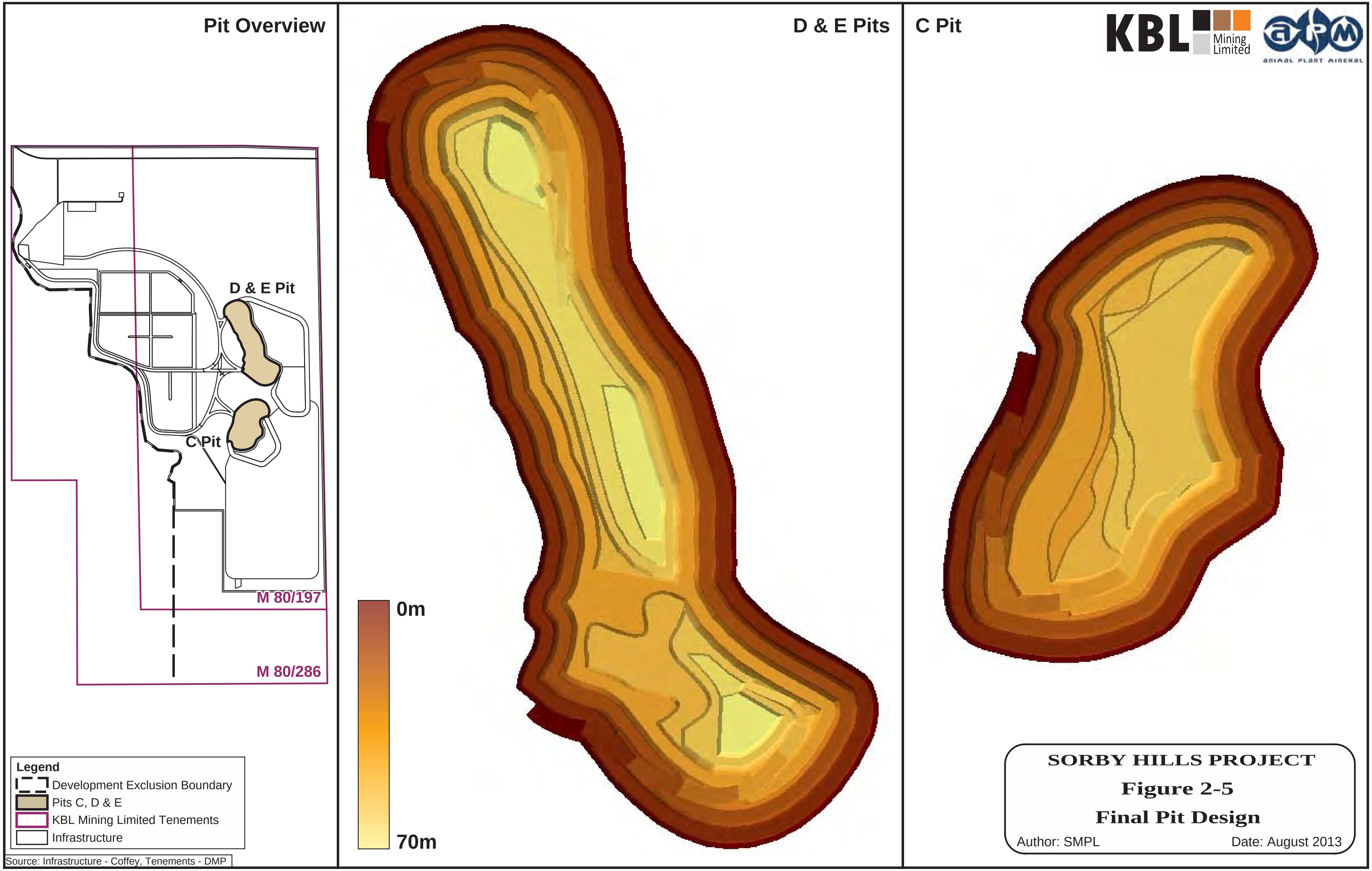
Initially C, D and E pods will be mined as separate entities in three small pits commencing with D pod. As mining progresses the D and E pods will be contained within one larger pit. The final pit design therefore consists of two main pits, the combined D and E pit and the C pit as shown in Figure 2-5. The pit design will be consistent with a typical open cut pit design; the pit slope parameters used in the design are given in Table 2-7.

Table 2-7: Pit Slope Angles

Domain	Batter Face Angle (°)	Berm Width (m)	Batter Height (m)	Inter Ramp Slope Angle (°)	Inter Ramp Slope Height (m)	Overall Slope Height (m)	Overall Slope Angle (°)
Oxide	55	13	10	27	40	75	37
Transition	55	13	10	27	40	75	37
Fresh	66	8.5	20	48.3	-	75	37

Further information on pit design for the Project is provided in the Pit Design and Schedule report compiled by Coffey Mining Pty Ltd (Coffey) for SMPL which is provided in Appendix 6 (Volume 3).

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_205.dgn



SORBY HILLS PROJECT

Figure 2-5

Final Pit Design

Author: SMPL Date: August 2013

2.3.3 Schedule of Mined Material

Mining will produce topsoil, waste material and ore. In general the open pit sites will be progressively stripped of topsoil and overburden to allow access to the ore. Mine production scheduling for the Project has been determined by Coffey (Appendix 6, Volume 3); an indicative schedule summarising the removal of ore and waste is provide in Table 2-8.

Mining will commence with the pre-production starter pit in D pod to allow mining of sufficient waste material for the construction of infrastructure; mining will continue in D pod until a year 8 of the Project. Waste stripping in E pod will commence in year 1 with ore extraction anticipated in year 2. The pre-production period and first two years of mining have been scheduled with aggressive targets to allow access to waste materials for construction and to extract sufficient ore for the mill. Waste stripping in C pod is anticipated to commence in year 4 and mining in year 9.

The mine schedule is based on a Pb cut-off grade of 0.5 % to include all of the mineralisation present in the three pods; this provides a production life span of 15 years for the Project. It is however unlikely that the entire resource will be mined as the economics of the Project will be dependent on metal prices and the cut-off grade will be continually adjusted to account for variation. Current economic conditions allow for a cut-off grade of 1 % Pb which is expected to provide approximately 10 years of production for the Project.

Table 2-8: Indicative Mining Schedule

	Period	Pre-production	Pre-production	Pre-production	Pre-production	Pre-production	Year 1 Quarter 1	Year 1 Quarter 2	Year 1 Quarter 3	Year 1 Quarter 4	Year 2 Quarter 1	Year 2 Quarter 2	Year 2 Quarter 3	Year 2 Quarter 4	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total
Starter Pit	Total [Mt]	0.48	0.44	-	-	0.28	-	0.12	0.12	0.10	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.65
	Waste [Mt]	0.48	0.44	-	-	0.26	-	0.10	0.10	0.05	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.48
	Ore [Mt]	-	-	-	-	0.03	-	0.03	0.03	0.04	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17
	Pb_%	-	-	-	-	1.95	-	1.93	1.93	2.43	3.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.51
	Zn_%	-	-	-	-	0.21	-	0.21	0.21	0.18	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.19
	Ag_ppm	-	-	-	-	19.51	-	19.86	19.86	22.10	28.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.87
	Pb_Zn_%	-	-	-	-	2.16	-	2.14	2.14	2.61	3.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.70
	Fe_%	-	-	-	-	6.36	-	5.29	5.29	4.54	4.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.01
D Pod	Total [Mt]	0.53	0.57	1.01	1.01	0.62	0.55	0.20	0.20	0.16	-	-	0.07	0.15	0.83	0.33	0.16	0.02	0.16	0.11	-	-	-	-	-	-	-	6.67
	Waste [Mt]	0.53	0.57	1.01	0.97	0.54	0.45	0.12	0.12	0.10	-	-	0.04	0.11	0.54	0.25	0.07	0.01	0.10	0.05	-	-	-	-	-	-	-	5.58
	Ore [Mt]	-	-	-	0.04	0.08	0.10	0.07	0.07	0.06	-	-	0.02	0.04	0.29	0.08	0.09	0.01	0.06	0.06	-	-	-	-	-	-	-	1.09
	Pb_%	-	-	5.99	4.00	4.34	4.50	5.11	5.11	5.11	-	-	5.11	4.82	4.55	4.20	4.46	4.46	4.10	5.73	-	-	-	-	-	-	-	4.65
	Zn_%	-	-	0.20	0.17	0.17	0.17	0.25	0.25	0.25	-	-	0.25	0.31	0.43	0.80	0.96	0.96	0.82	1.00	-	-	-	-	-	-	-	0.47
	Ag_ppm	-	-	101.37	43.25	46.86	48.47	53.96	53.96	53.96	-	-	53.96	51.99	53.01	58.75	67.73	67.73	54.96	59.81	-	-	-	-	-	-	-	54.27
	Pb_Zn_%	-	-	6.19	4.17	4.51	4.68	5.36	5.36	5.36	-	-	5.36	5.14	4.99	5.00	5.42	5.42	4.92	6.73	-	-	-	-	-	-	-	5.12
	Fe_%	-	-	5.93	3.56	2.85	2.66	2.48	2.48	2.48	-	-	2.48	2.50	2.62	3.16	3.56	3.56	3.87	3.78	-	-	-	-	-	-	-	2.90
E Pod	Total [Mt]	-	-	-	-	-	0.35	0.58	0.58	0.63	0.80	0.75	0.42	0.28	0.50	0.80	0.84	0.72	0.54	0.66	0.51	0.72	0.50	-	-	-	-	10.18
	Waste [Mt]	-	-	-	-	-	0.35	0.58	0.58	0.63	0.75	0.65	0.34	0.23	0.40	0.48	0.54	0.31	0.20	0.32	0.13	0.38	0.28	-	-	-	-	7.15
	Ore [Mt]	-	-	-	-	-	-	-	-	-	0.05	0.10	0.08	0.05	0.11	0.32	0.30	0.40	0.34	0.34	0.37	0.33	0.22	-	-	-	-	3.03
	Pb_%	-	-	-	-	-	-	-	-	-	2.37	2.37	2.27	2.27	2.29	2.41	2.63	2.88	2.98	3.14	3.36	3.38	3.11	-	-	-	-	2.90
	Zn_%	-	-	-	-	-	-	-	-	-	0.18	0.18	0.22	0.22	0.22	0.22	0.24	0.28	0.33	0.43	0.40	0.37	0.29	-	-	-	-	0.31
	Ag_ppm	-	-	-	-	-	-	-	-	-	28.71	28.71	30.08	30.13	30.38	31.44	35.61	41.32	43.86	46.85	47.61	45.89	44.43	-	-	-	-	40.61
	Pb_Zn_%	-	-	-	-	-	-	-	-	-	2.55	2.55	2.49	2.49	2.52	2.64	2.87	3.16	3.31	3.57	3.76	3.75	3.40	-	-	-	-	3.21
	Fe_%	-	-	-	-	-	-	-	-	-	5.76	5.76	5.39	5.37	5.25	4.75	4.20	3.87	3.80	3.79	3.71	3.64	4.20	-	-	-	-	4.17
C Pod	Total [Mt]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.27	0.40	0.67	0.70	0.63	0.77	0.57	0.91	1.41	1.17	1.11	0.18	8.78
	Waste [Mt]	-		-	-	-	-	-	-	-	-	-	-	-	-	0.27	0.40	0.67	0.70	0.63	0.73	0.51	0.73	1.05	0.87	0.71	0.08	7.35
	Ore [Mt]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	0.06	0.18	0.36	0.30	0.40	0.10	1.43
	Pb_%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.79	2.79	2.69	2.72	3.06	3.23	3.28	2.97
	Zn_%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.14	0.14	0.25	0.44	0.50	0.40	0.51	0.40
	Ag_ppm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.53	20.53	18.22	17.47	21.35	17.16	17.39	18.47
	Pb_Zn_%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.93	2.93	2.94	3.16	3.56	3.63	3.79	3.38
	Fe_%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.84	2.84	2.89	2.84	2.62	2.40	2.32	2.64
Stockpile	[Mt]	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.11	0.01	0.01	-	-	-	-	-	-	2.73	0.14	0.14	0.14	0.14	0.11	0.01	0.01	-	2.73
	Pb_%	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.53	2.18	2.18	-	-	-	-	-	-	3.55	3.56	3.56	3.56	3.56	3.53	2.18	2.18	-	3.55
	Zn_%	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.10	0.10	-	-	-	-	-	-	0.17	0.17	0.17	0.17	0.17	0.17	0.10	0.10	-	0.17
	Ag_ppm	33.53	33.53	33.53	33.53	33.53	33.53	33.53	33.53	33.25	20.55	20.55	-	-	-	-	-	-	33.51	33.53	33.53	33.53	33.53	33.25	20.55	20.55	-	33.51
	Pb_Zn_%	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.70	2.29	2.29	-	-	-	-	-	-	3.72	3.73	3.73	3.73	3.73	3.70	2.29	2.29	-	3.72
	Fe_%	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.52	2.17	2.17	-	-	-	-	-	-	3.53	3.55	3.55	3.55	3.55	3.52	2.17	2.17	-	3.53
Stok-feed	[Mt]	-	-	-	-	-	-	-	-	-	0.06	0.10	-	-	-	-	-	-	-	-	-	-	-	0.03	0.10	-	0.01	0.29
Direct-Feed	[Mt]	-	-	-	-	-	0.10	0.10	0.10	0.10	0.05	-	0.10	0.10	0.40	0.40	0.40	0.41	0.40	0.40	0.41	0.40	0.40	0.36	0.30	0.40	0.10	5.42
Total Material	TM_[Mt]	1.01	1.00	1.01	1.01	0.90	0.90	0.90	0.89	0.90	0.91	0.75	0.49	0.44	1.33	1.40	1.40	1.40	1.40	1.40	1.27	1.29	1.41	1.41	1.17	1.11	0.18	27.28
Total Feed	Ore_[Mt]	-	-	-	-	-	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.40	0.40	0.40	0.41	0.40	0.40	0.41	0.40	0.40	0.40	0.40	0.40	0.10	5.72
	Pb_%	-	-	-	-	-	4.50	4.27	4.27	3.99	2.98	3.75	2.92	3.41	3.95	2.78	3.05	2.92	3.14	3.53	3.31	3.29	2.92	2.80	3.21	3.23	3.30	3.26
	Zn_%	-	-	-	-	-	0.17	0.24	0.24	0.22	0.17	0.18	0.23	0.26	0.38	0.34	0.41	0.30	0.40	0.52	0.38	0.34	0.27	0.42	0.42	0.40	0.49	0.36
	Ag_ppm	-	-	-	-	-	48.47	44.94	44.94	40.61	70.10	62.84	35.75	39.88	46.97	37.11	42.97	41.97	45.50	48.82	45.41	41.99	32.84	18.95	24.61	17.16	73.40	39.34
	Pb_Zn_%	-	-	-	-	-	4.68	4.51	4.51	4.21	3.16	3.92	3.15	3.67	4.33	3.13	3.46	3.22	3.55	4.05	3.69	3.63	3.20	3.22	3.63	3.63	3.79	3.62
	Fe_%	-	-	-	-	-	2.66	3.22	3.22	3.34	5.12	3.73	4.73	4.09	3.32	4.42	4.06	3.86	3.81	3.79	3.64	3.51	3.62	2.91	2.88	2.40	2.39	3.53

2.3.4 Mining Method

Drill and Blast

Drill and blast techniques will be used to fragment the ore and waste material in the pits; the drill and blast operation will be carried out in pre-defined patterns. Drill crew and plant will consist of a single blast hole drill rig (Sandvick DP1100 or similar capacity drill rig) with operator, one bomb ute and shot-firer and an explosives mobile manufacturing unit (MMU) with operator. Blasting will only take place at designated blast times during dayshift. Explosives will be stored remote from the mining operations in an explosives magazine compliant with the *Dangerous Goods Safety Act 2004*, the *Dangerous Goods Safety (Explosives) Regulations 2007* and *AS 2187.1:1998, Explosives – Storage, transport and use, Part 1.*

Ore Delineation

The site geologist and pit technicians will assess broken (blasted) ground to identify and delineate ore, low grade material and waste prior to load and haul commencing in the area.

Load and Haul

Extraction will be predominantly carried out using conventional mining technique; the load and haul mining fleet will include a 120 t excavator loading four 90 t haul trucks on each mining bench. Suitable waste material will be used in the construction of infrastructure; all other waste produced during excavation of D pod will be hauled to designated active clay and waste rock stockpiles, subsequent waste from E and C pods will be immediately backfilled into exhausted pits. Ore and low grade material will be trucked along the haul road and tipped on the ROM pad in designated stockpiles.

2.3.5 Mining Fleet

Table 2-9 indicates the likely mining machinery requirement for the Project.

Table 2-9: Indicative Mining Fleet

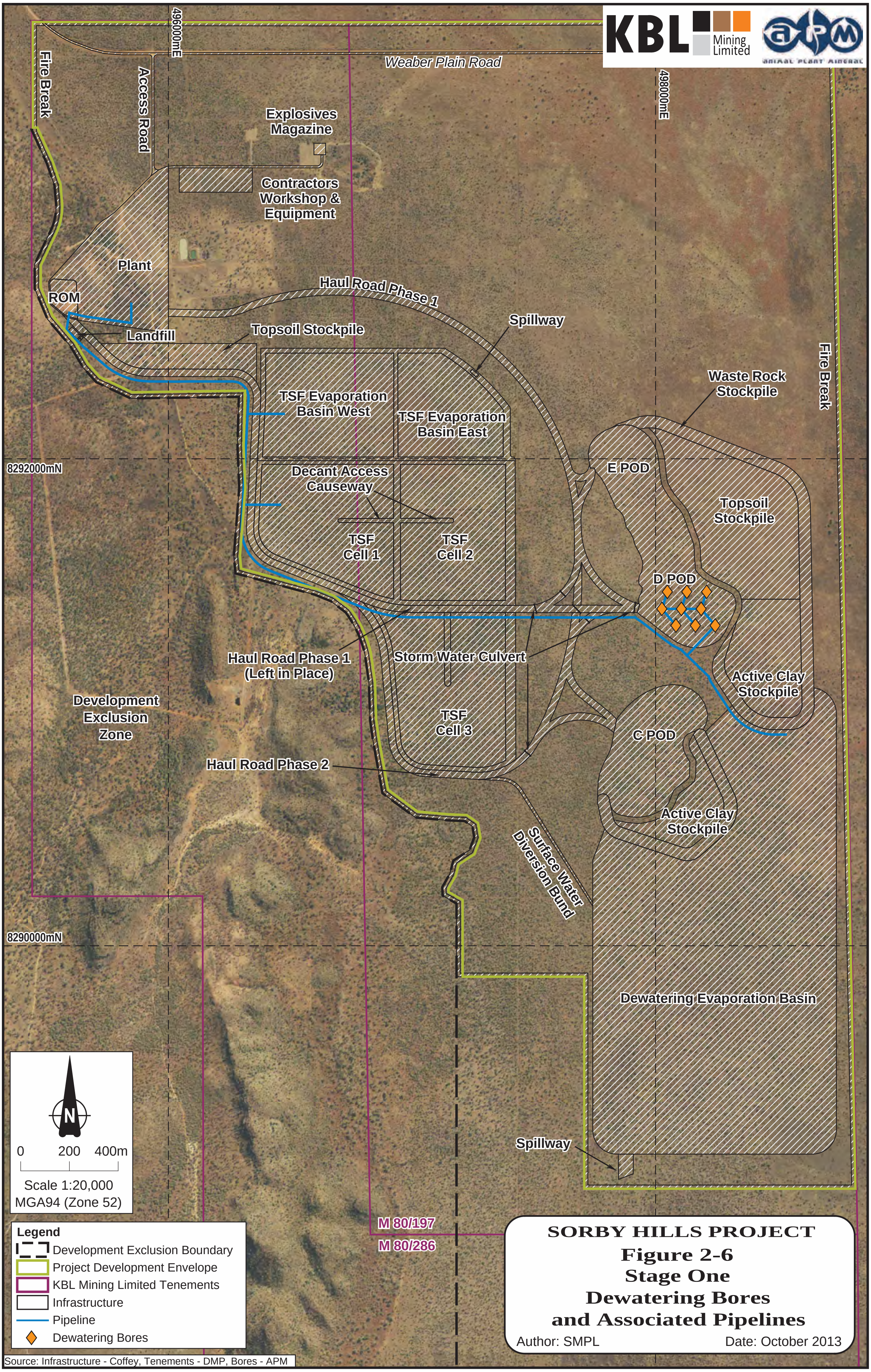
Machine	Number
Excavator (120 t)	1
Excavator (40 t)	1
Haul Truck (90 t)	4
Dozer (D10)	2
Grader (16H)	1
Scraper (631)	4
Water Cart (35 kL)	1
Blast Hole Drill (DP1100)	1

A fleet of service vehicles and ancillary equipment of various types will also be required including light vehicles, buses, service/refuelling trucks, lighting plants and explosives vehicles.

2.3.6 Pit Dewatering

Dewatering will be required to accompany mine development as the proposed pits will intersect the groundwater aquifer present within the mineralised dolomites hosting the resource. Dewatering will occur as a continuous process throughout the life of the mine using extraction bores within the periphery of the pit and an in-pit sump (Figure 2-6). A maximum of 2.678 ML/day will be extracted through dewatering bores. Analysis of the hydrogeology is summarised in Section 6.1.5, based on a hydrogeological assessment conducted by Australasian Groundwater and Environmental Consultants Pty Ltd (AGEC) (Appendix 7, Volume 3).

Water produced by the dewatering operation will be used in the processing facility and for dust suppression purposes, thereby offsetting additional requirements from a borefield; excess water will be directed to the evaporation basins. Management of groundwater resources and discharge of excess process water is discussed in detail in Sections 7.2.5 and 7.2.6.



SORBY HILLS PROJECT
Figure 2-6
Stage One
Dewatering Bores and Associated Pipelines
Author: SMPL Date: October 2013

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_206.dgn

2.4 ORE PROCESSING

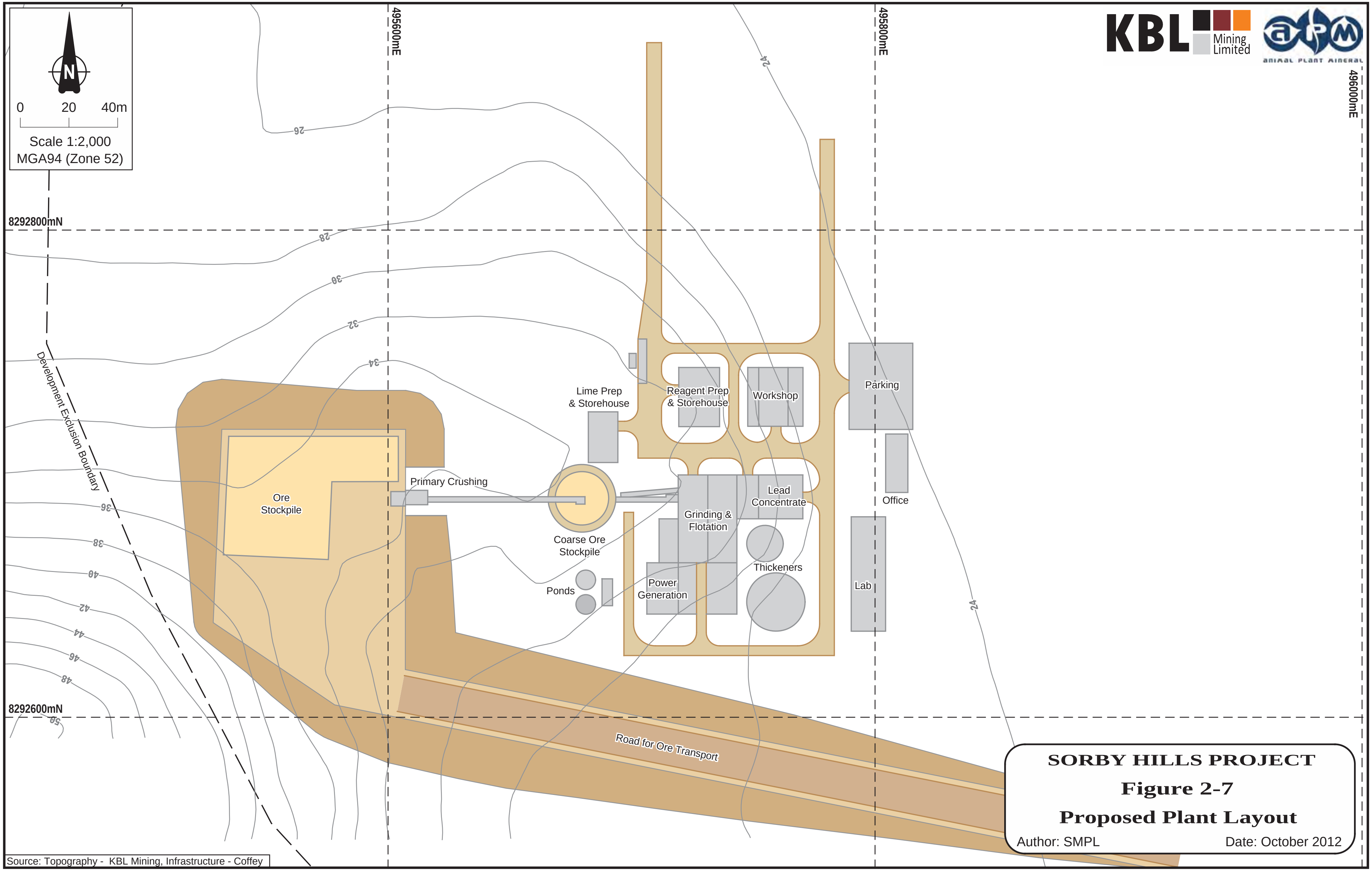
2.4.1 Ore Processing Plant Arrangement

The processing plant will comprise the following components:

- ROM pad and crusher loading facility
- Primary crusher, screens and associated coarse ore stockpile
- Grinding circuit comprising a SAG (semi-autogenous grinding) mill and a Ball mill
- Flotation circuit, including flotation tanks, pumps and pipe work
- Concentrate filter and container storage area
- Associated infrastructure including a tailings thickener, electrical switch room, laboratory, diesel generators and diesel storage area

Processing plant design has been completed by the Beijing Research Institute of Mining & Metallurgy (BGRIMM), using metallurgical data contained in a feasibility study report completed by MIM and from confirmation metallurgical tests carried out in 2008 by Australian Minmet Metallurgical Laboratories Pty Ltd. The processing circuit layout is provided in Figure 2-7.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_207.dgn



SORBY HILLS PROJECT

Figure 2-7

Proposed Plant Layout

Author: SMPL Date: October 2012

Source: Topography - KBL Mining, Infrastructure - Coffey

2.4.2 Ore Processing Method

A process chart of the ore treatment process detailing inputs, outputs and waste streams is presented in Figure 2-8.

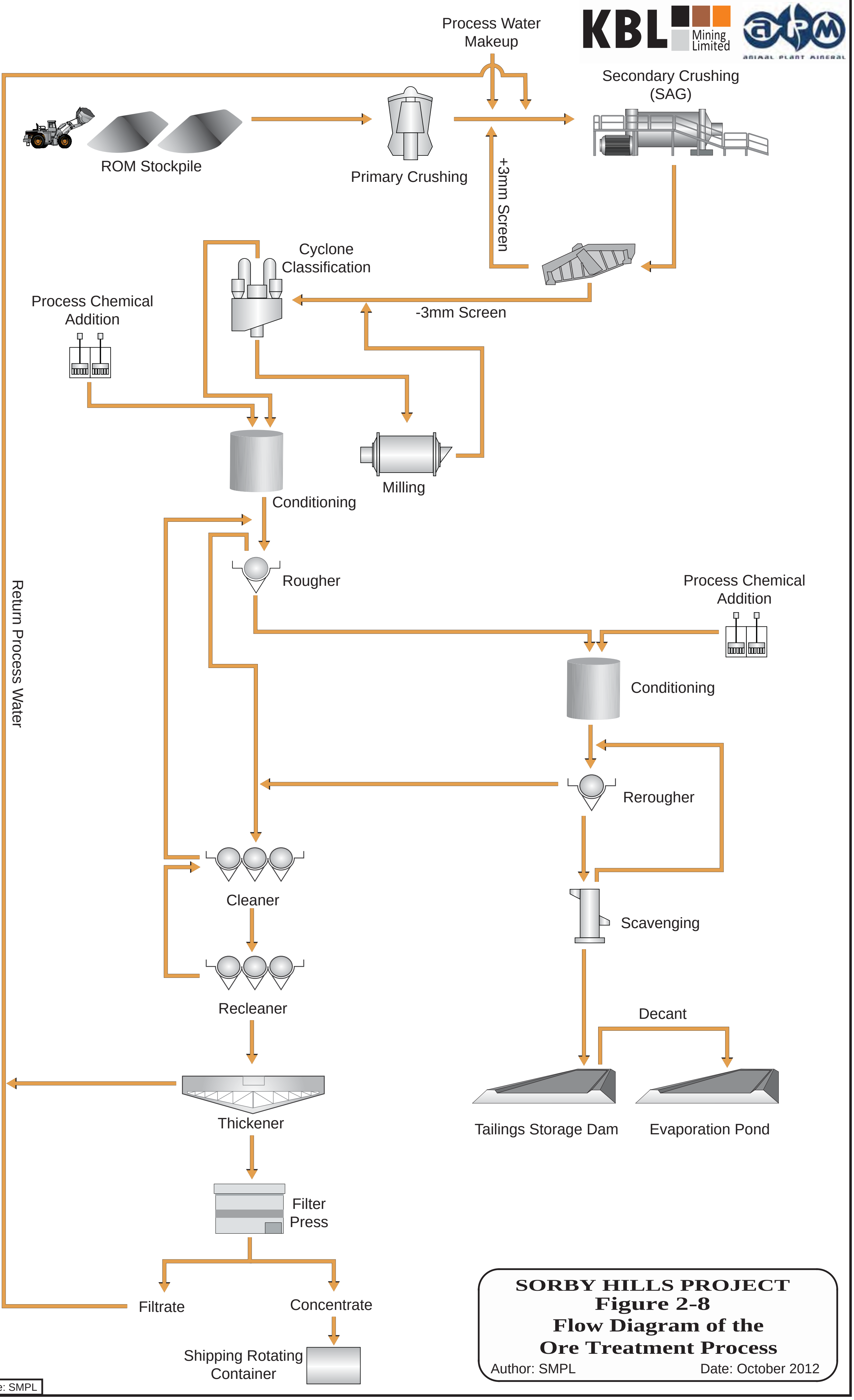
The ROM pad will be used to stockpile ore and low grade material prior to processing; material will be delivered by haul trucks and stockpiled according to the material's characteristics. Ore material from these stockpiles will be fed into the crusher hopper using a front-end loader. If required the material will be blended either through creation of secondary stockpiles or during crusher loading operations.

The feed material will be crushed using a primary jaw crusher then conveyed to a coarse ore stockpile. From the coarse ore stockpile, ore will be conveyed to the SAG mill, mixed with water for coarse grinding then pumped to the Ball mill for fine grinding. Ore will be milled to -200 microns before passing to the flotation circuit. The ore-water slurry will be mixed with a range of industry standard reagents (Table 2-10); the slurry and reagent mixture will then be passed to a series of stirred flotation tanks where air is blown through the pulp. Selected sulphide materials adhere to these air bubbles, float to the surface and are skimmed off to form a concentrate. The tails from the flotation circuit will be thickened to reclaim process water and then the slurry pumped to the TSF.

Following skimming the concentrate will be de-watered in a conventional thickener circuit followed by drying to shipping moisture specification in a ceramic Filter Press. The concentrate will then be packaged directly into fully sealed and lockable containers for short term on site storage and subsequent transport off site. The flotation circuit and Filter Press will be contained within covered concrete bunded areas. No concentrate stockpiles will be required on site.

The capacity of the processing circuit is approximately 400,000 tpa based on 24 hour operations.

The concentrate to be produced by the Project is described in Section 2.6.1.



Source: SMPL

SORBY HILLS PROJECT
Figure 2-8
Flow Diagram of the Ore Treatment Process
Author: SMPL Date: October 2012

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_208.ai

Table 2-10: Sorby Hills Processing Reagents and Chemicals

Reagent/Chemical	Purpose	Delivery Method	Reagent Form	Hazardous?
Sodium Sulphite	Flotation Activator	25 kg Bags	White/Tan Solid Crystalline Powder	Yes, requires management
Zinc Sulphate	Flotation Activator	25 kg Bags	White Powder	Yes, requires management, known carcinogen
Sodium Hydrosulphide	Flotation Activator	25 kg Bags	Off-White Solid	Yes, requires management, known carcinogen and flammable
Methyl Isobutyl Carbinol	Flotation Frother	Integrated Bulk Container (nominally 1000 L capacity)	Colourless Oily Liquid	Yes, requires management, known carcinogen and flammable
(SEX, SIBX or PAX) Xanthate	Flotation Collector	25 kg Bags	Yellow Powder	Yes, explosive vapour and known carcinogen
Sodium Meta Bisulphite	Weak Depressant	1 tonne Bags	White Flake	Yes, strong oxidant
IF6500	Flotation Frother	Integrated Bulk Container (nominally 1000 L capacity)	Yellow Liquid	No
Quick Lime	pH Adjustment	Tanker	Granular	Yes, requires management
Flocculant	Flocculant	25 kg Bags	White Powder	No
Hydrochloric Acid	Laboratory	Integrated Bulk Container (nominally 1000 L capacity)	Liquid	Yes, requires management
Liquefied Petroleum Gas (LPG)	Laboratory	Bulk 2.3 t tank	Liquefied Gas	Yes, requires management

NB: MSDS's for the above chemicals are provided in Appendix 8 (Volume 3).

2.5 TAILINGS STORAGE

2.5.1 Tailings Geochemical Characterisation

Geochemical characterisation of the tailings materials to be produced from the Sorby Hills deposit has been carried out by SWC (Appendix 5, Volume 3). Tailings materials have been classified as NAF with a low potential to generate ARD. In addition, the tailings have been found to have a high alkalinity and a low content of available oxyanion metals and metalloids; this combination results in a low potential for MD to occur. The geochemical characterisation and proposed environmental management strategies for the tailings are discussed in detail in Sections 6.1.7.2 and 7.2.8 respectively.

2.5.2 TSF Arrangement

Tailings produced during the processing of the ore material will be discharged and stored within a purpose built above ground paddock style TSF. The development of the TSF will be staged and involve a progressive cell by cell approach over the first few years of operations. The final TSF will comprise three cells with associated decant causeways and will be located within the proposed haul road envelope to the west of the mine pits, as shown in Figure 2-1.

The TSF has been designed in accordance with the DMP's *Safe Design and Operating Standards for Tailings Storage* (1999) and has been assigned a hazard rating of Low, Category 2 according to the hazard rating criteria contained within these guidelines. Further information regarding TSF design and the Tailings Storage Data Sheet for the Project's TSF is provided in the infrastructure design report compiled by Coffey in July 2012 for SMPL (Appendix 9, Volume 3). The TSF design exceeds that required to cater for a 1 in 100 year, 72 hour flood event. A surface flow analysis for the Project Area indicates that a 1 in 100 year, 72 hour flood event would deliver a rainfall intensity of 6.43 millimetres per hour (mm/hr) and a total rainfall depth of 463 mm. The surface flow analysis was carried out by SWC and is presented in Appendix 10 (Volume 3).

TSF Cell 1 will be constructed first to the Stage 1 (starter) embankment height of RL (relative level) 27.5 m; further development of the TSF will then be undertaken as the need for tailings storage increases. Stage 1 of Cell 2 will be developed prior to the completion of tailings deposition into Cell 1 which is anticipated to be after approximately 12 months. Construction of Cell 3 will follow during year 3 of operations. Cell 1 will then be raised to its Stage 2 (ultimate) level of RL 30 m using the downstream construction method as depicted in Figure 2-9. Cells 2 and 3 will be subsequently raised as required using the same method. The ultimate height of the TSF walls for all cells will be 6.9 m. The decant causeways associated with each TSF cell will be raised using centreline construction techniques. Cross sections of the proposed zone embankment configurations are shown in Figure 2-9 and Figure 2-10.

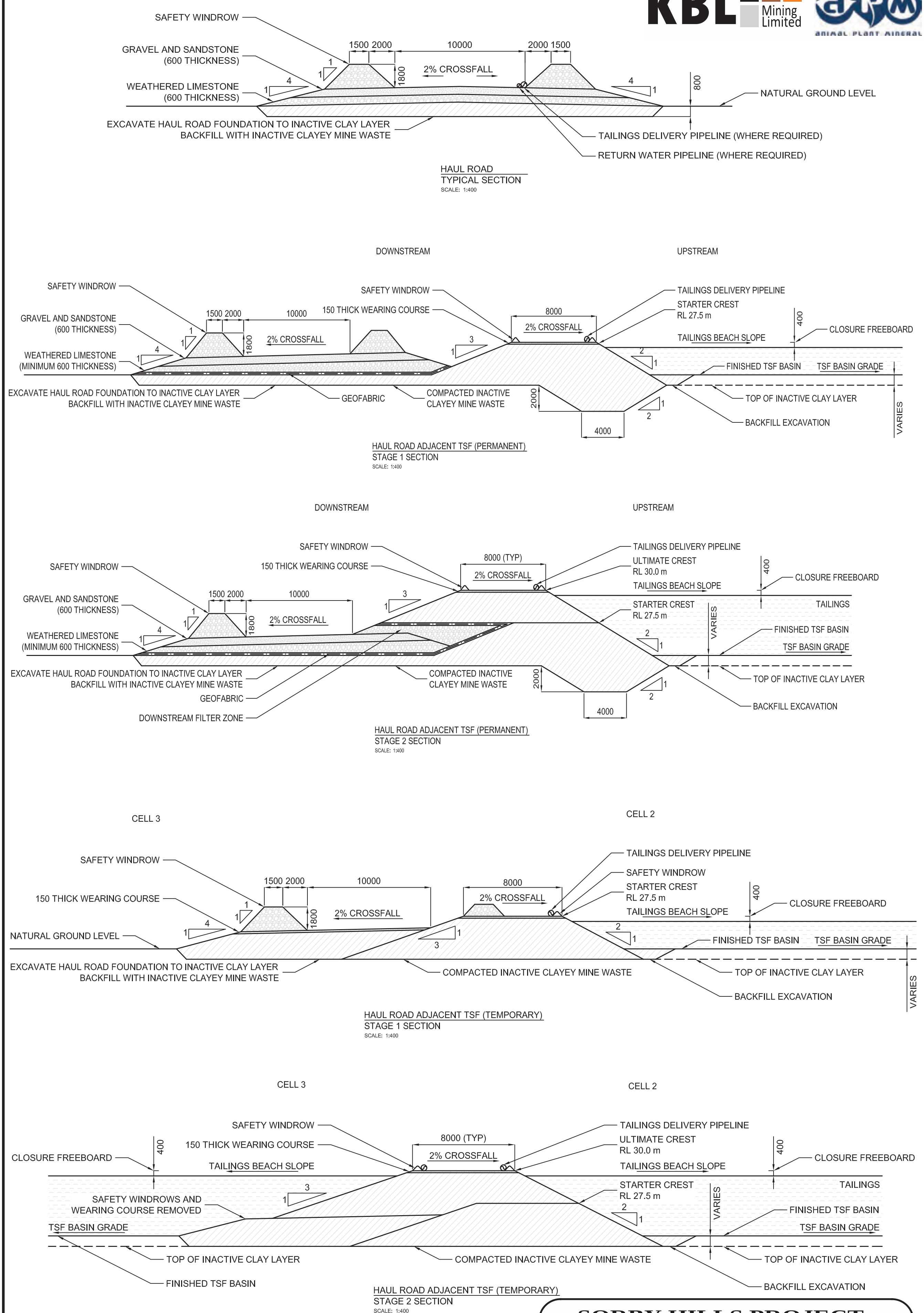
The tailings storage capacity was determined assuming a deposited, dry tailings density of 1.4 t/m^3 and a conservative tailings beach slope of 1 %. The total tailings storage capacity of the TSF is approximately 4.3 Mt which is sufficient to store the anticipated tailings production of 4 Mt over the life of the mine. The tailings storage capacity of each cell and stage of development is provided in Table 2-11.

Table 2-11: TSF Storage Capacity

Stage	Crest RL (m AHD)	Cell 1 (t)	Cell 2 (t)	Cell 3 (t)
1 (Starter)	27.5	365,000	605,000	655,000
2 (Ultimate)	30.0	840,000	790,000	965,000
Total	***30.0***	***1,205,000***	***1,395,000***	***1,620, 000***

The three cells of the TSF take advantage of the available space between the Development Exclusion Boundary and the open pits. By maximising the deposition surface area in this way there will be a lower rate of rise of the tailings beach, which in turn results in higher tailings densities and economic utilisation of the storage volume. Implementing multiple cells for the tailings storage allows for cycling of tailings deposition, drying and construction between various cells.

Further details regarding TSF design are provided in the infrastructure design report (Appendix 9 (Volume 3).

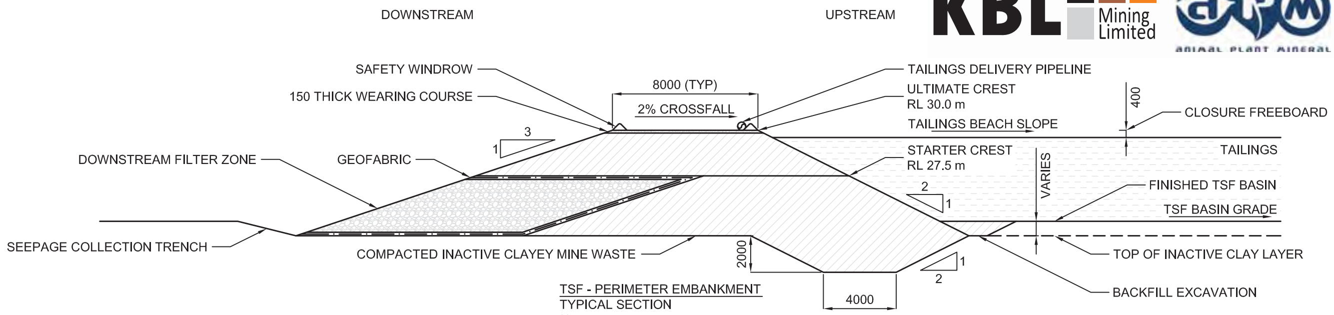


SORBY HILLS PROJECT
Figure 2-9
Haul Road and TSF Cross Sections

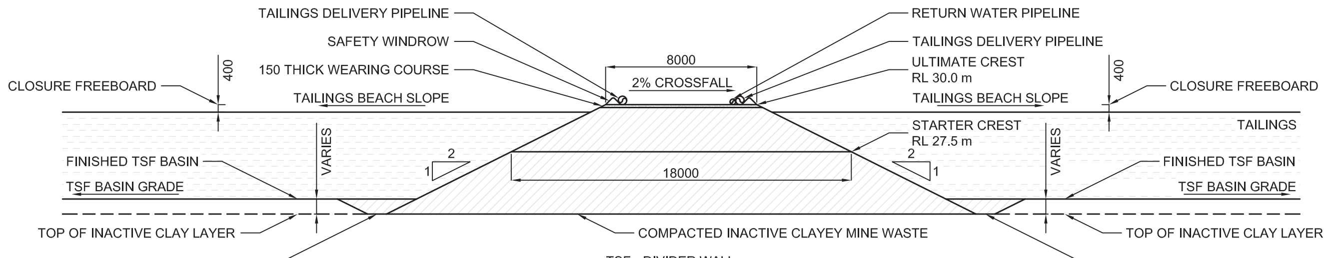
Author: Coffey for SMPL Date: October 2012

Source: Coffey

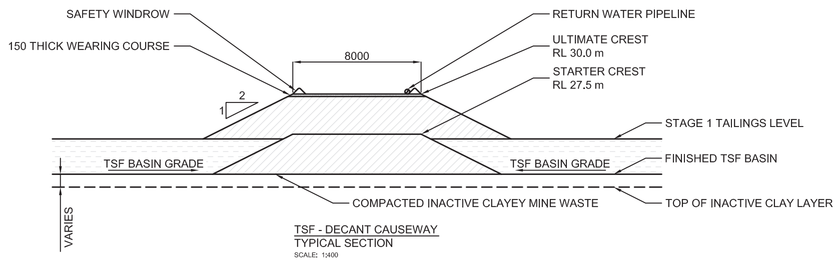
Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_209.ai



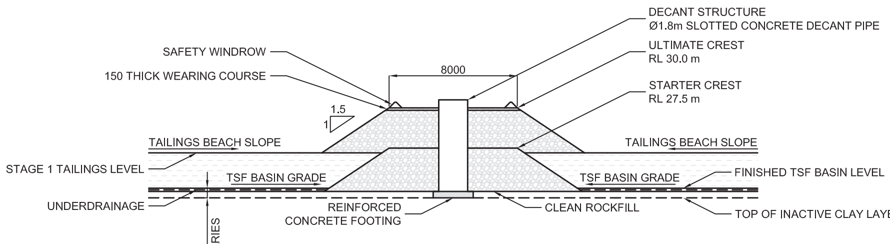
TSF - PERIMETER EMBANKMENT
TYPICAL SECTION
SCALE: 1:400



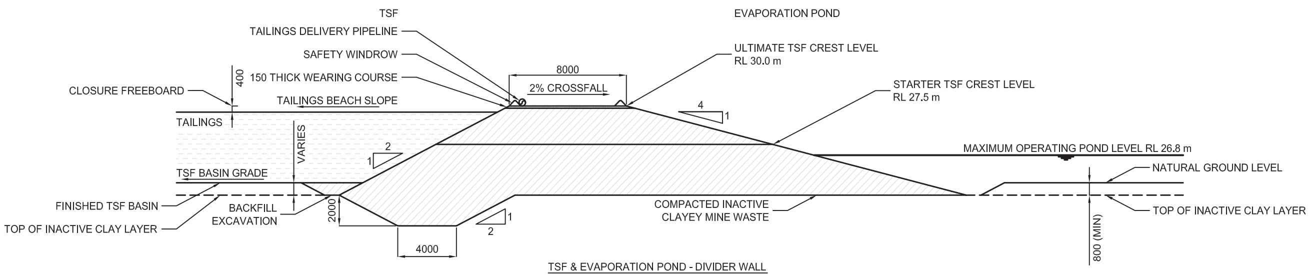
TSF - DIVIDER WALL
TYPICAL SECTION
SCALE: 1:400



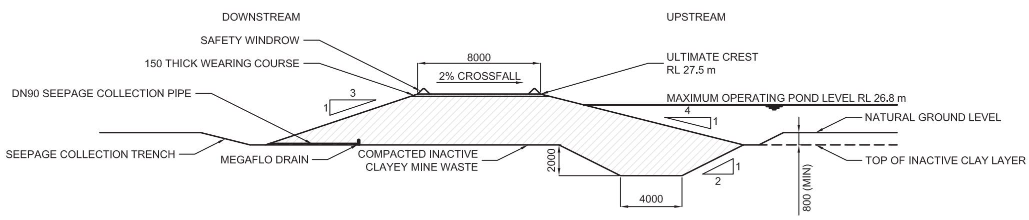
TSF - DECANT CAUSEWAY
TYPICAL SECTION
SCALE: 1:400



TSF - DECANT STRUCTURE
TYPICAL SECTION
SCALE: 1:400



TSF & EVAPORATION POND - DIVIDER WALL
TYPICAL SECTION
SCALE: 1:400



EVAPORATION POND - PERIMETER EMBANKMENT
TYPICAL SECTION
SCALE: 1:400

SORBY HILLS PROJECT
Figure 2-10
TSF and TSF Evaporation Basin Cross Sections

Author: Coffey for SMPL   Date: August 2013

Source: Coffey

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_210.ai

2.5.3 TSF Construction Materials

Components of the TSF embankments are described in Section 2.5.2 and illustrated in Figure 2-9 and Figure 2-10. The following materials will be utilised to construct TSF components:

- Stage 1 embankments will be constructed using inactive overburden clay from the pits; the clays will be sourced from depths of approximately 6 m to 18 m. Active clays will not be used
- Stage 2 embankments will comprise a downstream filter zone; filter material will be sourced from the pits at depths ranging between approximately 18 m to 24 m
- Geotextile will be placed between the upstream clay zone and the downstream filter zone of the embankments in order to prevent the migration of fine particles into the coarse fill
- Surface water protection of the TSF embankments has been integrated into the design by the incorporation of the haul road. Scouring of the TSF within the haul road envelope is not expected to occur due to the limited size of the catchment and the lack of gradient across the site, resulting in low flow volumes and velocities

Further details regarding TSF construction is provided in the Coffey infrastructure design report (Appendix 9, Volume 3).

2.5.4 TSF Operation

Tailings in the form of slurry containing 29 % solids will be discharged sub-aerially and cyclically into the active cell in thin discrete layers, allowing the tailings to gain optimum density and strength by subjecting each layer to a drying cycle. Deposition will take place via multiple spigots located on the perimeter embankments of the active cell.

Spigotting will be carried out such that the supernatant pond is maintained around the central decant structure of the active cell. At the cessation of tailings deposition into the active cell, the tailings beach will naturally form such that water from rainfall events will pond around the central decant structure of the cell. All decant ponds will be maintained to as small a size as practical, as far away as possible from the perimeter embankments at all times, for both active and inactive cells.

Water will be removed from the TSF beach by submersible pumps installed in the decant structures located centrally within each cell. Supernatant and storm water will be pumped to the adjacent TSF evaporation basin for storage prior to use in the plant. The TSF will not be used for the storage of water. The TSF and associated TSF evaporation basin will both have the capacity to cater for a 1 in 100 year, 72 hour flood event.

On eventual decommissioning the TSF will remain as a permanent feature of the landscape and will become increasingly stable. Closure and rehabilitation concepts for the Project are discussed in detail in Section 7.2.18.

2.5.5 TSF Seepage and Stability

Laboratory test work has determined the permeability of the surficial clays of the Project Area to be in the order of 1 x 10-11m/s to 1 x 10-10m/s. The clays of the TSF basin are therefore expected to be of lower permeability than the 1 x 10-9m/s value required by the Water Quality Protection

Guidelines No. 2: Mining and Mineral Processing – Tailings Facilities (2000). Details on the permeability of the TSF base are provided in Appendices 3 and 9 (Volume 3).

Coffey (Appendix 9, Volume 3) undertook analysis to estimate seepage flows from the TSF and to estimate the position of the phreatic surface for use in their subsequent stability calculations. The results indicate that the phreatic surface will be effectively controlled by the downstream filter zone of the embankment and the adjacent seepage collection trench (Figure 2-10). Based on an external embankment perimeter length of approximately 4,300 m and the cross-sectional flow rate of 7 x 10^{-4} m^3/d, the flow volume from the facility was estimated to be less than 5 m^3/d.

Results of the stability analysis indicate that the TSF has an adequate factor of safety against failure at unexpectedly high decant pond levels. The factor of safety against a deep seated failure through the embankments is greatly influenced by the position of the phreatic surface. To reduce the risk of such a failure the TSF will be operated in a manner that will maintain the phreatic surface at low levels within the embankment.

Full details of the seepage and stability analyses carried out by Coffey for the Project are provided in the Coffey infrastructure design report in Appendix 9 (Volume 3).

2.5.6 TSF Evaporation Basin

An evaporation basin will be constructed adjacent to the TSF to provide storage of all water decanted from the three TSF cells. Water for the process plant will be preferentially derived from this evaporation basin. The TSF evaporation basin has been sized to contain supernatant/stormwater from the three cells of the TSF and direct rainfall for events up to and including a 1 in 100 year, 72 hour flood event. Pit dewatering will primarily be directed to the separate dewatering evaporation basin, however if process water make up is required it will be diverted to the TSF evaporation basin.

The TSF evaporation basin will consist of two cells which will be developed in phases utilising waste material from pit excavation as it becomes available, with the initial cell being completed before processing of ore commences. The materials proposed for construction of the TSF evaporation basin will be the same as those for the TSF.

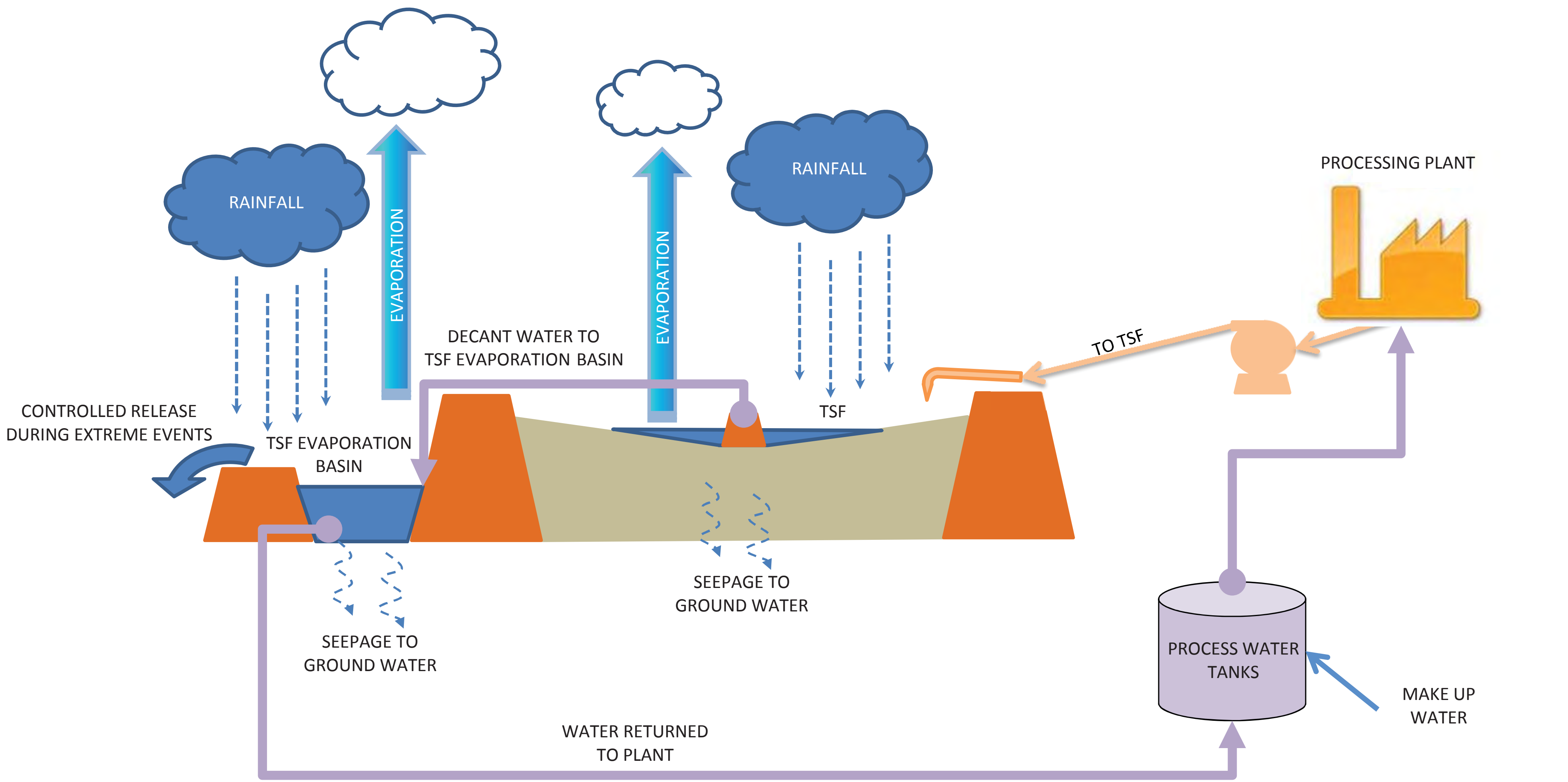
Seepage for the TSF evaporation basin was also assessed by Coffey (Appendix 9, Volume 3) and a cross sectional flow rate of 2 x 10^{-3} m^3/d/m (cubic metres per day per metre) was determined which corresponds to a daily seepage flow volume in the order of 5 m^3/d.

The TSF evaporation basin location is shown in Figure 2-1 and the cross sectional design is provided in Figure 2-10. Further details regarding the TSF evaporation basin design and construction are given in the infrastructure design report provided in Appendix 9 (Volume 3).

2.5.7 TSF and TSF Evaporation Basin Water Balance

A water balance diagram for the TSF and associated TSF evaporation basin is shown in Figure 2-11. Inflows into the TSF will be from direct rainfall and the water contained in the tailings slurry. Inflows into the TSF evaporation basin will be from direct rainfall, decanted water from the TSF and pit dewatering if make-up water is required for processing. Outflows from both facilities will be evaporation and return water to the processing plant, seepage losses are expected to be insignificant as discussed in Section 2.5.5.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_211.ai



SORBY HILLS PROJECT
Figure 2-11
TSF and TSF Evaporation Basin Water Balance

Author: SMPL Date: August 2013

Source: SMPL

2.6 CONCENTRATE HANDLING

2.6.1 Concentrate Composition and Classification

The concentrate to be produced by the Project is of Ag Pb Zn composition with a Pb grade of around 64 %. The composition of the concentrate will vary during the Project life however a representative composition is provided in Table 2-12.

Table 2-12: Representative Sorby Hills Concentrate Composition

Element	Percentage
Pb	64.3
Cu	0.3
Zn	1.3
Fe	8.0
S	15.0
Si	0.5
As	<0.1
Al	0.1
Mg	0.2
Trace elements: Ag, B, Be, Cd, Cr, Mn, Sb and Ni	<1

SMPL commissioned Toxikos toxicology consultants to derive an Australian dangerous goods (ADG) classification and an international maritime dangerous goods (IMDG) classification for the concentrate to be produced by the Project.

As a result of the analysis it was determined that the concentrate is not classifiable as an environmentally hazardous substance for the purpose of transport by road or rail. However the concentrate is classifiable as a Class 9 Miscellaneous Dangerous Good, Environmentally Hazardous Substance (chronic category II) for the purpose of marine transport. Consequently, the concentrate will be transported as a Class 6.1 lead compound, soluble, N.O.S. (UN 2291, packaging group III) with a subsidiary environmental hazard (Class 9) classification for marine transport.

Further information on the dangerous goods classification and details of the proposed management strategies for concentrate handling are included in Section 7.2.9; the Toxikos report is provided as Appendix 11 (Volume 3).

2.6.2 Handling of Concentrate at the Mine Site

SMPL will endeavour to achieve minimal handling of concentrate by utilising a predominantly mechanised system. Concentrate will be packaged at the final stage of the processing circuit; avoiding the requirement for concentrate stockpiles at either the plant site or Wyndham Port. The concentrate will be dried in a Filter Press and expelled directly into shipping containers. The Filter Press and container loading dock will be situated within a covered concrete bunker as depicted by Figure 2-12.

Once the containers have been filled to the desired level with concentrate they will be removed from the loading dock and a lid immediately applied and locked. The sealed containers will then be transferred to a designated hardstand area within the Project plant site for short term storage prior to transportation off site.

The Sorby Hills concentrate has a high specific gravity (SG) (3800 kg/m^3 at 10 % moisture content) and is therefore a heavy substance; containers will only be half filled and will be stacked two high as a maximum due to their weight. Load cells will be installed in the loading dock at the Project Site to control the quantity and weight of concentrate placed into each container. SMPL will utilise approximately 400 containers for the operation.

2.6.3 Container Design

SMPL propose to use “Rotabox” (or similar) shipping containers for the collection, storage and transport of concentrate; there will be no requirement for internal bags or packaging. “Rotabox” containers are purpose built, stackable, bulk ore containers that can be fully sealed with lockable lids as shown in Figure 2-13. The sealable, lockable lids provide security from product spillage, accidental discharge and variation in moisture level during transport. The smooth internal surfaces of the containers enable the contents to be easily emptied with minimal residue remaining.

The container design has taken into account the key material handling characteristics of concentrate and the containers are built to comply with *ISO 1496-1:1990 Series 1 Freight Containers Specification and Testing (Part 1).* More details on the design and proposed use of “Rotobox” containers are provided in the transport logistics statement produced by POAGS Bulk Logistics (POAGS) for the Project which is presented in Appendix 12 (Volume 3).

2.6.4 Transport of Concentrate to Wyndham Port

The trucking of concentrate from the Project Site to the Wyndham Port laydown facilities will be a 120 km (one way) trip on a sealed road network (Figure 2-14). The proposed MRWA Kununurra Heavy Vehicles Route would result in an alternative transport link that could be used by SMPL haul trucks. SMPL will support this project and utilise the route should it become available.

Trucking movements for the Project were considered as part of the *“Freight and Logistics Services in the East Kimberley Region”* report completed on behalf of the Freight and Logistics Council of WA by Strategic Design and Development Pty Ltd (2010), which aimed to assess the demand for freight and logistics services in the east Kimberley Region. According to this report the Project will contribute between 4.8 % and 5.7 % of total loads for the east Kimberley Region based on forecast movements during operations. The report is available in Appendix 13 (Volume 3).

Concentrate haulage will be completed by a specialist contractor carting approximately 117 t per load. Concentrate will be transported in the sealed ‘’Rotabox’’ containers; four containers carrying 25 t to 35 t net weight apiece will be loaded onto each road train for transport to Wyndham Port. Twelve return truck movements per week are expected, although up to 20 movements a week could occur following events such as road closures from flooding. These truck movements will also include supply of fuel and mine site consumables as back loading from the port at Wyndham.

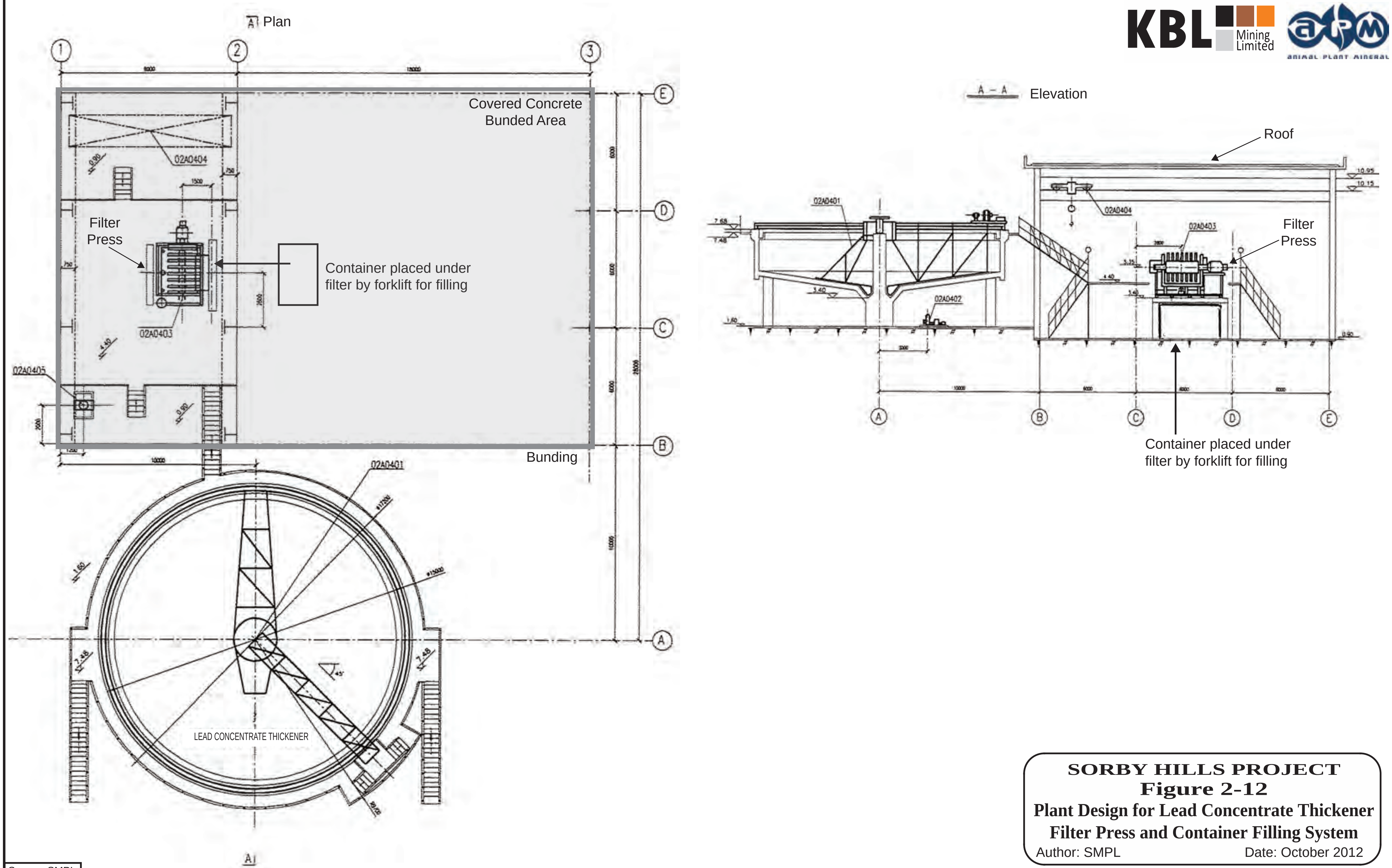
2.6.5 Handling of Concentrate at Wyndham Port Facilities

A new, purpose built hardstand area at Wyndham Port will be utilised by SMPL for container storage before unloading directly into the ships hold (Figure 2-13). The “Rotabox” containers are designed to be handled by ship cranes and can therefore be easily manoeuvred into position over the ships hold with the contents then unloaded by rotation of the container. Any out of specification product collected from wash down areas or sumps will be back hauled to the Project’s processing facilities in sealed “Rotabox” containers.

CGL personnel will be involved in stevedoring activities. CGL is the port operator under licence to the DoT. Shipping will be undertaken by a specialist contractor.

Further detail on the proposed “Rotabox” use for the Project is included in a transport logistics method statement produce by POAGS for SMPL (Appendix 12, Volume 3).

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_212.ai



SORBY HILLS PROJECT

Figure 2-12

Plant Design for Lead Concentrate Thickener Filter Press and Container Filling System

Author: SMPL Date: October 2012

Source: SMPL

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_213.ai

KBL Mining Limited

(a) “Rotabox” Container

(b) Container Unloading

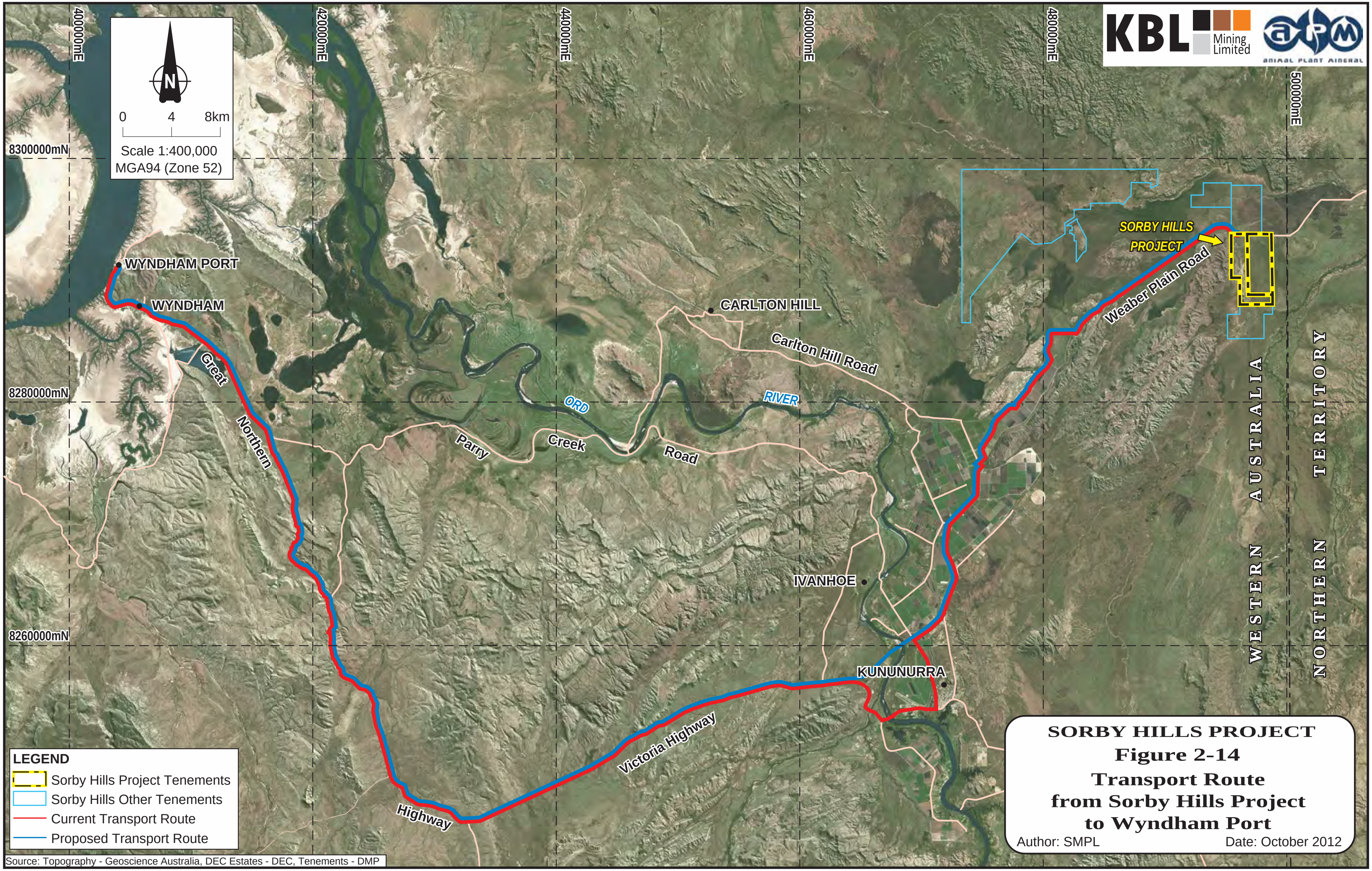
(c) Wyndham Port Facility

Source: SMPL

SORBY HILLS PROJECT
Figure 2-13
"Rotabox" Container (a), Container Unloading (b) and the Wyndham Port Facility (c)

Author: SMPL
Date: October 2012

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_214.dgn



SORBY HILLS PROJECT
Figure 2-14
Transport Route from Sorby Hills Project to Wyndham Port

Author: SMPL Date: October 2012

2.7 INFRASTRUCTURE AND ANCILLARY FACILITIES

2.7.1 Support Infrastructure

A layout of the proposed facilities and access roads at the Project Mine Site is presented in Figure 2-1. The support infrastructure on the site will include:

- An administration complex that will contain around 12 offices, meeting rooms, storage areas and crib facilities for staff
- Four workshops with associated hydrocarbon management systems and wash down areas
- A hardstand area (included within the plant site) for storage of concentrate transport containers. SMPL will have approximately 400 containers for the Project
- Diesel storage and refuelling area for 200 kL (four 50 kL tanks) of diesel for power generation and mine site equipment. Fuel will be transported to the site via the external road network by appropriately registered and qualified fuel transport companies. The fuel tanks are expected to be refilled approximately weekly. Refuelling of vehicles will be controlled by a fuel management system
- Explosives magazine for the storage of explosive in compliance with the *Dangerous Goods Safety Act 2004*, the *Dangerous Goods Safety (Explosives) Regulations 2007* and *AS 2187.1:1998, Explosives – Storage, transport and use, Part 1*
- A laydown and storage area for use during construction of the facilities; existing pads and degraded areas within the proposed plant site will be utilised for this purpose
- Landfill site

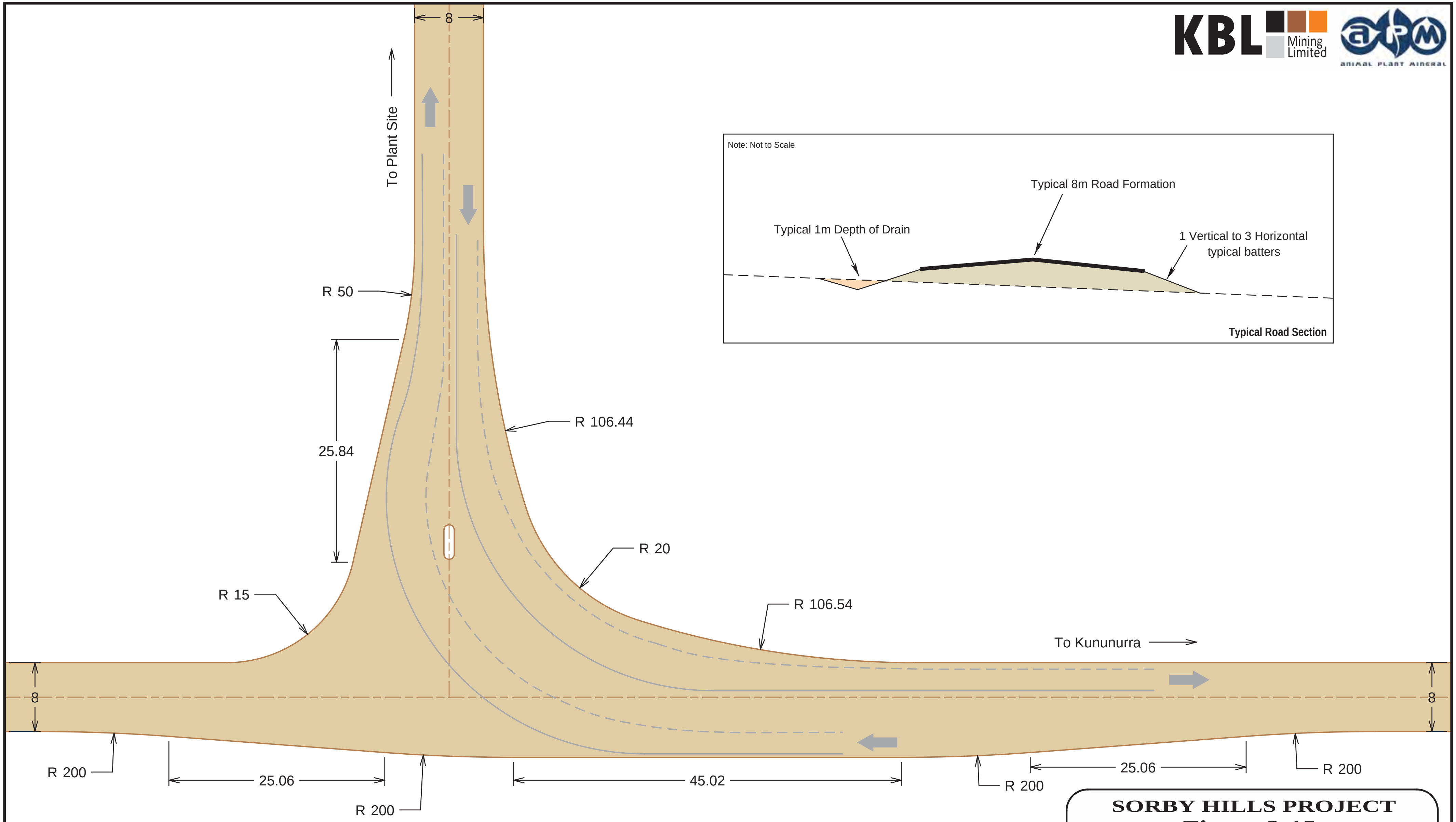
2.7.2 Transportation Corridors

Entry to the Project site will be via an existing access road from Weaber Plain Road which will be upgraded in line with SWEK and MRWA specifications. The access road will be raised to the same elevation as the Weaber Plain Road and the intersection will be widened to accommodate turning road trains. A passing lane will be constructed to allow following vehicles to safely pass road trains entering the site and a splitter island will be placed at the site entrance for the safety of exiting vehicles. The intersection design and access road cross section are illustrated in Figure 2-15.

The ore transport routes for the Project are in two stages:

- Pits to ROM pad for processing into concentrate
- Concentrate transported off-site to the laydown facilities at Wyndham Port via the site access road, Weaber Plain Road, Mills Road, Ivanhoe Road, Victoria Highway and Great Northern Highway

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_215.dgn



SORBY HILLS PROJECT
Figure 2-15
Schematic design of Access Road and Weaber Plain Road

Author: SMPL Date: August 2013

Source: KBL Mining. Note: All measurements in meters

The haul road from the pits to the ROM will be single lane running in an anticlockwise direction to facilitate a shorter burdened route from the pits to the ROM and a longer unburdened return route to the pits. Additionally the single direction of the haul road will provide a substantial improvement in safety relative to a dual direction haul road. The haul road will be constructed in two phases to allow for suitable construction materials to be sourced from pit excavations. Phase 1 will provide access between the ROM pad and D and E pods which will be developed first; phase 2 will extend the haul road southwards and provide access to C pod. Phase 2 constructions will coincide with the development of Cell 3 of the TSF with the haul road forming the western and southern embankments of the facility. The final alignment of the haul road, with phases 1 and 2 labelled, is provided in Figure 2-1. The haul road has been designed to function as a:

- Ore haul road
- Surface water diversion bund
- TSF embankment downstream filter zone
- TSF and associated TSF evaporation basin access road
- Pipeline containment corridor

The haul road will comprise the following components:

- Formation layer – the active clay layer within the footprint of the haul road will be removed and replaced by compacted select sandy clay from the pit overburden
- Sub Base – this will be a layer 60 cm in thickness comprising a gravelly weathered limestone obtained from pit overburden
- Wearing Course – a 60 cm thick gravel wearing course composed of material derived from either pit waste rock overburden, a quarry or borrow pit at the foot of the Sorby Hills or material excavated during development of the plant area
- Safety Bunds – positioned at the roads edges these will be 1.8 m in height with a crest width of 1.5 m

The haul road will be crowned with a 3 % camber and comprise a trafficable width of 10 m; horizontal and vertical curvatures have been designed for a maximum speed of 60 kilometres per hour (kph) for 90 t haul trucks. At its lowest point the haul road will be at least 1 m in height above natural ground level to avoid inundation during a 1 in 100 year, 72 hour flood event. The safety bunds, combined with the road embankment of 1 m, will contribute to the combined 2.8 m flood protection function of the haul road that will minimise potential for overtopping during a flood in excess of the 1 in 100 year, 72 hour flood event. The total width of the haul road, including safety bunds, will be 21 m. The cross sectional design of the haul road is provided in Figure 2-9.

Further details regarding haul road design and construction are presented in the Coffey infrastructure design report provided in Appendix 9 (Volume 3).

2.7.3 Borrow Pit

A gravel wearing course will be required for construction of the haul road. Approximately 110,000 m^3 of material will be required for this purpose which may need to be derived from a borrow pit. This material can be sourced from the area to be levelled for the plant site located at the foot of the Sorby Hills as indicated on Figure 2-1.

2.7.4 Water

Water will be required on site for many uses including potable drinking water and water for construction, processing and dust suppression.

Approximately 0.1 ML/day of water will be required for construction activities, this water will be sourced from a groundwater production bore. Figure 2-16 and Figure 2-17 indicate groundwater bore locations within the Project Area and regionally. Process and dust suppression water will be sourced from mine dewatering as described in Section 2.3.6. Any excess water not utilised by these activities will be diverted to the dewatering evaporation basin. Water will be pumped from the dewatering bores to the processing plant via pipelines running along the haul road (Figure 2-6). The current water balance for the site indicates a maximum of 2.678 ML/day will be extracted from pit dewatering, with 0.227 ML/day required in the processing plant and 0.1 ML/day required for dust suppression, the remaining 2.351 ML/day will be directed to the dewatering evaporation basin.

Potable water will most likely be sourced from rainwater and a groundwater bore (Figure 2-16) situated away from the mineralised field and stored in a potable water storage tank at the office/crib facility. Potable water at the Project site will be monitored in compliance with DoH requirements, particularly the DoH *Mine Sites and Exploration Camps Drinking Water Quality Monitoring Requirements* and DoH *System Compliance and Routine Reporting Requirements for Mine Sites and Exploration Camps.*

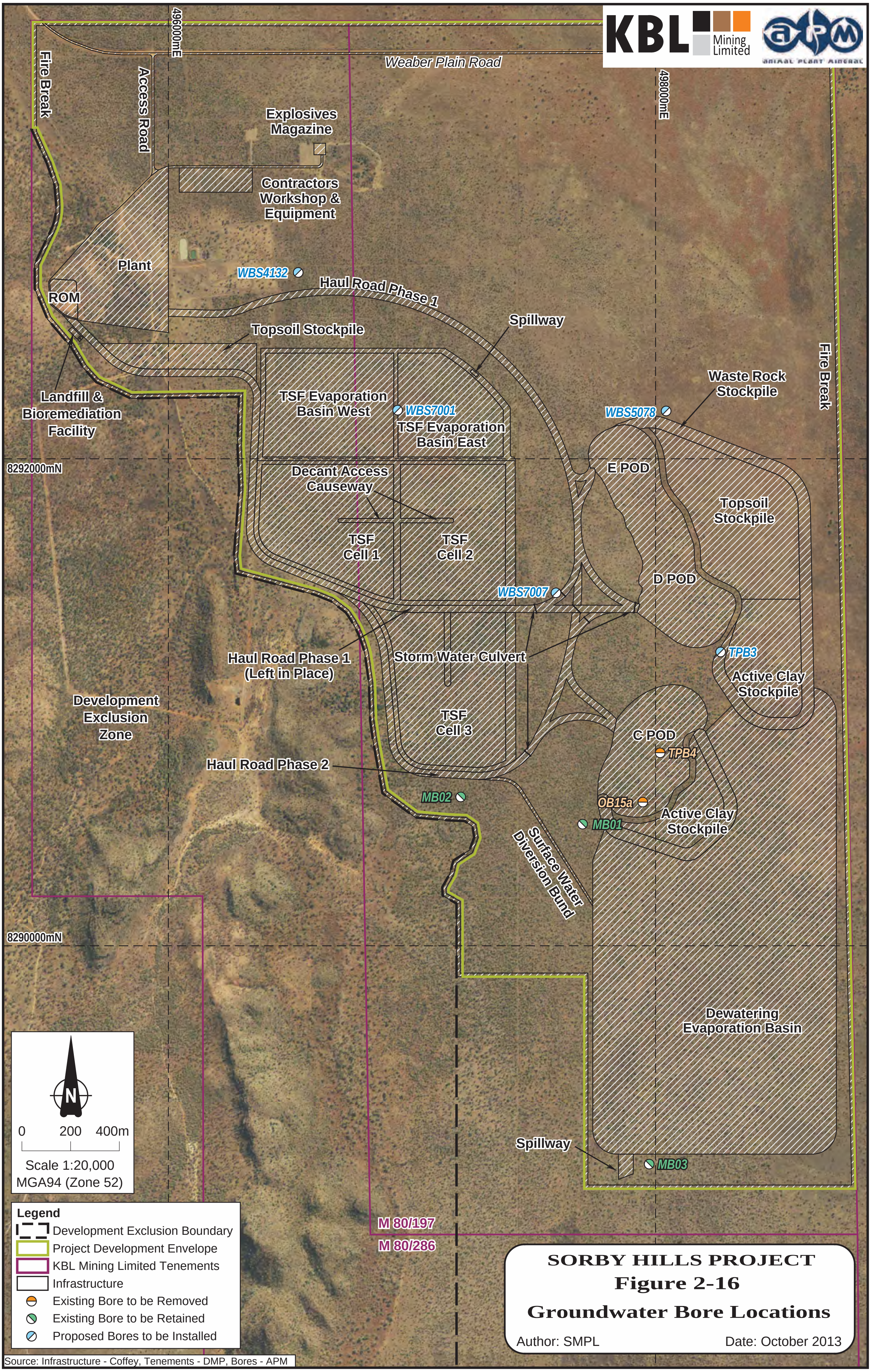
Further information on the hydrogeological setting of the Project Area is provided in Section 6.1.5.

2.7.5 Dewatering Evaporation Basin

A dewatering evaporation basin will be developed to the south east of the mining operations as shown on Figure 2-1. Water feeding into the evaporation basin will be derived from pit dewatering, runoff generated within the haul road envelope and direct rainfall. The purpose of the evaporation basin is to collect and store dewatering water and runoff generated within the haul road envelope prior to its subsequent evaporation.

2.7.6 Communications

Currently there is no communication in place at the Project site; the closest land line telephone facility and coverage for mobile telephones are approximately 30 km and 40 km away respectively. Site communications between vehicles, personnel, processing facilities and offices will be setup using VHF and UHF radio systems. Satellite communication will be used to provide voice over internet protocol (VOIP) and data links into existing external communication providers.



SORBY HILLS PROJECT

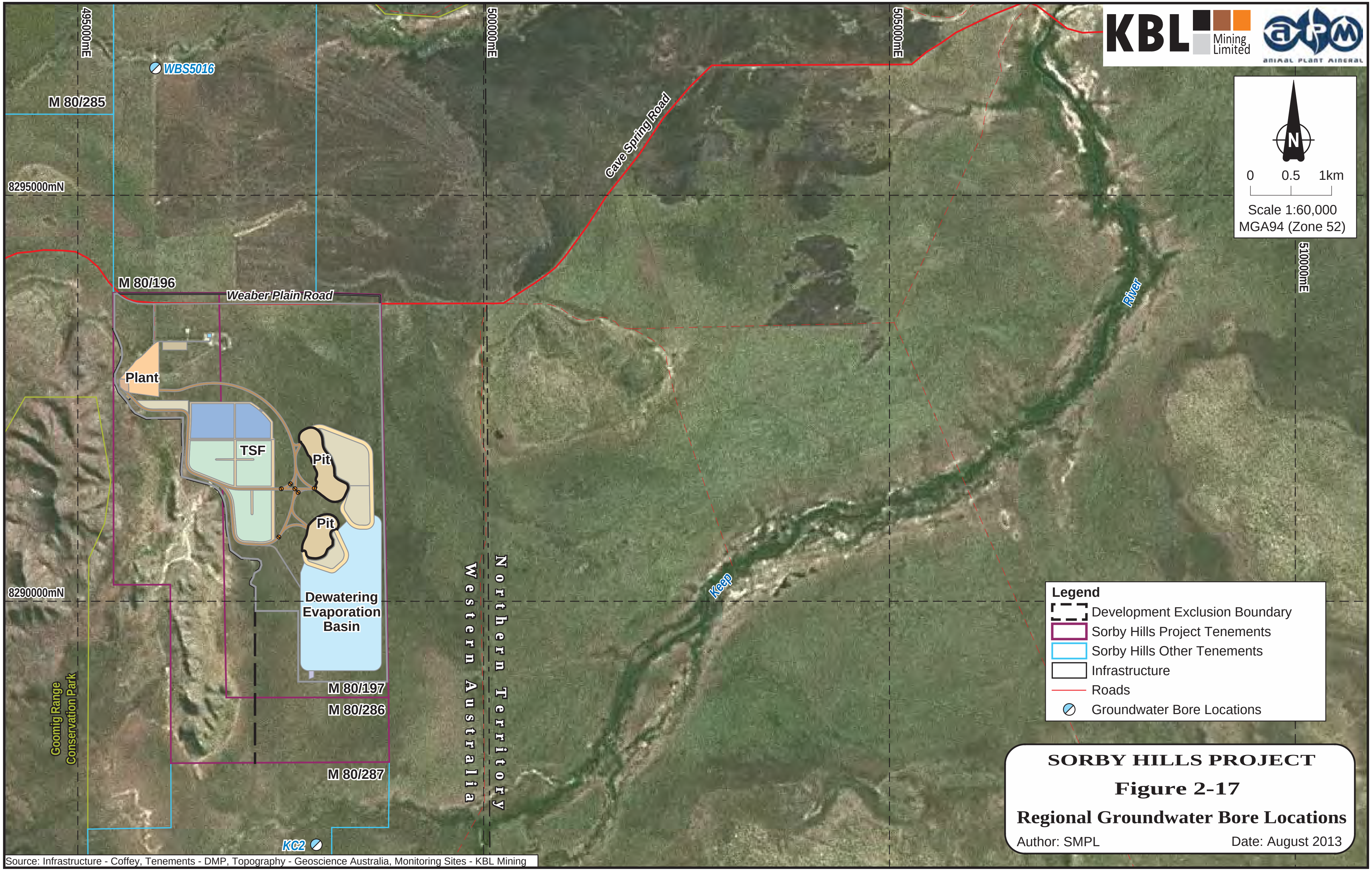
Figure 2-16

Groundwater Bore Locations

Author: SMPL Date: October 2013

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_216.dgn

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S2_217.dgn



SORBY HILLS PROJECT

Figure 2-17

Regional Groundwater Bore Locations

Author: SMPL Date: August 2013

2.7.7 Power Requirement and Supply

On site power generation facilities will be located within the plant site area. Power reticulation will be internal to the plant and either use underground cables or suspended cable trays. Power generation for the processing plant will be through diesel powered generator sets; power usage will be approximately 8624 megawatt hours per annum (MWHrsPa) and will require five 500 kilowatt (kW) generator sets on site. It is anticipated that during normal operations three generator sets will be required, with the fourth used during start up and the additional generator set as a back-up. In addition two 500 kW generator sets will be required to facilitate mine dewatering pumps, the locations of these generators is shown on Figure 2-1.

Although a gas supply is not currently available there may be the possibility in the future of sourcing a gas supply from the Weaber Gas Field. If this is the case SMPL would look at the economics of converting the diesel powered generators to use gas. In addition, with the development of the ORIA – Weaber Plains Project there is also the possibility of surplus power being available from other agricultural based industries; this would also be evaluated on its economics.

2.7.8 Workforce and Accommodation

SMPL has an ‘employ local’ policy and will endeavour to maximise employment of personnel from Kununurra and local indigenous communities. SMPL has identified that companies based in the Kununurra area can provide a range of services required to construct and operate the mine and these will be engaged on a commercial basis. It is however acknowledged that some specialist skills may not be available from the local area and may have to be sourced from elsewhere. SMPL is committed to Indigenous employment and training programs, with Indigenous employees already working for SMPL during exploration programs.

The Project will have a combination of residential and fly-in fly-out (FIFO) workforce. All employees will be transported between Kununurra and the Project site by bus on a daily basis for the duration of their roster. Employees that are not permanently resident in the township will be flown in and out of, and accommodated in, Kununurra, with flights for the operation utilising commercial airlines into Kununurra airport.

Rental housing will be provided in Kununurra for senior management staff; other staff will be housed in an accommodation facility. It is anticipated that the ORIA – Weaber Plains Project workers accommodation village will be available for use by SMPL and its employees by the time the Project is operational. Written correspondence to confirm the provision of this accommodation is provided in Appendix 14 (Volume 3). Should this accommodation be unavailable, SMPL will consult local landowners that have previously contacted SMPL with regards to providing accommodation for the Project (Appendix 15, Volume 3).

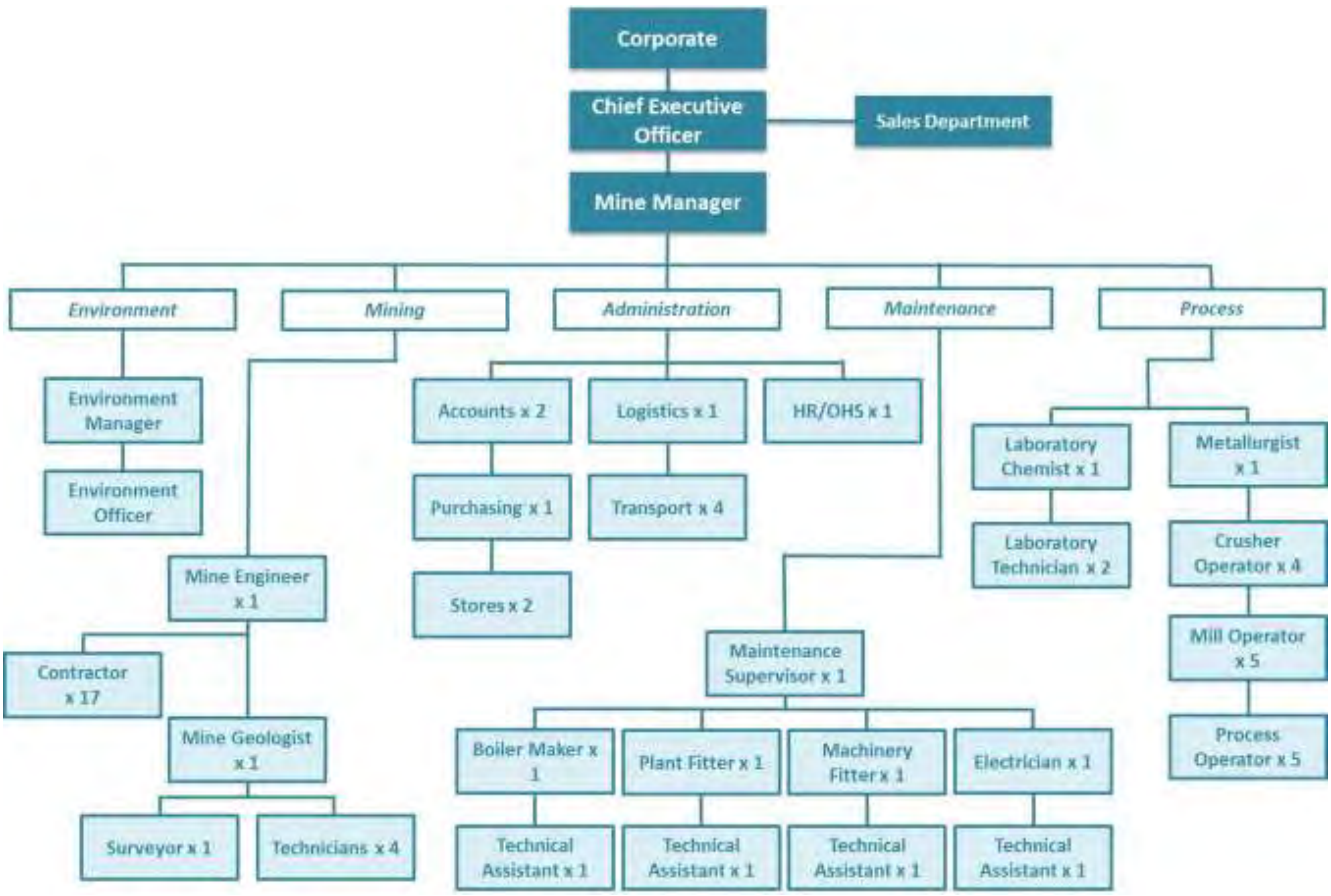
It is estimated that approximately 40 personnel will be required during the construction phase and a regular complement of 64 personnel during ongoing operations.

The workforce at the Project Mine Site will work a combination of roster, as detailed in Table 2-13. An indicative organisational structure is shown in Figure 2-18.

Table 2-13: Indicative Employee Roster

Category of Work	Workforce	Roster
Mining	24 (7 SMPL employees plus 17 contractors)	5 days:2 day (12 hr day shift)
Crushing	4	5 days:2 day (12 hr day shift)
Process	11	2 weeks:2 weeks (24 hr roster)
Laboratory	3	2 weeks:2 weeks (24 hr roster)
Maintenance	9	5 days:2 day (12 hr day shift)
Management, Administration and Environmental Staff	9	5 days:2 day (12 hr day shift)
Haulage/Transport	4	2 weeks:1 week (24 hr roster)
TOTAL	**64**	

Figure 2-18: Indicative Organisational Structure



2.8 AREA OF DISTURBANCE

The Sorby Hills mining tenure area covers 12,612.40 ha, with this proposal covering an area of 1,782.27 ha (tenements M80/197 and M80/286). Clearing of native vegetation will be required for development of the Project; areas to be cleared for specific aspects of the proposal are outlined in Table 2-14. The total disturbance footprint for the Project will be approximately 573 ha within a Project Development Envelope of 1045 ha. The disturbance figure includes firebreaks which will be 16 m wide in accordance with the *Kimberley Bush Fire Burning and Firebreak Location, Construction and Maintenance Guidelines* (Fire and Emergency Services Authority 2007).

Table 2-14: Indicative Areas of Disturbance

Disturbances	M80/197	M80/286
Open Pits	39.96 ha	-
TSF	71.16 ha	19.15 ha
TSF Evaporation Basins	26.51 ha	18.15 ha
ROM Pad	-	1.48 ha
Plant site and support infrastructure including process plant, office, workshops, bioremediation facility	-	22.68 ha
Explosives Magazine	-	0.23 ha
Haul roads (hypersaline and freshwater pipelines will run within the haul road bunding)	18.64 ha	8.47 ha
Access Road	1.59 ha	2 ha
Topsoil Stockpiles	25.41 ha	6.20 ha
Clay and Rock (including NAF material) Stockpiles	36.61 ha	-
Surface Water Diversion Bunding	0.76 ha	-
Landfill Site	-	0.10 ha
Dewatering Evaporation Basin and associated spillway, bunding, stockpiling and access roads	150.56 ha	-
Area Internal to infrastructure	84.52 ha	14.79 ha
Firebreaks	16.49 ha	7.17 ha
Total	**472.21 ha**	**100.42 ha**
Tenement Area	***993.91 ha***	***788.36 ha***

Areas are indicative only and may vary. The total clearing for mine infrastructure however will not exceed 573 ha without the appropriate approvals.

3 PROJECT JUSTIFICATION AND ALTERNATIVES

3.1 RATIONALE

SMPL's Project proposes to commence mining operations on an extensive ore deposit of a high quality thus maximising the long term production and economic benefits relative to the investments and environmental impacts incurred. It is estimated that current ore reserves will enable the Project to be operational until 2027, which may be extended depending on continued positive exploration results within the region.

The main factors driving the Project are summarised below:

- The demand for Ag Pb Zn concentrate is expanding due to the increase in consumption of these metals in industry. Ag is a metal of importance in the growing electronic industry and is seeing a re-emergence as a biocide in the control of infection and Pb is a major component in the manufacture of electrical storage devices such as batteries. The Sorby Hills venture provides an opportunity for the development of a large near surface Ag Pb Zn deposit to capitalise on these opportunities in the world market

- The Sorby Hills joint venture partners are currently producers and processors of Ag, Pb and Zn and need to grow and expand their business base to remain competitive in the world environment

- The Project is situated in a region of WA that has seen only minor development in the minerals industry but has hosted long term projects such as the Argyle diamond venture and longer term base metal operations within the Lennard Shelf Region. The Project will continue to provide benefits to the east Kimberly Region and will also provide opportunities for local industries to deliver services that are not solely based on seasonal agricultural industries

3.2 ECONOMIC AND SOCIAL BENEFITS

The Sorby Hills deposits subject to this proposal will contribute to Ag Pb Zn exports over the next 10-14 years. The Project will therefore have a significant positive influence on the economy of the Kimberley Region in addition to a considerable localised positive impact on the economy, business opportunities and employment prospects for the communities of Kununurra and Wyndham. The Project will provide a diversification of industry to the region other than agriculture and tourism. The location of the Project in relation to the future development of the ORIA in both WA and the NT provides synergy in terms of possible shared infrastructure such as roads, power and water supply.

3.2.1 Employment

The construction phase of the Project will require a workforce of approximately 40 people for 6 months; during the operational phase 64 people will be required each year until at least 2024. Dependant on further exploration success on other tenements held by the joint venture partners in the Sorby Hills area, expansion of the Project is envisaged, which may result in extended employment opportunities.

SMPL is an equal opportunities employer and under an agreement with the MG Corporation are committed to offering indigenous employment opportunities.

In addition to on-site employment, the increased exportation through Wyndham may lead to further employment opportunities at the port operations. Employment for the Project may also result in a flow-on effect for the Kimberley Region and may support employment in the businesses that supply goods and services to the Project.

3.2.2 Government Revenue

Revenue to the local shire (SWEK) will increase through direct and indirect effects such as the direct payment of rates associated with the Project infrastructure and a potential increase in the local population leading to increases in rate revenue. The key revenue benefits will be at the state level; the Project is anticipated to generate royalties for the WA Government in the order of $ 3 million per annum and approximately $ 0.5 million per annum in payroll tax as well as other state taxes and charges. In addition, the Commonwealth Government will receive revenue from the Project in the form of company taxes, income taxes and goods and services tax (GST). The Project will also contribute $ 65,000 annually in rents to the DMP and contribute to an increase in DMP royalties.

3.2.3 Economic Diversity

At the local level, the Project will broaden the economic base of the SWEK. The proposed development will also broaden business and employment opportunities by providing year round, stable employment within the east Kimberley Region which is currently dominated by seasonal industries such as tourism and agriculture. The Project will provide an economic injection into the region and will also serve to diversify the states mining base away from the dominant Pilbara and Goldfields regions.

3.2.4 Social Benefits

SMPL is committed to becoming an integral part of the local community and providing support and substantial benefits on a long term basis. SMPL already provides funding to a number of local community endeavours including:

- Young Australian Indigenous Arts and Writers Awards
- Heart Foundation for their 'Jump Rope for Heart' program at schools in the Kununurra/Wyndham area
- Kimberley Toad Busters

SMPL will continue to provide assistance in this way and will endeavour to find more opportunities to support the local community throughout the life of the Project.

3.3 PROJECT ALTERNATIVES

SMPL has considered a number of alternatives to minimise impacts of the operation and identify the most suitable and sustainable mine site design. Environmental constraints such as clearing footprints, alterations to biodiversity and/or ecosystem function and overall efficiency were taken into account in determining the proposed site design. This includes utilising an area currently impaired by previous quarrying operations and selection of a TSF area that does not impinge on areas of cultural significance to the TO's.

3.3.1 Project Infrastructure

The mine site is located within a tenement area that SMPL has secured and the mine pits will be situated at the economically viable, near surface, Ag Pb Zn deposits. The location of Project infrastructure has been heavily influenced by the findings of biological assessments; in order to maintain biological diversity. A self-imposed Development Exclusion Boundary has been defined to retain comprehensive, adequate and representative habitats by the avoidance of impact to Sorby Hills (an extension of the proposed GRCP) and the valuable and diverse interzone habitat between the foothills and the flood plains. This boundary also includes areas of significance to the TO's.

Working within the constraints of engineering and economic feasibility, the areas targeted for construction of infrastructure, wherever possible, utilise sites that are already degraded, are more broadly representative of the surrounding area and that are of lower value for fauna. In addition, the original haul road design has been re-routed to avoid direct impact to populations of priority plant species.

3.3.2 Open Cut or Underground Mining

Open cut mining is the preferred method of extracting the Sorby Hills C, D and E pod deposits as the ore occurs close to the surface. Underground mining is not a geologically or economically viable alternative at this time.

3.3.3 Process Alternatives

Traditional flotation processes involving the separation of mineral sulphides from Pyrite (iron sulphide) use cyanide compounds. Due to the hazards posed both to the environment and site personnel during operations from cyanide use, alternative chemicals will be used at the Project for the separation process.

3.3.4 Tailings Storage Facility Alternative

During the early planning and design stages of the Project, the site infrastructure arrangement placed the TSF in the foothills of the Sorby Hills Ranges. However due to the findings of biological survey work, heritage clearance survey's and the subsequent implementation of the Development Exclusion Boundary the TSF was relocated away from the foothills and onto the plain. This alternative location significantly reduced the ecological impact of the TSF.

In response to outcomes of stakeholder consultation the haul road has also been re-configured to provide flood protection for the TSF and secondary containment in the unlikely event of a TSF wall breach or overtopping. Details regarding the design of the TSF and haul road are provided in Sections 2.5 and 2.7.1 and the Coffey infrastructure design report (Appendix 9, Volume 3).

3.3.5 Concentrate Storage, Handling and Transport

Traditional methods would see the Sorby Hills concentrate conveyed or moved by front-end loader from the end of the process line (Filter Press) to open air stockpiles or an on-site bulk storage shed for short term storage prior to export. Concentrate would then be loaded into conventional covered road train containers for transport to Wyndham Port. Once at the port, the concentrate would be side tipped into stockpiles within a bulk storage shed and subsequently packaged and transferred to the export vessel by conventional ship loading techniques.

SMPL has moved away from the traditional technique and opted to use a containerised system which allows for complete control and visibility of the export chain from the mine site to the port. The containerised system is an environmentally superior method of exporting concentrate as the containers are sealed from the end of the process line (Filter Press) up until the point of loading inside the vessel's hull, therefore there is no rehandling of the product or stockpiling and fugitive dust issues are eliminated. A similar containerised system is currently utilised for the export of nickel (Ni) concentrate at Wyndham Port and is used at other Australian ports such as Adelaide and Darwin. The system has been operational at Wyndham Port for the past 12 months and no dust issues have been experienced to date.

3.3.6 Power Supply

Alternative Power supply options have been investigated for the Project:

- The closest suitable power supply at present would be sourced from the hydroelectric supply from Lake Argyle. This source is carried to Kununurra by a 130 kilovolt (kV) line which would have to be extended approximately 50 km to the Project site. Horizon Power, the operator, have advised that there is a limited supply from this source and the cost of the line extension would be uneconomic for the amount of power required for the Project
- A gas fuel source from local gas fields has also been considered; these fields are not yet in production but this could be an option in the future
- Discussions have been held with proponents interested in the future development of the Ord agriculture regions. This may include the construction of sugar or cotton processing facilities which maybe an additional source of power from cogeneration

Until an alternative power supply becomes viable, the Project will generate power from on-site diesel fuelled generating sets.

3.3.7 Water Supply

The Project will require water for the processing of the ore, for general road maintenance and for personnel requirements. The pits to be mined will require dewatering and this water supply has been estimated to be sufficient and suitable for these purposes.

Water surplus to these requirements could be possible additional sources of water for the development of agricultural operations in the area.

Potable water will be sourced from capture of rainfall from suitable infrastructure buildings such as administration and workshop/stores buildings.

4 SUSTAINABILITY AND ENVIRONMENTAL MANAGEMENT SYSTEM

4.1 OVERVIEW

The principles behind environmental protection and the influences that have shaped the Project's management of environmental impacts are described in this section. The section also sets out the framework for the Project's SHECMS where it relates to environmental issues and impacts. Further, the management system elements that will enable the Project's environmental objectives and commitments to be achieved are outlined.

Management and mitigation strategies relating to the environmental impacts associated with the Project are described in detail in Section 7.

4.2 SUSTAINABILITY AND THE PRINCIPLES OF ENVIRONMENTAL PROTECTION

Regardless of location, any new mining project will have a negative impact on the environmental values of an area for a variety of reasons including, but not limited to, it's ecological footprint, the consumption of energy and the depletion of non-renewable ore resources. However new mining projects can also offer to enhance social values through employment and economic development and can provide targeted environmental benefits such as increased scientific knowledge of the area and improved fire management. SMPL recognises that the actions of today must not compromise the ability of future generations to satisfy their own needs and is therefore committed to the responsible development of the Project.

Within the mining industry, the International Council on Mining and Metals (ICMM) sustainable development framework principles and the Minerals Council of Australia (MCA) enduring values communicate the mining industry's commitment to sustainable development and provide standards and implementation guidelines on sustainability.

Section 4A of the *EP Act* establishes five principles of environmental protection which reinforce the environmental component of sustainability:

- The precautionary principle
- The principle of intergenerational equity
- The principle of the conservation of biological diversity and ecological integrity
- Principles relating to improved valuation, pricing and incentive mechanisms
- The principle of waste minimisation

These principles have been expanded upon in *EPA Position Statement Number 7: Principles of Environmental Protection*, which provides direction for their application. Table 4-1 summarises how these principles have been considered as part of the Project development.

Table 4-1: Consideration of the Principles of Environmental Protection

Principle	Consideration in the Project	Addressed in RER
The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of the precautionary principle decisions should be guided by: a) Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and b) An assessment of the risk with weighted consequences of various options	A risk based approach has been adopted for the Project. SMPL has conducted a thorough risk assessment to ascertain potential issues and risks associated with the Project enabling development of comprehensive management actions to avoid or mitigate those issues and risks identified. As part of the risk assessment process comprehensive investigations have been conducted. Where the investigations identified significant environmental assets, the Project design was modified to avoid or reduce potential impacts.	Yes (Sections 4 and 7)
The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	To ensure that the Project is managed sustainably an EIA has been conducted. SMPL recognise that mining is a short term land use and as such the permanent isolation of land from beneficial post-mining land uses is unacceptable and should be avoided. To ensure the land is persevered for future generations, SMPL is committed to the rehabilitation of the Project to a state that is safe, stable, non-polluting and capable of supporting an ecosystem appropriate to the location.	Yes (Sections 5, 7 and 8)
The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Conservation of biological diversity and ecological integrity is a major consideration for SMPL. SMPL has sought to reduce the Project's impact footprint as far as practicable. SMPL has limited the disturbance considerably with the implementation of the self-imposed Development Exclusion Zone, to protect high value habitat, and the alignment of some aspects of the Project with areas of existing disturbance. Extensive biological investigations indicate that the Project will not adversely impact on the conservation of biodiversity or ecological integrity of the Project Area or immediate surrounds.	Yes (Sections 2, 4, 7 and 8)
Principles relating to improved valuation, pricing and incentive mechanisms a) Environmental factors should be included in the valuation of assets and services b) The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement c) The users of goods and services should pay prices based on the full life cycle costs of providing goods	Environmental management requirements and costs for the life of the Project have been taken into consideration. SMPL is committed to including the protection of environmental assets, as well as the successful closure and rehabilitation of operations, into the budget for the Project. Conceptual mine closure and rehabilitation strategies have been included within this RER. A MCP will also be developed prior to commencement of the Project, which will ensure that the Project can be closed, decommissioned and rehabilitated in an ecologically sustainable manner.	Yes (Sections 5, 7 and 8)

Principle	Consideration in the Project	Addressed in RER
and services, including the use of natural resources and assets and the ultimate disposal of any wastes d) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems		
The principle of waste generation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	SMPL is committed to ensuring the efficient use of resources, such as water, fuel, energy and products throughout the Project life. The Project will implement a 'reduce, re-use, recycle and recover' approach to minimise waste disposal of products that are required on site. Additionally, SMPL is committed to energy efficiency to minimise GHG emissions.	Yes (Section 7)

4.3 ENVIRONMENTAL MANAGEMENT SYSTEM

SMPL is committed to promoting excellence in environmental management and protection in accordance with the SMPL Environmental Policy (Figure 4-1) and key strategic documents such as this RER document. This commitment encompasses not only compliance with all applicable laws and regulations, but also encouraging employees, contractors and suppliers to exercise exemplary environmental practices.

SMPL will develop a SHECMS to ensure environmental management is effectively integrated into operations and that planning, implementation and review processes achieve continuous improvement. The SHECMS will be developed in accordance with the principles of AS/NZS ISO14001:2004 and AS/NZS 4801:2001, and will provide a structured approach to managing risks and potential impacts arising from the Project.

The SHECMS will be the overarching framework that documents health, safety, environment, indigenous heritage and community policies and procedures with which all personnel will be expected to comply. The SHECMS will cover construction, operation and closure phases of the Project.

The broad structure of the SHECMS is illustrated in Figure 4-2 and will incorporate the following aspects:

- Policy
- Planning
- Implementation
- Measurement, evaluation and corrective action

- Management review

The SHECMS will operate on a continuous improvement philosophy and will be expanded and enhanced over the life of the Project as new information becomes available or as standards change. External drivers of the management system will include legislation, EPA guidance, approval conditions and external auditing.

Figure 4-1: SMPL's Environment Policy

Sorby Joint Venture
Sorby Management Pty Ltd

Level 3, 2 Elizabeth Plaza, NORTH SYDNEY NSW 2060
PO Box 98, NORTH SYDNEY NSW 2059
Telephone: +61 2 9927 2006
Fax: +61 2 9927 2050

ACN 145 292 486

Environment Policy

Sorby Management Pty Ltd (SMPL) is committed to protecting the environment. We share the desire of the community to develop our operations in ways that meet the needs of the present, without compromising the environment for future generations. We operate in a responsible manner that respects the environment at all stages of our business. We plan and perform and monitor activities so that adverse effects on the environment are avoided or minimised and remediated.

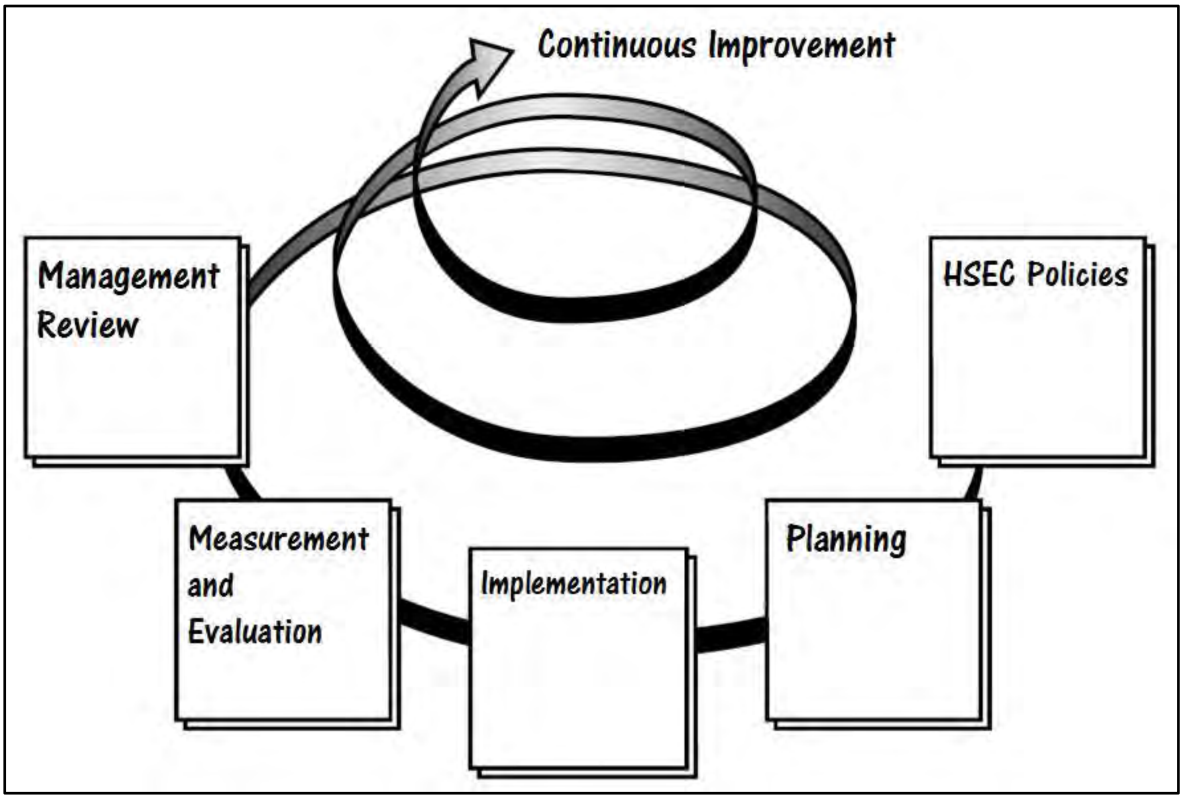
SMPL requires projects and operations to conform to relevant state and federal legislation with the ultimate aim to achieve industry best practice.

SMPL projects and operations will endeavour to:

- Assess adverse environmental impacts and their potential and ensure mitigation measures are in place and acted upon
- Set and regularly review environmental objectives and targets to achieve continuous improvement
- Prevent pollution and promote efficient use of resources
- Update plans for disturbance and closure and progressively rehabilitate
- Protect natural, historic and culturally significant sites
- Ensure that all people who work or visit our projects and operations are aware of and have the necessary skills to fulfil their environmental obligations
- Monitor the implementation and effectiveness of our Environmental Management System by conducting internal and external audits
- Protect and manage biodiversity values
- Seek, respect and consider community views
- Openly communicate our environmental performance with our workforce, Government and the wider community

We will not compromise our commitment to sound environmental management for profit or production.

Figure 4-2: Broad Structure of the SHECMS



4.3.1 Policy

SMPL is committed to managing its activities in an environmentally responsible manner, as reflected by the Environment Policy (Figure 4-1). This policy is an important component of the environmental management system as it provides a standard to which environmental performance can be measured.

SMPL acknowledges that sound business practice requires compliance with environmental standards as a minimum. As it is not possible to completely eliminate all potential impacts associated with the Project, SMPL will conduct operations with the objective of achieving best practice so that adverse environmental effects are avoided or kept within acceptable levels.

4.3.2 Planning

The planning phase is an essential component of the SHECMS and provides a systematic and methodical approach to identifying and achieving the company's objectives and targets. Good planning will ensure that SMPL is aware of, and can address, any ongoing obligations and that planned environmental outcomes are achieved in an efficient manner throughout the life of the Project.

4.3.3 Implementation

SMPL recognise that whilst the planning phases are important in determining what is required, the implementation phase focuses on achieving the objectives established through planning. Procedures and management strategies within the SHECMS will help to maintain compliance with obligations and environmental performance targets for all Project aspects that have the potential for environmental impact.

Environmental management responsibilities will apply to various personnel involved in different aspects of the Project operations; SMPL will ensure that all personnel have the appropriate skills, knowledge and training to conduct their activities in compliance with Project policies, objectives and targets. The environmental objectives and each employee's obligations for environmental management will be clearly communicated to all staff and contractors through inductions and ongoing training.

4.3.4 Measurement, Evaluation and Corrective Action

Regular supervision, inspections and auditing will be undertaken by suitably qualified and experienced personnel to assess compliance with environmental management objectives and commitments. The frequency of the inspections and audits will depend on the degree of risk associated with the hazard in question. Periodic third party inspections and audits will be carried out as part of SMPL's audit process.

Non-conformances shall be identified, documented, notifications raised, evaluated, and appropriate corrective and preventative actions implemented to control those activities that do not conform to specified requirements. Non-conformances may be generated as a result of:

- Audits
- Inspections
- Incident Reports
- Hazard Reports
- Complaints
- Job Safety and Environment Analysis (JSEA)

All non-conformances shall be recorded in the site Non-Conformance and Corrective Actions Register. The register will identify what is required, responsibilities and timeframes for completion. Corrective and preventative actions will be monitored to completion and a process of escalation to managers will be undertaken if actions are not carried out as stipulated. The register will be maintained throughout the life of the Project.

4.3.5 Management Review

Internal reviews of the SHECMS by suitably qualified and experienced personnel will be a key mechanism in promoting continuous improvement in levels of compliance and consistency across the Project and ensuring that the Project site remains a safe and effective working environment.

The SHECMS shall be reviewed and updated at least annually to ensure its continuing suitability, adequacy and effectiveness. It shall also be reviewed should there be any significant Project scope changes or high level incidents. These reviews will be documented and records maintained.

Continuous improvement is an important aspect of SHEC management. The following processes shall be adopted to assist in the review of SHEC performance and identification opportunities for improvement:

- SHEC committee meetings

- Review of feedback and complaints
- Completion of audits
- Review of SHEC performance

4.3.6 Environmental Management Plans

An important aspect of the SHECMS is the development of specific management plans for the construction, operational and closure phases of the Project:

- Construction Environmental Management Plan (CEMP) (Appendix 1, Volume 2)
- Operational Environmental Management Plan (OEMP) (Appendix 2, Volume 2)

These plans will provide the framework for identifying and managing environmental issues during the life of the Project and will formalise SMPL's environmental commitments, ensuring personnel are aware of their responsibilities and that activities are conducted in accordance with SMPL's environmental requirements and obligations. Details on how, when and by whom activities should be undertaken will be included in the documents. The CEMP and OEMP are currently in draft form to enable both documents to be updated to include any amendments or conditions following approval of the Project.

The environmental aspects of the Project during the construction phase will be managed in accordance with the CEMP. Implementation of the CEMP will ensure that the proposal is constructed in accordance with legislative requirements and that all internal and external environmental objectives and obligations are met.

The operation of the Project will be primarily managed through an OEMP. Implementation of the OEMP will ensure that the Project meets its environmental obligations including internal objectives, legislation regulations and conditions of approvals relating to the Project. The OEMP will comprise a series of environmental management strategies that will address the key environmental factors and associated impacts identified in Section 7. Each strategy will describe measures to be applied to avoid and minimise the environmental impact of the Project and will include contingency measures to mitigate accidental impact. The OEMP will be a dynamic document, undergoing regular reviews and updates to maintain relevance.

Planning for mine closure is a critical component of environmental management for the Project. Leading practice requires that mine closure planning should start prior to mining commencing and should continue throughout the life of the mine until final closure and relinquishment. To ensure that the Project can be closed, decommissioned and rehabilitated in an ecologically sustainable manner planning has been initiated and a framework of concepts, targets and predicted outcomes has been produced for the Project in the form of conceptual mine closure and rehabilitation strategies. SMPL will also develop a MCP in accordance with the DMP/EPA '*Guidelines for Preparing Mine Closure Plans'* (June 2011). The MCP will be submitted to the DMP alongside the Mining Proposal for assessment during the final stages of Project approval. The MCP will be regularly reviewed and revised throughout the life of the Project to allow for incorporation of new information. These plans demonstrate SMPL's commitment to best practice environmental management and continuous improvement in environmental performance.

5 STAKEHOLDER ENGAGEMENT AND CONSULTATION

5.1 CONSULTATION PROGRAM

SMPL is committed to an open and transparent approach to stakeholder consultation. SMPL has established communications with regulators and key stakeholders to ensure that any potential issues and concerns are raised and appropriately addressed.

The objectives of the stakeholder consultation program to date have been to:

- Identify and facilitate consultation with key stakeholders and communities regarding the Project
- Provide accurate and detailed information about the Project to stakeholders to increase their knowledge and involvement
- Provide opportunities for open communication so stakeholders feel able and comfortable about expressing any problems, difficulties or concerns that they may have with the Project
- Provide a basis for ongoing consultation throughout the life of the Project

5.2 RELEVANT STAKEHOLDERS

Stakeholders include individuals, groups, communities or organisations that can potentially affect or be affected by an organisations activity, in this case, SMPL's proposed Project. Key stakeholders have been identified and are presented in Table 5-1. The nearest townships to the Project are Kununurra and Wyndham; these communities have been included as key stakeholders.

Table 5-1: Key Stakeholders

Stakeholder Group	Stakeholder Details/Organisation Name
State Government Departments and Agencies	DER
	DPaW
	DRDL
	DoW
	DMP
	Department of Agriculture (DoA)
	DoT
	EPA
	Office of the Environmental Protection Authority (OEPA)
	Department of Mines and Petroleum - Resource Safety (DMP-RS)
	MRWA

Stakeholder Group	Stakeholder Details/Organisation Name
	Department of Indigenous Affairs (DIA)
	Department of State Development (DSD)
Commonwealth Government Departments	SEWPaC
Local Government Authorities	SWEK
Utility and Infrastructure Groups	CGL
	Advent Energy
	POAGS
	ORIA – Weaber Plains Project Proponents
Indigenous Groups	MG Corporation
	Yawoorroong Miriuwung Gajerrong Yirrgeb Noong Dawang Corporation
Neighbouring Land Holders / Communities	Carlton Hill Station
	Community of Kununurra
	Community of Wyndham
Industry Groups	CME
	Kimberley Regional Council
	Kimberley Chamber of Commerce and Industry
Environment Interest Groups	Kimberley Land Council (KLC)
	Environs Kimberley (EK)
	Kimberley Toad Busters

5.3 STAKEHOLDER ENGAGEMENT

SMPL has utilised a number of communication mechanisms to facilitate consultation and has engaged in stakeholder consultation on no less than 122 separate occasions with 52 Federal, State or Local authorities or private companies and members of the public. Extensive consultation with key stakeholders, including local communities, has occurred within Kununurra and Wyndham.

The first major stakeholder consultation took place in Kununurra and the majority of local government regulators were represented by one or more personnel. The following agencies attended:

- DER
- DoW
- MRWA

- Department of Resource and Land Development
- SWEK

The objective of this initial meeting was to give the regulators a broad overview of the Project and provide them with an opportunity to identify any major issues or development constraints. The Project was well received with the majority of stakeholders considering the potential of the Project to provide social and economic benefits to the towns of Kununurra and Wyndham. Issues that were raised centred predominantly around transport methods of concentrate from the Project site to Wyndham Port. Other transport related issues included the cumulative impact of the increased number of road trains moving through the town of Wyndham.

Other significant consultation events include:

- Project presentation plus question and answer session conducted at a meeting held at the Chamber of Commerce on November 18th 2011 which 65 individuals attended
- Compilation and issue of a number of letters on December 7th 2011 to key stakeholders asking for comments on the most appropriate final land use for mine closure
- Distribution of a community information pamphlet (Appendix 16, Volume 3) in December 2011 to 378 households in Wyndham and 1126 households in Kununurra. The pamphlet detailed the nature, size and extent of the Project
- Full page, detailed advert (Appendix 17, Volume 3) published in the Kimberley Echo on December 12th 2011 with the express purpose of raising awareness of the Project and to give the receiving public the greatest opportunity to comment

5.4 STAKEHOLDER RESPONSE

In response to the letters sent to key stakeholders, SMPL received a reply from the DRDL who acknowledged the return of the site to a pastoral land use at this stage of the Project however expressed interest in holding further negotiations with SMPL as the Project progressed with the view of a final land use of agricultural purposes.

In response to the community information pamphlet and Kimberley Echo advert SMPL have received several enquiries from local groups interested in providing services to the Project. No environmental issues have been raised to date.

5.5 ONGOING CONSULTATION

Stakeholder consultation has been an important aspect of the Project to date and will continue to be an integral factor in the overall environmental management of the Project. SMPL will endeavour to update the public and other stakeholders on the progress of the development throughout the life of the Project. The objective is to maintain a high degree of transparency and ensure due consideration of all Project related opportunities and concerns.

A stakeholder consultation register has been developed and will be maintained for the life of the Project to document details of stakeholder consultation and outcomes. The stakeholder register to date is available in Appendix 18 (Volume 3).

6 DESCRIPTION OF EXISTING ENVIRONMENT

6.1 EXISTING ENVIRONMENT – PROJECT MINE SITE

6.1.1 Regional Setting

The Project Area is located within the SWEK on unallocated crown land. The site is situated at the north eastern extent of the Sorby Hills Ranges. Tenement M80/286 encompasses a portion of the ranges and associated foot slopes, the remainder of tenement M80/286 and tenement M80/197 cover predominantly flat alluvial plain of greyish brown cracking clay soils.

Mapping for the Interim Biogeographic Regionalisation for Australia (IBRA) programme (version 6.1) placed the Project Area in the Victoria Bonaparte Bioregion, as shown by Figure 6-1. This bioregion comes under the Tropical and Subtropical Grasslands, Savannas and Shrublands Ecoregion which stretches across northern Australia into northern New South Wales (NSW). The Victoria Bonaparte Bioregion continues into the NT as far as Bradshaw (SEWPaC 2011). Within the Victoria Bonaparte Bioregion the vegetation over lowland parts of the survey area has been mapped as 'Tussock grasslands' while upland areas come under 'Tropical Eucalyptus woodland/grasslands'. Tussock grasslands covered an estimated 631,088 ha (8.7 %) of the bioregion prior to European settlement. By about 1997 this area was little changed at 631,032 ha (8.7 %). Tropical Eucalyptus woodland/grasslands covered an estimated 4,696,792 ha (64.6 %) of the bioregion prior to European settlement. By about 1997 this area had been slightly reduced to 4,678,368 ha equating to 64.4 % (Australian Government 2011).

The Project Area lies in the Gardner Botanical District within the Northern Botanical Province of WA (Beard 1975) and encompasses the Pinkerton and Ivanhoe Land Systems (Department of Agriculture and Food 2009).

6.1.2 Goomig Range Conservation Park

The proposed GRCP is located adjacent to the Project Area as illustrated by Figure 1-1. The GRCP has been proposed by the WA Government to offset the clearing of vegetation and fauna habitat for the ORIA – Weaber Plains Project (Department of Lands, Planning and Environment 2000). The GRCP covers 17,900 ha and contains the Pincombe and Cave Spring Ranges. The ranges trend north east to south west and form a series of parallel ridges comprising Proterozoic sandstone and typically feature skeletal sandy soils with low tree savannas and hummock grasslands. The GRCP is dominated by open woodland composed of *Corymbia dichromophloia* (Variable-barked Bloodwood), *Eucalyptus miniata* (Darwin Woollybutt) and *Eucalyptus tetrodonta* (Darwin Stringybark) with *Triodia bitextura* (Curly Spinifex) and sorghum grasses (Strategen 2011).

SORBY HILLS PROJECT

Figure 6-1

Project Area and Bioregions

Author: SMPL Date: October 2012

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_601.dgn

6.1.3 Climate

6.1.3.1 Current Climatic Conditions

The east Kimberley Region is subject to a hot and humid wet season from November to April (summer), with highly variable rainfall resulting from monsoonal depressions and tropical cyclones, and a warm dry season extending from May to October (winter). The region receives approximately 90 % of its annual rainfall during the summer wet season with torrential rain events often leading to wide-scale flooding. The dry season experiences infrequent rainfall with consecutive dry months common. Evaporation rates are high, with the average annual pan evaporation exceeding the average annual rainfall by a factor of 3.3.

The Bureau of Meteorology (BoM) has been recording rainfall and temperature since 1944 at the Kimberley Research Station (BoM Site Number 002014), 36.5 km south west of the Project Mine Site (BoM 2010). Average monthly temperature and rainfall data for the period up to August 2010 is presented in Table 6-1 and in Figure 6-2. Recorded data suggests that the Project Area is likely to receive approximately 834 mm of rain on an annual basis and experience temperatures ranging between 14 and 39 degrees Celsius. Rainfall in the Kimberley Region can be sporadic and localised; although rainfall and daily temperatures in the Project Area may vary slightly, data from the Kimberley Research Station provides a good indication of climatic conditions within the region.

Table 6-1: Kimberley Research Station Meteorological Data, Mean Daily Temperature and Monthly Rainfall

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Max Temp (°C)	36.2	35.0	35.6	35.4	33.2	30.6	30.7	33.1	36.5	38.6	39.0	37.6	35.1
Mean Min Temp (oC)	24.6	24.4	23.5	20.8	18.1	15.3	14.3	15.6	19.5	22.9	24.7	24.9	20.7
Mean Rainfall (mm)	203.3	207.9	133.1	41.1	8.6	4.1	3.8	0.4	2.6	22.4	60.8	144.8	834.7

In order to continually monitor site specific climatic aspects for the Project site SMPL installed an onsite weather station (Environdata DL3006 6 channel Weather Maestro) in September 2011; parameters being recorded include wind speed and direction, temperature, rainfall, humidity and evaporation rate. A summary of the data collected from October 2011 to October 2012 is presented in Table 6-2. Wind roses, created using the onsite weather station data, are provided in Figure 6-3. The wind roses indicate that Project Area wind directions are relatively constant during the dry season with prevailing south easterly winds while the wet season winds are more variable, changing between westerly to north easterly; the overall prevailing wind direction is toward the north west. The wind roses indicate that the majority of wind speeds experienced in the Project Area are less than 14 kph. The Project Area is within a cyclone zone which is categorised as Wind Region B, as defined by and illustrated in Figure 6-4. During cyclonic events, Wind Region B is characterised by a regional basic wind velocity of 176 kph.

Table 6-2: SMPL Weather Station Daily Meteorological Data

	Wind Speed (km/h)	Relative Humidity (%)	Max Air Temp (°C)	Min Air Temp (°C)	Total Rain Gauge (mm)	Evaporation (mm)
Average	4.69	54.97	34.67	22.01	3.52	4.91
Minimum	0.00	12.38	22.93	12.50	0.00	1.23
Maximum	12.08	92.19	42.06	28.13	98.60	7.95

6.1.3.2 Projected Future Climatic Conditions

Projections of climate change in Australia have been undertaken as part of the Australian Climate Change Science Program, a joint initiative of the Department of Climate Change and Energy Efficiency, BoM and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (http://www.climatechangeinaustralia.gov.au/index.php).

Temperature changes that WA could experience under low, medium and high GHG emission scenarios by 2030 are shown in Figure 6-5. This indicates that by 2030 the Project Area could expect an elevation in temperature between 0.3°C (10th percentile, low emissions) and 2°C (90th percentile, medium emissions), with the 50th percentile value of a 0.6°C to 1.5°C elevation in temperature more likely.

Predictions for changes in annual rainfall for WA under low, medium and high GHG emissions scenarios are shown in Figure 6-6; the models are divergent on their predictions for a change in annual rainfall affecting the Project Area by 2030. Tenth percentile predictions indicate that the Project Area rainfall could be reduced by up to 10 %, the 90th percentile projections indicate an increase in rainfall of up to 10 % based on medium to high emissions scenarios however the most likely scenario (50th percentile) suggests that rainfall is likely to remain similar to what it is currently.

Figure 6-2: Kimberley Research Station Average Monthly Rainfall and Temperature

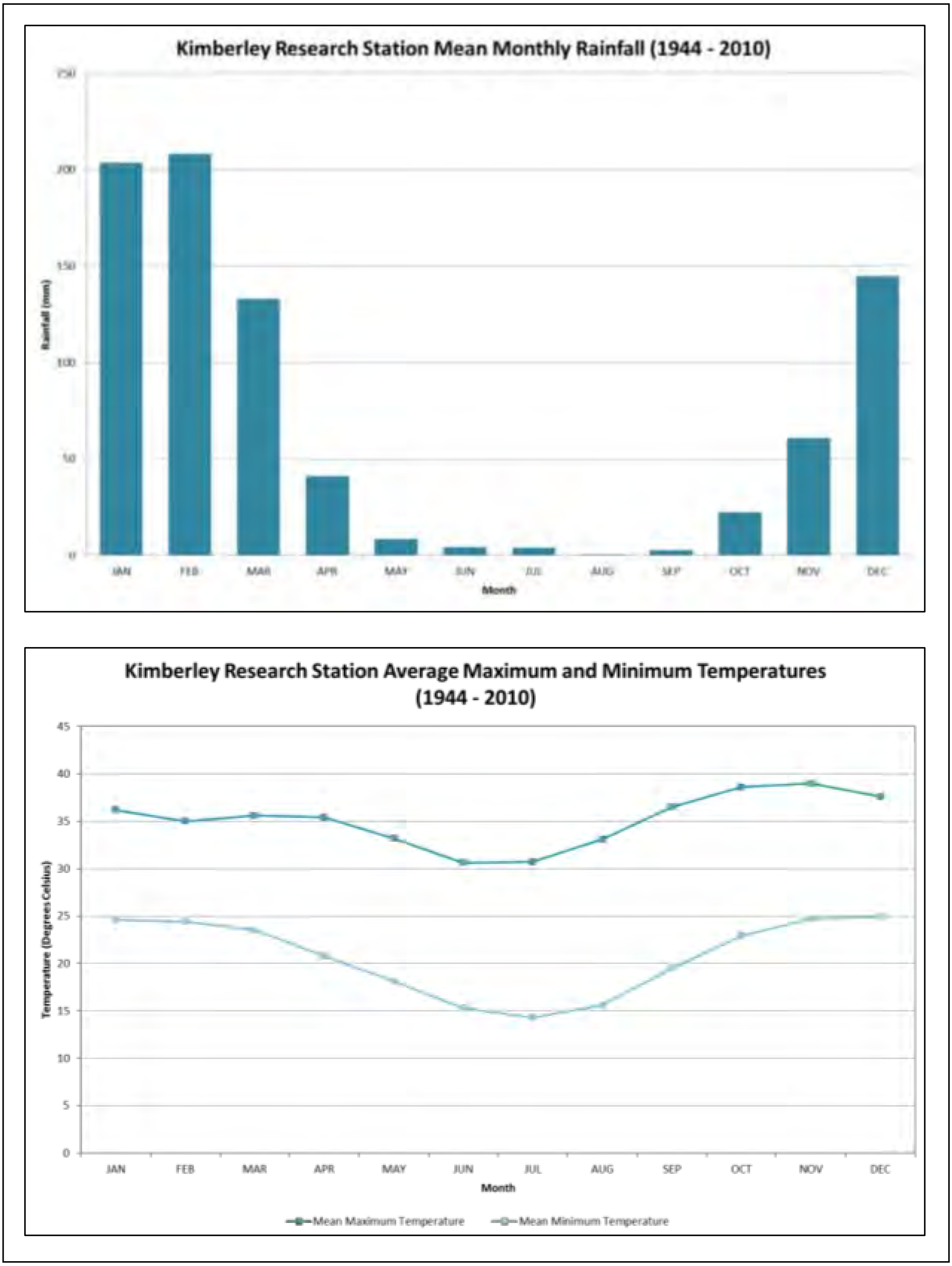
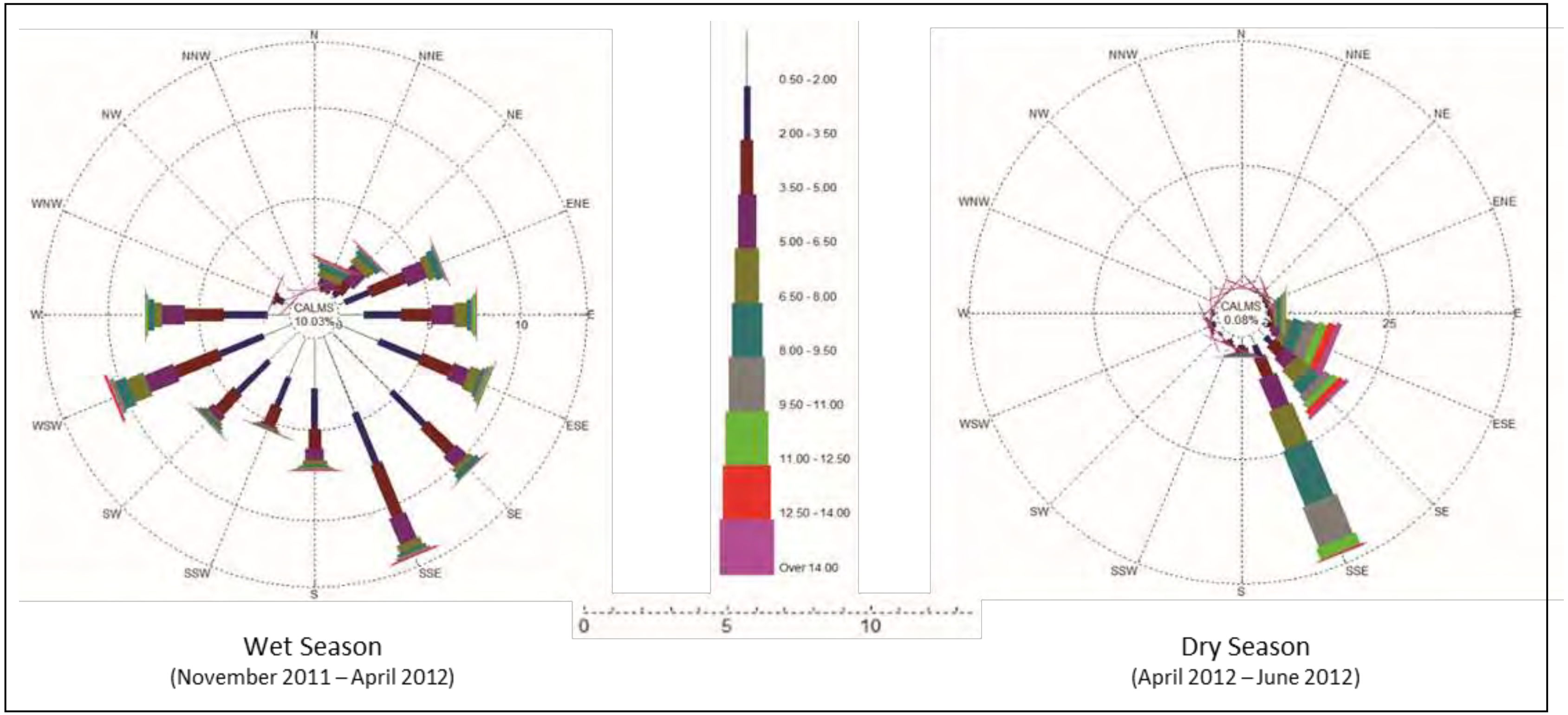
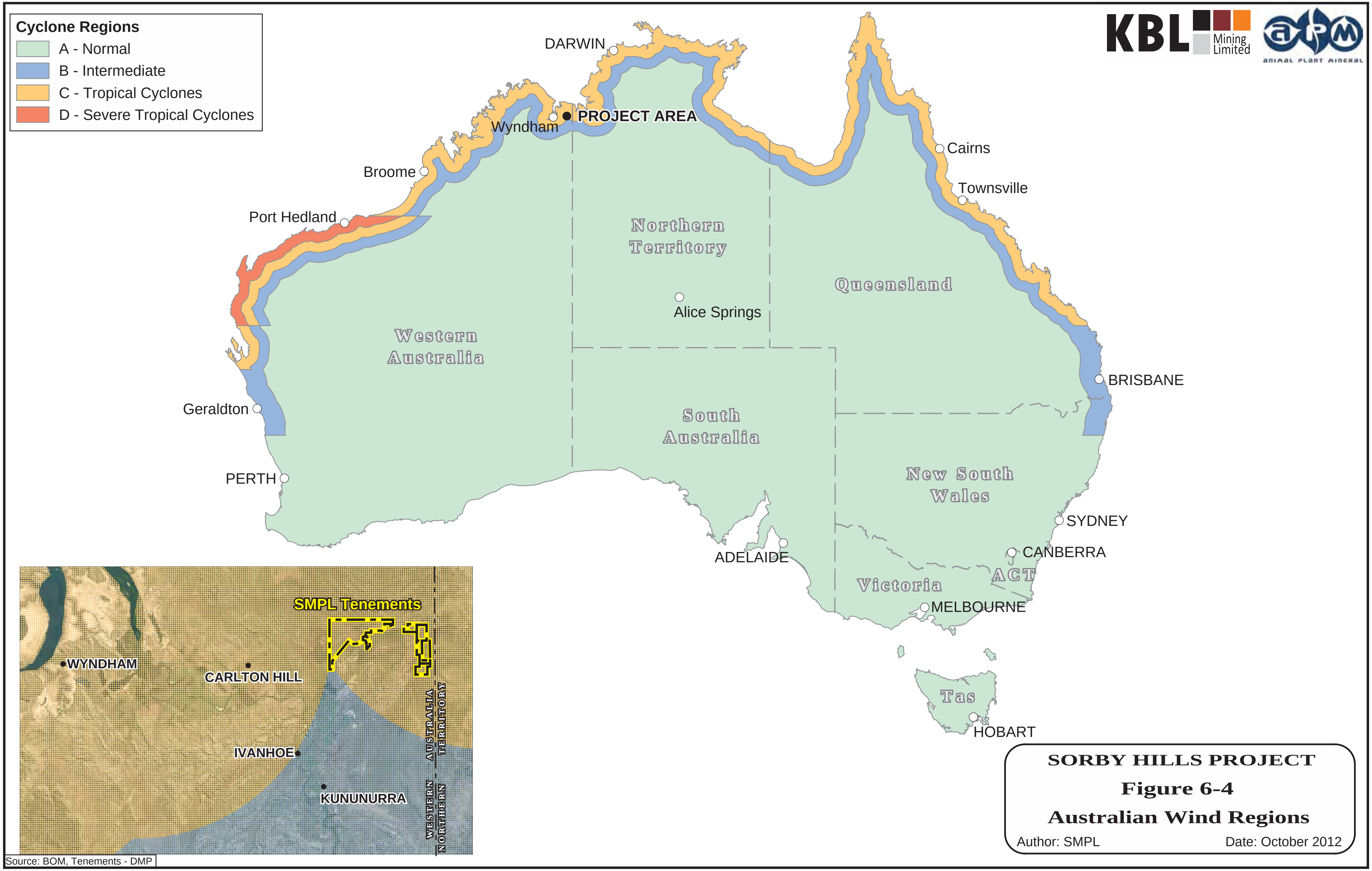


Figure 6-3: Project Area Wet and Dry Season Wind Roses



Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_604.dgn



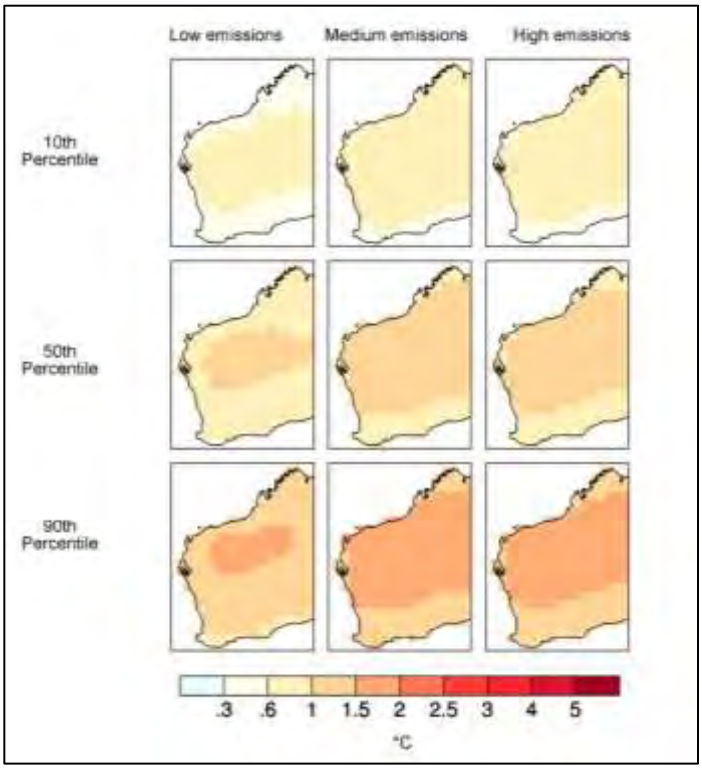
SORBY HILLS PROJECT

Figure 6-4

Australian Wind Regions

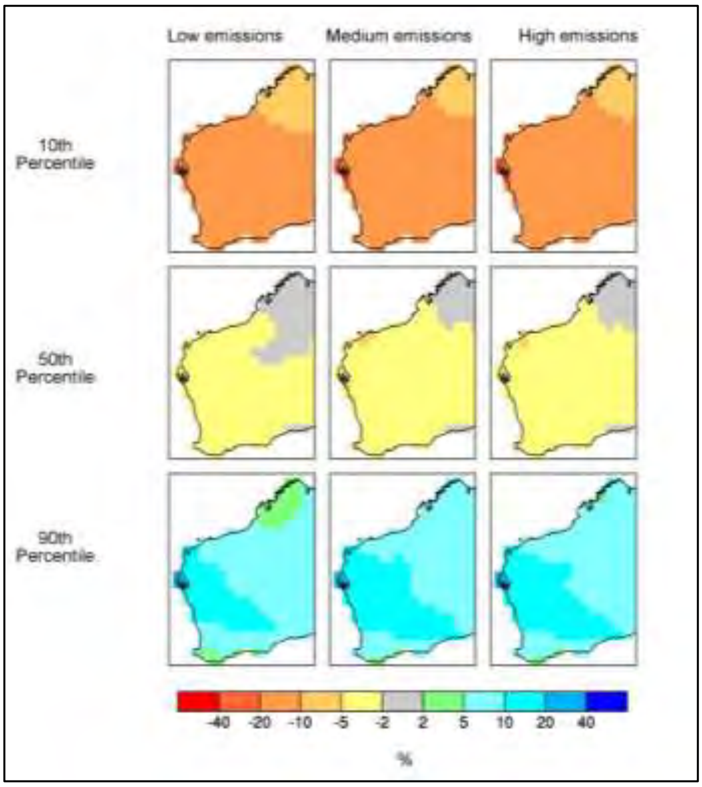
Author: SMPL Date: October 2012

Figure 6-5: Predictions in Temperature Change for a Western Australian Summer in 2030 under Low, Medium and High Greenhouse Gas Emissions Scenarios



Sourced from http://www.climatechangeinaustralia.gov.au/watemp1.php

Figure 6-6: Predictions in Changes for Annual Rainfall for a Western Australia Summer in 2030 under Low, Medium and High Greenhouse Gas Emissions Scenarios



Sourced from http://www.climatechangeinaustralia.gov.au/warain1.php

6.1.4 Surface Hydrology

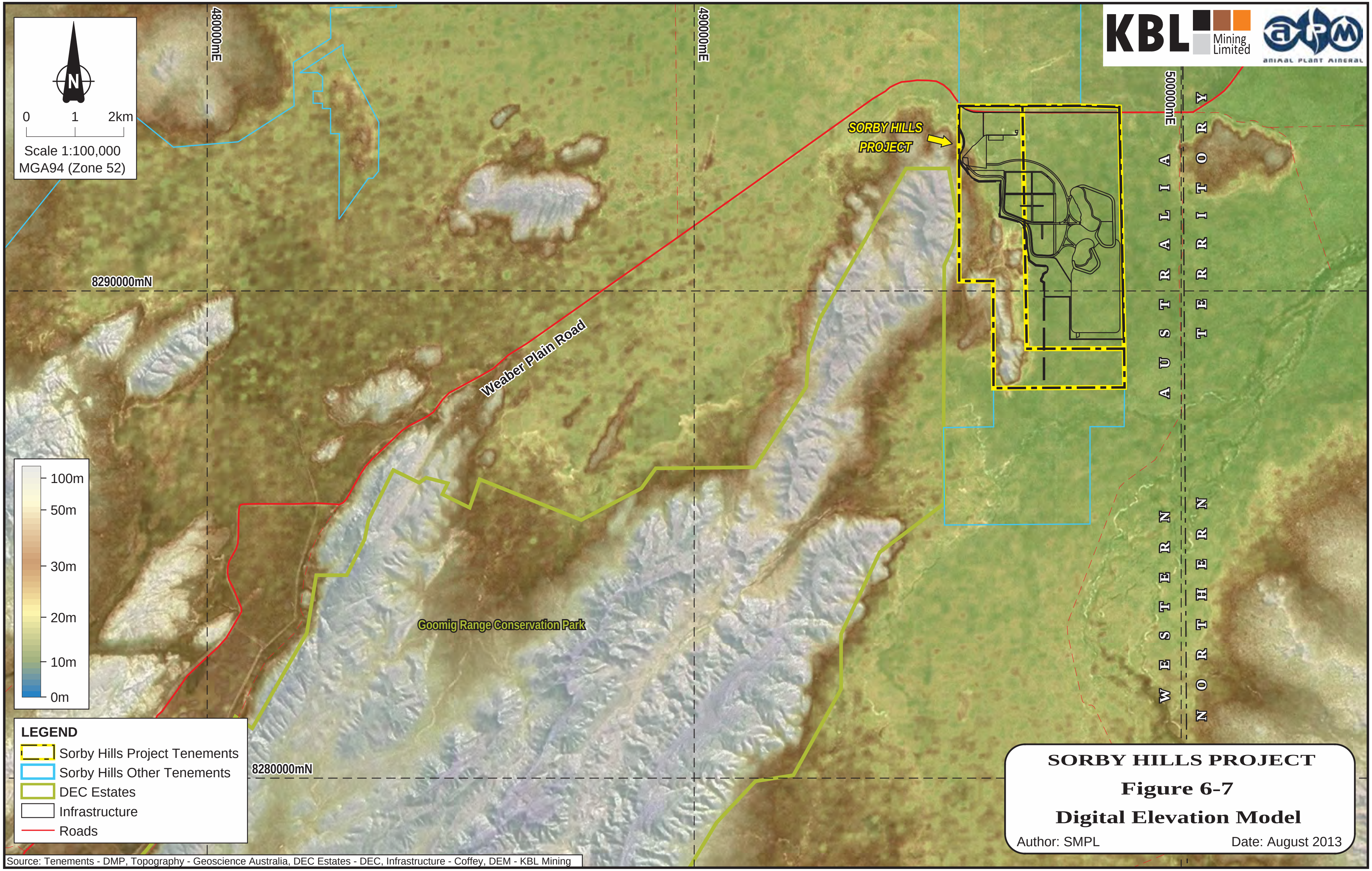
A surface water and flood assessment for the Project Area was conducted by SWC in 2011, the full report is provided in Appendix 10 (Volume 3). To establish the surface water flows and catchments within the Project Area and surrounding regions a digital elevation model (DEM) was constructed, and presented in Figure 6-7. Surface flows were identified using TOPAZ (Topographical PArameteriZation; Garbrecht *et al*. 2004) with a maximum flow accumulation size (i.e. catchment area) of 10 ha. Modelled surface flows and identified catchment boundaries are shown in Figure 6-8 and Figure 6-9.

The Project Area is located in the upper portions of the Knox Creek and Keep River Catchments; all surface flows within the Project Area tend south east towards these watercourses. No significant creeks or defined drainage systems occur within the Project Area; the ephemeral Border and Knox Creeks are located 3.5 km to the north and south respectively, and the Keep River (which Knox Creek flows into) is situated 4.6 km to the south east.

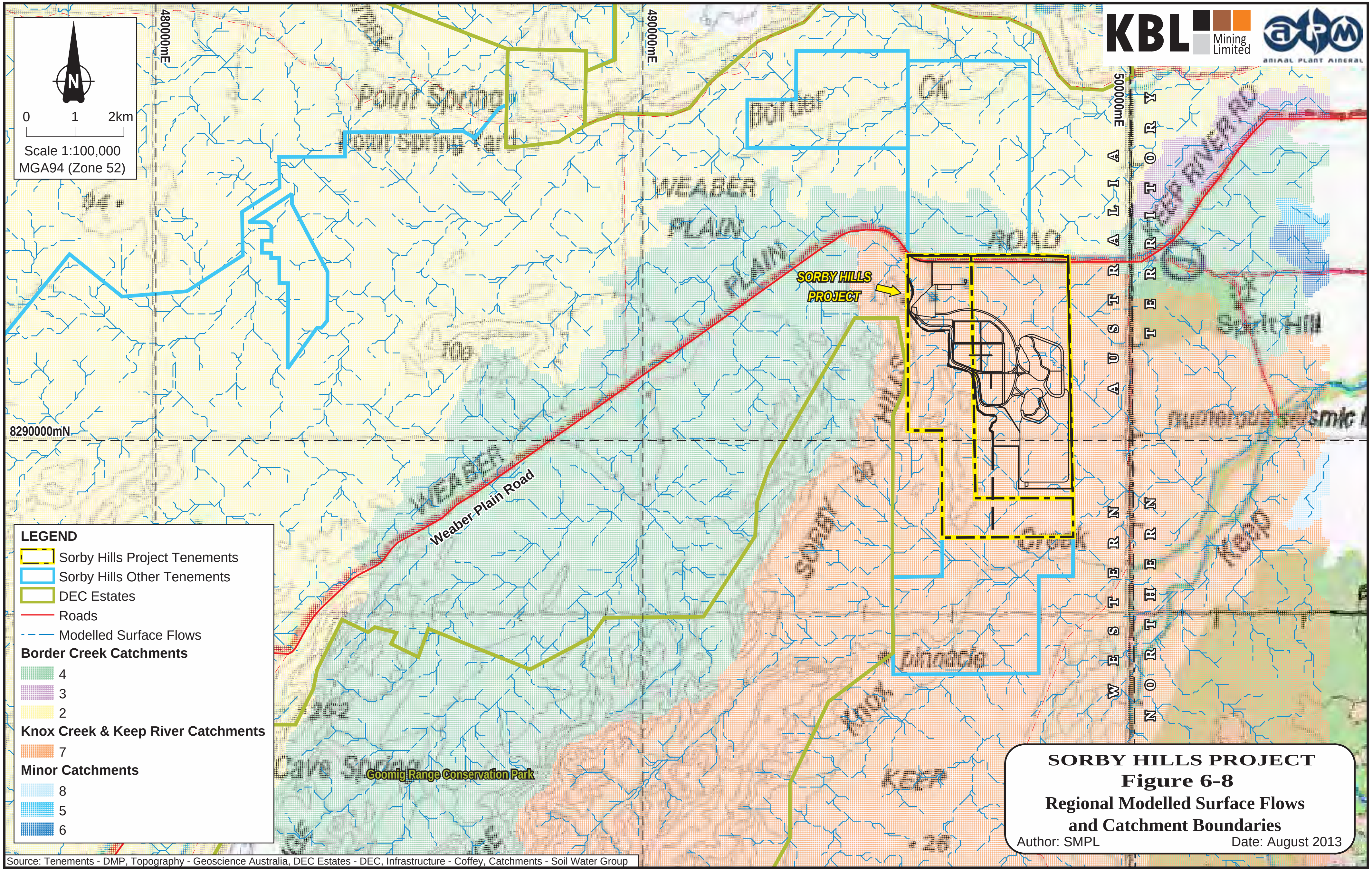
All surface water north of the Weaber Plain Road (beyond the northern boundary of the Project Area) and draining the western side of the Pincombe Ranges and Sorby Hills (area covered by ORIA – Weaber Plains Project) flows into Border Creek and does not enter the Project Area. The upstream catchment for the Project Area (eastern side of Sorby Hills) is relatively small, with all surface water reporting to Knox Creek. Therefore water from the Project Area will flow towards Knox Creek and Keep River, away from the ORIA – Weaber Plains Project.

Within the Project Area surface flows are generally sluggish due to the flat nature of the alluvial plain. During the wet season the surface portion of the alluvial clays becomes saturated and swells resulting in waterlogging and ponding conditions on the surface. Onsite observations during the wet season and following cyclonic events has identified that the alluvial plain is covered with approximately 20-30 cm of surface water with very slow flow to Knox Creek. Hydrological modelling of intense rainfall events (i.e. 1 in 100 year, 72 hour flood events) carried out by SWC (Appendix 10, Volume 3) indicates that during this period the water level in the vicinity of the Project Area is likely to rise to approximately 1 m above the ground surface. These ponded conditions are likely to remain for an extended period after the storm event (i.e. >5 days after) due to the low permeability of the underlying alluvial clays and the low slope gradient towards Knox Creek.

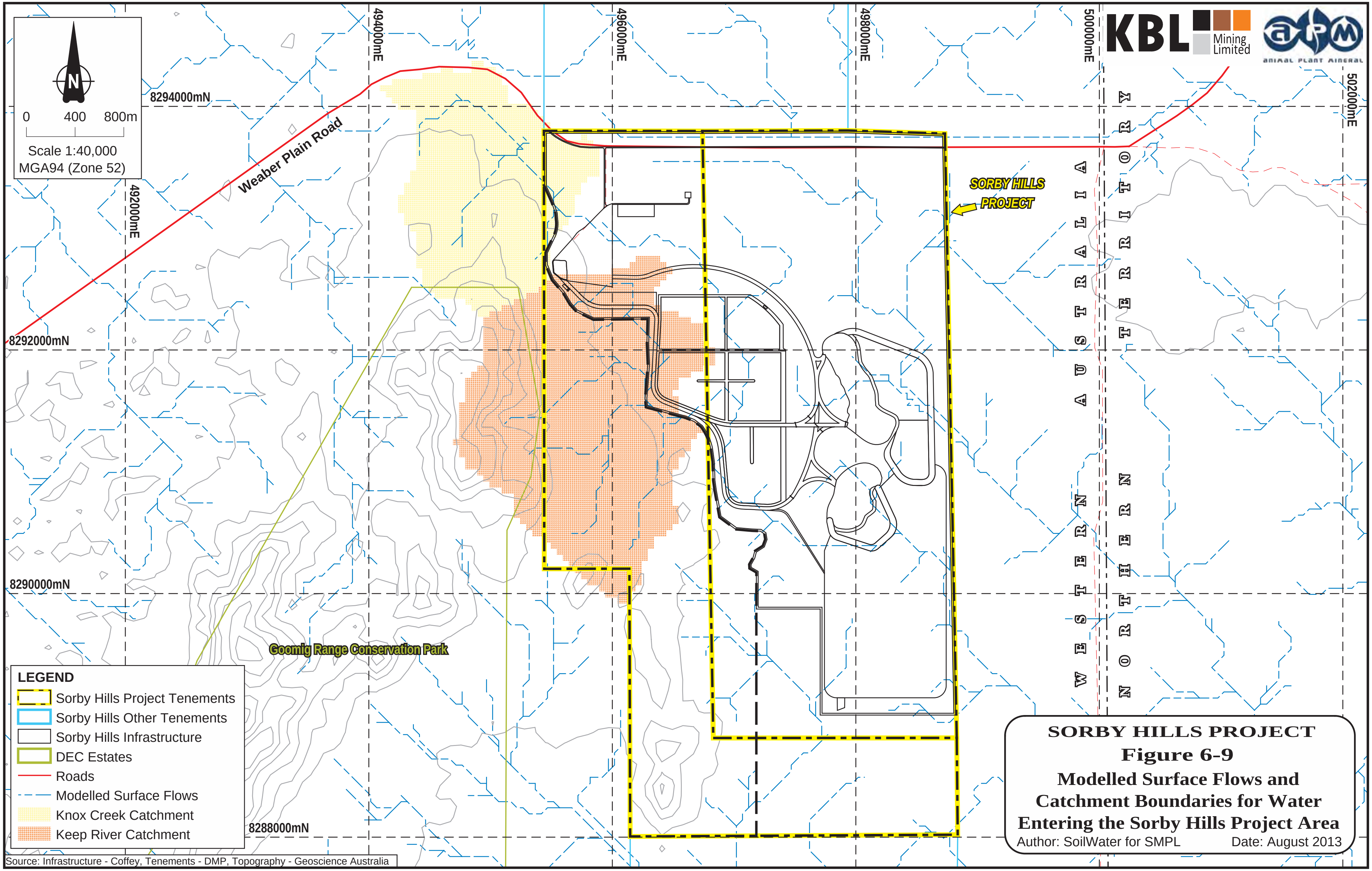
Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_607.dgn



Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_608.dgn



Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_609.dgn



SORBY HILLS PROJECT

Figure 6-9

Modelled Surface Flows and Catchment Boundaries for Water Entering the Sorby Hills Project Area

Author: SoilWater for SMPL Date: August 2013

6.1.4.1 Baseline Surface Water Parameters

Surface water samples have been collected and analysed from the Keep River on a quarterly basis since July 2011 to establish a baseline data set for surface water quality at the Project site; samples were collected in accordance with *AS/NZS 5667.1:1998 – Standards for Water Quality Sampling.* The measured parameters are provided in Table 6-3 and Table 6-4. Laboratory analysis components have been carried out by a National Association of Testing Authorities (NATA) accredited test centre.

The field testing results are presented in Table 6-5 and laboratory results are summarised Table 6-6 and provided in full in Appendix 19 (Volume 3). The results have been compared to guideline trigger values set out by the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)*; comparison has been made against the following:

- Freshwater guidelines which are based on slightly to moderately disturbed systems on the basis the site was a pastoral station and has been subject to previous mineral exploration. This adopts trigger levels calculated from a 95 % protection level

- Marine water quality guidelines which are based on high conservation/ecological value systems on the basis of potential groundwater and surface water drainage/discharge into the Keep River estuary, which could be considered to have a significant impact on MNES, specifically in relation to Threatened and Migratory species. This adopts trigger levels calculated from a 99 % protection level

During this baseline testing to establish pre-disturbance conditions, guideline trigger values have been exceeded for many of the parameters tested. Where trigger values have been exceeded the results have been presented in graph form (Figure 6-10 to Figure 6-16). Due to its high toxicity, the presence of Tl in the surface water will be closely monitored throughout the life of the Project. At present there are no Australian guidelines with regard to acceptable levels of Tl; SMPL will however use the United States Environmental Protection Agency (USEPA) safe limit guideline of 0.013 mg/L. All samples collected to date are well below this USEPA safe limit. Tl results have been presented in Figure 6-17.

To provide additional information, opportunistic sampling of the ephemeral Knox Creek will commence this wet season if the creek is running. Samples will be tested for the same range of parameters as the existing baseline monitoring program for Keep River.

Border Creek was opportunistically sampled for surface water quality in July 2012, the results are provided in Appendix 28 (Volume 3). However, as surface water flows from the Project Area do not enter Border Creek and as the groundwater flows from the Project Area to Border Creek will not become surface water expressions, SMPL feel that there is no value in continuing to sample surface water at Border Creek.

Surface water quality monitoring of the Keep River, Knox Creek and selected sites in the Project Area will be carried out throughout the life of the Project; the monitoring program is discussed further Section 7.2.5.

Table 6-3: Water Testing Measurement Parameters – Field Testing

Parameter	Symbol/Abbreviation	Unit
Temperature	Temp	°C
pH	pH	n/a
Total Dissolved Solids	TDS	mg/L
Electrical Conductivity	EC	mS/m
Standing Water Level	SWL	M

Table 6-4: Water Testing Measurement Parameters – Laboratory Analysis

Analyte	Symbol/Abbreviation	Unit
pH	pH	n/a
Electrical Conductivity	EC	mS/m
Total Dissolved Solids	TDS	mg/L
Total Suspended Solids	TSS	mg/L
Major Ions		
Calcium	Ca	mg/L
Potassium	K	mg/L
Magnesium	Mg	mg/L
Sodium	Na	mg/L
Chloride	Cl^-	mg/L
Sulphate	SO_4_S	mg/L
Alkalinity	n/a	mg/L
Carbonate	CO_3	mg/L
Bicarbonate	HCO_3	mg/L
Hardness	n/a	mg/L
Trace Metals		
Silver	Ag	mg/L
Aluminium	Al	mg/L
Arsenic	As	mg/L
Boron	B	mg/L
Barium	Ba	mg/L
Cadmiun	Cd	mg/L
Cobalt	Co	mg/L
Chromium	Cr	mg/L
Copper	Cu	mg/L
Iron	Fe	mg/L
Fluorine	F	mg/L
Mercury	Hg	mg/L
Manganese	Mn	mg/L
Molybdenum	Mo	mg/L
Nickel	Ni	mg/L
Lead	Pb	mg/L
Selenium	Se	mg/L
Thallium	Tl	mg/L
Vanadium	V	mg/L
Zinc	Zn	mg/L
Nutrients		
Nitrate	NO_3	mg/L
Nitrite	NO_2	mg/L
Total Nitrogen	N_total	mg/L
Total Phosphorous	P_total	mg/L
Petroleum Hydrocarbons		
Benzene	n/a	µg/L
Toluene	n/a	µg/L
Ethylbenzene	n/a	µg/L
Xylene	n/a	µg/L
Total BTEX	n/a	µg/L
C6-C9	n/a	µg/L
C10-C14	n/a	µg/L
C15-C28	n/a	µg/L
C29-C36	n/a	µg/L
Total Petroleum Hydrocarbons	TotalTPH	µg/L

Table 6-5: Field Results Summary for Keep River Surface Water Quality

ID for analyses	Name	Temperature (°C)		pH		Total dissolved solids (mg/L)		Electrical conductivity (mS/m)	
		Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
B10	Keep River	25.1	29.9	7.37	7.77	39	494	8	74.7

Table 6-6: Laboratory Results Summary for Keep River Surface Water Quality

Component	Unit	95 % Trigger Value Fresh Water	99 % Trigger Value Marine Water	B10	
				Lowest	Highest
Ag	mg/L	0.00005	0.0008	<0.0001	<0.0001
Al	mg/L	0.055	ID	0.021	1.2
Alkalinity	mg/L	ID	ID	25	145
As	mg/L	0.013	ID	<0.001	<0.001
B	mg/L	0.37	ID	0.03	0.09
Ba	mg/L	ID	ID	0.066	0.12
CO_3	mg/L	N/A	N/A	<1	<1
Ca	mg/L	ID	ID	6.3	38
Cd	mg/L	0.0002	0.0007	<0.0001	<0.0001
Cl-	mg/L	0.003	ID	4	145
Co	mg/L	N/A	0.000005	<0.005	<0.005
Cr	mg/L	0.001	0.00014	<0.001	0.001
Cu	mg/L	0.0014	0.0003	<0.002	0.004
EC	mS/m	0.009	N/A	8.1	84.8
F	mg/L	N/A	N/A	0.08	0.16
Fe	mg/L	ID	ID	0.052	0.72
HCO_3	mg/L	N/A	N/A	31	177
Hardness	mg/L	N/A	N/A	30	210
Hg	mg/L	0.0006	0.0001	<0.0001	<0.0001
K	mg/L	N/A	N/A	1.6	3.9
Mg	mg/L	N/A	N/A	3.4	28.5
Mn	mg/L	1.9	ID	0.068	0.4
Mo	mg/L	ID	ID	<0.001	<0.001
NO_2	mg/L	N/A	N/A	<0.1	<0.1
NO_3	mg/L	0.7	ID	<0.05	0.09
N_total	mg/L	N/A	N/A	0.16	0.83
Na	mg/L	N/A	N/A	3.3	83.7
Ni	mg/L	0.011	0.007	<0.001	0.002
P_total	mg/L	N/A	N/A	0.01	0.12
Pb	mg/L	0.0034	0.0022	0.0001	0.0017
SO_4_S	mg/L	N/A	N/A	6.6	62.3
Se	mg/L	0.111	ID	<0.001	<0.001
TDS_calc	mg/L	N/A	N/A	45	470
TSS	mg/L	N/A	N/A	10	770
Tl	mg/L	0.013*	0.013*	<0.0001	0.0004
V	mg/L	ID	0.05	<0.005	0.013
Zn	mg/L	0.008	0.007	<0.005	0.014
pH		N/A	N/A	7.4	7.9
Benzene	ug/L	950	500	<1.0	<1.0
Toluene	ug/L	ID	ID	<1.0	<1.0
Ethylben	ug/L	ID	ID	<1.0	<1.0
Xylene	ug/L	200	ID	<2.0	<2.0
TotalBTE	ug/L	N/A	N/A	<5.0	<5.0
C6-C9	ug/L	N/A	N/A	<25	<25
C10-C14	ug/L	N/A	N/A	<25	<25
C15-C28	ug/L	N/A	N/A	<100	<100
C29-C36	ug/L	N/A	N/A	<100	<100
Total TPH	ug/L	N/A	N/A	<250	<250

** USEPA Safe Limit for Thallium* *Note: Red text indicates exceeded trigger levels*

Figure 6-10: Surface Water Quality Results for Aluminium

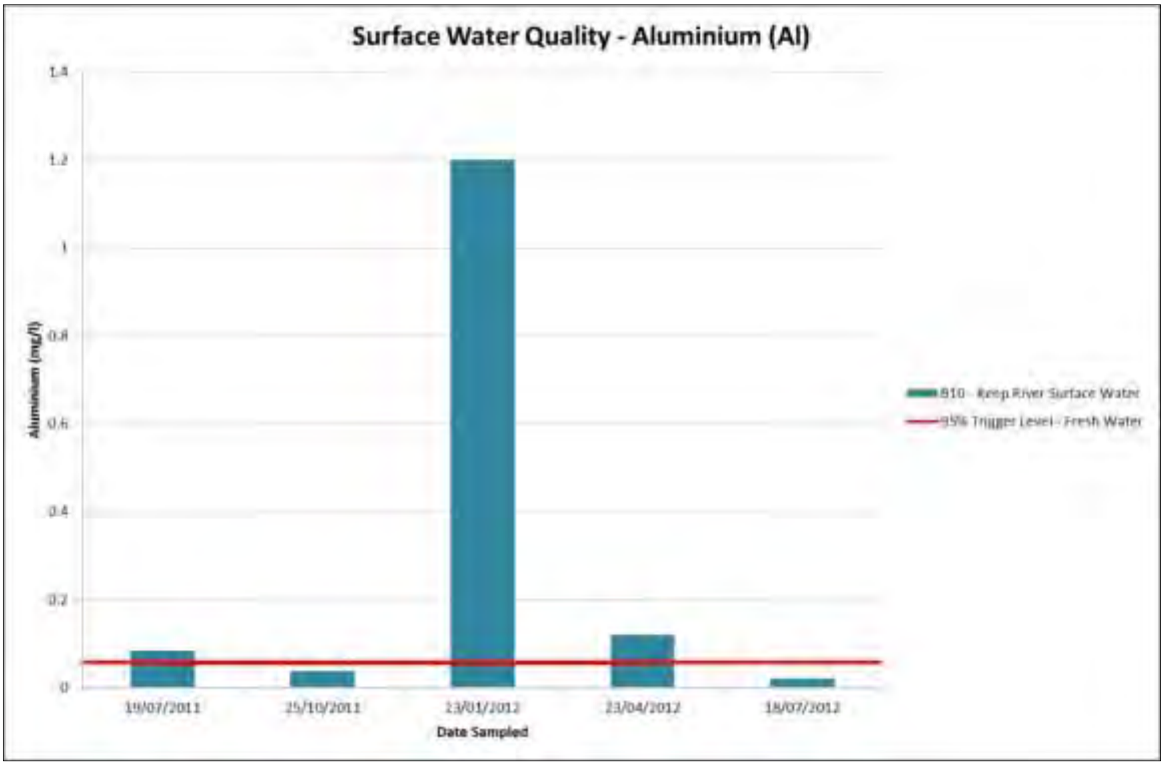


Figure 6-11: Surface Water Quality Results for Chloride

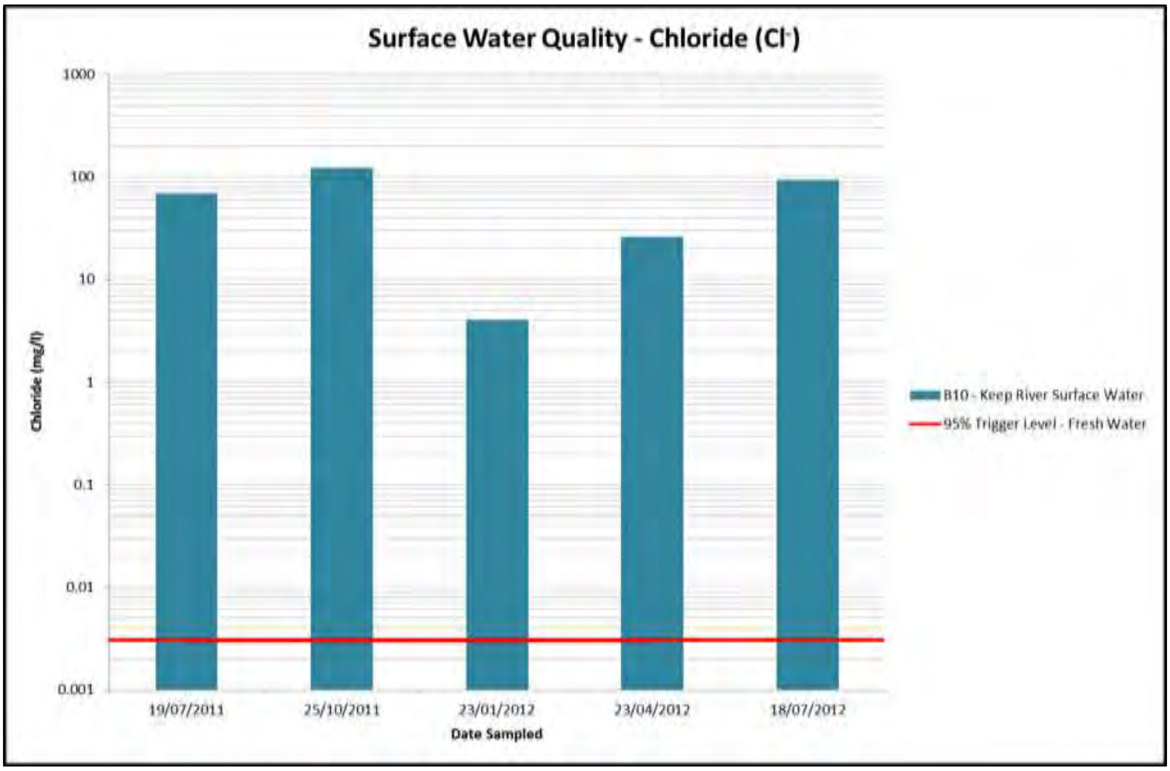


Figure 6-12: Surface Water Quality Results for Cobalt

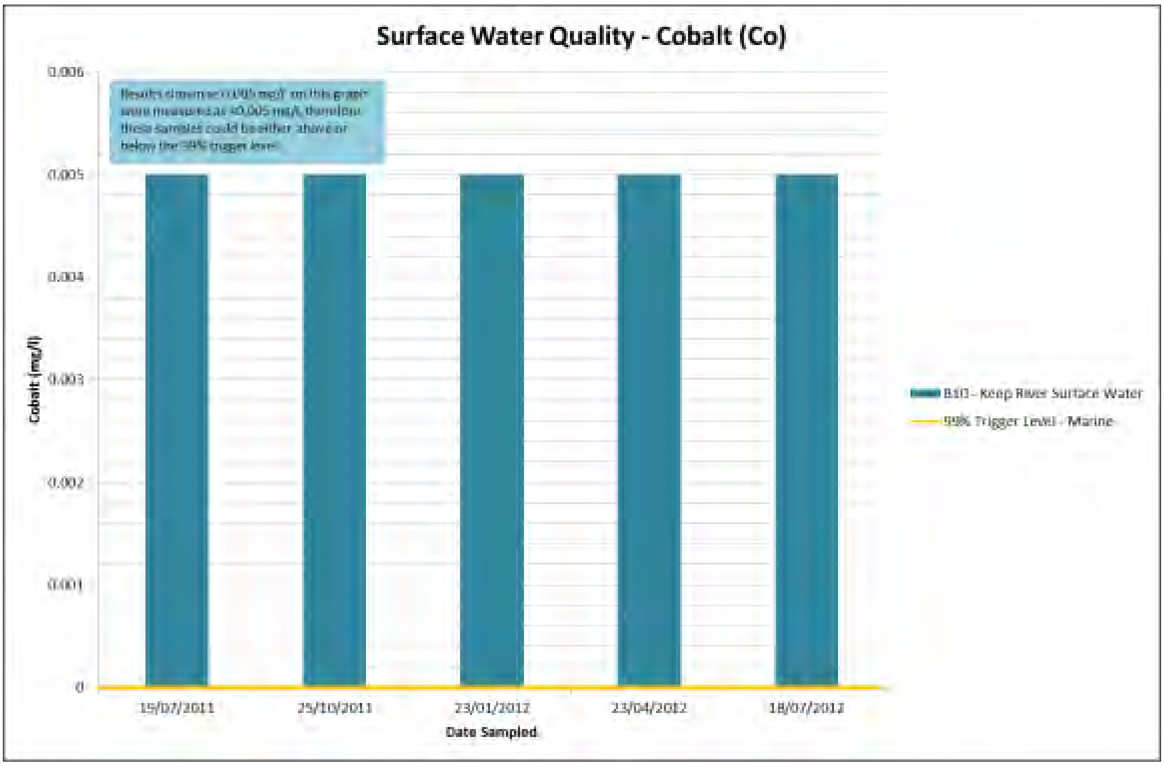


Figure 6-13: Surface Water Quality Results for Chromium

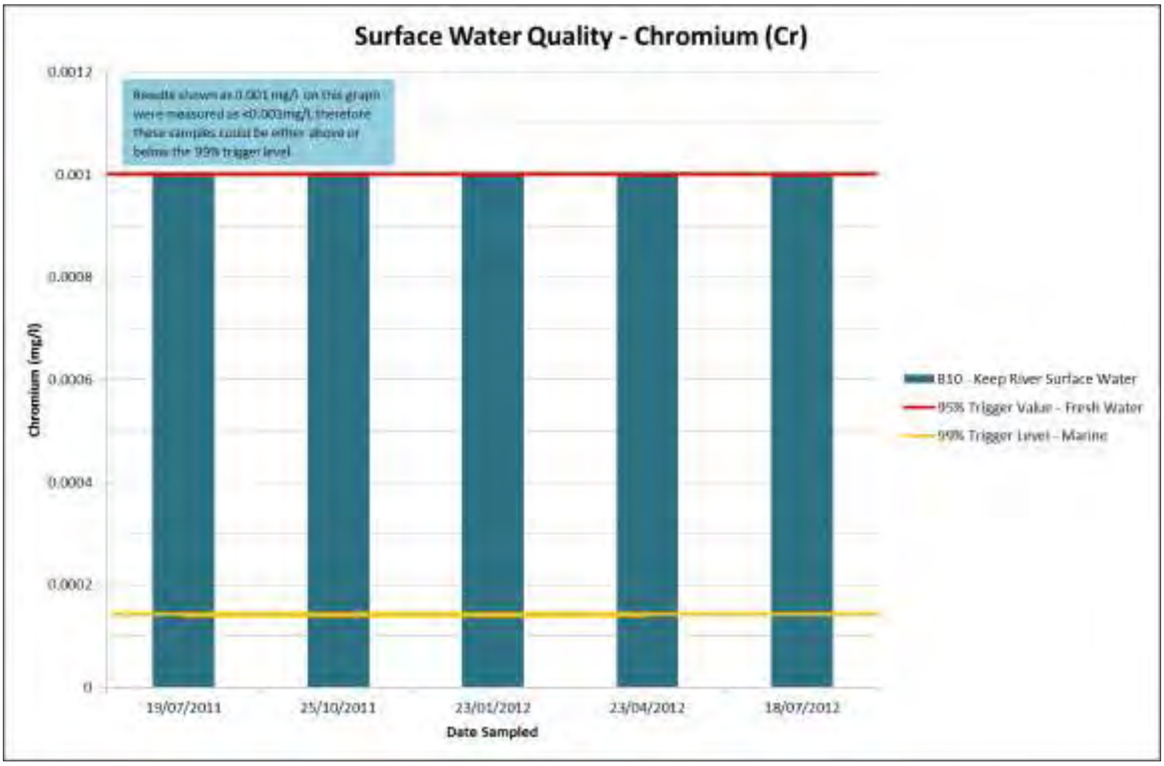


Figure 6-14: Surface Water Quality Results for Copper

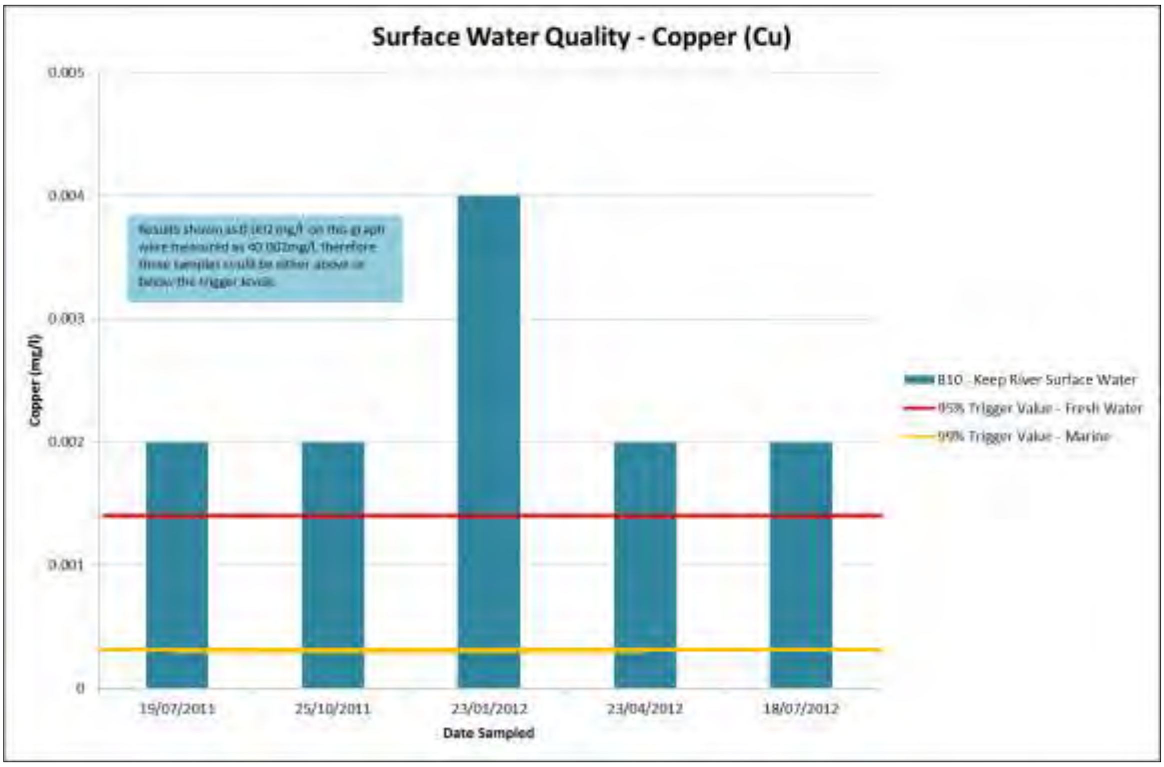


Figure 6-15: Surface Water Quality Results for Zinc

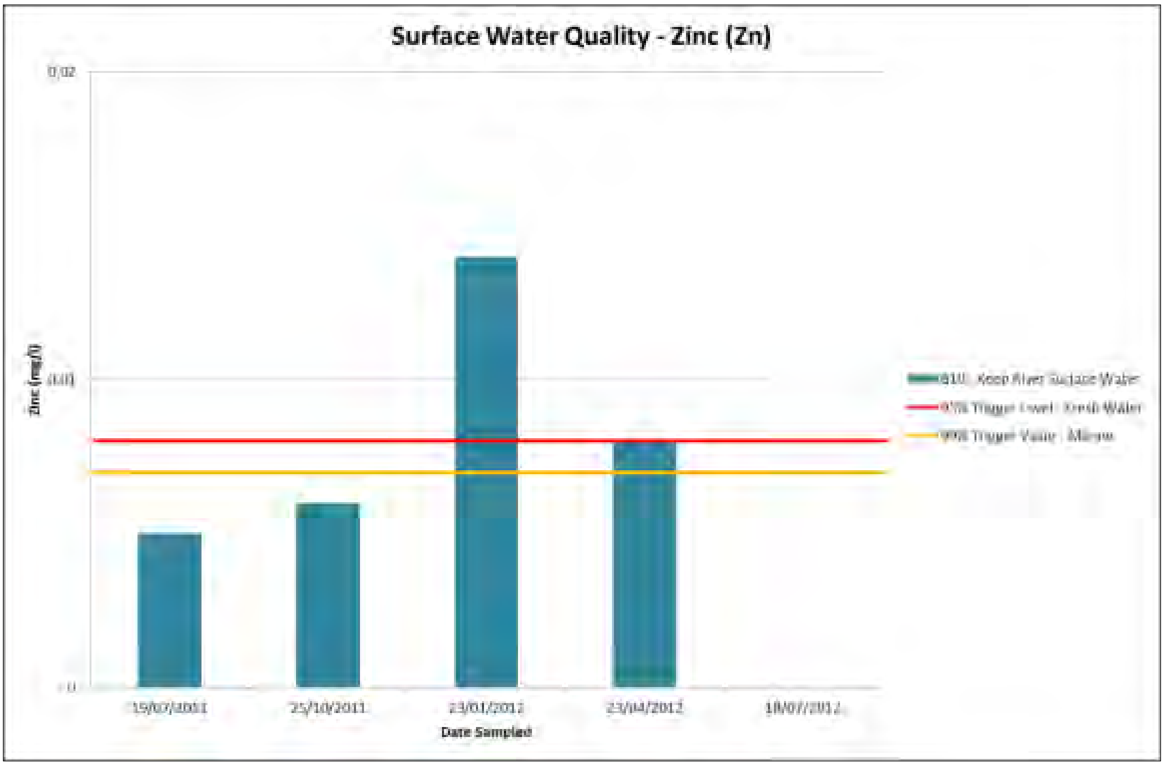


Figure 6-16: Surface Water Quality Results for Electrical Conductivity

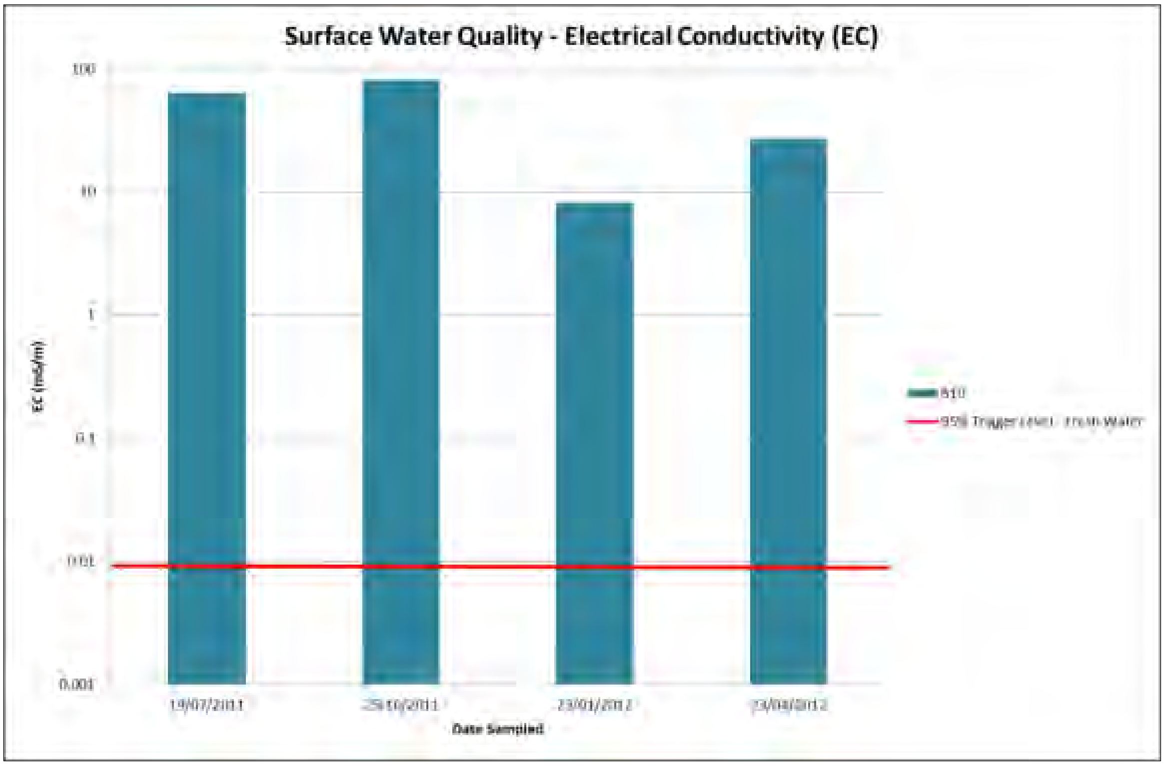
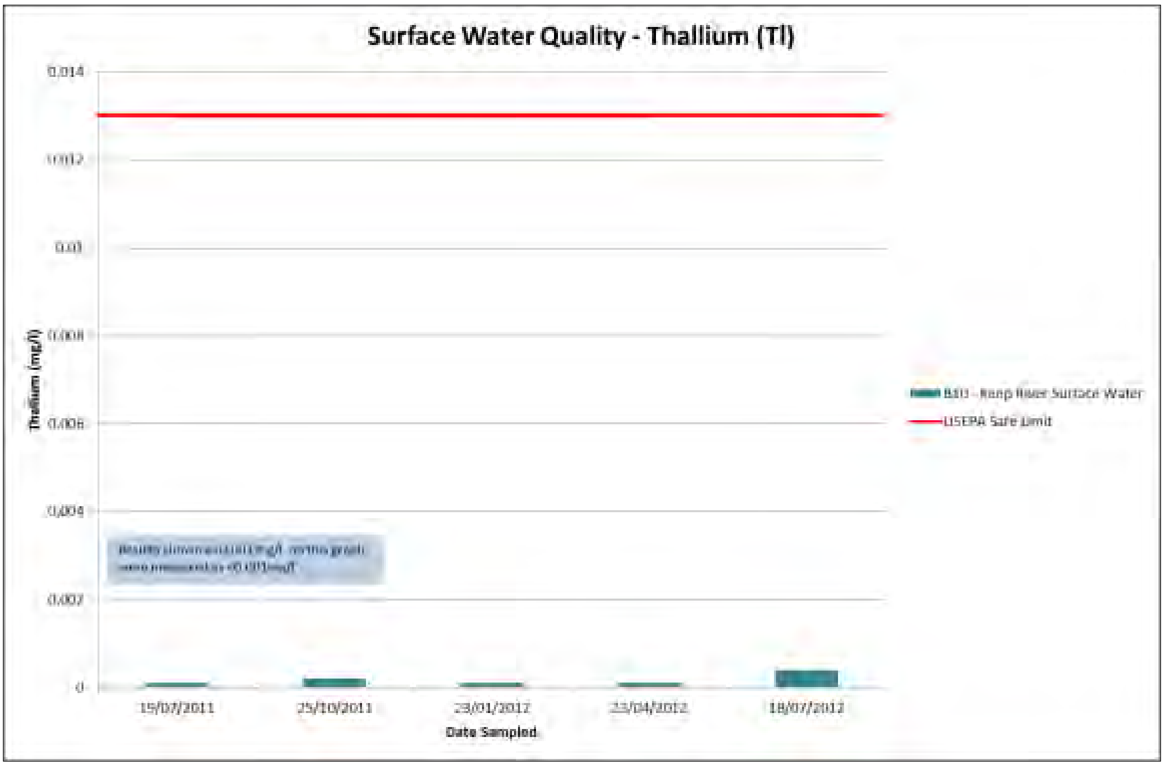


Figure 6-17: Surface Water Quality Results for Thallium



6.1.5 Sub-surface Hydrogeology

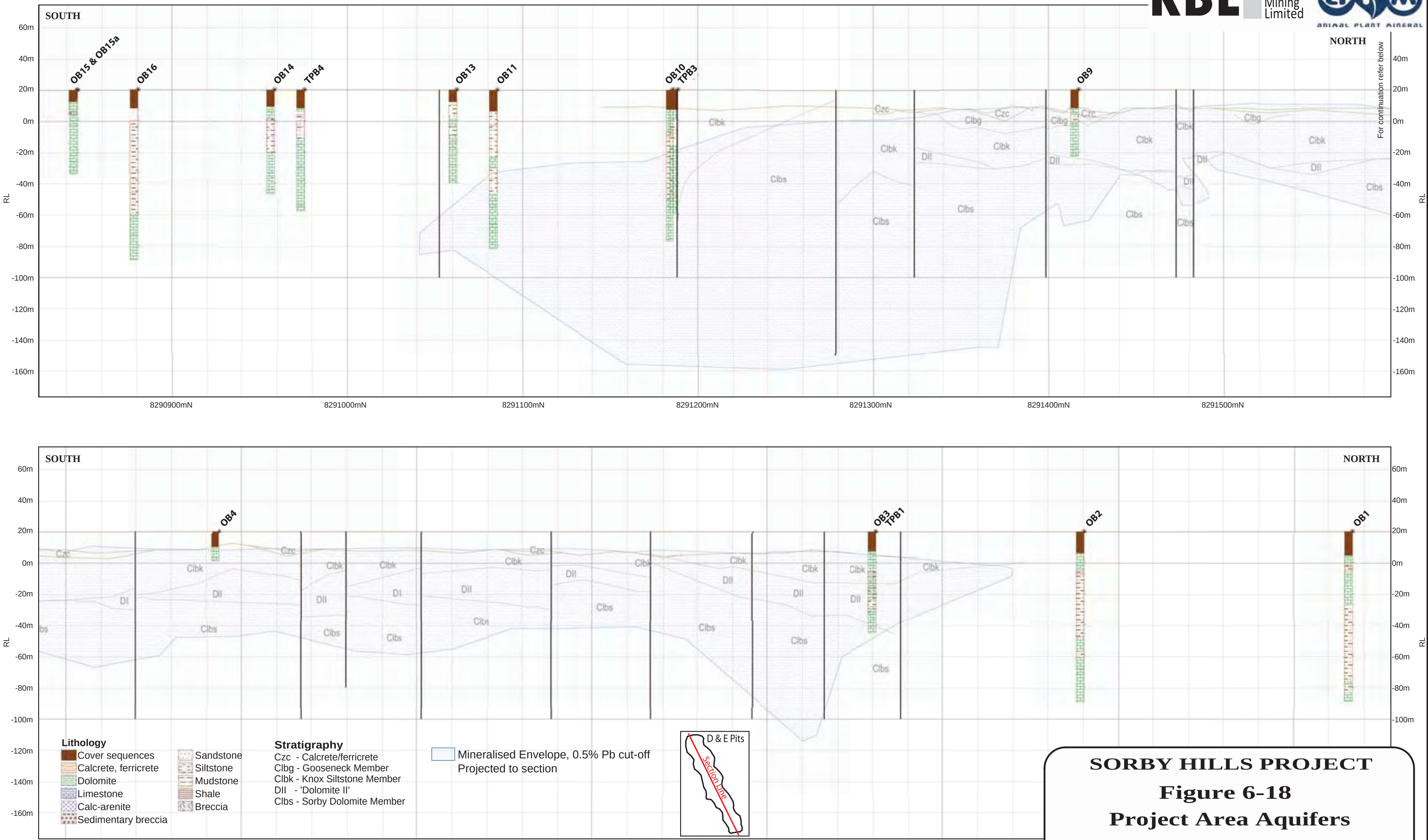
A hydrogeological assessment for the Project has been conducted by AGEC and is included as Appendix 7 (Volume 3). The Sorby Hills area has a geology dominated by Carboniferous aged dolomitic formations which overlie the Devonian basement stratigraphy. Whilst the Carboniferous sediments are permeable, the basement Devonian geology complex is distinctly less permeable. As a result of this geological setting, three groundwater aquifers occur:

- An upper alluvial aquifer within surficial alluvial sediments, which is considered unconfined
- An intermediate confined aquifer within the D3 dolomite unit
- A deeper confined aquifer within D2/D1 dolomite units

Within the Project Area only the two deeper aquifers have been found to occur (Figure 6-18). Variability in hydraulic conductivity of the groundwater in these aquifers suggests that these are faulted/fractured rock aquifers. The alluvial aquifer typically exists in the sandy to gravelly alluvium that occurs around Border Creek which is 3.6 km north of the proposed pits and outside of the Project Area. Groundwater levels are highest at the southern end of the mining tenements where they range from 14.4 m AHD to 8.2 m AHD adjacent to Knox Creek. Groundwater levels have been measured across the Project Area and regionally on a quarterly basis since July 2011 as part of the baseline groundwater monitoring program (Figure 2-16, Figure 2-17, Section 6.1.5.1, Table 6-7 and Appendix 19, Volume 3), thus providing wet season and dry season aquifer groundwater levels. Groundwater is generally neutral pH and brackish, with EC (Electrical Conductivity) at the end of pump testing ranging between 0.011 mS/m and 0.027 mS/m. The cation/anion balance of the groundwater shows no dominant water type other than an overall predominance associated with sodium, magnesium, calcium, sulphate and bicarbonate (Appendix 7, Volume 3).

The Department of Agriculture and Food WA (DAFWA) carried out a hydrogeological assessment of the Weaber Plains in 2011 as part of the environmental planning and approvals process for the ORIA – Weaber Plains Project; this report and the associated Groundwater Chemistry of the Weaber Plain report are provided in Appendices 20 and 21 (Volume 3) for reference. The DAFWA hydrological investigation observed groundwater levels from a selection of bores to produce maps of watertable elevation (m AHD) (Figure 6-19) and depth to groundwater (m BGL) (Figure 6-20) for the Weaber Plain; a total of 47 bores were included in the analysis. The groundwater levels (Figure 6-19 and Figure 6-20) show elevated groundwater in the north west and a groundwater sink to the north east of Brown Ridge at the junction of the Weaber, Knox and Keep Plains (Appendix 20, Volume 3). The DAFWA and AGEC hydrological assessments indicate that the general groundwater flow gradient beneath the ORIA – Weaber Plains Project and the Sorby Hills Project is towards Border Creek, therefore groundwater from the Project Area will not flow towards the ORIA – Weaber Plains Project. There is the potential, over the long-term, for the ORIA – Weaber Plains Project to increase the elevation of groundwater levels in the region by up to approximately 2 m. However even if the water table was to be elevated under the influence of projects beyond the Project Area, excess water would simply flow into the receiving Border Creek and Keep River.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_618.ai



SORBY HILLS PROJECT

Figure 6-18

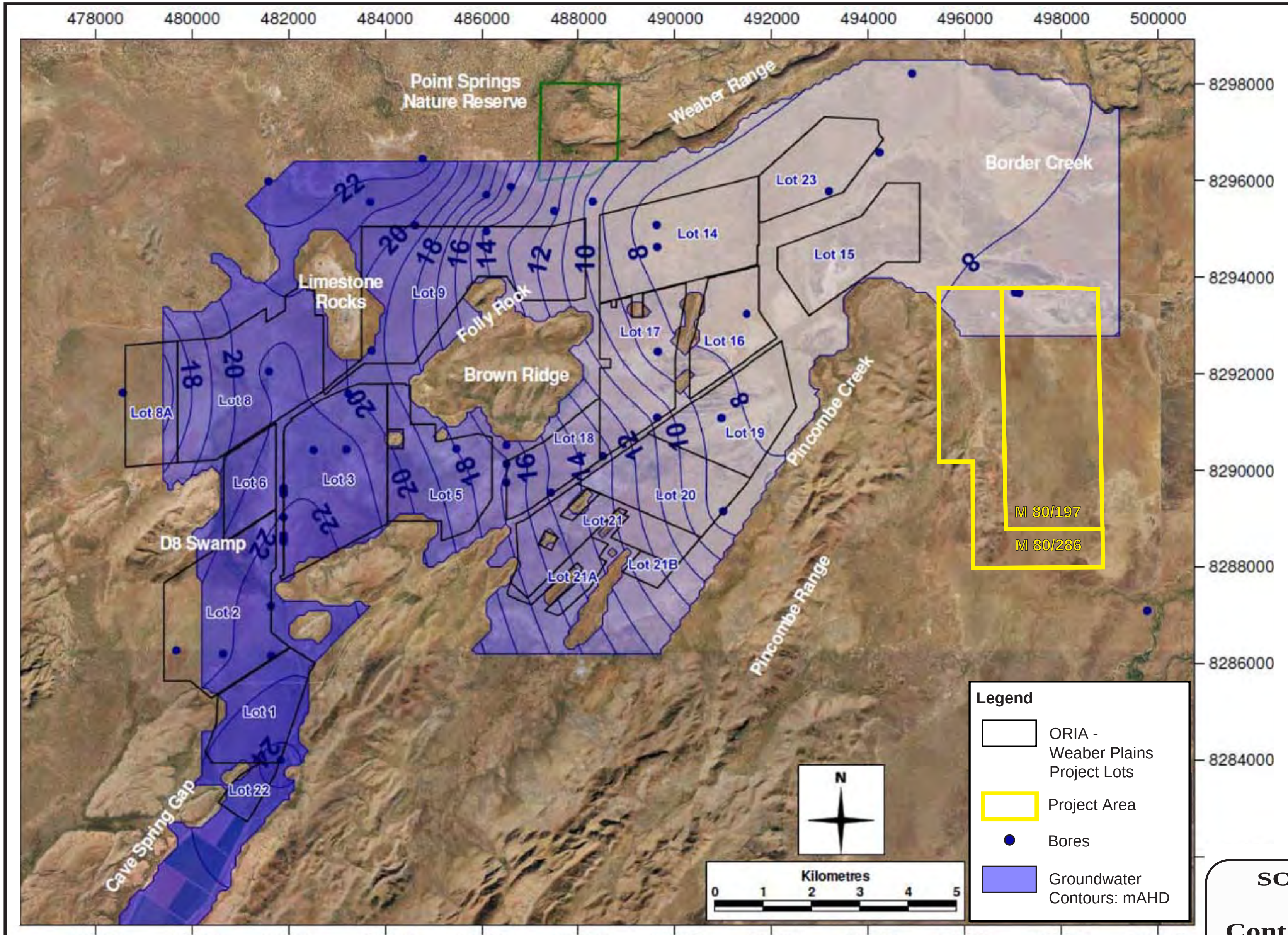
Project Area Aquifers

Author: SMPL

Date: August 2013

Source: SMPL

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_619.ai

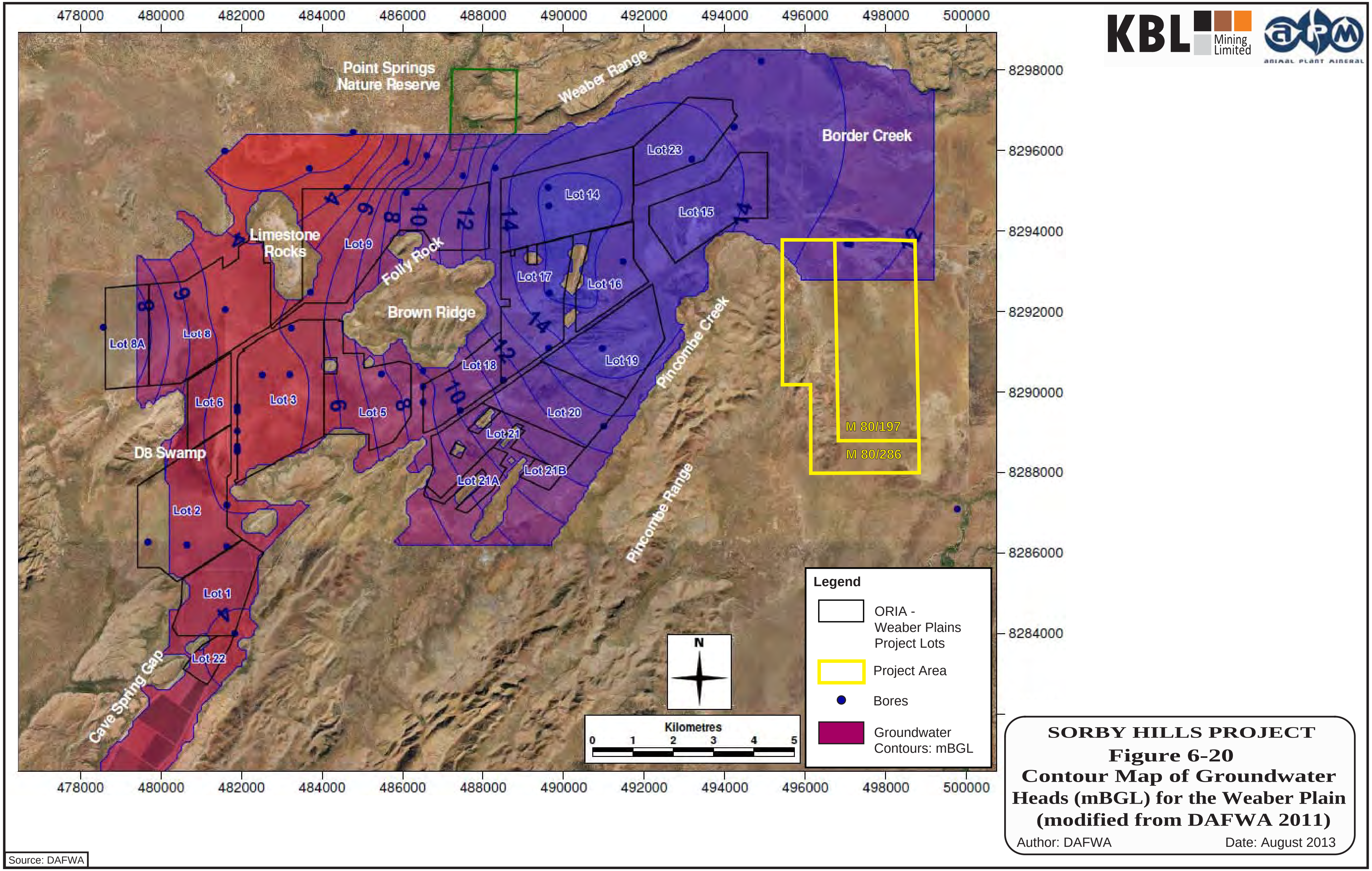


SORBY HILLS PROJECT
Figure 6-19
Contour Map of Groundwater Heads (mAHD) for the Weaber Plain (modified from DAFWA 2011)

Author: DAFWA Date: August 2013

Source: DAFWA

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_620.ai



SORBY HILLS PROJECT
Figure 6-20
Contour Map of Groundwater Heads (mBGL) for the Weaber Plain (modified from DAFWA 2011)

Author: DAFWA
Date: August 2013

Source: DAFWA

6.1.5.1 Baseline Groundwater Parameters

Groundwater samples have been collected and analysed from selected monitoring bores within the Project Area (Figure 2-16) and regionally (Figure 2-17) on a quarterly basis since July 2011 to establish a Project specific baseline data set for the Project. As per the baseline surface water sampling procedure the samples have been collected in accordance with *AS/NZS 5667.1:1998 – Standards for Water Quality Sampling* and the measured parameters are consistent with those outlined in Table 6-3 and Table 6-4. The laboratory analysis has been carried out by a NATA accredited test centre and results compared to trigger values set out by the *Australian and New Zealand Guidelines for Fresh and Marine water Quality (2000).*

The field and laboratory water quality results are summarised in Table 6-7 and Table 6-8 and provided in full in Appendix 19 (Volume 3).

During this baseline testing to establish pre-disturbance conditions, guideline trigger values have been exceeded for many of the parameters tested. Where trigger values have been exceeded the results have been presented in graph form (Figure 6-21 to Figure 6-31). Although the Tl concentration in the groundwater does not exceed the USEPA safe limit the results have also been graphed and are presented in Figure 6-32.

In addition to SMPL's Project specific baseline groundwater monitoring, SMPL have been granted access to all of the Weaber Plain hydrological data through the ORIA – Weaber Plains Project development partners. This information will be used to establish regional baseline conditions.

Table 6-7: Field Results Summary for Groundwater Quality

ID for analyses	Bore Name	Temperature (°C)		pH		Total dissolved solids (mg/L)		Electrical conductivity (mS/m)		Standing water level (m)	
		Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
B1	TPB3	28.3	29.8	7.12	7.49	1366	1570	227	259	10.23	11.10
B2	WBS 5078	27.1	31.1	6.91	8.18	192	311	34	56	10.33	11.09
B3	TPB4	27.4	28.9	6.85	7.06	829	891	142.2	159	9.93	10.69
B4	OB15a	26.4	29.1	6.60	6.94	1003	1261	169	222	8.33	10.19
B5	WBS 7007	27.1	29.3	6.83	7.17	380	434	66	76	10.34	11.30
B6	WBS 7001	28.5	29.9	6.96	7.20	377	404	66	74	10.50	0.72
B7	WBS 4132	29.2	30.7	6.97	7.59	242	266	43	46.7	11.23	11.68
B8	WBS 5016	28	31.7	6.36	7.46	44.8	1540	9	269	10.76	13.05
B9	KC2	27.9	30.2	7.54	7.71	213	248	38	45	10.39	11.39

Table 6-8: Laboratory Results Summary for Groundwater Quality

Component	Unit	95 % Trigger Value Fresh Water	99 % Trigger Value Marine Water	B1		B2		B3		B4		B5		B6		B7		B8		B9	
				Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ag	mg/L	0.00005	0.0008	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Al	mg/L	0.055	ID	<0.005	0.049	0.009	0.066	<0.005	0.058	0.013	0.085	<0.005	0.023	<0.005	0.023	<0.005	0.014	0.011	0.23	0.014	0.12
Alkalinity	mg/L	ID	ID	163	385	118	178	339	560	244	500	223	394	183	360	215	237	27	145	131	190
As	mg/L	0.013	ID	0.002	0.027	0.002	0.01	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.001	0.001	0.002
B	mg/L	0.37	ID	0.06	0.12	0.03	0.11	0.03	0.06	0.03	0.05	0.03	0.06	0.03	0.05	<0.02	0.03	0.03	0.34	0.03	0.05
Ba	mg/L	ID	ID	0.014	0.02	0.02	0.055	0.021	0.044	0.007	0.03	0.006	0.011	0.005	0.014	0.016	0.023	0.016	0.17	0.075	0.11
CO3	mg/L	N/A	N/A	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ca	mg/L	ID	ID	76.4	99.9	23.2	37.8	75.4	94.7	101	138	47.7	81.8	34.5	76.5	40.9	48.5	5.7	184	18.4	24.8
Cd	mg/L	0.0002	0.0007	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl^-	mg/L	0.003	ID	269	352	17	64	81	103	119	316	8	19	9	11	6	8	6	445	11	14
Co	mg/L	N/A	0.000005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cr	mg/L	0.001	0.00014	<0.001	0.006	<0.001	0.002	<0.001	0.006	<0.001	0.002	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001
Cu	mg/L	0.0014	0.0003	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	0.009	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	<0.002	0.003
EC	mS/m	0.009	N/A	233	282	36.5	61.2	91.5	150	87.1	199	43	68.9	35.5	67	41.4	45.6	9.2	238	35.2	42.6
F	mg/L	N/A	N/A	0.22	0.23	0.11	0.27	0.15	0.18	0.11	0.19	0.08	0.11	<0.05	0.08	0.08	0.09	0.05	0.06	0.24	0.25
Fe	mg/L	ID	ID	0.05	0.57	0.39	2.1	0.027	0.38	<0.005	0.29	0.23	1.9	0.74	7.3	<0.005	3.4	<0.005	0.87	<0.005	0.17
HCO3	mg/L	N/A	N/A	199	470	143	217	413	682	297	610	272	481	222	439	262	289	33	177	160	232
Hardness	mg/L	N/A	N/A	420	540	120	200	390	570	630	770	290	400	230	360	200	230	26	750	96	130
Hg	mg/L	0.0006	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
K	mg/L	N/A	N/A	4	8	3	6.1	2.7	13.5	1.6	2.1	1.1	1.4	2	2.3	2.7	3.2	3.1	14.4	1.4	2.7
Mg	mg/L	N/A	N/A	55.2	75.5	16.1	25	48	82.5	85.4	116	37.7	47.2	34.3	41.5	22.6	26.5	2.8	71.1	11.8	17.3
Mn	mg/L	1.9	ID	0.008	0.034	0.16	0.82	0.002	0.043	0.003	0.021	0.11	0.18	0.049	0.19	0.03	0.09	0.019	0.042	0.004	0.034
Mo	mg/L	ID	ID	0.002	0.003	<0.001	0.002	<0.001	0.012	<0.001	<0.001	<0.001	0.014	0.005	0.028	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
NO2	mg/L	N/A	N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1
NO3	mg/L	0.7	ID	<0.05	0.09	<0.05	0.18	<0.05	0.22	<0.05	0.93	0.09	0.18	<0.05	0.66	<0.05	0.22	<0.05	0.09	0.31	0.62
N_total	mg/L	N/A	N/A	0.04	0.45	0.71	2.5	0.03	0.19	<0.02	1.2	0.06	0.38	0.06	0.45	0.57	2.5	0.33	0.58	0.18	0.86
Na	mg/L	N/A	N/A	273	396	19	58.2	59	140	71.3	101	4.6	7.2	5.4	8.4	3.5	4.2	5.4	175	28.8	43.6
Ni	mg/L	0.011	0.007	<0.001	0.004	<0.001	0.001	<0.001	0.009	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
P_total	mg/L	N/A	N/A	<0.01	0.05	<0.01	0.04	<0.01	0.01	<0.01	0.13	<0.01	<0.01	<0.01	0.01	<0.01	0.11	<0.01	0.06	0.02	0.23
Pb	mg/L	0.0034	0.0022	0.0006	0.036	0.0012	0.034	0.0011	0.028	0.0024	0.028	0.0005	0.014	0.0013	0.045	0.0013	0.19	0.0004	0.0011	0.0024	0.025
SO4_S	mg/L	N/A	N/A	419	601	27.1	70.9	86.6	170	113	150	3.2	6.8	1.9	7.9	0.1	2.5	2.3	456	15.1	22.3
Se	mg/L	0.111	ID	<0.001	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Component	Unit	95 % Trigger Value Fresh Water	99 % Trigger Value Marine Water	B1		B2		B3		B4		B5		B6		B7		B8		B9	
				Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
TDS_calc	mg/L	N/A	N/A	1300	1600	200	340	500	820	480	1100	240	380	200	370	230	250	51	1300	190	230
TSS	mg/L	N/A	N/A	3	31	27	170	4	88	32	1200	3	87	20	120	7	34	8	120	56	990
Tl	mg/L	ID	ID	<0.0001	0.001	<0.0001	0.0001	<0.0001	0.0008	<0.0001	0.0002	<0.0001	0.0002	<0.0001	<0.0001	0.0001	0.0002	<0.0001	0.0001	<0.0001	0.001
V	mg/L	ID	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.008
Zn	mg/L	0.008	0.007	0.015	0.11	0.008	0.035	<0.005	0.071	<0.005	0.24	0.009	0.03	0.008	0.14	0.57	3.3	0.011	0.028	0.007	0.095
pH		N/A	N/A	7	7.6	7.4	7.6	6.8	7.4	7	7.4	7.1	7.3	7	7.5	7.4	7.6	7	7.6	7.6	7.9
Benzene	ug/L	950	500	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene	ug/L	ID	ID	<1.0	7	<1.0	<1.0	<1.0	1.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ethylben	ug/L	ID	ID	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Xylene	ug/L	200	ID	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
TotalBTE	ug/L	N/A	N/A	<5.0	7	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
C6-C9	ug/L	N/A	N/A	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
C10-C14	ug/L	N/A	N/A	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
C15-C28	ug/L	N/A	N/A	<100	<100	<100	410	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
C29-C36	ug/L	N/A	N/A	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
TotalTPH	ug/L	N/A	N/A	<250	<250	<250	410	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250

Figure 6-21: Groundwater Quality Results for Aluminium

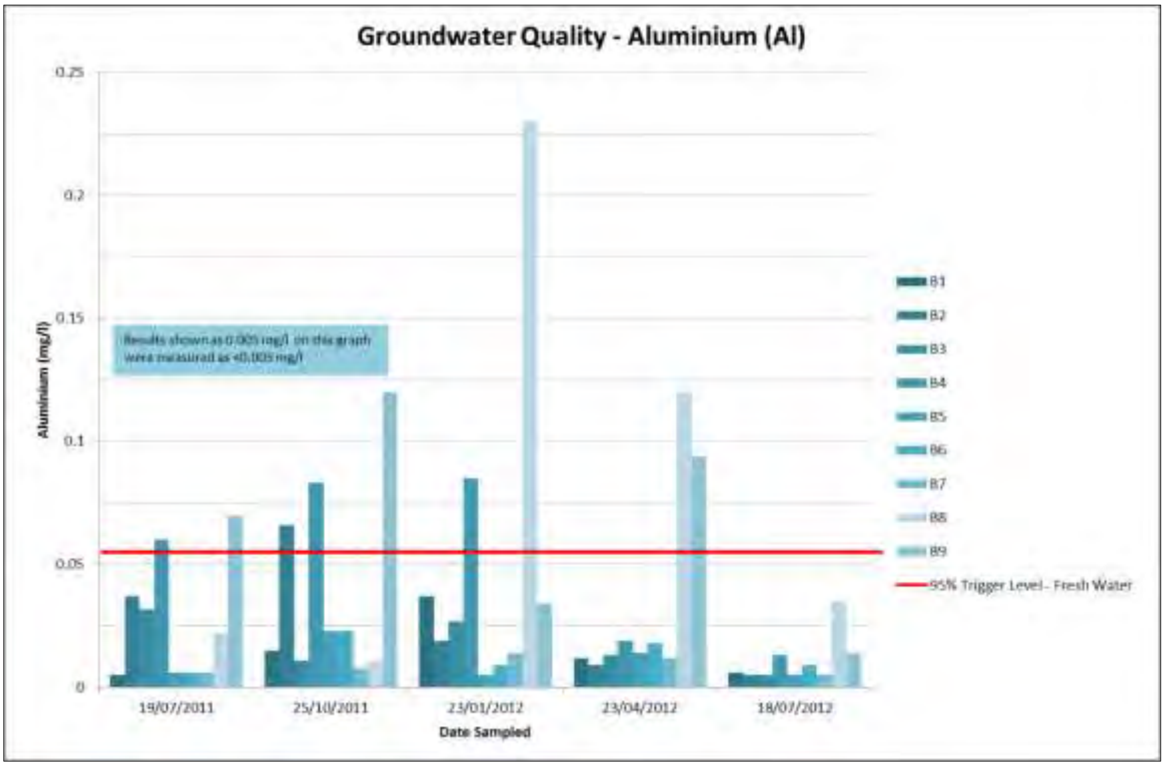


Figure 6-22: Groundwater Quality Results for Arsenic

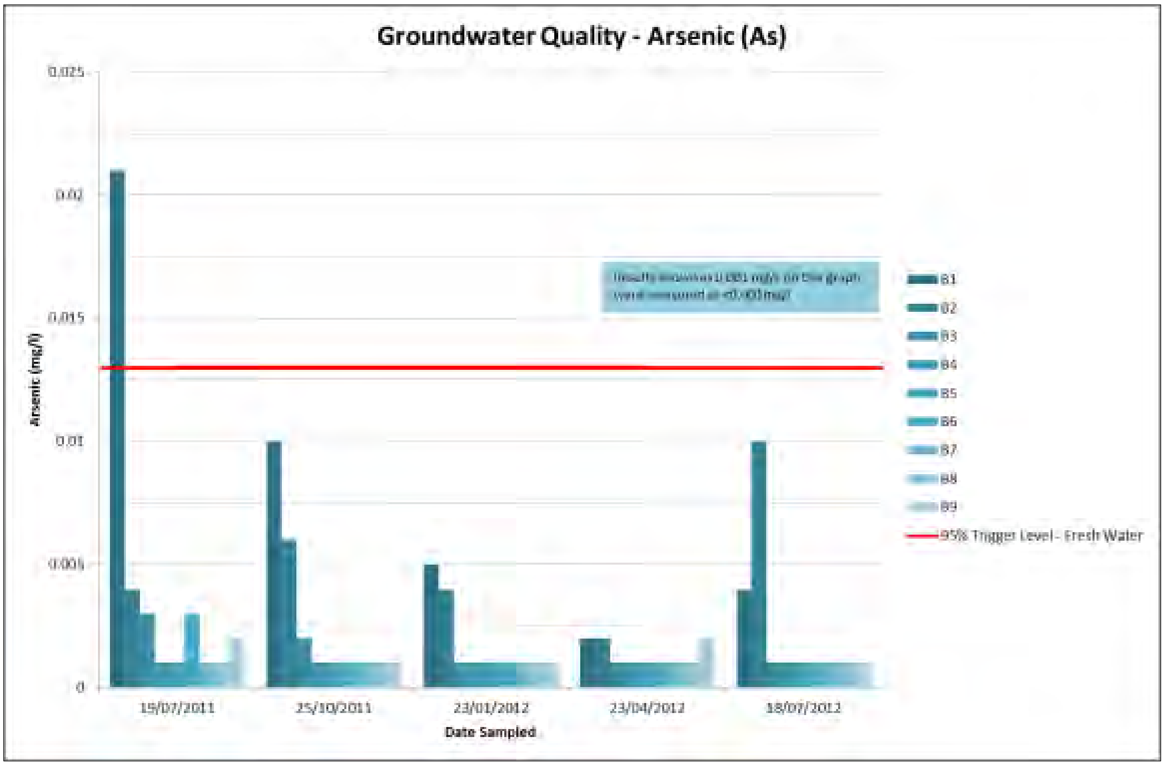


Figure 6-23: Groundwater Quality Results for Cadmium

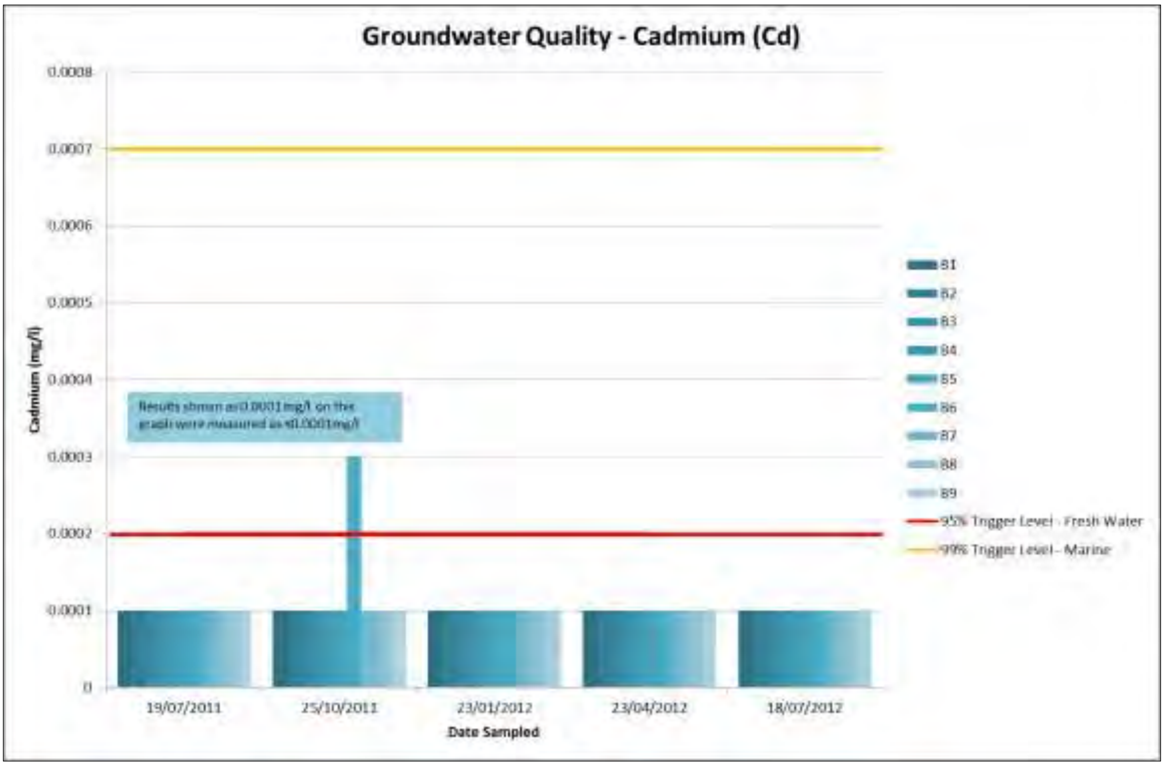


Figure 6-24: Groundwater Quality Results for Chloride

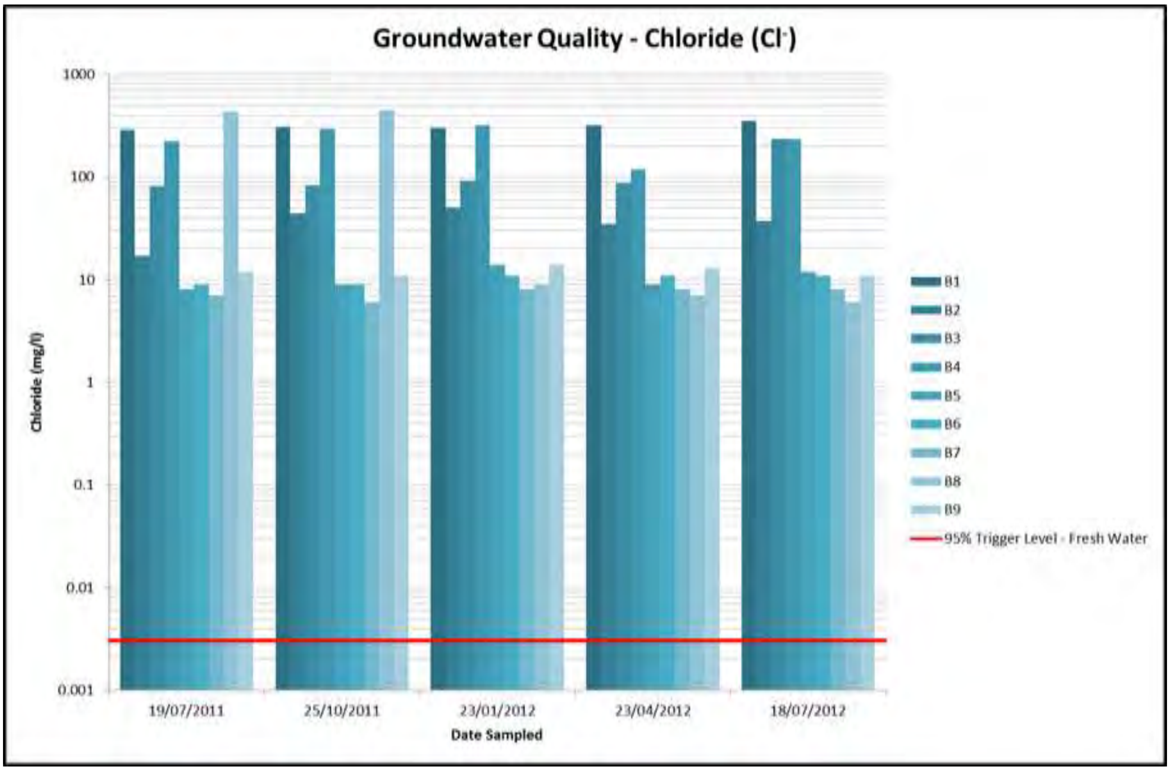


Figure 6-25: Groundwater Quality Results for Cobalt

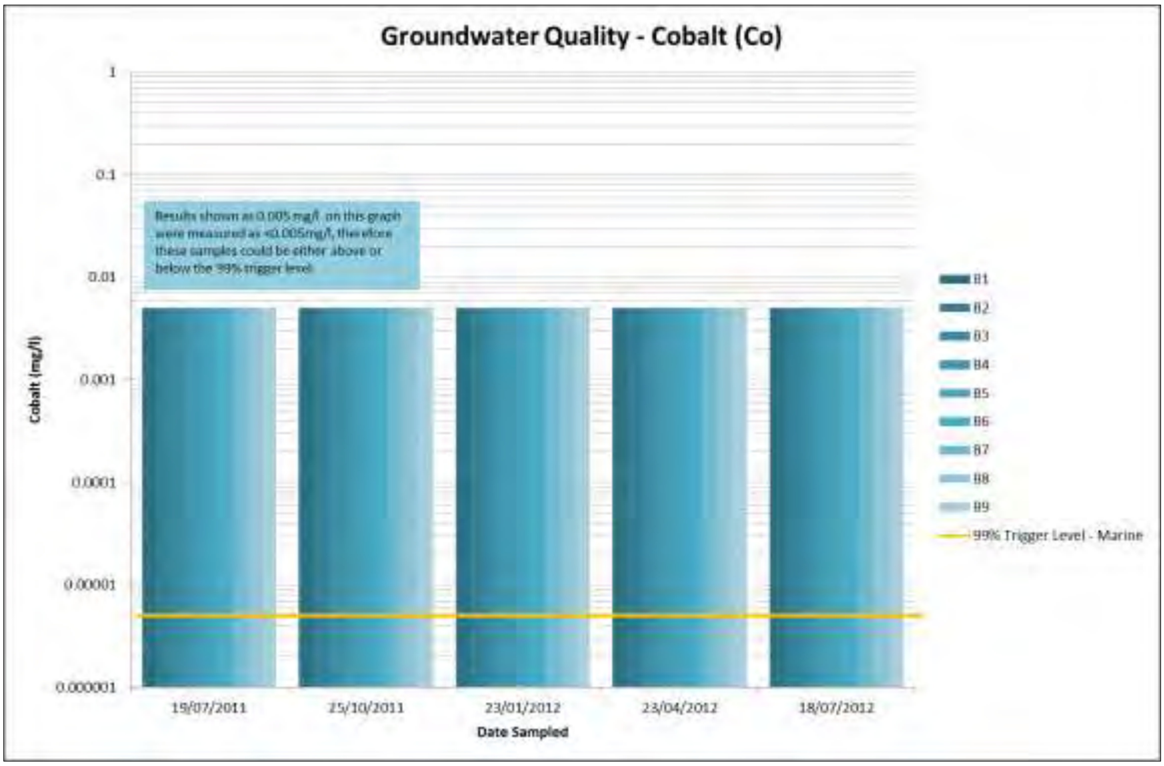


Figure 6-26: Groundwater Quality Results for Chromium

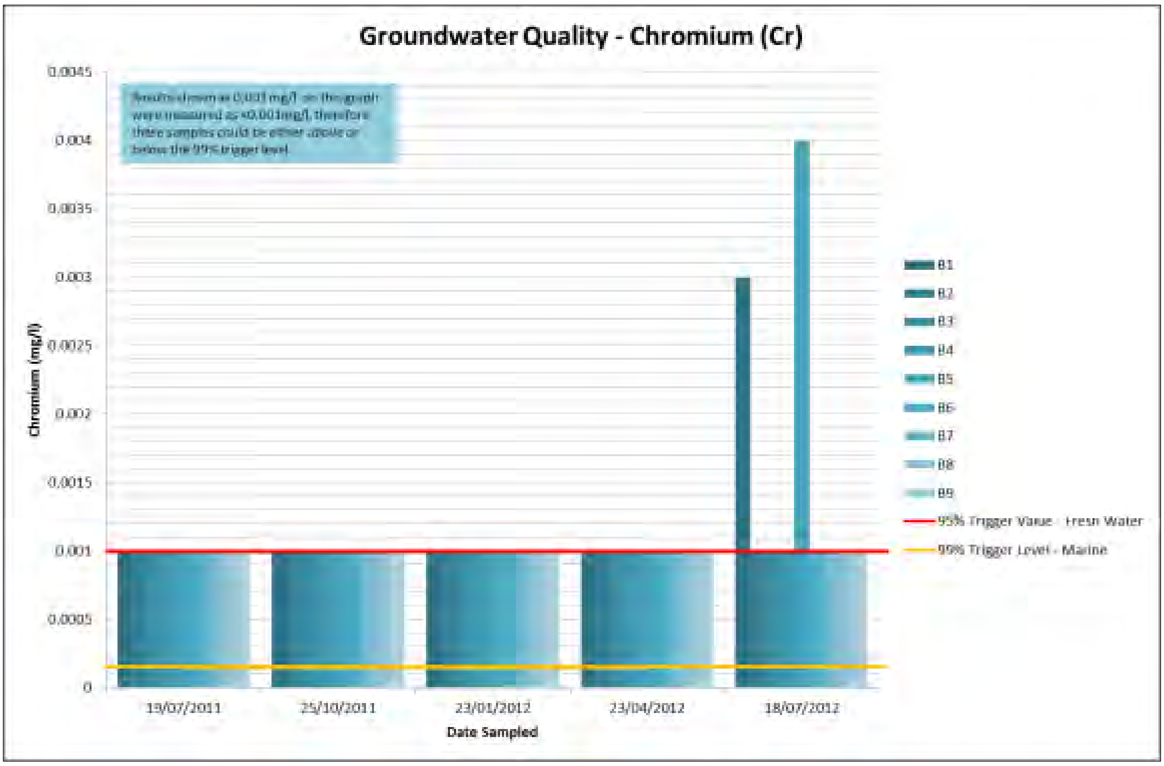


Figure 6-27: Groundwater Quality Results for Copper

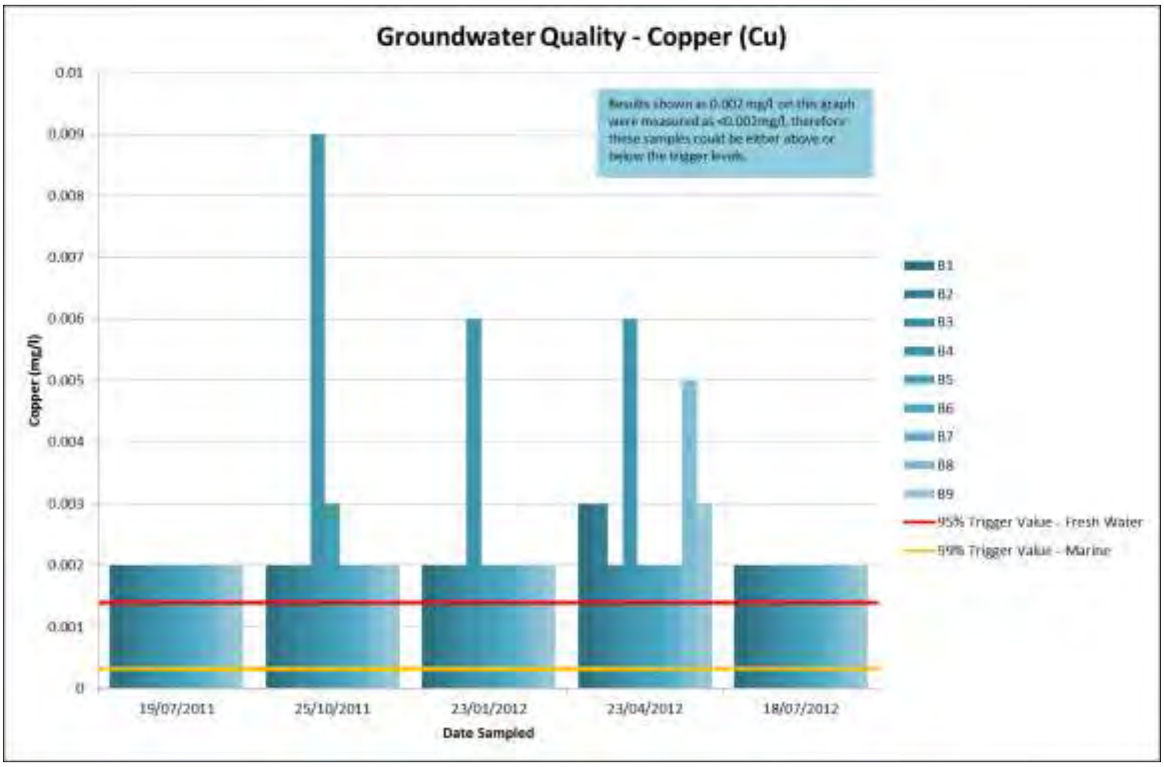


Figure 6-28: Groundwater Quality Results for Nitrate

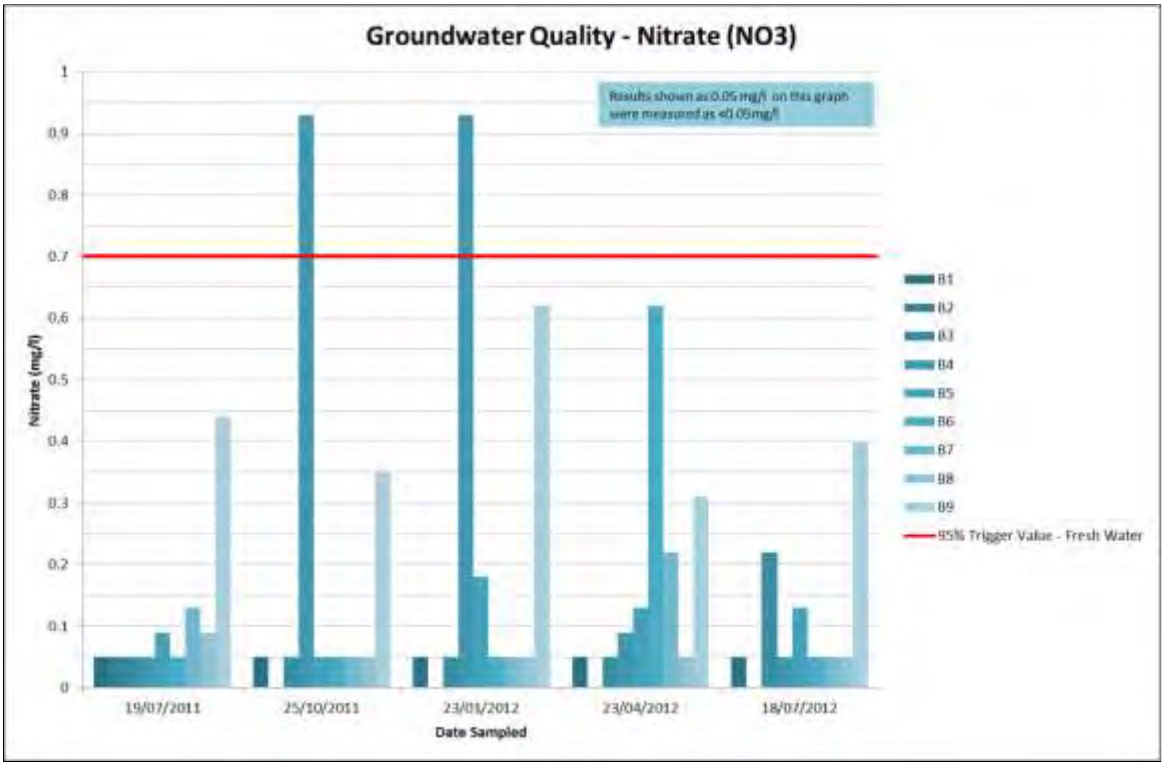


Figure 6-29: Groundwater Quality Results for Lead

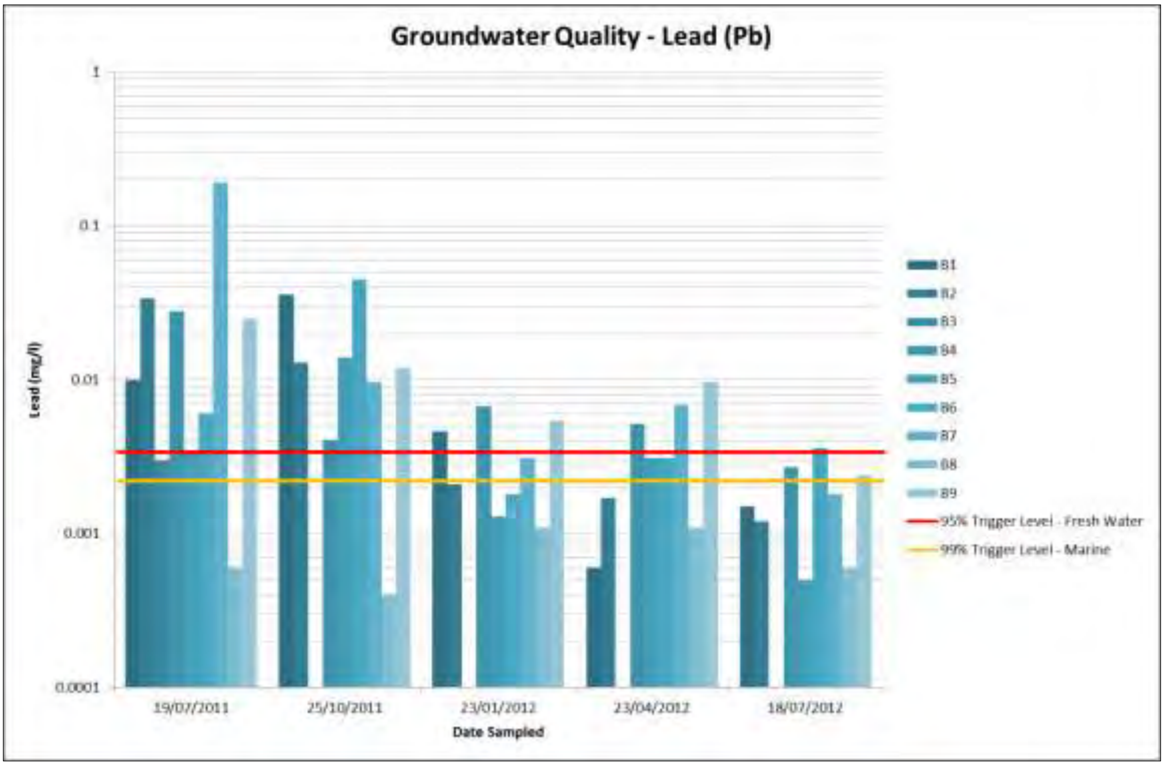


Figure 6-30: Groundwater Quality Results for Zinc

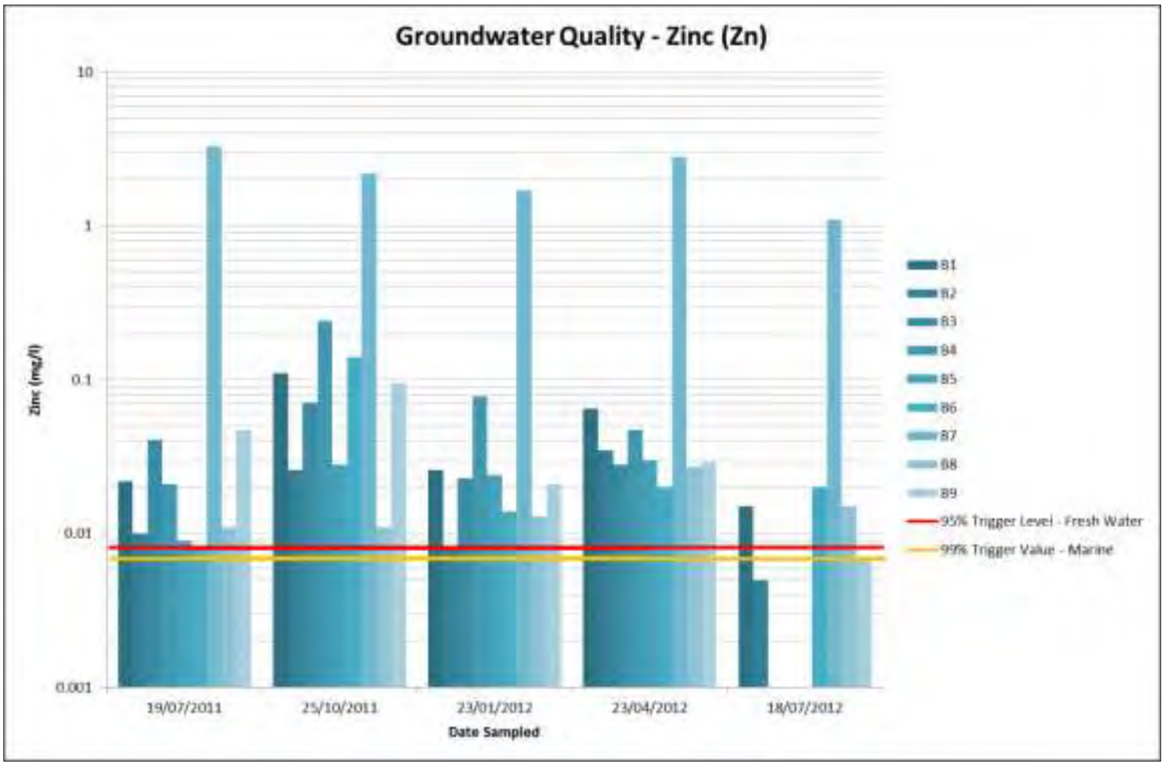


Figure 6-31: Groundwater Quality Results for Electrical Conductivity

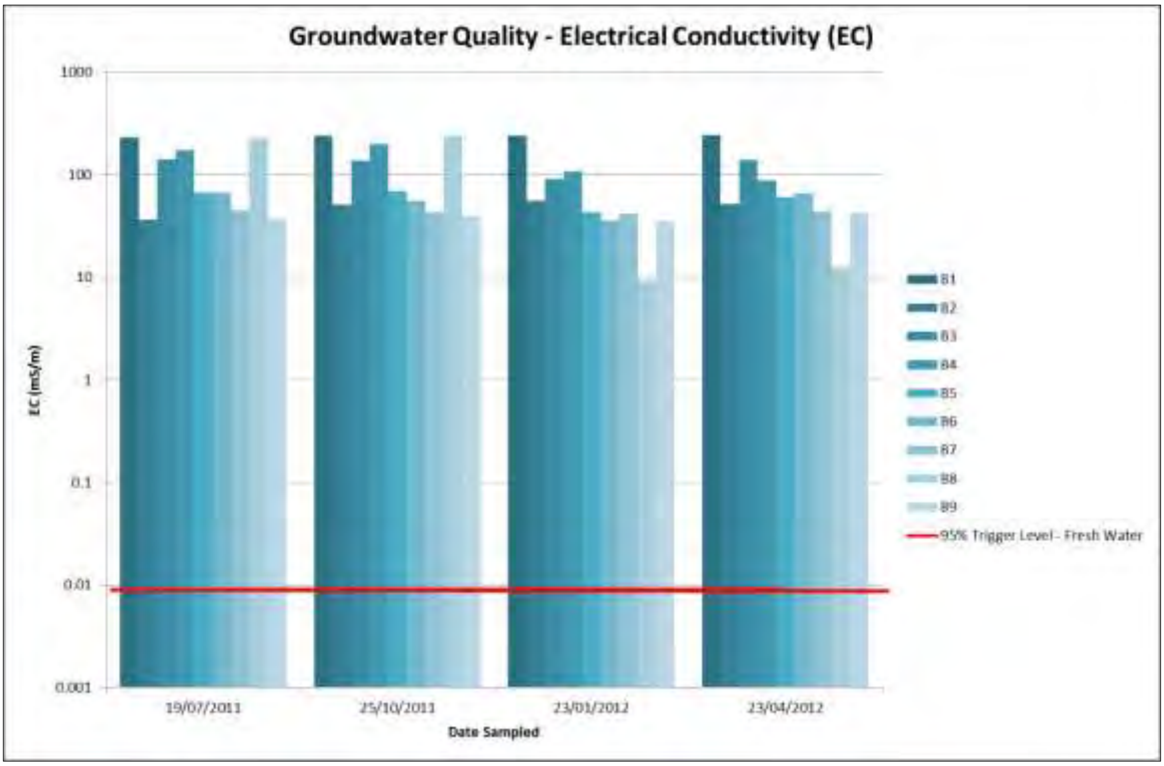
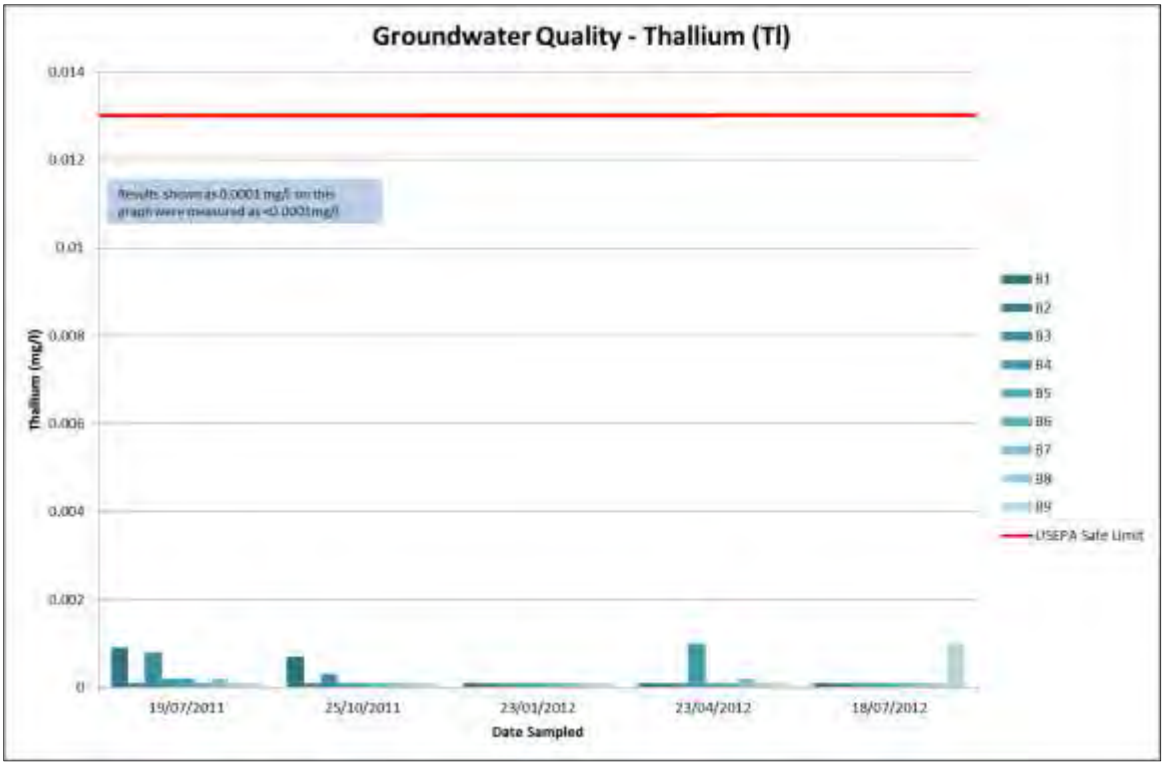


Figure 6-32: Groundwater Quality Results for Thallium



6.1.6 Soils and Soil Profiles

The soil materials of the Project Area were investigated to gain an understanding of their physical and chemical nature and to identify any key issues for handling and management of soils during mining and rehabilitation. The key objectives of the study carried out by SWC were to:

- Define the distribution of soil materials in the Project Area
- Characterise the physical and chemical properties of these materials
- Identify materials that may be beneficial to, or have an adverse impact on, rehabilitation
- Suggest management strategies for the handling and utilisation of these materials during mining and rehabilitation

This section summarises the findings of the soil assessment, the full report is included as Appendix 4 (Volume 3). Soil materials within the Project Area were investigated by deep trench excavation and spot sampling throughout the proposed disturbance area. Representative samples were collected from 12 trenches covering the mining and TSF footprint (Figure 6-33). Rectangular trenches were excavated with a 3 t excavator to expose profiles and enable samples to be collected at regular intervals, providing detailed information on the principal profile characteristics to 2.2 m depth. Soil profiles were assessed in accordance with McDonald and Isbell (2009), using characteristics including:

- Degree of horizonation and nature of contacts between horizons
- Presence and abundance of coarse fragments and mottling
- Fabric and structure
- Field texture
- Plant root abundance

The soil survey identified a single soil mapping unit (SMU) of cracking clay otherwise known as heavy texture soils, or Vertisols, under current Australian classification schemes. Based on the evolutionary history of the area, these soils are known to be derived from alluvial sediments deposited by the Ord and Keep River paleochannels (Kinhill 2000). The identified SMU, henceforth referred to as SMU 1, covers the territory east of the Pincombe Range, across a broad topographically subdued alluvial plain (eastern Weaber Plain) bound by prominent surface drainage channels: Keep River (east), Knox Creek (south), and Border Creek (north).

Field surveys and laboratory test work further characterised SMU 1 into two principal materials: active greyish brown cracking clay and inactive brown clay. The greyish brown clay comprises all surface soils of the Project Area and is characterised by high clay content (> 50 %), surface reticulate (0-30 cm) and deep (30-100 cm) vertical cracking promoting water infiltration at depth and high hard-setting potential. The brown clay comprised all subsoils generally below 110 cm. The brown clay has a high clay content (> 60 %) and moderate hard-setting potential, although shrinkage cracks were rare, inhibiting water infiltration in this material. Physical and chemical properties of the two principal soil materials were similar, but they retained some critical differences. Similarities included heavy texture (> 50 % clay), moderate bulk density, low saturated hydraulic conductivity, low mineral nutrients, and high base cations and cation exchange capacity. Critical differences including macro- and micro-structural stability, water retention, organic carbon, EC and sodicity (exchangeable sodium percentage) highlight some important factors for handling and management of these materials.

Figure 6-34 shows a typical SMU 1 profile with the characteristic features, including:

a) Reticulate cracking in the surface 20-30 cm, defining blocky peds. Commonly a sparse occurrence of deep vertical cracks extended to 1 m defining a coarse, blocky to columnar structure (labelled a-v in Figure 6-34). Cracking was generally not observed in the subsoil brown clay material

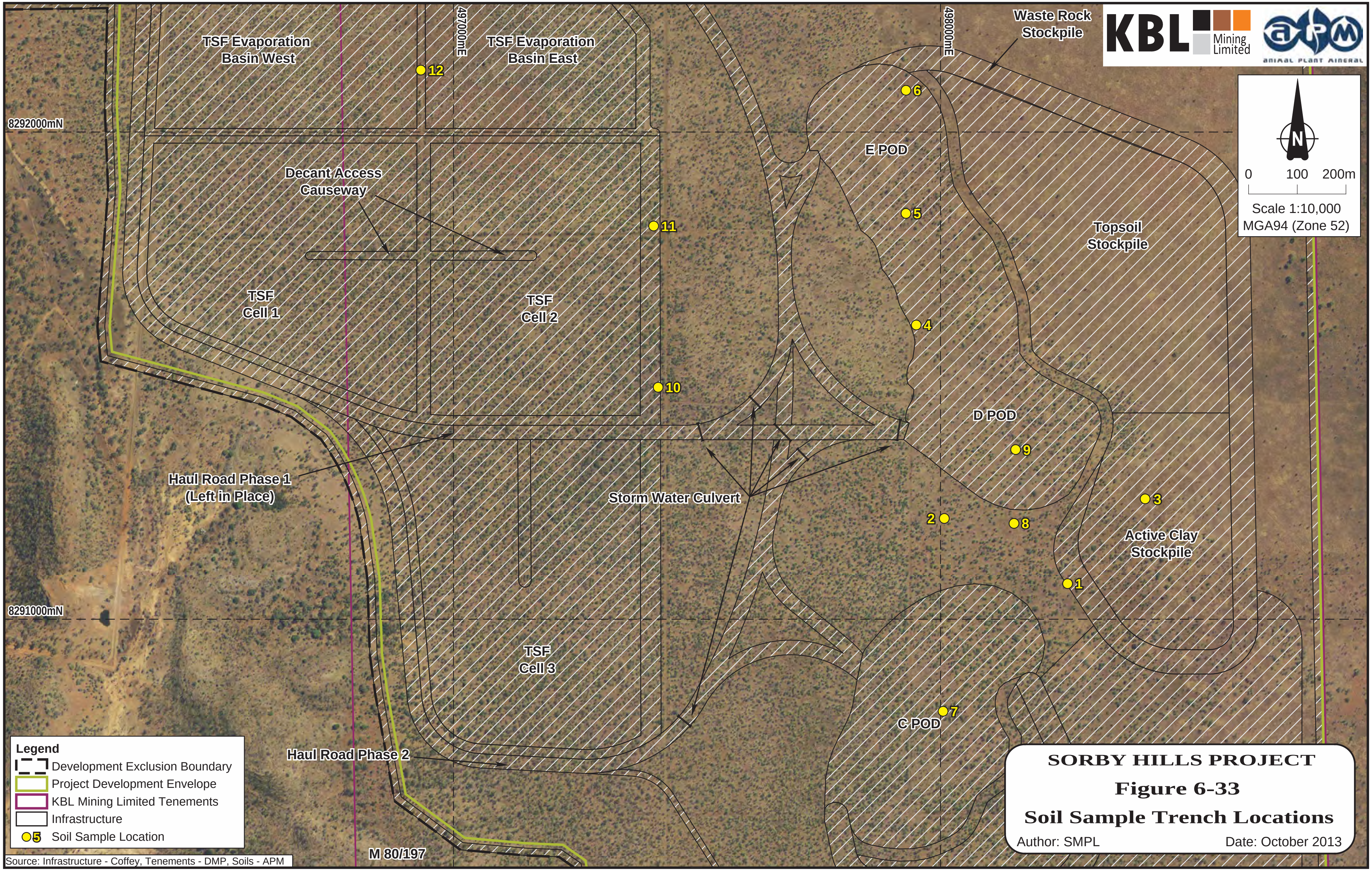
b) Preferential root growth along well defined ped surfaces, especially in the surface 1 m. Coarse roots commonly exploited deep vertical cracks but were uncommon in the brown clay. However, fine roots were common in the surface and subsoil materials exploiting structural discontinuities

c) Structural discontinuities such as slickensides and cutans were common in the subsoil, positioned below the maximum depth of shrinkage cracks

d) Carbonate nodules were common in the subsoil

Test work also identified that the surficial clayey alluvium materials in the Project Area contain negligible sulfidic material and have a high inherent alkalinity, thus ensuring that it will remain alkaline following disturbance. It is important to note that these alluvium materials exist in an unsaturated, oxidising condition in their natural state and that subsequent handling and utilisation during mining and rehabilitation will not alter the redoximorphic condition of these materials.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_633.dgn



SORBY HILLS PROJECT

Figure 6-33

Soil Sample Trench Locations

Author: SMPL

Date: October 2013

KBL Mining Limited

SORBY HILLS PROJECT
Figure 6-34
Typical Soil Profile
Characteristics of
Soil Mapping Unit 1

Author: SMPL
Date: August 2013

Source: Soil Water Group

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_634.ai

6.1.7 Materials Characterisation and Contaminated Site Potential

SWC (2011) analysed the geochemical characteristics of the proposed waste rock and tailings materials associated with the Sorby Hills deposits to assess the potential for ARD and MD to occur following disturbance of these materials, and to identify the distribution of other potential problematic waste rock and tailings characteristics. The main findings of the analysis are described below and the full report is provided in Appendix 5 (Volume 3).

6.1.7.1 Waste Characterisation

The majority of all the waste rock material that will be mined for the Project can be classified as NAF with a low potential to produce ARD. Although a high total sulphur (S) content was reported for large sections of sedimentary units (limestone and dolomite) this is not considered problematic because of the high buffering capacity inherent to these rock types. There is however a localised presence of PAF materials within the proposed mine pit voids. Negligible PAF materials are expected to occur in the mine pit walls, with only limited exposure at the base of the pit and in the eastern wall. The PAF materials occur only in areas which do not contain limestone or dolomite (i.e. shale), or in isolated zones that have experienced oxidation. The shales have potential to be acid forming given their relatively high total S content and lack of buffering capacity. No impact on pit water quality is anticipated from oxidising PAF materials. The spatial distribution and volumes of the PAF materials have been determined based on current block models as illustrated in Figure 6-35 and Appendix 1 (Volume 3). Scheduling indicates that PAF materials will be intersected in year 4 of mining.

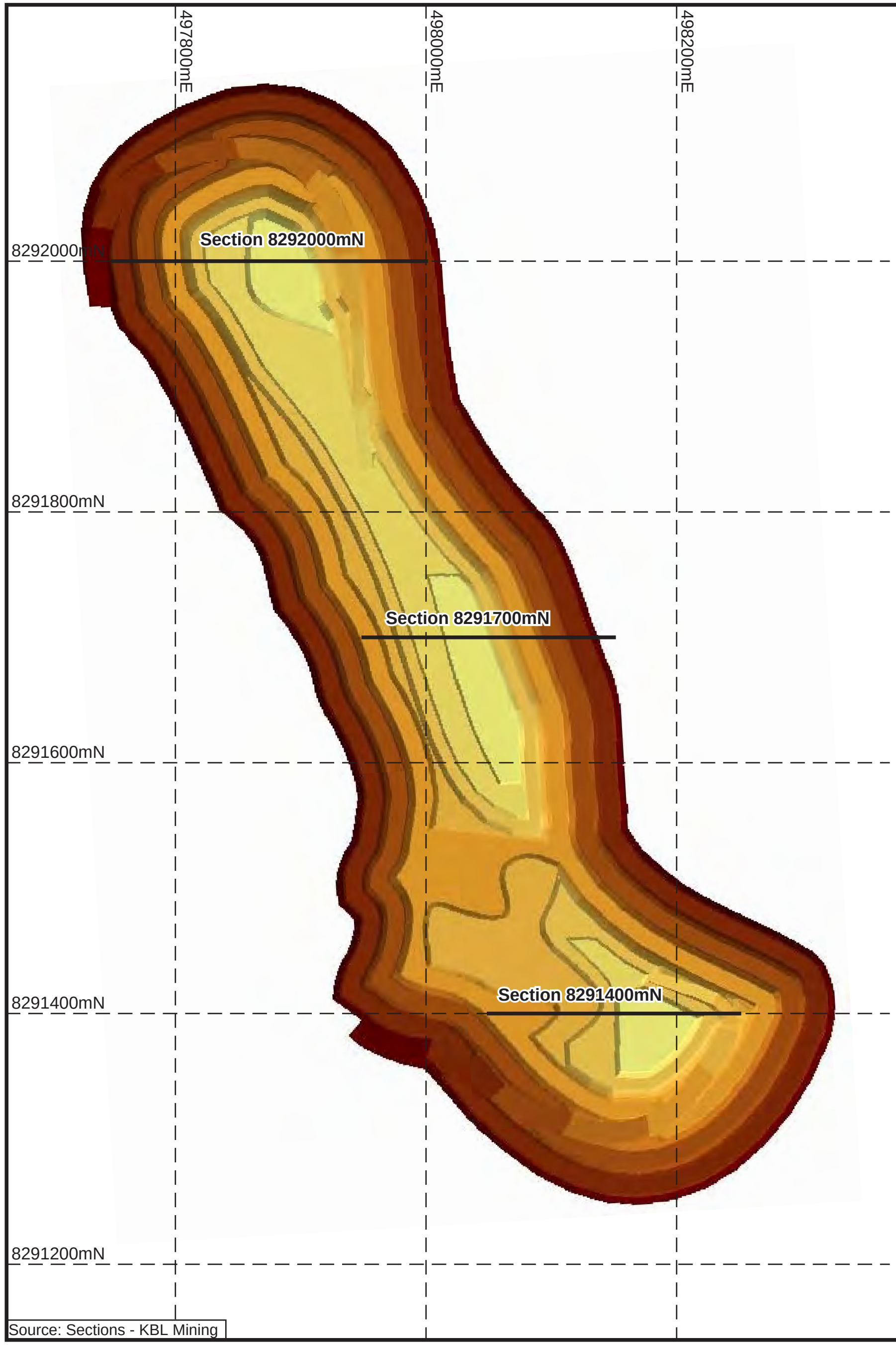
Below the base of the proposed pit, siltstone and shales have been observed to contain disseminated pyrite; it is likely that these materials are PAF. In the long term these materials will be underwater and therefore not exposed to oxidising conditions.

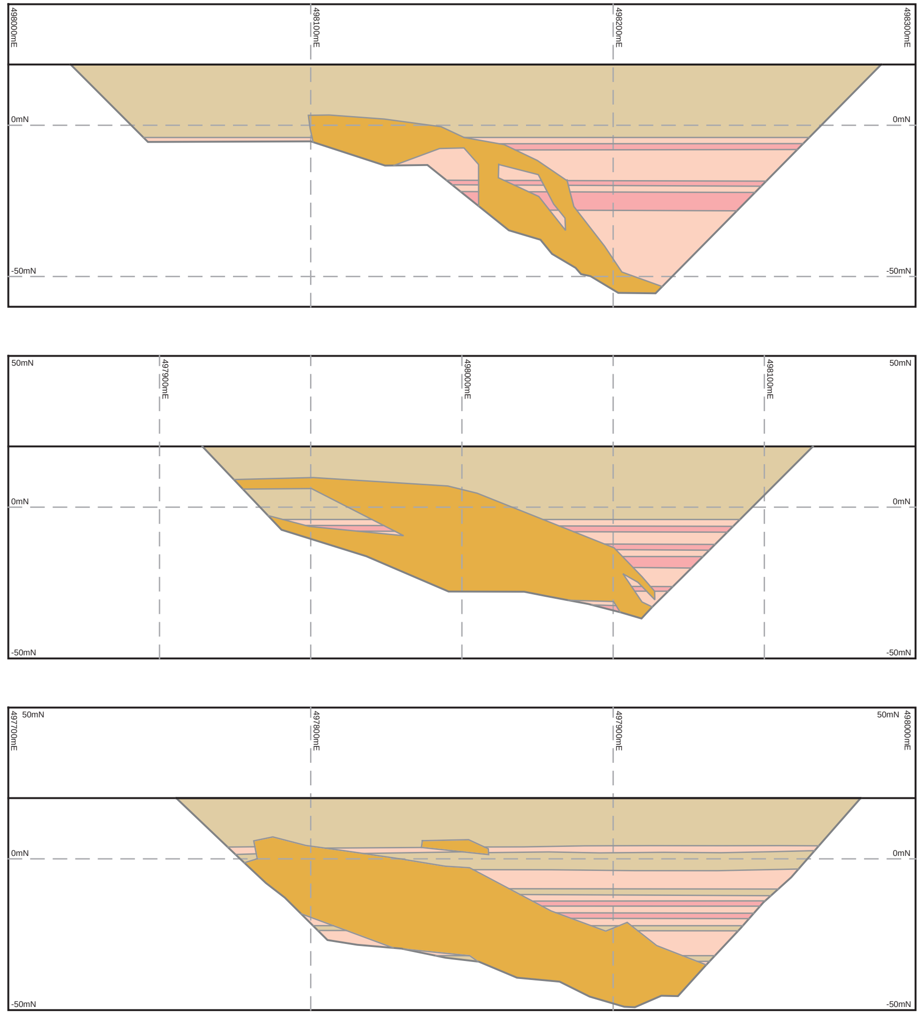
The dominant waste rock materials generally contain low levels of metals and metalloids, with some enrichment of primary Chalcophile elements (i.e. Arsenic, Cadmium and Antimony). These enriched elements are likely to be either strongly associated with iron in the crystal mineral structure of the waste rock material, or associated with the ore body and are therefore unlikely to be available for leaching. Additionally as arsenic and antimony form oxyanions in solution they are likely to be rapidly adsorbed by the aquifer materials and hence there is a low risk of MD and no impact on pit water quality is expected to occur.

The majority of the waste rock to be produced by the Project is considered non-saline with a suitable pH that is unlikely to impact on revegetation establishment and sustainable vegetation growth during rehabilitation.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_635.dgn

KBL Mining Limited





Legend

- Ore
- Waste
- Waste Containing Less Than 3% Pyrite
- Waste Containing Greater Than 3% Pyrite

Source: Sections - KBL Mining

SORBY HILLS PROJECT

Figure 6-35

Spatial Distribution of PAF Material

Author: SMPL Date: August 2013

6.1.7.2 Tailings Characterisation

Tailing materials to be produced during mine operations are likely to be NAF and are not expected to generate significant MD. The elevated carbonate content of the source host rocks results in the tailings material being strongly alkaline (pH > 8.5); this abundance of alkalinity ensures that any acidity released from entrained sulfides are effectively neutralised. It is therefore expected that the tailings will remain highly alkaline within the TSF.

Analysis of the tailings materials also identified Tl, the values of which are within limits that will allow material to be effectively managed within the TSF. Tl forms cation-hydrolysis complexes in solution (i.e. positively charged species) and hence any Tl released into the TSF will be rapidly adsorbed onto mineral surfaces. Absorption of Tl will significantly minimise its mobility and potential for release into the environment. Furthermore, the reducing properties of the TSF will cause Tl to form insoluble complexes, come-out of solution and be retained in the TSF.

6.1.7.3 Contaminated Site Potential

It can be concluded that the majority of the waste rock and tailings materials that will be produced by the Project can be classified as NAF and that there is a low potential for either ARD or MD to occur.

There are no known or potential contaminated sites, as defined by the *Contaminated Sites Act 2003*, within the Sorby Hills mining tenements.

6.1.8 Flora and Vegetation

6.1.8.1 Survey Work

A baseline flora and vegetation survey for the Project was carried out by Animal Plant Mineral Pty Ltd (APM) in accordance with the requirements of a Level 2 survey described within *EPA Guidance Statement No. 51 - Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). The survey included a desktop review of the flora and ecological communities of conservation significance from the study area and detailed field surveys of all aspects of flora and vegetation undertaken in May and June 2011. Field work comprised sampling of flora, vegetation classification and a vegetation condition assessment; the full report is available in Appendix 22 (Volume 3).

A follow up survey targeting the flora of conservation significance identified during the baseline assessment was undertaken by APM in March/April and May 2012; the full report is available in Appendix 23 (Volume 3). The aim of this survey was to establish the representation of populations of conservation significant flora both inside and outside of the proposed impact footprint and to determine the potential impact of the Project on those populations.

6.1.8.2 Regional Vegetation

The Project Area falls within the Victoria Bonaparte Bioregion which comes under the Tropical and Subtropical Grasslands, Savannas and Shrublands Ecoregion. Of the 439 vegetation associations, occurring within 26 broad vegetation groups, the majority of the Project Area is divided into two units described by Fox *et al*. (2001) as:

- Map Unit C21: Occurs on gently sloping floodplains and back plains, often with braided channels, and is dominated by low woodlands of *Bauhinia cunninghamii*. A frequent co-dominant species is *Excoecaria parvifolia* (Gutta Percha) which can also occur as the dominant in some large patches (Wilson *et al*. 1990). Other species that may be present include *Eucalyptus tectifica* (Darwin Box) or *Eucalyptus microtheca* (Coolibah). In some areas the shrub layer is sparse to absent, while in others it may include *Atalayahemiglauca*, *Terminalia volucris* and *Acacia* sp. The ground layer is generally dominated by tussock grasses such as *Sorghum plumosum* and *Themeda* sp

- Map Unit D26: Low open woodland of *Eucalyptus brevifolia* (snappy gum) over hummock grasslands dominated by *Triodia* sp. (spinifex). Some scattered low shrub species may be present including *Acacia monticola*, *A. holosericea*, *A. lysiphloia*, *A. pachycarpa*, *A. tumida*, *A. umbellata*, and *Grevillea* sp. In some areas, such as on ridges, the *Triodia* sp. grassland may be the dominant community. The unit includes small areas of *Corymbia dampieri* and *C. zygophylla* low open-woodland with a *Triodia pungens* understorey and small areas of *T. inutilis* hummock grassland with scattered, low trees of *Eucalyptus brevifolia* (Beard 1979)

6.1.8.3 Vegetation of the Project Area

The local vegetation can be further divided into distinct vegetation units specific to the Project Area. The vegetation units identified within the survey area encompassed a range of community types related to landscape, soils and disturbance. Eight vegetation units were recognised, including one forest, one shrubland and six woodland units. These vegetation units are described below, with their distribution provided in Figure 6-36. Introduced species are preceded by an asterix.

F1: Open forest of *Eucalyptus pruinosa* subsp. *pruinosa*, *Eucalyptus microtheca*, *Corymbia confertiflora* and *Melaleuca minutifolia* over patchy open shrubland of *Bauhinia cunninghamii*, *Acaciacolei* var. *colei* and *Atalaya hemiglauca* over mixed grassland/low shrubland of *Aristida pruinosa*, **Sida acuta*, *Heteropogon contortus, *Sida cordifolia* and *Eragrostis schultzii* (P3). This vegetation was restricted to the pale brown/grey loams, clays and clay loams of a valley system in the south west corner of the survey area.

Plate 6-1: Vegetation Unit F1

S1: Open to sparse shrubland of *Terminalia volucris* and *Bauhinia cunninghamii* over closed tussock grassland of *Themeda triandra, Iseilema vaginiflorum, Ophiurus exaltatus, Sorghum plumosum* and *Arundinella nepalensis* with isolated trees (*Corymbia bella, Vachellia valida* and *Bauhinia cunninghamii*). This vegetation was recorded on seasonally water logged grey/brown 'black soil' clays in the north east of the survey area.

Plate 6-2: Vegetation Unit S1

W1: Woodland or open forest of *Eucalyptus tetrodonta, Eucalyptus brevifolia* and *Corymbia confertilflora* over open to sparse shrubland of **Hyptis suaveolens, Buchanania oblongifolia, Grevillea* sp. and *Acacia* sp. over mixed grassland/forbland of *Eragrostis schultzii* (Priority 3), **Cynodon dactylon, Eriachne obtuse, Heteropogon contortus, Stemodia lythrifolia, Blumea* saxatilis and *Cyperus pulchellus.* Vegetation Unit W1 was found on brown and grey loamy sands, sandy loams and clay loams on flat or gently sloping country at the base of limestone hills.

Plate 6-3: Vegetation Unit W1

W2: Woodland or open forest of *Corymbia dichromophloia, Corymbia confertilflora, Erythrophleum clorostachys, Buchanania oblongifolia, Owenia vernicosa* and *Terminalia platyphylla* over grassland/hummock grassland of *Chrysopogon* sp. *Triodia bitextura, Chrysopogon setifolius, Sehima nervosum* and *Eriachne avenacea.* Vegetation Unit W2 grew in brown loams on the limestone hills that occupied much of the western part of the survey area.

Plate 6-4: Vegetation Unit W2

W3: Woodland or open forest of *Corymbia collina* and *Corymbia confertilflora* over closed grassland/forbland of *Pseudopogonatherum irritans, Eriachne obtusa, Ludwigia perennis, Fuirena ciliaris, Fimbristylis tetragona, Bacopa floribunda* and *Drosera indica* (s.l.). This vegetation was found on a brown and grey-brown loams, clay loams and sandy loams lining the western boundary of the 'black soil' flats.

Plate 6-5: Vegetation Unit W3

W4: Woodland or open forest of *Eucalyptus tetrodonta, Eucalyptus brevifolia* and *Corymbia dichromophloia* over sparse shrubland of *Erythrophleum chlorostachys, Grevillea refracta, Dodonaea hispidula* var. phylloptera and *Buchanania oblongifolia* over grassland of *Chrysopogon* sp.*, Sorghum stipoideum, Eriachne obtusa, Triodia bitextura* and *Eragrostis schultzii* (Priority 3). The vegetation was found on brown and grey loams, sandy loams and loamy sands on the scree slopes and flats around the feet of the limestone hills running down the western side of the survey area.

Plate 6-6: Vegetation Unit W4

W5: Woodland and open woodland of *Bauhinia cunninghamii*, *Excoecaria parvifolia* and *Eucalyptus tectifica* over open to sparse shrubland of *Terminalia volucris, Atalaya hemiglauca, Vachellia valida* over mixed grassland/forbland and closed grassland/forbland of *Ludwigia perennis, Iseilema vaginiflorum, Chionachne hubbardiana, Ophiurus exaltatus, Panisum decompositum* and *Oryza australiensis*. This vegetation was recorded on seasonally waterlogged grey/brown 'black soil' clays in the centre and south east of the survey area.

Plate 6-7: Vegetation Unit W5

W6: Open woodland of *Bauhinia cunninghamii*, *Excoecaria parvifolia* and *Vachellia valida* over mixed shrubland/grassland/forbland of *Sorghum plumosum*, **Calotropis procera* and *Vigna lanceolata*. This vegetation was found in two locations which had been subject to earthworks for dam construction and pit excavation in the past. The flora was a mix of exotics, native disturbance opportunists and Unit W5 or S1 species.

Plate 6-8: Vegetation Unit W6

6.1.8.4 Vegetation of Conservation Significance

The Kimberley has 11 recognised Threatened Ecological Communities (TEC's) and 16 listed PEC's.

The vegetation on upland parts of the Project Area (Vegetation Units W1, W2, W3, W4 and F1; Section 6.1.8.3) is part of a widespread association (1,528,117 ha) within a larger alliance that stretches across the Kimberley and Arnhem Land. It does not correspond to any TEC's; however it does include two small patches of dense vegetation that could be deemed the PEC 'Monsoon vine thickets of limestone ranges'. The 'Monsoon vine thickets of limestone ranges' are Priority 1; Priority 1 PEC's are poorly-known ecological communities that occur in small and isolated patches of which all or most are not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas or active mineral leases) and for which current threats exist. The two identified areas will not be disturbed by the Project as they are located within the Development Exclusion Zone as illustrated by Figure 6-37.

The lowland vegetation (Vegetation Units S1, W5 and W6; Section 6.1.3.8) is part of a widespread association (1,085,228 ha) within a larger alliance that has a patchy distribution across northern Australia from the west Kimberley to northern Queensland (QLD). It does not correspond to any TEC's or PEC's.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_636.dgn

Legend

Development Exclusion Boundary

Project Development Envelope

Infrastructure

0 250 500m

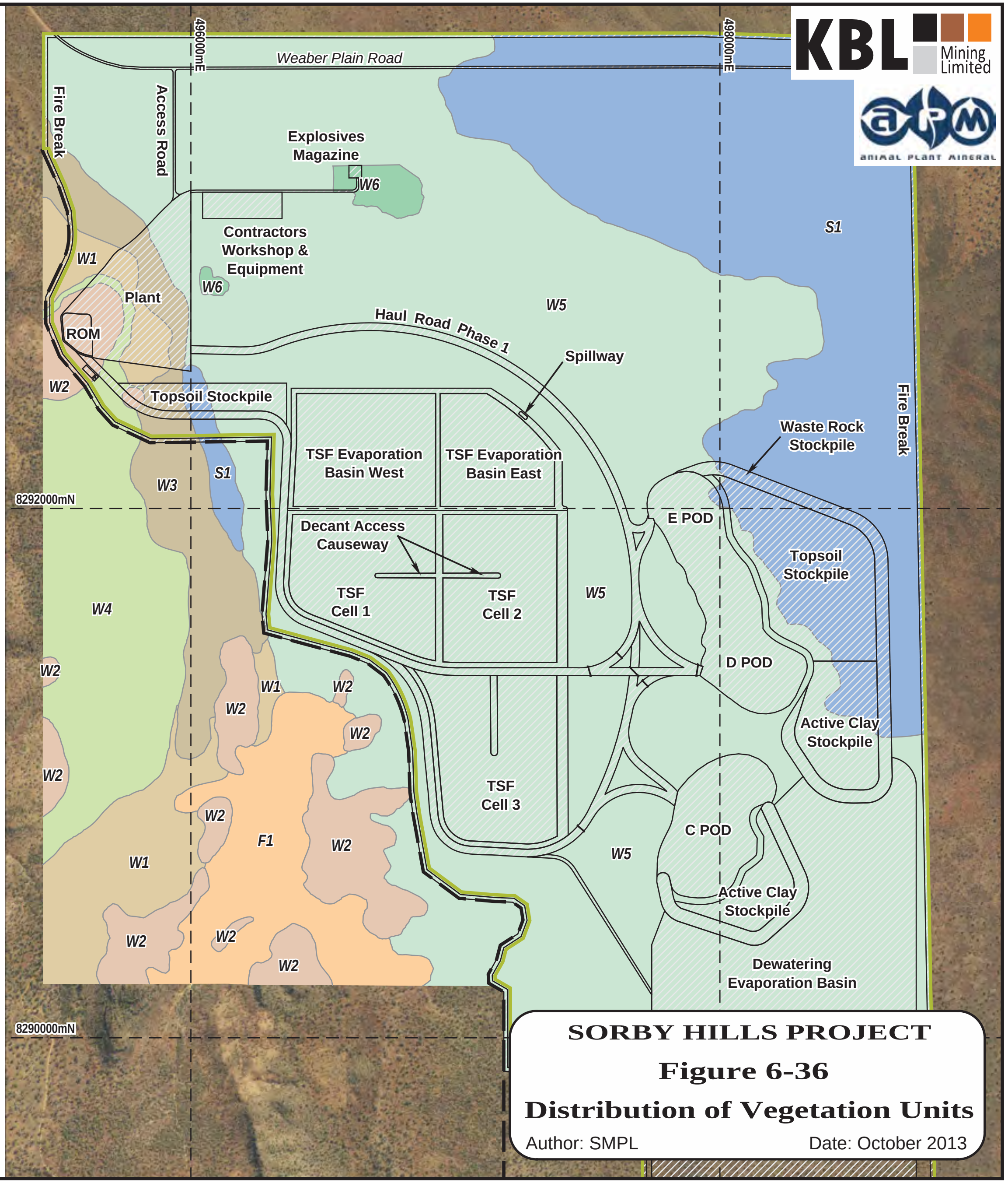
Scale 1:25,000

MGA94 (Zone 52)

Vegetation

Code	Description
F1	Open Forest of *Eucalyptus pruinosa* subsp. *pruinosa*, *Eucalyptus microtheca*, *Corymbia confertiflora* and *Melaleuca minutifolia* over patchy Open Shrubland of *Bauhinia cunninghamii*, Acacia colei var. colei and *Atalaya hemiglauca* over mixed Grassland/Low Shrubland of *Aristida pruinosa*, **Sida acuta*, *Heteropogon contortus*, **Sida cordifolia* and *Eragrostis cumingii*
S1	Open to Sparse Shrubland of *Terminalia volucris* and *Bauhinia cunninghamii* over Closed Tussock Grassland of *Themeda triandra*, *Iseilema vaginiflorum*, *Ophiurus exaltatus*, *Sorghum plumosum* and *Arundinella nepalensis* with isolated trees (*Corymbia bella*, *Vachellia valida* and *Bauhinia cunninghamii*).
W1	Woodland or Open Forest of *Eucalyptus tetrodonta*, *Eucalyptus brevifolia* and *Corymbia confertiflora* over Open to Sparse Shrubland of **Hyptis suaveolens*, *Buchanania oblongifolia*, *Grevillea* spp. and *Acacia* spp. over mixed Grassland/Forbland of *Eragrostis cumingii*, **Cynodon dactylon*, *Eriachne obtusa*, *Heteropogon contortus*, *Stemodia lythrifolia*, *Blumea saxatilis* and *Cyperus pulchellus*
W2	Woodland or Open Forest of *Corymbia dichromophloia*, *Corymbia confertiflora*, *Erythrophleum chlorostachys*, *Buchanania oblongifolia*, *Owenia vernicosa* and *Terminalia platyphylla* over Grassland/Hummock Grassland of *Chrysopogon* sp. , *Triodia bitextura*, *Chrysopogon setifolius*, *Sehima nervosum* and *Eriachne avenacea*
W3	Woodland or Open Forest of *Corymbia collina* and *Corymbia confertiflora* over Closed Grassland/Forbland of *Pseudopogonatherum irritans*, *Eriachne obtusa*, *Ludwigia perennis*, *Fuirena ciliaris*, *Fimbristylis tetragona*, *Bacopa floribunda* and *Drosera indica*.
W4	Woodland or Open Forest of *Eucalyptus tetrodonta*, *Eucalyptus brevifolia* and *Corymbia dichromophloia* over Sparse Shrubland of *Erythrophleum chlorostachys*, *Grevillea refracta*, *Dodonaea hispidula* var. *phylloptera* and *Buchanania oblongifolia* over Grassland of *Chrysopogon* sp., *Sorghum stipoideum*, *Eriachne obtusa*, *Triodia bitextura* and *Eragrostis cumingii*
W5	Woodland and Open Woodland of *Bauhinia cunninghamii*, *Excoecaria parvifolia* and *Eucalyptus tectifica* over Open to Sparse Shrubland of *Terminalia volucris*, *Atalaya hemiglauca* *Vachellia valida* over mixed Grassland/Forbland and Closed Grassland/Forbland of *Ludwigia perennis*, *Iseilema vaginiflorum*, *Chionachne hubbardiana*, *Ophiurus exaltatus*, *Panicum decompositum* and *Oryza australiensis*
W6	Open Woodland of *Bauhinia cunninghamii*, *Excoecaria parvifolia* and *Vachellia valida* over mixed Shrubland/Grassland/Forbland of *Sorghum plumosum*, **Calotropis procera*, *Vigna lanceolata*

Source: Infrastructure - Coffey, Vegetation - APM

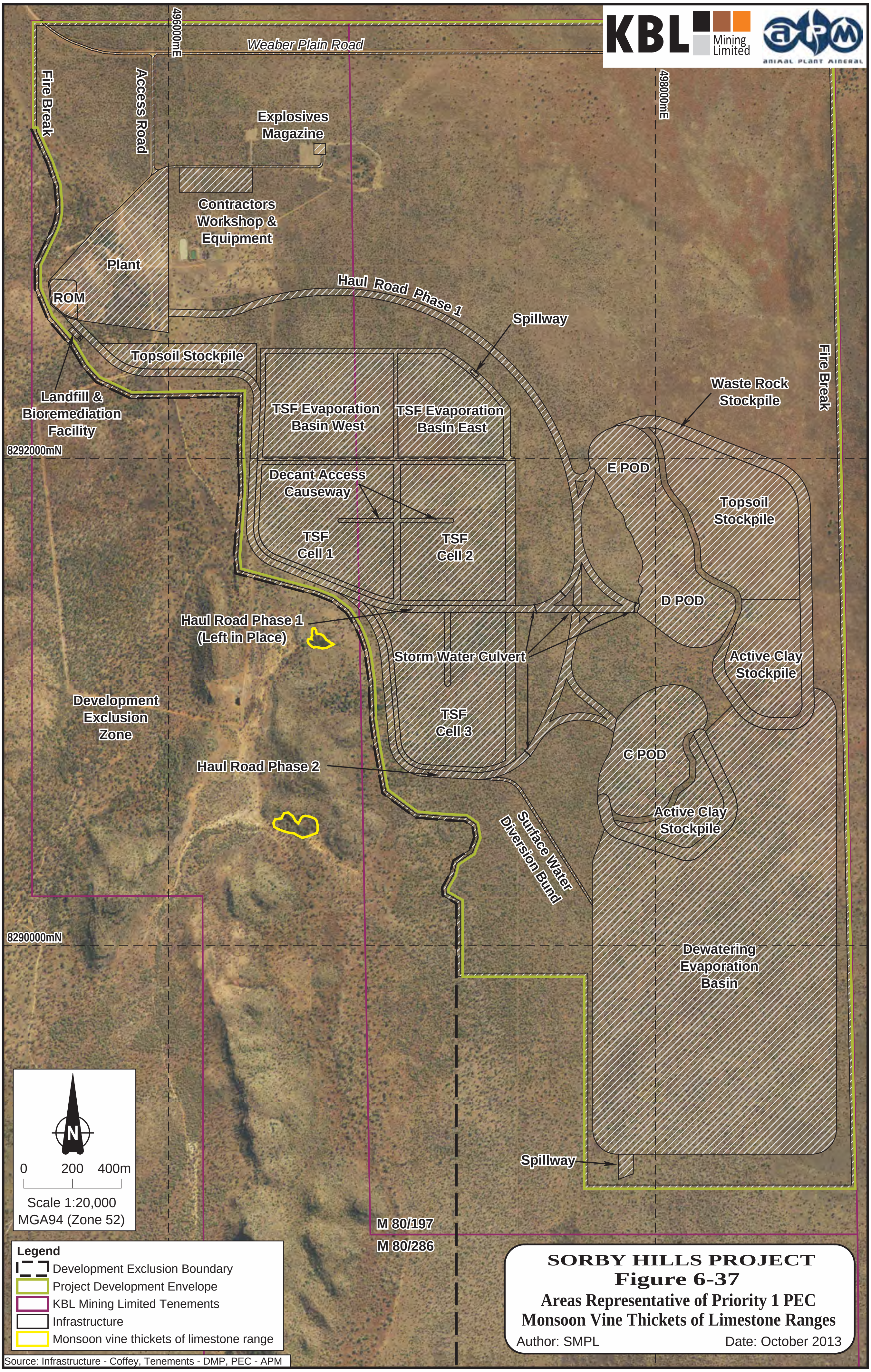


SORBY HILLS PROJECT

Figure 6-36

Distribution of Vegetation Units

Author: SMPL Date: October 2013



SORBY HILLS PROJECT
Figure 6-37
Areas Representative of Priority 1 PEC Monsoon Vine Thickets of Limestone Ranges
Author: SMPL Date: October 2013

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_637.dgn

6.1.8.5 Flora

A total of 334 taxa (species, subspecies and varieties) from 69 families and 201 genera were recorded in Project Area over approximately 20 field person days in May and June 2011. Representation was greatest among the Fabaceae (53 taxa), Poaceae (52 taxa), Cyperaceae (24 taxa) and Malvaceae (22 taxa) families. A summary of vascular plant taxa by family, by site and by percentage cover can be found in the baseline flora report (Appendix 22, Volume 3).

Pilbara Flora (2010) recorded a total of 496 taxa from 70 families and 238 genera in 96 person days over a 15,367.11 ha in May and June 2009. Three families that were dominant in the Pilbara Flora survey area were also dominant in the Project Area; Poaceae, Fabaceae and Malvaceae. This survey covered the Mantinea, Packsaddle, West and East Bank proposed agricultural areas, all of which are located less than 50 km from the Project Area.

During the M2 Development Area survey of Keep River, Weaber Plain, Knox Creek Plain and Carlton Plain (Ecologia Environmental Consultants 1997), 397 taxa from 72 families and 215 genera were recorded in 44 field person days over 32,000 ha.

The MRWA Potential Borrow Material survey, undertaken by Pilbara Flora in 2009 recorded 458 taxa from 72 families and 218 genera in a survey area of 5,519.46 ha (Pilbara Flora 2010).

These four survey areas lie in close proximity to each other and all of the survey areas support many, if not all, of the following landforms in various extents:

- Alluvial plains
- Cracking clay plains
- Drainage areas
- Artificial drainage areas
- Moderate creeks
- Major creeks
- River banks
- Sandstone hills
- Ironstone hills
- Limestone hills
- Disturbed areas

Collectively, the outcomes of all four surveys show that flora species richness is relatively consistent across survey areas that exceed 1,200 ha and support a diverse array of landforms. More importantly the data show that richness does not continue to increase proportionate to survey area, with survey sites in excess of 30,000 ha supporting 397 taxa, and smaller areas of under 6,000 ha supporting 458 taxa.

6.1.8.6 Flora of Conservation Significance

Baseline Survey Outcomes

No plant taxon gazetted as DRF, pursuant to the *Wildlife Conservation Act 1950*, or listed as 'Threatened' under Schedule 1 of the *EPBC Act* has been found within the Project Area. The DRF species *Typhonium* sp. Kununurra (A.N. Start ANS 1467) has previously been recorded 44 km south west of the Project Area in 2001; however, despite suitable habitat for *Typhonium* sp. being located within the Project Area, no individuals were recorded in the 2011 or 2012 surveys.

Ten Priority flora taxa were collected during the baseline botanical survey. Priority taxa are those taxa on which not enough information is known to determine its conservation status; the full definitions of the Priority levels are described in the baseline flora report (Appendix 22, Volume 3). In addition to the Priority taxa, four plants may be considered to be new taxa and one taxa was found outside its previously known range. *Hydrolea zeylanica* represented both a priority taxa and a possible range extension. A list of the conservation significant flora found during the baseline botanical survey is provided in Table 6-9.

Based on the outcomes of the baseline flora and fauna (Appendix 22 and 24, Volume 3) surveys, a Development Exclusion Zone was proposed to commence at the foothills of the Sorby Hills and extend west towards the GRCP. Several of the conservation significant flora taxa listed in Table 6-9 were recorded in this area. Implementing a Development Exclusion Zone will effectively reduce the potential net environmental impact of the Project by avoiding this floristically diverse flora habitat assemblage.

Table 6-9: List of Flora of Conservation Significance Located during the APM 2011 Survey
(Priority = P, Possible New Taxa = PNT, Range Extension = RE)

Taxa	Conservation Significance
Croton arnhemicus	P1
Fimbristylis pachyptera	P1
Goodenia brachypoda	P1
Goodenia byrnesii	P1
Goodenia malvina	P1
Hydrolea zeylanica	P1 /RE
Jacquemontia sp. Keep River	P1
Polygala sp. Rhianthoides shoulders	P1
Fimbrisylis laxiglumis	P2
Minuria macrorhiza	P2
Fimbristylis aff. *carolinii*	PNT
Fimbristylis cf. *dichotoma* (desert form)	RE
Hibiscus aff. *calcicola*	PNT
Polygala triflora	PNT
Spermacoce aff.*leptoloba*	PNT

Flora Potential Impact Assessment

Prior to the follow up survey targeting flora of conservation significance, SMPL clearly defined the potential Primary Impact Footprint for the mine and associated infrastructure within tenements M80/197 and M80/286 so that a more accurate and quantitative assessment of conservation significant flora could be undertaken.

In the first instance, only one of the four possible new taxa collected in the 2011 surveys was located in the proposed impact area, near to the proposed haul road. As a consequence the design plan was immediately changed to avoid impacts to this taxon. The remaining three taxa were all located west of the Development Exclusion Boundary in the Development Exclusion Zone.

From data collected during the baseline survey five known Priority taxa were identified as having the potential to be impacted by the Project. An additional taxa was identified in the first of the follow-up surveys, making a total of six taxa (hereafter referred to as Target Taxa) for which an evaluation of the potential impact of the Project was required. The following was investigated:

- The distribution, size and density of populations occurring within the Primary Impact Footprint and Project Development Envelope
- An estimate of the extent to which populations extend beyond tenements M80/197 and M80/286
- Microhabitat requirements

The distribution of the six Target Taxa is shown in Figure 6-38 and the size of each population is presented in Table 6-10. The number of Target Taxa and the percentage of the total population size located within the Primary Impact Footprint are provided in Table 6-11.

Table 6-10: Target Taxa and Estimated Population Size in Relation to the Project Development Envelope

Target Taxa and Conservation Code	Mean Density (300 m²)	Sample Population within the Project Development Envelope		Sample Population outside the Project Development Envelope/SMPL Tenements		Total Sample Population
		Number of Plants	% of Sample Population	Number of Plants	% of Sample Population	
Croton arnhemicus (P1)	12	18223	49.93	18278	50.07	36501
Fimbristylis pachyptera (P1)	9	5513	36.2	9746	63.8	15276
Fimbristylis sp. E Kimberley (P1)[1]	0.07	70	100	Not detected	-	70 *
Goodenia malvina (P1)	8.5	564683	83	113333	16.72	678017
Fimbristylis laxiglumis (P2)	10	664333	83	133333	17	797667
Minuria macrorhiza (P2)	7	9622	56.19	7503	43.81	17126

* *Fimbristylis sp.* E Kimberley could not be distinguished in the field from a range of similar taxa

Table 6-11: Target Taxa within the Primary Impact Footprint

Number of Target Taxa and the respective per cent of the total sample population located in the Primary Impact Footprint											
***Croton arnhemicus* (P1)**		***Fimbristylis pachyptera* (P1)**		***Fimbristylis sp.* E Kimberley Flora (P1)**		***Goodenia malvina* (P1)**		***Fimbristylis laxiglumis* (P2)**		***Minuria macrorhiza* (P2)**	
No of Plants	**% of Sample Pop**	**No of Plants**	**% of Sample Pop**	**No of Plants**	**% of Sample Pop**	**No of Plants**	**% of Sample Pop**	**No of Plants**	**% of Sample Pop**	**No of Plants**	**% of Sample Pop**
5581	15.3	3513	23	32	45	130378	19.23	112081	13.5	2919	17.05

A description of each of the Target Taxa together with local and regional distribution information is provided below.

[1] Statement regarding *Fimbristylis* sp. E Kimberly Flora: This species was initially identified by Russel Barrett, a specialist in the Kimberly Flora, as *Fimbristylis* sp. E Kimberley Flora and at the time of publication of the PER it was believed that this was the case. Examples of *Fimbristylis* sp. E Kimberly Flora, *F. punctata* and *F. simplex*, as determined by Russel Barrett, were lodged with the State Herbarium; in March 2013 the identity of the vouchered species was checked further by a State Herbarium botanist, who determined all the above specimen vouchers to be *F. punctata,* a relatively common species, wide spread throughout the northern Kimberley and were submitted to the State Herbarium as such. Therefore the reported presence of *Fimbristylis* sp. E Kimberly Flora within the SMPL tenements was a mistake, the result of misidentification.

Croton arnhemicus is an understorey tree reaching 5 m in height, with broad (60-70 mm) cordate leaves. *Croton arnhemicus* belongs to the Euphorbiaceae family and is one of six taxa in this genus, all confined to the Kimberley Region, except for *Croton aridus*, which has a disjunct population in the Great Sandy Desert and *Croton setigerus*, an introduced taxon. There is only one other known location for this taxon in WA, approximately 1 km north of Wyndham. A full census of the Wyndham population has not been reported, however it is recorded as common in the area (FloraBase 2012). The Kimberley populations represent the western extreme of this taxon's distribution, which occurs across the northern end of Australia including the NT and QLD (Australia's Virtual Herbarium 2012).

Croton arnhemicus occurs in the W1, W2 and W4 open forest or woodland vegetation units (Section 6.1.8.3) within the Project Area. It is confined to the lower slopes of limestone hills, on loamy skeletal soil in a limestone rock/bolder complex. This complex can extend up to 500 m from the foot of the slopes and supports *Eucalyptus tetrodonta, Eucalyptus brevifolia* and *Corymbia dichromophloia* open woodland (W4).

It is estimated that aproximatly 50 % of the observed population occurs within the Project Development Envelope (Table 6-10) and approximately 15.3 % of the sample population occurs within the Primary Impact Footprint (Table 6-11). The sample population extends beyond the M80/286 tenement boundary and into the lower eastern slopes of the Sorby Hills. No populations were observed on the western slopes of the Sorby Hills.

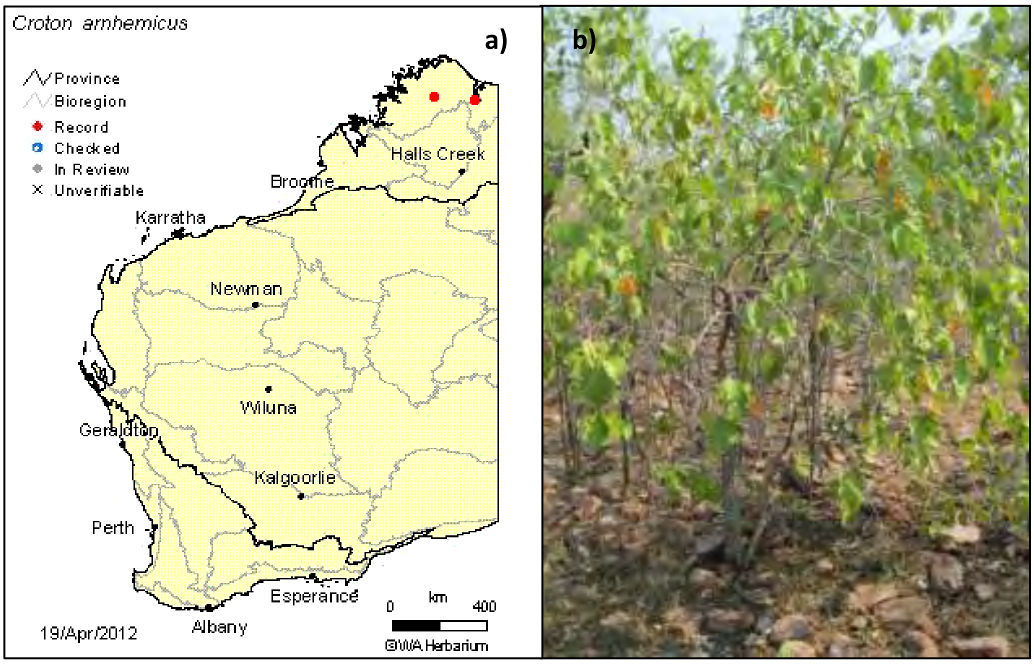


Plate 6-9: *Croton arnhemicus*

a) Distribution in WA (image from FloraBase 2012)

b) Mature Example (photo taken within the proposed plant site)

Fimbristylis pachyptera is an annual sedge reaching up to 30 cm in height, with a single compressed terminal inflorescence. *Fimbristylis pachyptera* belongs to the Cyperaceae family and is one of 58 taxa in the genus *Fimbristylis* found in WA and distributed throughout the State. *Fimbristylis pachyptera* is known from two other populations in the Kimberley, one within the Leopold Ranges and the other occurring in the north west section of the Mitchell Plateau. No census has been reported of these two populations. *Fimbristylis pachyptera* is common throughout the NT and also occurs sporadically in northern QLD (Australia's Virtual Herbarium 2012).

Fimbristylis pachyptera is a ground layer species found in *Corymbia dichromophloia, Corymbia confertiflora, Erythrophleum chlorostachys, Buchanania oblongifolia, Owenia vernicosa* and *Terminalia platyphylla* open forest or woodland on hill tops (Vegetation Unit W2, Section 6.1.8.3). It was also found more sporadically as a ground layer taxon in *Eucalyptus tetrodonta, Eucalyptus brevifolia* and *Corymbia confertiflora* open woodland or forest on lower hill slopes (Vegetation Unit W4, Section 6.1.8.3).

All populations of *Fimbristylis pachyptera* described in FloraBase (2012) records are associated with hills and rocky areas with skeletal loamy soils. This is consistent with plants found within the Project Area, with clusters of sub-populations occupying small terraces of gravely soil occurring in small plateaus on the crests of low hills and along east facing slopes of the north western end of the Project area, including the plant site. It is estimated that approximately 36 % of the observed population occurs within the Project Development Envelope (Table 6-10) and 23 % of the sample population occurs within the Primary Impact Footprint (Table 6-11). *Fimbristylis pachyptera* was also found outside of the Project Development Envelope and there does appear to be an abundance of suitable habitat within the Pincombe Range.

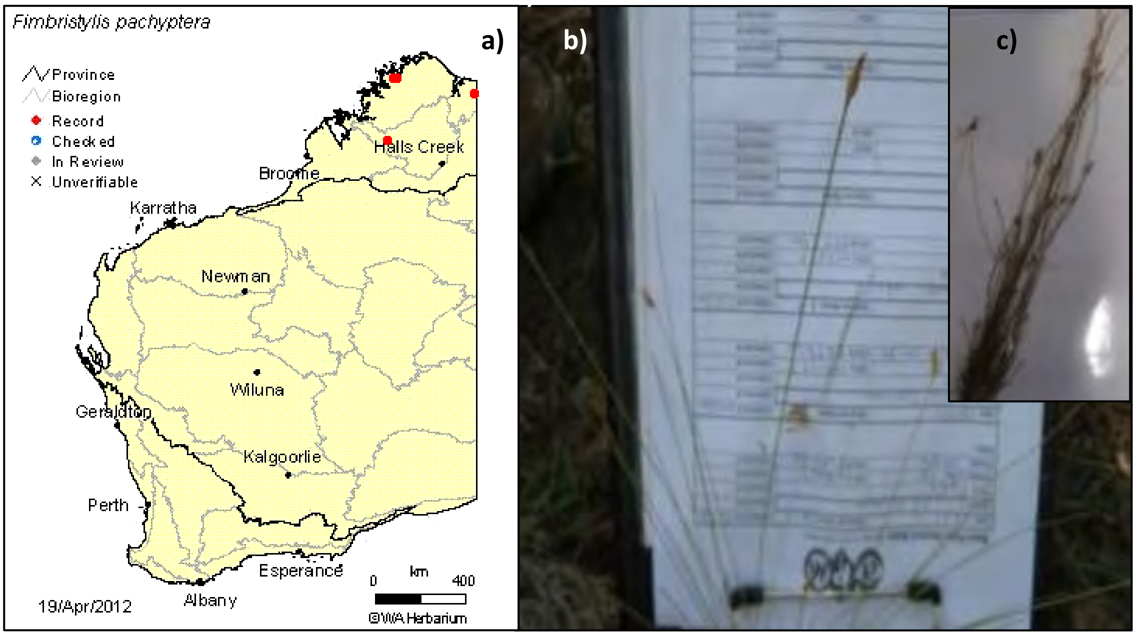


Plate 6-10: *Fimbristylis pachyptera*
a) Distribution in WA (image from FloraBase 2012)
b) Mature example (photo taken within the proposed plant site)
c) Mature example (WA Herbarium specimen)

***Fimbristylis* sp. E Kimberley Flora** is an annual sedge, similar to *Fimbristylis pachyptera* in that it has a single terminal inflorescence. The discovery of *Fimbristylis* sp. E Kimberley Flora, within the Project Area represents one of only three records for this taxon reported in 30 years, the taxon is only known from two other locations within a northern region of the Mitchell Plateau. The population discovered within the Project Area represents a range extension of approximately 320 km. The two records associated with the Mitchell Plateau occur on open grasslands associated with thin sandy soils derived from basalt. However, in the Project Area, *Fimbristylis* sp. E Kimberley was collected from deeper sandy soils derived from limestone.

Fimbristylis sp. E Kimberley was closely associated with discreet patches of seasonally wet grass/herb/sedge land, present in open areas of the W3 woodland (Section 6.1.8.3) and also occurred within the mixed grass and forblands associated with the W1 woodland (Section 6.1.8.3) or open forest of *Eucalyptus tetrodonta*, *Eucalyptus brevifolia* and *Corymbia confertiflora* over open to sparse Shrubland of **Hyptis suaveolens*, *Buchanania oblongifolia*, *Grevillea* sp. and *Acacia* sp.

Fimbristylis sp. E Kimberley is a cryptic taxon, superficially similar to a number of co-occurring taxa including *Fimbristylis cardicarpa*, *F. puntata*, *F. similans* and *F. simplex*. Positive identification of these taxa can only be achieved via dissection of the terminal inflorescence. Based on the number of specimens collected it was estimated that 45 % of the sample population falls within the Primary Impact Footprint (Table 6-11). No other populations were detected outside the Project Area however suitable habitat does occur further south in valleys associated with the Pincombe Range.

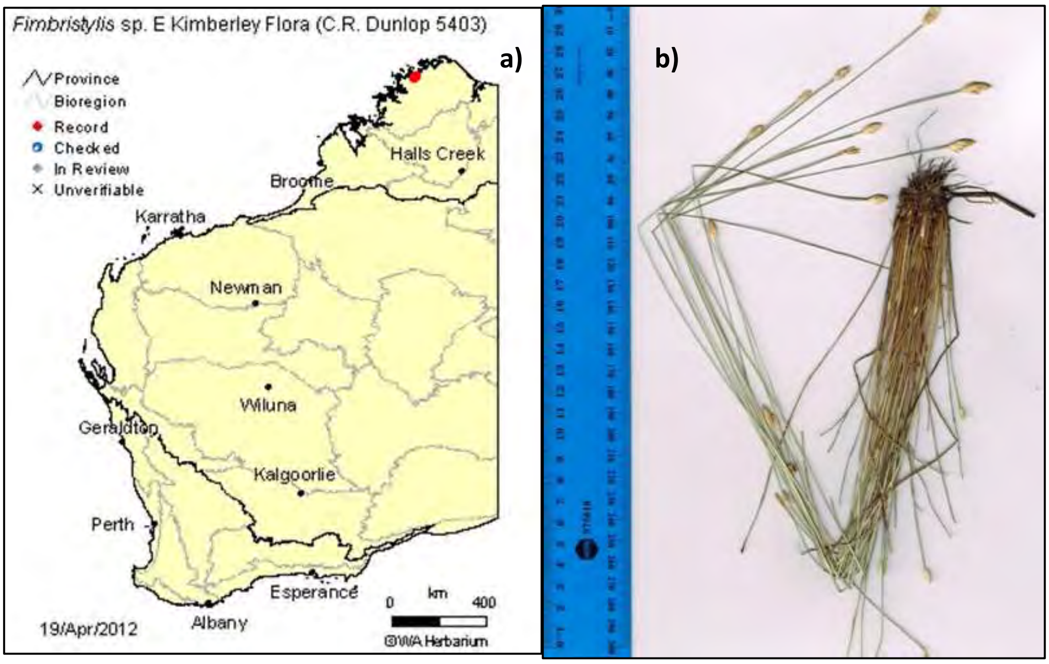


Plate 6-11: *Fimbristylis* sp. E Kimberley Flora
a) Distribution in WA (image from FloraBase 2012)
b) Mature example (photo taken of specimen found within the proposed plant site)

Goodenia malvina is a semi prostrate, spreading herb, up to 15 cm high and spreading to 50 cm wide. This taxon is possibly perennial, producing abundant yellow flowers between March and May. *Goodenia malvina* belongs to the family Goodeniaceae. There are 121 taxa within this genus in WA. The genus is distributed throughout the state, with a concentration of diversity in the south west. *Goodenia malvina* is broadly distributed across the Kimberley Region, occurring on grey/brown clays 'blacksoil' associated with floodplains, mainly within the Ord River Floodplain and the Weaber Plain. This taxon is also known from scattered locations in the NT and a single population in QLD (Australia's Virtual Herbarium 2012).

Within the Project Area, *Goodenia malvina* was associated with seasonal swampland of *Terminalia volucris* and *Bauhinia cunninghamii* open to sparse shrubland over closed tussock grassland (Vegetation Unit S1, Section 6.1.8.3), *Excoecaria parvifolia* and *Eucalyptus tectifica* woodland and open woodland over open to sparse shrubland of *Terminalia volucris, Atalaya hemiglauca* and *Vachellia valida* over mixed grassland/forbland (Vegetation Unit W5, Section 6.1.8.3). Within these habitats *Goodenia malvina* occurred in small discreet populations of 1-2 individuals at the edge of small pools and open clay areas.

Goodenia malvina occurred throughout the Project Development Envelope and Primary Impact Footprint where suitable habitat occurred. It is estimated that 83 % of the observed population occurs within the Project Development Envelope (Table 6-10) and 19.23 % of the sample population occurs within the Primary Impact Footprint (Table 6-11). Populations of this taxon also extended into tenements M80/286 and M80/196 to the north of Weaber Plain Road and outside the southern boundary of tenement M80/197 where there is an abundance of suitable habitat.

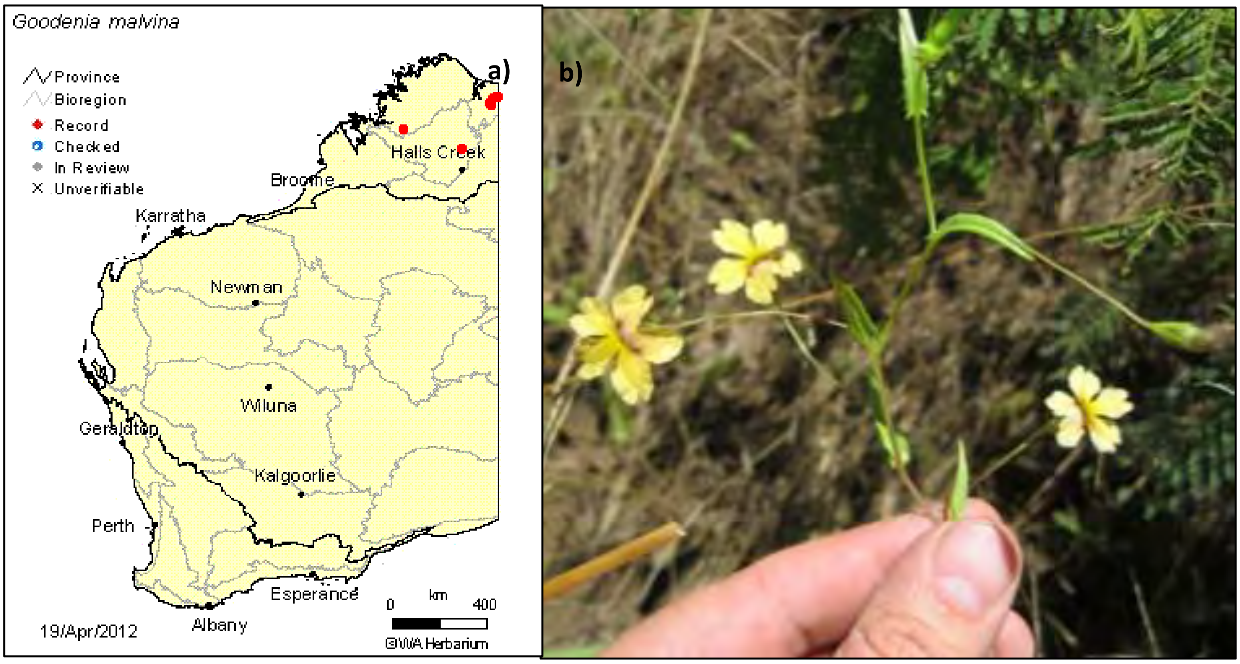


Plate 6-12: *Goodenia malvina*
a) Distribution in WA (image from FloraBase 2012)
b) Mature example (photo taken within the proposed plant site)

Fimbristylis laxiglumis is a tall perennial sedge reaching 100 cm, with brown flowers forming a loose terminal panicale. In WA this taxon is only known from the Weaber Plain area; however it occurs more frequently in the NT, with the Weaber Plain population representing the westerly extreme for this taxon (Australia's Virtual Herbarium 2012).

Fimbristylis laxiglumis often co-occurred with *Goodenia malvina* in seasonally wet swampland of *Terminalia volucris* and *Bauhinia cunninghamii* open to sparse shrubland over closed tussock grassland (Vegetation Unit S1, Section 6.1.8.3) and *Bauhinia cunninghamii, Excoecaria parvifolia* and *Eucalyptus tectifica* woodland and open woodland over open to sparse shrubland of *Terminalia volucris, Atalaya hemiglauca* and *Vachellia valida* over mixed grassland/forbland (Vegetation Unit W5, Section 6.1.8.3). Within these habitats *Fimbristylis laxiglumis* was widespread and abundant, tending to thin out or become absent in areas dominated by the grass *Panicum decompositum,* a robust tufted grass forming dense tussocks.

Fimbristylis laxiglumis occurred mainly in the proposed plant site but was also present throughout the Project Development Envelope where suitable habitat occurred. It is estimated that approximately 83 % of the sample population occurs within the Project Development Envelope (Table 6-10) and 13.5 % of the sample population occurs within the Primary Impact Footprint (Table 6-11). Populations of this taxon also extended into tenements M80/286 and M80/196 to the north of Weaber Plain Road and outside the southern boundary of tenement M80/197. *Fimbristylis laxiglumis* was also found in abundance (an average of 10/5 m²) along drainage ditches running parallel to the Weaber Plain Road. The Weaber Plain Road population began at the north east boundary of the agricultural zone and continued into the NT.

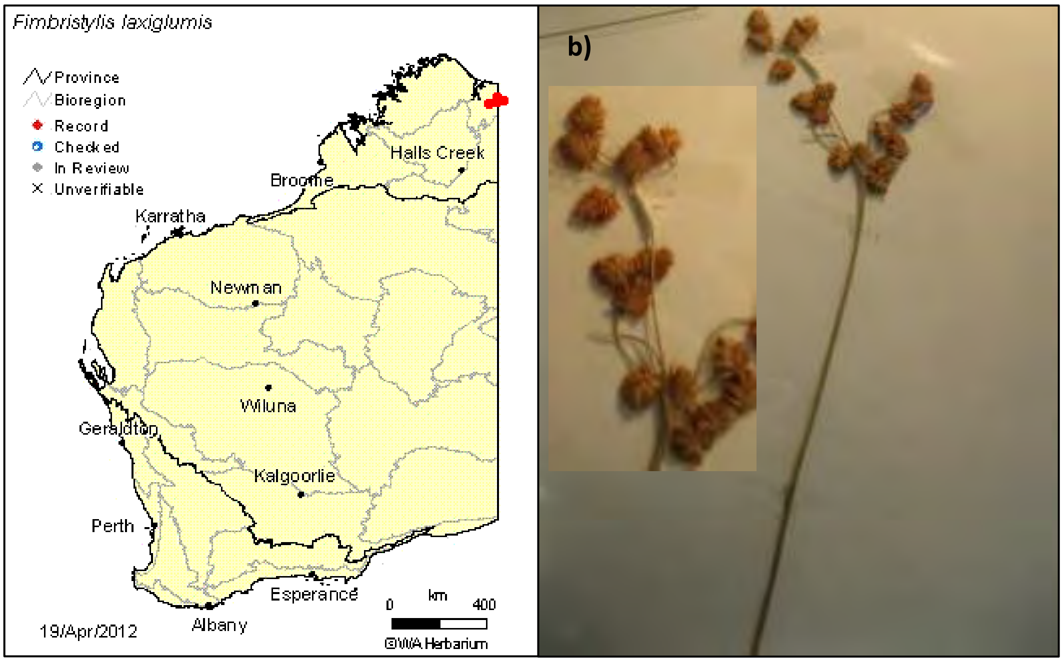


Plate 6-13: *Fimbristylis laxiglumis*
a) Distribution in WA (image from FloraBase 2012)
b) Mature example (WA Herbarium specimen)

Minuria macrorhiza is an erect perennial herb up to 60 cm high. *Minuria macrorhiza* belongs to the Asteraceae family and is one of six genera, broadly scattered throughout the dry and arid zones of WA. *Minuria macrorhiza* is known from the King Leopold Range, Mitchell Plateau and coastal locations along the north west Kimberley coast. This taxon also occurs across the northern end of Australia including the NT and north to central QLD (Australia's Virtual Herbarium 2012).

Minuria macrorhiza is an occasional ground layer species that occurs in *Eucalyptus tetrodonta, Eucalyptus brevifolia* and *Corymbia confertiflora* woodland or open forest (Vegetation Unit W1, Section 6.1.8.3), and *Eucalyptus tetrodonta, Eucalyptus brevifolia* and *Corymbia dichromophloia* woodland or open forest (Vegetation Unit W4, Section 6.1.8.3). This taxon occurs in habitat similar to *Croton arnhemicus* as it is also confined to the lower slopes of limestone hills, on loamy skeletal soil in a limestone rock/bolder complex. This plant community can extend up to 500 m from the foot of the slopes and supports *Eucalyptus tetrodonta, Eucalyptus brevifolia* and *Corymbia dichromophloia* open woodland (Vegetation Unit W4, Section 6.1.8.3). Throughout these habitats *Minuria macrorhiza* appeared unaffected by tree cover and tended to occur in intermittent clusters of up to 20 individuals with large tracts of suitable habitat unoccupied.

Minuria macrorhiza occurred within the proposed plant site, along the lower slopes of hills running along the western boundary of tenement M80/286. It is estimated that approximately 56 % of the observed population occurs within the Project Development Envelope (Table 6-10) and 17.05 % of the sample population occurs within the Primary Impact Footprint (Table 6-11).

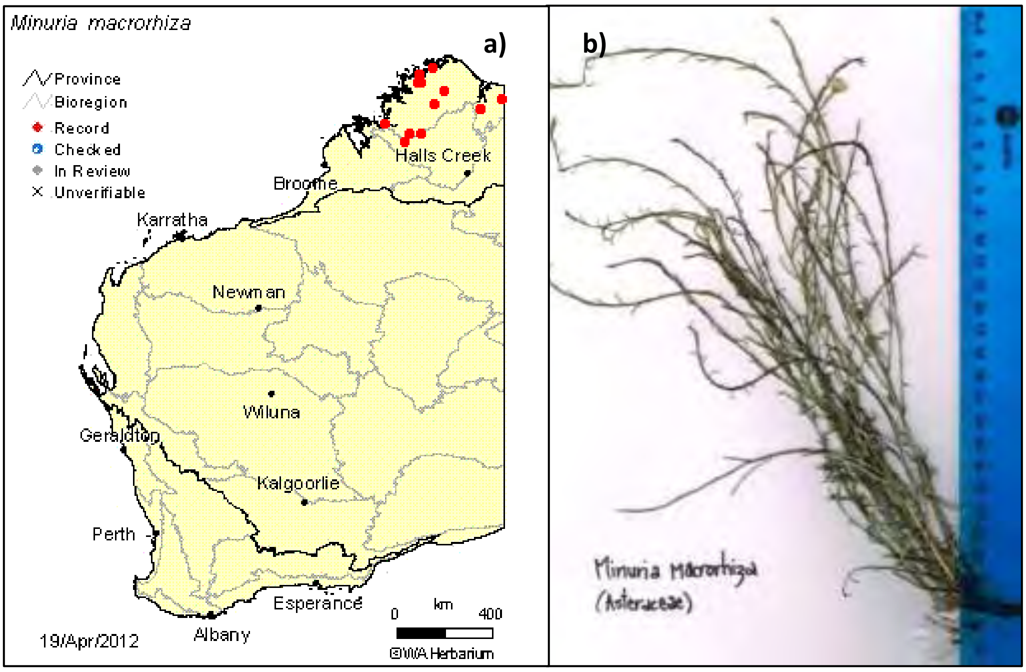
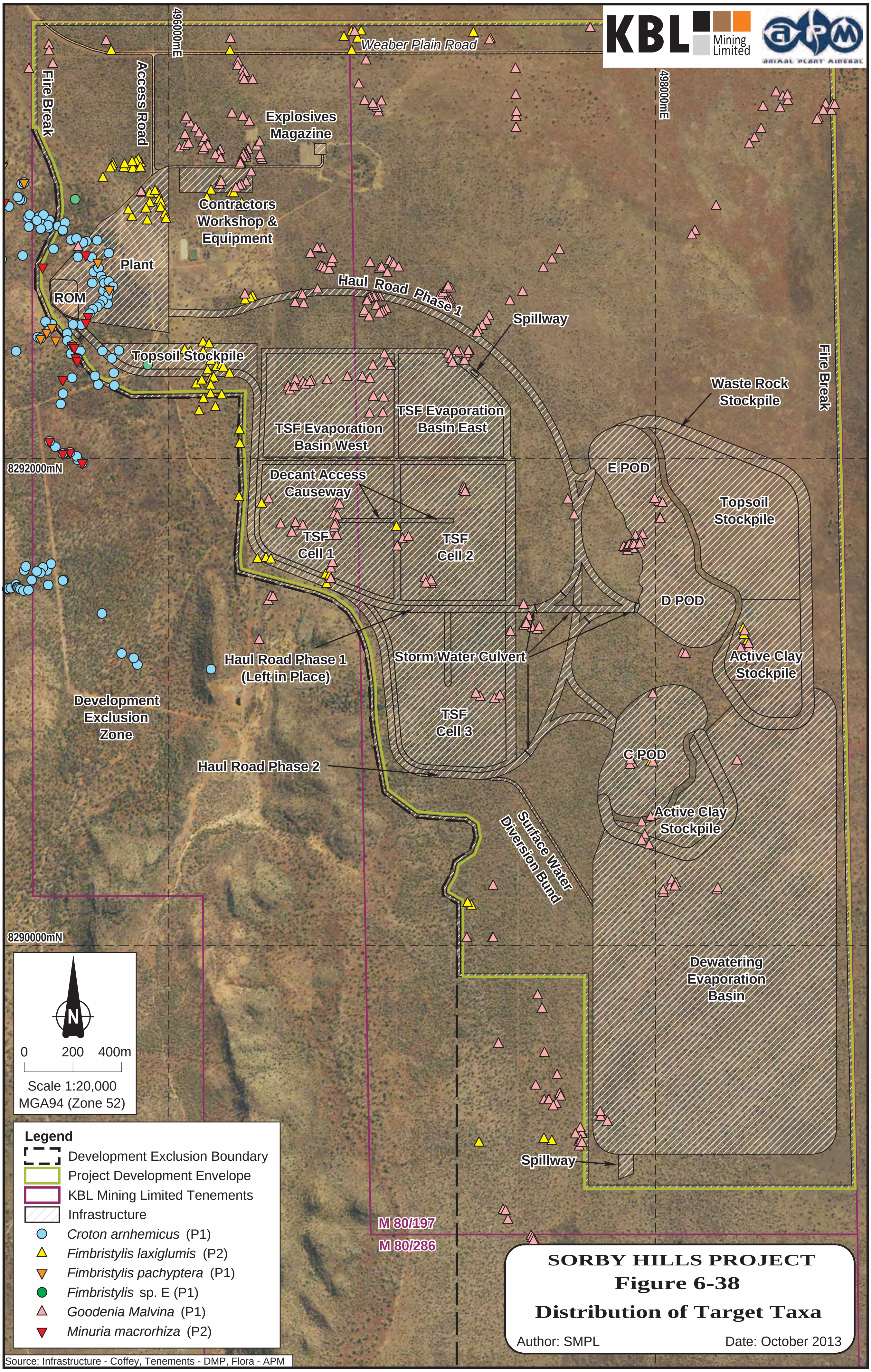


Plate 6-14: *Minuria macrorhiza*
a) Distribution in WA (image from FloraBase 2012)
b) Mature example (photo taken of specimen found within the proposed plant site).

Further information relating to conservation significant flora of the Project Area and the botanical survey work undertaken is provided in Appendix 23 (Volume 3).



SORBY HILLS PROJECT

Figure 6-38

Distribution of Target Taxa

Author: SMPL   Date: October 2013

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_638.dgn

6.1.8.7 Vegetation Condition

An assessment of the condition of the vegetation was also undertaken during the baseline survey. The methodology of Keighery (1994) was used as the basis for the condition rating. The overall condition of the vegetation within the survey area ranged from Excellent to Completely Degraded (Figure 6-39). The main impacts to the vegetation were from weeds, grazing, old earthworks and vehicular disturbance.

Cattle appeared to favour low-lying areas, despite the fact that the upland areas were accessible to them. Much of the upland country away from vehicle tracks remained undisturbed and was deemed to be in 'Excellent' condition. Most of the lowland country was quite heavily grazed; however the high productivity of the 'black soil' clays appeared to make the vegetation resilient to trampling, grazing and weed invasion and the majority of this vegetation was rated 'Very Good'.

One lowland area from which cattle had been excluded was deemed to be in 'Excellent' condition during the March 2011 survey. However, on a subsequent assessment in June 2011, following mustering, the condition had degraded to 'Poor'. A valley system in the south west of the survey area and woodland at the north west extent of the proposed plant site (Figure 6-39) had been invaded by the large weeds *Sida acuta, Sida cordifolia* and *Hyptis suaveolens.* Nevertheless, these areas retained their original structure and a substantial number of native species, and were therefore rated 'Good'.

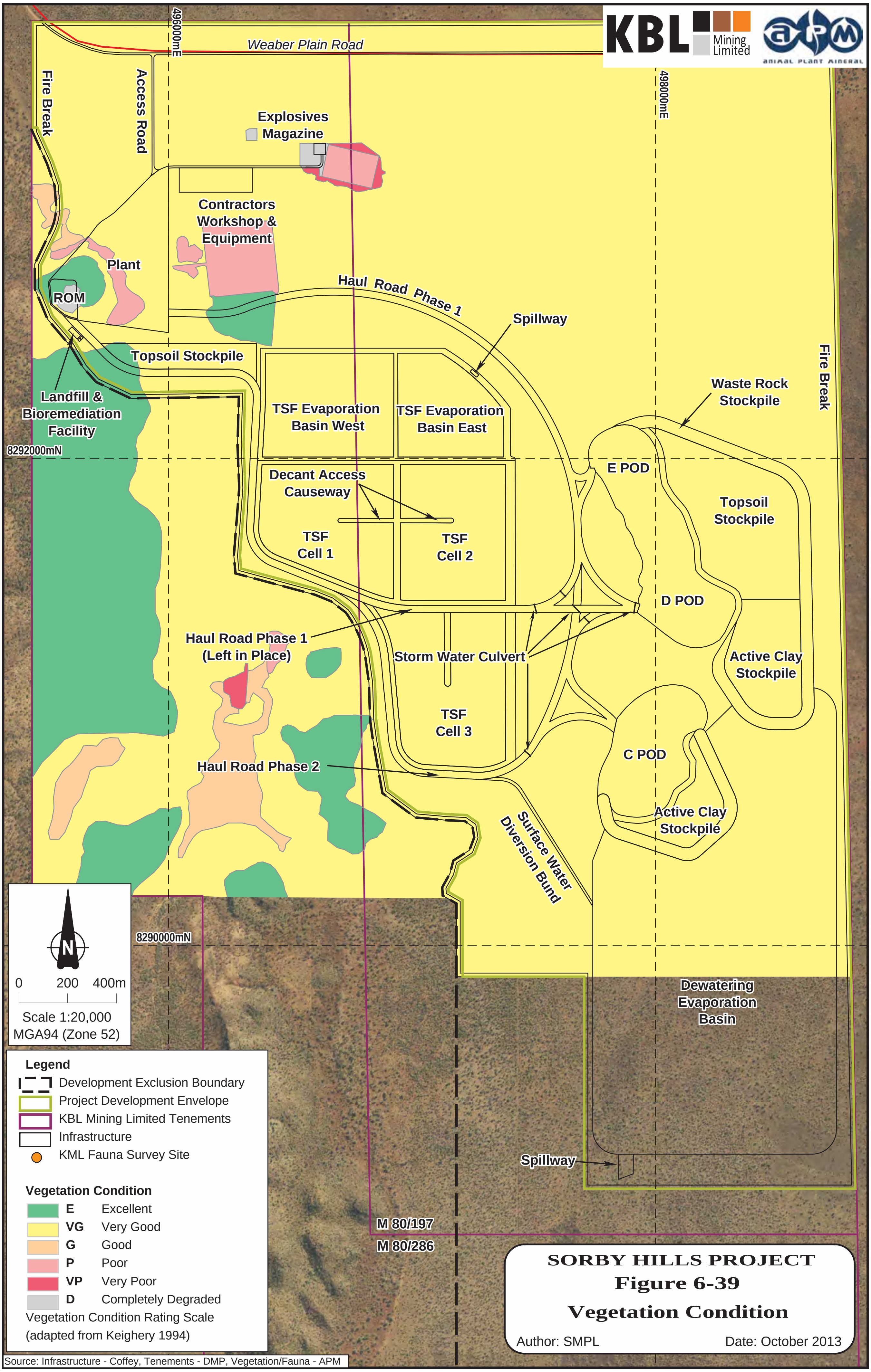
Historical earthworks for a dam in the area corresponding with the proposed contractors workshop (Figure 6-39), and a pit, located adjacent to the east of the proposed explosives magazine, had permanently altered the natural substrate and vegetation structure allowing weeds such as *Calotropis procera* to become subdominant. Around the historic coring pad and area currently used intermittently as a drovers' campsite, which corresponds with the proposed ROM and plant site (Figure 6-39), *Hyptis suaveolens* dominated the understorey. These three areas were rated 'Poor'. A few patches of ground had been cleared for infrastructure such as dams and lay down areas and were virtually free from vegetation. These were rated 'Completely Degraded'.

In total, 31 introduced (weed) species were identified in the Project Area including three that are listed by DAFWA as Declared Plants for the SWEK. The 31 identified weed species are listed in Table 6-12.

Table 6-12: Weed Species found in the Sorby Hills Project Area

Weed Species	
Aerva javanica	*Gomphrena celosioides*
Alysicarpus vaginalis	*Hyptis suaveolens*
Bidens bipinnata	*Macroptilium lathyroides*
Calotropis procera	*Malvastrum americanum*
*Cardiospermum halicacabum*var. *halicacabum*	*Melochia pyramidata*
Citrullus lanatus	*Mitracarpus ?hirtus*
Corchorus olitorius	*Myriophyllum* sp.
Crotalaria juncea	*Passiflora foetida*
Cucumis melo	**Senna obtusifolia*
Cynodon dactylon	**Sida acuta*
Digitaria ciliaris	**Sida cordifolia*
Echinochloa colona	*Sporobolus jacquemontii*
Emilia sonchifolia	*Stylosanthes hamata*
Eragrostis minor	*Tribulus terrestris*
Euphorbia hirta	*ridax procumbens*
Vachellia farnesiana	

* Denotes weeds listed by the DAFWA as Declared Plants for SWEK



SORBY HILLS PROJECT
Figure 6-39
Vegetation Condition

Author: SMPL
Date: October 2013

6.1.9 Fauna

The fauna surveys carried out for the Project by APM in 2011 were designed to meet the criteria of a Level 2 survey as defined by the EPA *Guidance Statement No. 56 - Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* and *EPA Guidance Statement 54A – Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia* (EPA 2004). The fauna surveys and their relevant reports include the following:

- Terrestrial fauna assessment describing non-volant (flightless) vertebrate fauna species (Appendix 24, Volume 3)
- Ornithological assessment describing all avifauna species (Appendix 25, Volume 3)
- Echolocation survey describing bat species (Appendix 26, Volume 3)
- Subterranean fauna assessment describing stygofauna and troglofauna species (Appendix 27, Volume 3)

The likelihood of SRE invertebrate fauna occurring in the Project Area was considered in accordance with *EPA Guidance Statement No. 20 - Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia (EPA 2009).* A broad habitat assessment conducted at the inception of the Project showed that the area could be divided into two habitat types; the upland sandstone of the Sorby Hills and the cracking clay floodplain of the Knox Creek Plain. The only fragmented habitat present in the Project Area is two isolated patches of monsoon vine thicket in the Sorby Hills and the Project has been designed in such a way as to leave the sandstone hills and the monsoon vine thickets undisturbed. The impact footprint will occur on the dominant habitat type of the area; the cracking clay floodplain. This habitat is continuous both to the east, north and south of the Project Area. Additionally, the impact area does not intersect any creek lines or limestone outcrops. Due to the obvious lack of discontinuous or disjunct fauna habitat types that may promote endemism it was determined that no survey work for SRE invertebrate fauna was required. This approach was discussed and approved by the DPaW Environmental Management Branch in March, 2011 (pers comm. Brad Durrant).

Sampling for non-volant terrestrial vertebrate fauna and echolocation surveys for bat species were undertaken on three occasions, from April to late May 2011. Nineteen days were spent in the field resulting in a total of 2938 trap nights. Ornithological assessments were undertaken for nine days in April and November 2011 to ensure adequate sampling of *EPBC Act* listed Threatened and Migratory bird species. The Project specific field data was supplemented with data from a further 23 collection events carried out by APM in the area between the period of May 2009 and November 2011. The location and objectives of these collection events are presented in Table 6-13.

Table 6-13: Summary of Fauna Surveys Conducted in Sorby Hills Area (not including the current surveys)

Environmental Consultants	Area Surveyed	Scope of Survey	Year of Survey
APM	Ord Expansion & M2 Project Area encompassing the Keep River floodplain and adjacent parts, Spirit Hills station, Knox Creek Plains, Weaber Plains, Carlton Plains, Mantinea Flats and the Ivanhoe/West Bank area.	Broad scale survey	2009
HLA Envirosciences (HLA)		Follow up of Ecologia 1996 survey specifically targeted at the herpetological component	2005
Kinhill		Broad scale survey	1999
Ecologia		Broad scale survey	1996

6.1.9.1 Fauna Species Richness, Abundance and Diversity

The Kimberley is regarded as being a *National Biodiversity Hotspot* with 230 plant, 16 fish, 10 frog, 31 reptile, 2 bird and 6 mammal species known to be endemic to the region (McKenzie *et al*. 2009).

Database searches reveal significant variation in the known species richness in different areas around the east Kimberley, highlighting the limited historical survey work undertaken in the area. Up to 509 vertebrate species are known to occur in the region; however, only 310 species have been reported for the localised area around Sorby Hills. A very high proportion of these species are birds.

Approximately 134 species of reptiles, amphibians and non-volant mammals are expected to occur in the Project Area based on previous studies, database searches and known habitat requirements. This represents approximately 45 % of the known reptiles, amphibians and mammals known to occur across the region (McKenzie *et al*. 2009), and is a reasonable estimate of expected occurrence or species richness given that the Project Area does not include large areas of rugged and heavily dissected ranges.

Tributaries associated with Keep River and Knox Creek would support at least 15 species of freshwater fishes (mainly catfishes, grunters and gudgeons). However, database searches did not reveal any species that have been previously collected in the artificial or temporary water bodies that occur locally in the Sorby Hills area.

A total of only 25 reptile, 15 amphibian, eight non-volant mammal fauna and ten bats were trapped or recorded during the Project specific Sorby Hills 2011 survey. Table 6-14 shows richness and abundance of fauna collected over all of the relevant surveys in the local area and therefore provides a more accurate reflection of the number of species that may occur in the Project Area. No data were available for fish.

Table 6-14: Richness and Abundance for Fauna Trapped in the Local Area

	NatureMap	Sorby	Packsaddle	Mantinea	Westbank	Ecologia	Kinhill	HLA
Richness								
Non-volant Mammals	8	8	7	4	5	10	0	N/A
Amphibians	21	15	12	8	6	13	4	15
Reptiles	63	25	22	17	21	47	14	44
Abundance								
Non-volant Mammals	Abundance not recorded by NatureMap	18	37	18	14	0	0	N/A
Amphibians		370	386	164	49	91	27	266
Reptiles		160	119	124	102	157	56	423

The abundance of frog fauna captured at Sorby Hills was relatively high compared to the other sites sampled, with the 370 individual records surpassed only by the number of individuals captured at Packsaddle by APM in 2009. The survey undertaken at Sorby Hills has added two new frog species records for the Sorby Hills area; the Northern Spadefoot Toad *Notaden melanoscarphus* and the Black-shinned Rocket Frog *Litoria tornieri.* The *L. tornieri* record also represents a new species for the local region.

The number of reptiles captured was very high compared to other sites, with only HLA catching more individuals. However, the comparison with HLA is not specifically relevant as the results from this survey mostly came from opportunistic sampling and not from the trapping sites. Seven new species were recorded for the Sorby Hills area and *Suta punctata* and *Gehyra koira* were also new records for the local region.

Three species of freshwater turtle are known from the area and one of these, *Emydura australis*, is restricted to the Kimberley – Victoria River Region. Described as poorly known, *Emydura australis* was easily captured in Packsaddle Creek in 2009 and so is expected to be relatively common in Knox Creek and the upper reaches of the Keep River.

A large number of mammal species that were expected to occur based on historical records were not captured. However, the mammal species richness recorded at Sorby Hills exceeded the richness recorded at Packsaddle, Mantinea and West Bank. *Sminthopsis macroura* constituted a new species record for the area. The bat survey identified ten insectivorous species as present within the study area (Appendix 26, Volume 3). It was determined that nine of the species are relatively common in the eastern Kimberley Region. The tenth species, the Pygmy Long-eared Bat *Nyctophilus walker* is at the edge of its range and is not normally recorded. This species is not listed as being of conservation significance under current legislation. However, populations have declined in the area due to the destruction, by cattle, of roosting habitat which comprises pandanus thickets. The Pygmy Long-eared Bat feeds on insects whilst flying low over water bodies and would be utilising the dams and lagoons in the Project Area as foraging areas.

The overall results of the Project specific ornithological survey provided a total record of 113 species; this figure is slightly lower than anticipated when comparing the size and structure of the Project Area to similar areas. The majority of the species recorded during the survey have been recorded in surrounding areas, with 81 % of the species identified during the current survey found in five or more other locations considered and reported in the APM (2012) Ornithological Survey Report (Appendix 25, Volume 3).

The bird assemblages recorded in the Project Area are representative of those communities that would inhabit similar habitats elsewhere. There were no habitats or microhabitats in the proposed impact area that are not well represented elsewhere in the east Kimberley Region, other than the two small patches that may be described as 'Monsoon vine thickets of limestone ranges'. These thickets are not proposed to be disturbed and are located west of the Development Exclusion Boundary.

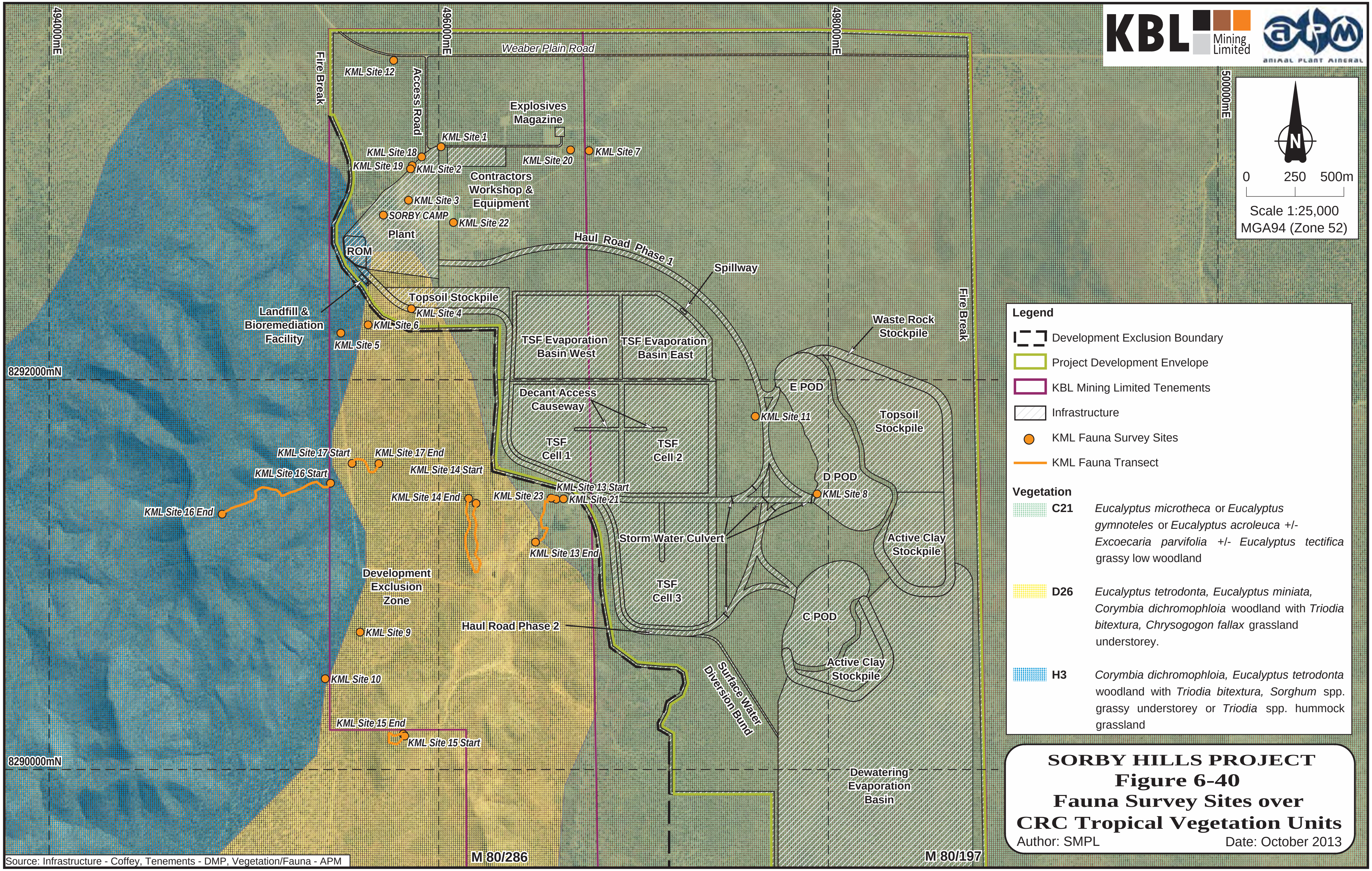
The Sorby Hills area provides some important fresh water bodies for a number of species. Twenty-eight species of waterbird were recorded during the survey despite the fact that three of the four water bodies are artificial (e.g. cattle yards, the Sorby Hills dam).

6.1.9.2 Fauna Habitat Value

The Sorby Hills area can be divided into three distinct fauna habitats; cracking clay floodplain, the elevated sandstone slopes and the pediment. The pediment occurs in the foothills and is an interzone between the sandstone slopes and the floodplains. The value of these habitats to the fauna that utilise them was assessed by analysing the species assemblages and assigning each trapping site to either the floodplains, pediment or sandstone slopes (Table 6-15).

A total of 23 fauna survey sites were sampled at Sorby Hills across a variety of habitats relating to the CRC Tropical Vegetation Units (Figure 6-40). However, only eleven sites provide the type of systematic data (trapping data) required to calculate fauna assemblage indices. Table 6-15 ranks the 11 sites in relation to fauna species richness, abundance and diversity. This ranking was used as a surrogate to assess the habitat values of the sites for terrestrial vertebrate fauna. Site species richness, abundance and diversity were scored, ranked and summed to identify the most valuable fauna sites in the Sorby Hills (Table 6-16).

Drawn: CAD Resources ~ Date Oct 2012 ~ A4 ~ CAD Ref g2004_PER_S6_640.dgn



SORBY HILLS PROJECT

Figure 6-40

Fauna Survey Sites over CRC Tropical Vegetation Units

Author: SMPL Date: October 2013

Table 6-15: Site Rankings Based on Ecological Indices

Site and Environment Type	Richness	Site and Environment Type	Abundance	Site and Environment Type	Diversity
Site 7 Cracking Clay	15	Site 7 Cracking Clay	80	Site 3 Cracking Clay	2.40
Site 4 Pediment	14	Site 4 Pediment	70	Site 7 Cracking Clay	2.17
Site 2 Cracking Clay	12	Site 3 Cracking Clay	56	Site 2 Cracking Clay	2.15
Site 6 Pediment	12	Site 6 Pediment	47	Site 6 Pediment	2.13
Site 3 Cracking Clay	12	Site 2 Cracking Clay	37	Site 11 Cracking Clay	1.87
Site 1 Cracking Clay	10	Site 8 Cracking Clay	25	Site 4 Pediment	1.80
Site 8 Cracking Clay	8	Site 11 Cracking Clay	24	Site 8 Cracking Clay	1.78
Site 11 Cracking Clay	8	Site 1 Cracking Clay	19	Site 10 Elevated Sandstone	1.61
Site 10 Elevated Sandstone	5	Site 9 Elevated Sandstone	9	Site 9 Elevated Sandstone	1.21
Site 9 Elevated Sandstone	4	Site 10 Elevated Sandstone	5	Site 1 Cracking Clay	1.04
Site 5 Elevated Sandstone	2	Site 5 Elevated Sandstone	2	Site 5 Elevated Sandstone	0.69

Table 6-16: Habitat Values

Site and Environment Type	Habitat value
Site 7 **Cracking Clay**	32
Site 3 **Cracking Clay**	29
Site 4 **Pediment**	26
Site 2 **Cracking Clay**	25
Site 6 **Pediment**	25
Site 8 **Cracking Clay**	16
Site 11 **Cracking Clay**	16
Site 1 **Cracking Clay**	12
Site 10 **Elevated Sandstone**	9
Site 9 **Elevated Sandstone**	8
Site 5 **Elevated Sandstone**	3

Based on the survey results, Site 7 was deemed to have the highest fauna habitat value of all the sites sampled across the Project Area. Despite supporting vegetation and soils representative of the floodplain habitat, Site 7 was a very disturbed site that had once been a mining decline; flora was a mix of exotics, native disturbance opportunists and the typical cracking clay woodland species. Nevertheless, the vegetation was in excellent condition as cattle had been excluded from the area, resulting in a notable increase in tussock grasses (Plate 6-8 and Figure 6-40). The presence of a permanent water body adds to the habitat value of the site and contributes to the overall species richness. Site 7 most accurately represents the fauna assemblages of the broad floodplains in the absence of disturbance created by cattle. With the exception of Sites 4 and 6, all of the sites with the highest habitat value ranking occurred on cracking clay soils.

Sites 4 and 6 represented a pediment habitat that occurs between the foothills of the sandstone ranges and the floodplains. Interzone habitats, such as pediments, are generally considered very valuable to fauna species as greater habitat heterogeneity supports greater species richness per unit area. The trapping results and calculated habitat value of Site 4 were possibly greatly influenced by very low intensity of cattle impact at the site; trapping lines were located on a fence line on one side of which cattle were excluded (Plate 6-6).

Sites 5, 9 and 10 were located in the complex and hetrogenous sandstone ranges that were expected to support a high diversity and species richness. The woodlands of the sandstone hills provided an abundance of fauna microhabitats. The soil profile comprised brown and grey loamy sands, sandy loams and clay loams on flat or gently sloping country ideal for burrowing species, and the abundant over storey vegetation contributed to very well developed detrital and litter piles around the base of large trees (Plate 6-3).

Despite the diversity of microhabitats and utility of the soil profile this environment returned the lowest species richness and diversity. However, trapping at these sites revealed a number of highly cryptic species that are not frequently recorded and were not recorded at any other sites. These included the Little Spotted Snake *Suta punctata* and the Northern Shovel-nosed Snake *Brachyurophis roperi*.

6.1.9.3 Non-Volant Fauna Species of Conservation Significance

Rare or specially protected fauna are not often recorded during single survey events, so their presence and significance can usually only be appreciated in a regional context. The current survey at Sorby Hills and previous surveys in the local region reveal that of all the recorded species only 12 terrestrial fauna species are listed under the following three ranks of conservation significance:

- Conservation Significance 1: Commonwealth or State Listed
- Conservation Significance 2: DPaW Priority Fauna
- Conservation Significance 3: Locally or Regionally Significant

Though not all of the above categories provide statutory protection to the fauna listed, all fauna listed under these categories are included in Table 6-17, as they represent poorly understood fauna known to occur in the region.

Table 6-17: Fauna of Conservation Significance

Level of Conservation Significance	Sorby Hills	Ecologia	HLA	Kinhill	APM
Conservation Significance 1 – Commonwealth or State Listed					
Freshwater Crocodile, *Crocodylus johnstoni* – Other matters EPBC and WA		✓			✓
Conservation Significance 2 – DPaW Priority Fauna					
Short-tailed Mouse, *Leggadina lakedownensis* – Priority 4					✓
Cryptoblepharus exochus – Priority 4					
Conservation Significance 3 – Locally or Regionally Significant					
Ningbing Pseudantechinus, *Pseudantechinus ningbing*		✓			
Long-tailed Planigale, *Planigale ingrami*	✓	✓			✓
Dusky Rat, *Rattus colletti*		✓			
Ctenotus tantillus		✓	✓		✓
Northern Spadefoot Toad, *Notaden melanoscaphus*	✓	✓	✓		✓
Northern Toadlet, *Uperoleia borealis*	✓	✓			✓

Conservation Significance 1 – Commonwealth or State Listed

One species of Conservation Significance 1, the Freshwater Crocodile *Crocodylus johnstoni* has been recorded within and nearby the Project Area. Freshwater Crocodiles occur only in freshwater environments such as rivers, streams and billabongs. They eat a range of fish, crustaceans, insects, reptiles, amphibians and birds.

This species is present in the upper reaches of the Keep River and almost certainly present along the greater extent of the Knox Creek, in close proximity to the Project Area. There is a possibility that individuals could enter the Project Area during the extensive flooding of the wet season. When the water retracts individuals may remain in some of the man-made water bodies where they will continue to prey on trapped aquatic food. When the food source is depleted they are capable of moving long distances over land to find new wetland habitats to occupy.

As the quality of the water leaving the Project Area and potentially draining into both Knox Creek and Keep River will be actively managed, there is very little potential for impact on this species.

Conservation Significance 2 – DPaW Priority Fauna

The Short-tailed Mouse *Leggadina lakedownensis* is listed as Priority 4 by the DPaW, in WA. A total of 179 individuals have been lodged with the WA Museum but none of these have been lodged from the Kimberley in the last 10 years. However, this may only reflect the lack of collection through lack of survey work in the area. The Short-tailed Mouse is generally regarded as occurring in low population densities when compared with other rodents. This makes it vulnerable to disturbance and predation. Moro (2001) also details that this species suffers impact arising from competition with the House Mouse *Mus musculus*. The single capture of this species during the survey of Mantinea Plain in 2009 gives little indication of the distribution of this species across the Ord River flood plains. The habitat from which it was recorded was badly degraded cracking clay with sparse

Bauhinia woodland. The potential threat of the Project will be to the few individuals that occur on site.

Cryptoblepharus exochus is likely to occur in the Project Area when considering its restricted geographical range and habitat; floodplains on the border region of far north western NT and far north eastern WA (Horner 2007). *C. exochus* was only recently recognised as a distinct species. In 2007 the genus *Cryptoblepharus* underwent a major taxonomic revision and increased from 6 to 25 recognised taxa. During this revision *C. exochus* was one of the species to be split from *C. carnabyi*. Due to this recent split earlier surveys will not have recorded this species, but both HLA and Kinhill have recorded *C. carnabyi*.

Conservation Significance 3 – Locally or Regionally Significant

The highest number of conservation significant fauna recorded during the Sorby Hills survey fall within the group of locally or regionally significant fauna. These species either have a distribution restricted to the Kimberley such as the Ningbing Pseudantechinus, *Pseudantechinus ningbing* and the *Ctenotus tantillus*, or their distribution in WA is restricted to a few populations within the Kimberley, e.g. Dusky Rat *Rattus colletti*.

The Ningbing Pseudantechinus is associated with rocky habitats and occurs in limestone and sandstone outcrops in a variety of vegetation associations, while the *Ctenotus tantillus* occurs in pediment habitat adjacent sandstone outcrops. The habitat of both species will be protected by the creation of the Development Exclusion Zone around the Sorby Hills.

The Northern Toadlet *Uperoleia borealis* is regarded as being locally or regionally significant. Tyler (1997), reports that this species is confined to the east Kimberley, though populations probably spread more broadly into the NT. This species was one of the most locally abundant species in the Sorby Hills area, and was similarly common in the Packsaddle Project Area.

To date the Dusky Rat *Rattus colletti* has not been recorded in WA. The records nearest the Sorby Hills area belong to Ecologia (1997) who collected their specimens just across the NT border in the Keep River Region.

The Northern Spadefoot Toad and the Long-tailed Planigale *Planigale ingrami* both mainly occur in the floodplain habitat. Their distribution range extends throughout the Ivanhoe Land System and the clearing of 573 ha of cracking clay habitat in the Project Area will result in a habitat reduction of approximately 0.5 % within WA (see section 6.1.9.2). However, both species utilise additional habitat, therefore the overall suitable habitat reduction will be even less.

6.1.9.4 Bats

Ten insectivorous species have been identified as present within the Project Area. It was determined that nine of the species are relatively common in the eastern Kimberley Region. The tenth species, the Pygmy Long-eared Bat (*Nyctophilus walkeri*) is at the edge of its range and is not normally recorded. This species is not listed as being of conservation significance under current legislation; however, populations have declined in the area due to the destruction, by cattle, of roosting habitat which comprises pandanus thickets. The Pygmy Long-eared Bat feeds on insects whilst flying low over water bodies and would be utilising the dams and lagoons in the Project Area as foraging areas.

6.1.9.5 Avifauna

Ornithological survey work provided a total of 113 species. When considering the avifauna assemblage of areas directly adjacent to the Project Area it is reasonable to expect that the avifauna species richness for Sorby Hills is approximately 149 species The majority of the recorded species are common in the surrounding areas, with 81 % of the species identified at Sorby Hills found in five or more survey locations in the local region.

Systematic surveys were conducted to determine whether or not Sorby Hills provided an avifauna habitat that was of significantly better quality than the habitat of the Weaber Plain 'buffer zone' in the ORIA or Parry Lagoons. When comparing the three areas Sorby Hills supported marginally lower avifauna diversity than Weaber Plain, while Parry Lagoons had significantly higher avifauna diversity than the other two areas. As a designated nature reserve Parry Lagoons was expected to have a higher diversity value due to active land management strategies dedicated to the conservation of flora and fauna.

6.1.9.5.1 Avifauna of Conservation Significance

Of the 18 EPBC listed species with the potential to occur in the Project Area only five species were recorded:

- Gouldian Finch *Erythrura gouldiae* (Endangered)
- Rainbow Bee-eater *Merops ornatus* (Migratory)
- Cattle Egret *Ardea ibis* (Migratory)
- Eastern Great Egret *Ardea modesta* (Migratory)
- Magpie Goose *Anseranas semipalmata* (Other Matters)

Additionally, two species listed as Priority 4 by the DPaW were recorded:

- Australian Bustard *Ardeotis australis*
- Bush Stone-curlew *Burhinus grallarius*

Gouldian Finch

Three Gouldian Finches, *Erythrura gouldiae*, were recorded at the base of the Sorby Hills within the Project Area during the 2011 surveys, suggesting that similar flocks of Gouldian Finches could occupy other foothills in the local area.

Gouldian Finches are distributed throughout WA in the north Kimberley, south to Beagle Bay, Oobagooma, King Leopold Ranges, middle of the Durack River, Dunham River and Lake Argyle. They can also be found further south, for example in Derby and Louisa Downs. Gouldian Finches are also distributed throughout the north of the NT and the north of QLD. They are generally classed as moderately common in the northern, central and eastern Kimberley and the lower Ord drainage area, but are uncommon or scarce in most of the southern Kimberley (Johnstone and Storr 2004).

The ecology and breeding biology of the Gouldian Finch is relatively well known and many aspects of the biology of the species have been published in peer reviewed journals (Brazill-Boast *et al.* 2010; Tidemann and Woinarski 1994; Tidemann *et al.* 1992; Tidemann *et al.* 1999).

Gouldian Finches prefer a habitat of grassy open forests and woodlands that are near to drinkable water. Breeding individuals prefer stony hills supporting *Eucalyptus* and *Corymbia* species, where trunks and stems form hollows suitable for nesting. Gouldian Finches feed on ripe and unripe small seeds of *Sorghum plumosum*, *Eriachne obtusa*, *Eragrostis* sp. and spinifex. They also feed on invertebrates, such as flying termites and small spiders.

Nesting takes place from February to August depending on the region and seasonal rainfall, and may occur in small colonies with several breeding pairs in close proximity.

The Gouldian Finch is most easily observed in the late dry season when it congregates around remnant water holes, though it can be recorded at any time of the year.

The entire design and layout of the Project has been structured around maintaining the required habitat for the Gouldian Finch, with the Development Exclusion Boundary and resulting Development Exclusion Zone allowing quality breeding habitat in the foot hills of the Sorby Hills to remain undisturbed.

A number of existing permanent freshwater sources in the Project Area will remain undisturbed. Baseline water quality of these existing wetlands was recorded in July 2012, and modelling predicts no potential for a decline in water quality as a result of the Project (see Appendices 28 and 29, Volume 3).

The nomination of Pincombe Range as the GRCP under the Ord Final Agreement Native Title Agreement has greatly enhanced the representation of breeding habitat in conservation reserves. The reserve holds 10,585 ha of suitable Gouldian Finch breeding habitat (Shedley 2012). As part of the ORIA – Weaber Plain Project, the Weaber Plain area will also have 10,805 ha set aside as a buffer zone and conservation area. The primary purpose of this development exclusion was to increase breeding and feeding habitat, and movement corridors, for Gouldian Finch.

Within the 1782 ha of the SMPL lease areas (M80/197 and M80/286), only 573 ha are going to be impacted and therefore 67 % will be retained. SMPL will be destocking the area and burning will be managed. All of this remaining habitat will comprise valuable feeding habitat for the finches. There is expected to be little or no impact on breeding habitat and species specific environmental management of the Project and surrounding leases may result in a net positive impact on the feeding habitat for this species.

Rainbow Bee-eater

The Rainbow Bee-eater (*Merops ornatus*) is moderately common to common in open woodland and near water. Though classified as migratory, not all individuals of the species migrate. Those that do, start arriving in late September and leave in April. Birds that are resident breed throughout the dry season often in dirt banks along roads, rivers and dunes. They hawk insects over grasslands from perches in nearby trees.

Rainbow Bee-eaters were recorded at 19 locations throughout the Project Area during the 2011 surveys of Sorby Hills, 81 individuals were recorded in total. More than 1000 records of this species have been made by APM ornithologists in the region between 2009 and 2011.

Potential nest sites may be impacted where clearing and construction occurs around the sandy banks of drainage lines or where loamy banks of existing dams are disturbed. However, the safety bunds created around the haul roads may create additional nesting habitat through the provision of sandy/loamy banks in which this species digs nest burrows. The commonality and broad distribution of the Rainbow Bee-eater means that populations of the species are not likely to be impacted by the Project.

Cattle Egret

The Cattle Egret (*Ardea ibis*) is classed as a migrant, as it was originally from Asia. In reality, the species is actually now a resident in the Kimberley, breeding in big numbers. The species often feeds with cattle, eating insects disturbed by the cattle as they graze. The Cattle Egret can also be seen feeding in fresh water environments if conditions are favourable and frogs and tadpoles are abundant. This species can be present at all times of the year and they generally roost communally in colonies.

Thirty-one individuals were recorded during two surveys of Sorby Hills in 2011. Seventy-four individuals were also recorded over two surveys of the Weaber Plain in 2010 and a further 28 individuals were recorded at Packsaddle and Mantinea Plains and West Bank in 2009.

The Cattle Egrets observed during the 2011 surveys were recorded in the inundated grasslands near larger water sources associated with the cattle yards. It is likely that these individuals would retreat to and forage around these water bodies as the flooding in the grasslands recedes. The Project will have an impact on the amount of flooded grassland feeding habitat remaining. However, most of the near permanent water sources will remain undisturbed and new ones are proposed to be created providing late dry season refuge for this species. It is possible that the exclusion of cattle could lead to an increase in the quality of flooded grassland that may offset the small areas that are cleared for mining and construction.

Eastern Great Egret

Eastern Great Egret (*Ardea modesta*) are classified as migratory but there is little evidence to support this. It can be present at all times of year in fresh and saltwater environments. Towards and during the end of the wet season numbers peak as the water levels begin to recede.

The Eastern Great Egret was recorded by APM in 2009 at three nearby survey areas as part of the ORIA – Weaber Plains Project. An additional 32 individuals were recorded at Packsaddle and Mantinea Plains and at West Bank in 2009 and a further 24 individuals were recorded on three occasions on the Weaber Plain in 2010. However, only three individuals were recorded during the 2011 Sorby Hills surveys. The Eastern Great Egret seems omnipresent in low numbers wherever there is suitable habitat across the Ord River floodplains.

There are a number of man-made near-permanent water sources across the Project Area. The individuals recorded during the field surveys were located in the inundated grasslands near to larger water sources associated with the cattle yards. It is likely that these individuals would retreat to and forage around these water bodies as the flooding in the grasslands recedes. The Project will have an impact on the amount of flooded grassland feeding habitat remaining. However, most of the near permanent water sources will remain undisturbed providing late dry season refuge for this species. Active management of existing man-made water bodies or wetlands within the Project Area could also increase the habitat value of the area for Eastern Great Egret.

The Project is not likely to negatively impact the Eastern Great Egret. Rather there may be a net-positive impact on this species through the exclusion of cattle and reduction of wildfires, which together may offset the small areas that are cleared for mining and construction.

Magpie Goose

The Magpie Goose (*Anseranas semipalmata*) is more nomadic than migratory. In recent years birds tagged in Kununurra have been recovered near Darwin. Tens of thousands can be seen along the Ord River and in Lake Argyle. Fifty-one individuals were recorded during the 2011 Sorby Hill surveys, while only one individual was recorded during the adjacent Weaber Plain 2010 survey.

This species will often loaf around at roost sites and feed at night in flooded areas. It is usually associated with freshwater environments, though more recently it has been observed feeding in mangroves if the time of year is suitable. Peak numbers would be expected late in the dry season when breeding and nesting can be observed.

The Project will have an impact on the amount of flooded grassland feeding habitat remaining. However, most of the near permanent water sources will remain undisturbed providing late dry season refuge for this species. Active management of existing man-made water bodies or wetlands within the Project Area could increase the habitat value of the area for the Magpie Goose. The Project is not likely to negatively impact this species.

Australian Bustard and Bush Stone-curlew

The Australian Bustard (*Ardeotis australis*) inhabits the grasslands and savanna woodlands of Sorby Hills. The Australian Bustard is a partially nomadic species and will cover large distances to follow available food. The species is widespread throughout the Kimberley; however there has been a steady decline in numbers attributed to a combination of factors such as hunting, altered fire regimes and grazing.

The Bush Stone-curlew (*Burhinus grallarius*) can be found in the open woodlands and around the freshwater bodies on Sorby Hills. It is considered to be a sedentary species and generally lives in pairs or loose flocks. Unlike most birds, this species hides during the day in grass or low shrubs and feeds at night, looking for seeds, insects, spiders and small frogs and reptiles. The main factors threatening this species are feral predators and loss of habitat.

The Australian Bustard and Bush Stone-curlew were both recorded during the Sorby Hills 2011 surveys, the adjacent Weaber Plain 2010 survey and the Keep River 2010 survey. It is possible that a few individuals of both the Australian Bustard and the Bush Stone-curlew might suffer local displacement, but the overall population is not expected to be impacted by the Project as they are transient species.

6.1.9.6 Cane Toads

The proposed Project will include the creation of surface water bodies, in addition to those that already exist on the site. The Cane Toad (*Bufo marinus*) was observed in large numbers during the field surveys.

Since their introduction into Australia, Cane Toads have spread throughout much of QLD, northern NSW and northern parts of the NT, impacting on native fauna, agriculture and social and cultural values along the way. The movement of the Cane Toad invading front has increased in pace over time, with the front now moving at an average rate of approximately 55 km a year (Phillips *et al.* 2007). The first Cane Toads crossed the NT-WA border in February 2009 (Western Australian Government 2009) and as of December 2011 the Cane Toad frontline was at a position west of the Great Northern Highway (Kimberley Toad Busters 2011) and they are now well established in the region. Cane toads were first observed in the Sorby Hills area in March 2010. The Government of WA has funded a range of innovative and ground-breaking programs including a field-based Cane Toad surveillance and response team, biological surveys, strengthened quarantine measures, awareness campaigns, free-call Cane Toad hotline, Cane Toad drop off points and funding research programs to find longer-term solutions for the control of Cane Toads. Despite the above efforts, the westward movement of Cane Toads to the Kimberley has continued and it is now clear that this movement cannot be stopped using any of the methods currently available.

Cane Toads can live in a variety of environments, but they are dependent on fresh water bodies for breeding. The local area around Kununurra is rich in water sources with approximately 300 km of irrigation and drainage channels in the ORIA Stage 1 and Lakes Argyle and Kununurra covering a combined area of 117,495 ha. The ORIA – Weaber Plains Project is about to progress and this will include a similar length of irrigation channels to Stage 1.

Given the proliferation of naturally occurring water in the Kununurra area and the increase in year round surface water due to the water carrying channels and consistent irrigation of the ORIA – Weaber Plains Project, it is not envisioned that water bodies in the Project Area will significantly contribute to the proliferation of Cane Toads in the local area.

6.1.9.7 Subterranean Fauna

Subterranean fauna are primarily invertebrate species that inhabit caves and the many small voids and tunnels that occur within some unconsolidated and rocky substrates. Troglofauna persist above the water table and stygofauna persist within the saturated zone below the water table.

Troglofauna

The troglofauna desktop analysis included a compilation of previous troglofauna records in the region covering the extensive floodplains on which the proposed Project is located. The results identified a moderately rich array of troglofauna species in this broad area, none of which are currently listed as specially protected under either Commonwealth or Western Australian legislative or policy frameworks. Furthermore, the desktop survey revealed that no troglofauna species have been previously collected from within the Sorby Hill tenements (M80/197 and M80/286).

Within the proposed Project impact area, the occurrence of very fine grained alluvial sediments unlikely to contain extensive interconnected voids the generally shallow water table and seasonal inundation suggest that there is no suitable habitat for troglofauna to occupy; therefore it is unlikely that troglofauna occur in the Project Area.

Stygofauna

The stygofauna desktop analysis did reveal the potential presence of stygofauna, and as such a stygofauna survey was conducted within tenements M80/197 and M80/286 in 2011 at an intensity to meet the recommendations of *EPA Guidance Statement 54A – Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia*. This survey identified the presence of ten species. All of the species were new to science and therefore none are currently listed as specially protected under either Commonwealth or Western Australian legislative or policy frameworks. Of the ten species, all but one was collected outside of the proposed impact footprint. The single species known only from the impact footprint was collected as a single valve and is considered to be a surface water species with a range likely to be orders of magnitude greater than the predicted impact footprint. It is considered that the localised impact of mining for the Project is unlikely to threaten the persistence of any stygofauna species (Appendix 27, Volume 3).

6.1.10 Aboriginal Heritage

The Project site lies within the traditional lands of the Miriuwung Gajerrong people. Although the tenements pre-date Native Title, a Heritage Protection Agreement was developed between the previous owners of the Sorby Hills tenements and the MG Corporation. As part of this agreement SMPL will develop a MOU with the MG Corporation.

An initial Aboriginal Heritage Desktop Analysis was undertaken by Land Access Solutions (LAS) for the Project Area in June 2011, this report has been included in Appendix 30 (Volume 3) for reference. The tenements were not identified in National or World Heritage Lists. The DIA Heritage Register identifies five heritage sites that lie wholly or partly within the Sorby Hills tenement areas. Of these registered sites, only the buffer zone of Site 15427 (Jingil Complex) will be intersected by the northern edge (approximately 300 m) of the relevant tenements (M80/197 and M80/286); there is limited public information for DIA Site 15427 as it is a closed site (Appendix 31, Volume 3).

Detailed archaeological and ethnographic surveys have been conducted of the areas proposed to be impacted by the Project (Appendices 32 and 33, Volume 3). The surveys were conducted concurrently with participants from the Mirriuwung Gajerrong people and were coordinated through the MG Corporation. The archaeological survey was conducted from the 19th to the 21st of October 2011 and the ethnographic survey was conducted with senior men on the 20th of October 2011 and with senior women on the 21st of October 2011.

The archaeological survey incorporated both a desktop analysis of previous survey work conducted in the area and a site inspection of the entire Project impact footprint. The footprint that was surveyed considered the amendments to the boundaries as a result of discussions with the older men from the Mirriuwung Gajerrong people. No archaeological material was collected in the areas inspected during this survey.

The ethnographic survey was conducted in two parts; the first part had the participation of the older men from the Mirriuwung Gajerrong people and the second part employed the participation of the older women. This ensured that the men were able to determine if there were going to be any "men only" sites within the footprint of the mining and infrastructure area. In consultation and discussion with the Mirriuwung Gajerrong people the disturbance boundary for the Project footprint was moved to exclude a small limestone hill; as a result of this boundary change the TO's advised SMPL that they approved the development of the Project within the new boundary area. The MG Corporation also confirmed this position in written correspondence which has been included as Appendix 34 (Volume 3).

6.2 EXISTING ENVIRONMENT – WYNDHAM PORT

Wyndham Port is situated on the eastern bank of the West Arm Estuary of the Cambridge Gulf and is approximately 100 km from Kununurra by road.

Wyndham port is a fully operational facility with all required infrastructure in place. The port facility is owned and controlled under the Western Australian Port Authority (DoT) and managed and operated by registered stevedoring company CGL.

The laydown area to be utilised by SMPL has a sealed tarmac surface and is completely devoid of vegetation. No new infrastructure will be required to facilitate SMPL operations at the port and current dredging schedules will not need to be altered.

6.2.1 Marine and Intertidal Environment

The Cambridge Gulf has an average depth of 12 m and is approximately 50 km long. At the tip, the Gulf is divided into two estuaries, the East Arm that drains the Ord River and the West Arm that drains the Durack and Pentecost Rivers. The flow of these rivers is only significant a few days or weeks after the passing of a tropical rain depression. The Cambridge Gulf is a very turbid bay. The bulk of the sediment is transported from the West Arm Estuary and gets deposited in the East Arm or flows through into the Timor Sea (Wolanski *et al*. 2004).

The tidal pattern at the Port of Wyndham is semi-diurnal with a spring tidal range of 8 m. Very strong tidal currents are experienced in the Cambridge Gulf and the West Arm Estuary. Due to the sheltered nature of the gulf the local wind waves are small and ocean swell is limited.

6.2.1.1 Marine and Intertidal Flora and Vegetation

Mapping for the IBRA programme places the Wyndham Port area in the Victoria Bonaparte Bioregion. APM conducted a flora survey in the dry season of 2009 and the wet season of 2010 in the vicinity of the Wyndham Port for another purpose. However, these data are relevant for the current Project as they describe the local vegetation representative of areas that remain undisturbed. Undisturbed vegetation exists around the periphery, but not within the active Wyndham Port area.

A total of 76 taxa (species and subspecies) from 32 families and 64 genera were recorded by APM in the surveys conducted adjacent to Wyndham Port. None of the species recorded are protected under either Commonwealth or Western Australian legislative or policy frameworks. Four plant communities were recognised and are described in Table 6-18. None of the plant communities resembled any of the TEC’s or PEC’s listed in Commonwealth or Western Australian legislation.

Table 6-18: Broad Vegetation types of the Wyndham Port Area

Habitat	Vegetation Type
	Grassland of *Triodia bitextura* and *Xerochloa imberbis* with occasional annual forbs. This community was restricted to an area of scree and rubble on the landward side of the mudflats.
	Scrub and Low Shrubland of *Avicennia marina* over Grassland of *Sporobolus virginicus* and Low Shrubland *Tecticornia indica.* This vegetation fringed both the inland and seaward margins of the bare mudflats.
	Thicket of *Aegialitis annulata*, *Avicennia marina*, *Aegiceras corniculatum* and *Ceriops tagal.* These mangrove thickets were recorded on the mudflats bordering the West Arm Estuary.

Habitat	Vegetation Type
	This community incorporates vegetation types which were severely degraded by weed infestations. They were found on higher ground to the landward side of the mudflats and often showed signs of multiple disturbances from vehicles and rubbish dumping.

6.2.1.2 Marine and Intertidal Fauna

APM conducted a fauna survey of natural habitat adjacent the Wyndham Port in the dry season of 2009. This was primarily an assessment of fauna habitat, rather than a species richness survey, but any species observed at the time were recorded. A NatureMap (DPaW 2009) search carried out as part of the 2009 survey indicated that 207 species had previously been recorded within a 10 km radius of Wyndham Port (APM 2009).

The waters around Wyndham Port have a high turbidity which limits the amount of species that can utilise the local marine environment. A review of Commonwealth and Western Australian legislation showed that 36 protected species had the potential to occur in the Wyndham Port area. Of these, only 16 have actually been recorded (Appendix 3, Volume 2).

The local fauna can generally be divided into four distinct communities:

- ***Marine community:*** These species spend the majority of their life in the water column and mostly include a diverse fish community and marine mammals and reptiles. The Green Turtle is a protected species under Commonwealth legislation and has been recorded in the vicinity of the Port
- ***Mudflat community:*** These species feed on the exposed mudflat and either move inland or into the water column when the mudflat is submerged. This community mostly includes shorebirds, egrets, crabs and mudskippers. Three protected species have been recorded within this habitat; these are the Eastern Great Egret, Eastern Curlew and White-bellied Sea-eagle
- ***Mangrove community:*** These species utilise the mangrove habitat at low tides when the mud underneath is exposed and include mangrove specialist birds, mangrove snakes, Saltwater Crocodile, Water Rat, crabs and fish. Four protected species could potentially utilise this habitat, these are the Rufous Fantail, Rainbow Bee-eater, Water Rat and Saltwater Crocodile

- ***Grassland and low shrubland community:*** This is an incredibly varied community and consists of many bird, reptile and small mammal species. Four protected species that utilise this particular habitat have been recorded within a 20 km radius of Wyndham Port; these are the Bush Stone-Curlew, Flock Bronzewing, Gouldian Finch and Pictorella Mannikin

Additional protected species were recorded from habitats that are absent from the immediate surroundings of the Wyndham Port.

The limited amount of natural undisturbed vegetation around Wyndham Port greatly reduces the likelihood of any of the afore mentioned species occurring within the Wyndham Port boundary.

6.2.2 Contaminated Site Status

Wyndham Port is currently listed as a contaminated site under the *Contaminated Sites Act 2003;* the listings relate to a decommissioned fuel storage depot on Lots 719 and 896 which is classified as *'Contaminated - Restricted Use'* and to the area surrounding an old Ni, Pb and Zn transit shed on Lot 600 which is classified as *'Possibly Contaminated – Investigation Required'*. Wyndham Port lot locations are shown on Figure 6-41. Further details of the listings are provided in DPaW records for the Wyndham Port (Appendix 35, Volume 3).

The listed sites are not located in the vicinity of the areas which will be utilised by SMPL for the Project and contaminant levels are currently below those required for industrial or commercial land use, therefore under either classification the land is deemed suitable for industrial or commercial purposes. The contaminated sites classifications will therefore not impact on Project operations.


KBL Mining Limited
8292000mN
8291750mN
8291500mN
8291250mN
8291000mN
8290750mN
403750mE
404000mE
404250mE
Lot 2
Lot 1768
Lot 1302
Lot 1272
Lot 1
Lot 1737
Lot 719
WYNDHAM PORT
Lot 654
Lot 896
Lot 600
Lot 600
LAYDOWN AREA
Lot 1770
Lot 600
Lot 1233
N
0 50 100m
Scale 1:5,000
MGA94 (Zone 52)
Legend
Laydown Area
Cadastral Boundary
Source: Imagery - Landgate, Cadasta - Landgate
SORBY HILLS PROJECT
Figure 6-41
Wyndham Port Lots
Author: SMPL
Date: August 2013
Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S6_641.dgn

7 ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

7.1 ASSESSMENT OVERVIEW

EIA is an iterative process which involves the determination of environmental values likely to be impacted and identifies potential changes to the Project design to avoid, minimise or otherwise manage the adverse environmental impacts to an acceptable level. SMPL has undertaken an impact assessment of the Project in accordance with the EPA *Guide to EIA Principles, Factors and Objectives* (EPA 2009). Impacts of the Project (as described in Section 2) on the existing environment of the Project Area (as described in Section 6) are examined in this Section.

As previously discussed in Section 5, SMPL is committed to the responsible development of the Project and will endeavour to develop the Project to meet the environmental expectations of current and future stakeholders. Table 7-1 provides examples of how SMPL has made changes to the Project design in response to the findings of environmental studies.

Table 7-1: Project Design Alterations for Environmental Benefit

Project Design Alteration	Environmental Benefit
Self-imposed Development Exclusion Boundary implemented.	Retention of valuable flora and fauna habitats.
Project designed to utilise areas that are already degraded for the construction of mine infrastructure.	Retention of higher value habitats by utilising those of lower value.
Project designed to minimise disturbance area.	Retention of flora and fauna habitats.
Haul road design re-routed.	Avoid direct impact to populations of priority plant species.
Use of rotating container system for concentrate transport.	Reduces the potential for fugitive concentrate emissions.

Table 7-2 summarises SMPL’s evaluation of the key environmental factors pertinent to the assessment of the Project and details the corresponding environmental objectives, potential environmental impacts, environmental management and mitigation measures and predicted outcomes.

Table 7-2: Key Preliminary Environmental Factors

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
Biophysical Factors				
Flora and Vegetation – Relevant to the Victoria Bonaparte Bioregion, with emphasis on the Project Area and immediate surrounds				
• Maintain the abundance, diversity, geographic distribution and productivity of flora species and ecosystem levels and the vegetation units in which they occur through the avoidance or management of adverse impacts and improvement in knowledge	• The Project Area supports eight vegetation units; the condition of the vegetation ranged from Excellent to Completely Degraded • The Project tenements support two areas that may be classified as the 'Monsoon vine thickets of limestone ranges' which are a Priority 1 PEC • A total of 334 taxa (species, subspecies and varieties) from 69 families and 201 genera have been recorded in the Project Area • No DRF were located, however 16 flora of conservation significance are known to occur	• Clearing of 573 ha of native vegetation • Loss of a proportion of flora species of conservation significance • Vehicle and earth movements could potentially introduce or spread weeds which may result in competition for resources with native flora, cause degradation of habitats and reduce rehabilitation success • Mine development and operation has the potential to increase the number of ignition sources which may increase fire frequency/intensity and, as a result, favour the establishment of weeds and prevent the regeneration of native species • Dust settling on soil and vegetation foliage may result in physical effects such as stomata blockage causing plant death and altered soil chemistry • Vegetation scalding or death from use of brackish water for	• All disturbance areas have been subjected to biological surveys and have been selected at the design phase to minimise impacts to flora and vegetation of conservation significance • Where possible, infrastructure is located on pre-cleared/disturbed areas • Creation of a self-imposed Development Exclusion Boundary to maintain biological diversity and preserve the two areas of the Priority 1 PEC 'Monsoon vine thickets of limestone ranges' • Internal clearing procedure will be implemented • Progressive rehabilitation will be conducted throughout the Project life and revegetation continued after cessation of production • Weed mapping will be undertaken and a weed inventory will be maintained • Implementation of weed hygiene and management procedures • Appropriate firebreaks will be created and maintained • Procedure and permitting process for all hot work • Implementation of safe smoking practices and appropriate disposal of	• The removal of 573 ha of native vegetation over the life of the Project and the subsequent progressive rehabilitation of that same area of land • Implementation of environmental management plans and strategies will help to avoid or minimise impacts to flora and vegetation • No significant impact to the Priority 1 PEC 'Monsoon vine thickets of limestone ranges' due to implementation of the Development Exclusion Zone • No significant impact to the majority of flora taxa of conservation significance due to strategic placement of impact footprint and implementation of the Development Exclusion Zone • Avoidance of the introduction and spread of weeds • No increase in frequency and a reduction in size and intensity of wild fires • No noticeable evidence of dust accumulation on roadside

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
		dust suppression • Changes in surface hydrology due to infrastructure could impact flora and vegetation that are adapted to the natural surface water fluctuations	cigarette butts • All fires will be investigated • Implementation of dust management strategies and procedures • Water sprayed onto haul roads will be contained within bunding • Equipment suitable for the task will be utilised for dust suppression • Water will be applied at an appropriate rate • Any saline water spills or leaks will be contained and cleaned up • Installation of appropriately designed and located culverts to minimise potential for water ponding • Collection and storage of seed from flora species of conservation significance for replanting at the rehabilitation stage • Stock for replanting flora species of conservation significance can be collected from topsoil at the time of land clearing	vegetation following the wet season • Any accumulated saline residue from dust suppression will not impact vegetation • No surface water to accumulate in areas other than those that naturally occur or those that have been engineered into the Project design
Fauna – Relevant to the Victoria Bonaparte Bioregion, with emphasis on the Project Area and immediate surrounds				
• Maintain the abundance, diversity, geographic distribution and productivity of fauna species and ecosystem levels through the avoidance or	• There is potential for 12 ground dwelling fauna species of conservation significance to occur in the Project Area • Ornithological surveys in the region found five *EPBC Act* species of conservation significance within the vicinity	• Vegetation clearing will directly disturb fauna habitat and may result in the loss or displacement of individuals • Activities associated with the Project such as increased movement of personnel and machinery may result in	• All disturbance areas have been subjected to biological surveys and have been designed to minimise impacts to fauna of conservation significance • Infrastructure located on pre-cleared/disturbed areas • Development of the exclusion boundary to maintain biological diversity,	• The Project will result in the loss of approximately 573 ha of native vegetation and fauna habitat, however, high value fauna habitat will be retained due to implementation of the Development Exclusion Zone • Implementation of

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
management of adverse impacts and improvement in knowledge	of the Project Area and 2 species listed as Priority 4 by DPaW	disturbance to, or the loss or displacement of fauna • Secondary impacts, such as altered fire regimes, increased light and noise, and dust deposition over the life of the project, may reduce the value of fauna habitat that remains after clearing • The Project may potentially increase the presence of feral animals in the area which could result in competition, predation and/or habitat degradation	ecological function and the most valuable habitats for threatened species such as the Gouldian Finch • Internal clearing procedure will be implemented • Cleared areas will be rehabilitated as soon as practicable. This will include replacing vegetation as this provides refuge for fauna and the construction of Gouldian Finch artificial nest boxes, these strategies will help offset the impacts of clearing. • All habitats identified as 'Monsoon vine thickets of limestone ranges' are to be avoided (i.e. Development Exclusion Boundary) • Implement dust management strategies and procedures • Management of fire directly associated with construction and operations will focus primarily on prevention and control • Destocking of the Project Area • Implementation of management controls for feral fauna • Implementation of good housekeeping and waste control • Speed limits will apply to all vehicles on site to reduce the potential for impacts to fauna on site roads • Site personnel will be discouraged from feeding wildlife	environmental management plans and strategies will help to avoid or minimise impacts to fauna • No significant impact to fauna habitat of high conservation significance • No significant impact to fauna occupying the Priority 1 PEC 'Monsoon vine thickets of limestone ranges' due to implementation of the Development Exclusion Zone • No significant impact to fauna of conservation significance due to strategic placement of impact footprint and implementation of the Development Exclusion Zone • No increase in frequency, and a reduction in size and intensity of wild fires • No noticeable evidence of dust accumulation causing a decline in vegetation health and the subsequent decrease of fauna habitat values • No surface water to accumulate in areas other than those that naturally occur or those that have been engineered into the Project design

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
SRE Fauna – Relevant to the Project Area and immediate surrounds				
• Maintain the abundance, diversity, geographic distribution and productivity of fauna species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge	• Habitats likely to promote short range endemism do not occur in the Project Development Envelope of the Project Area	• It is considered that there is little or no potential for the Project to impact on SRE fauna	• Given the assessment that habitats likely to promote short range endemism do not occur in the Project Area, no management strategies are proposed	• No significant impact to SRE fauna
Subterranean Fauna (Stygofauna and Troglofauna) – Relevant to the Project Area where it is subject to below ground level disturbance and the Project's zone of hydrological influence				
• Maintain the abundance, diversity, geographic distribution and productivity of fauna species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge	• Within the proposed Project impact area, the occurrence of very fine grained alluvial sediments unlikely to contain extensive interconnected voids, the generally shallow water table and seasonal inundation suggest that there is no suitable habitat for troglofauna to occupy; therefore it is unlikely that troglofauna occur in the Project Area • Stygofauna are known to occur in the area and the subterranean fauna assessment carried out for the Project (Appendix 27, Volume 3) identified the presence of ten	• As the habitat present in the Project Area is not favourable for troglofauna and is unlikely to contain significant troglofauna communities it is considered that there is little or no potential for the Project to impact on troglofauna • It is possible that the Project may impact local populations of stygofauna through the excavation of ore and dewatering activities, however based on the findings of the subterranean fauna assessment it is considered unlikely that the localised impact will have a significant effect on regional	• Given the findings of the subterranean fauna assessment, no management strategies are proposed, SMPL will however minimise pit disturbance areas and dewatering activities wherever possible	• No significant impacts to troglofauna are anticipated • No significant impacts are anticipated to local populations of stygofauna through the excavation of ore and dewatering activities

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
	species. All of the species were new to science and therefore none are currently listed as specially protected under either Commonwealth or Western Australian legislative or policy frameworks. Of the ten species, all but one was collected outside of the proposed Primary Impact Footprint. The single species known only from the impact footprint was collected as a single valve and is considered to be a surface water species with a range likely to be orders of magnitude greater than the impact footprint	populations or threaten the persistence of any stygofauna species		
Conservation Areas – Relevant to the proposed GRCP				
• Protect the environmental values of areas identified as having significant environmental attributes	• The proposed GRCP is located immediately adjacent to the Project Area. The GRCP covers 17,900 ha and contains the Pincombe and Cave Spring Ranges. The ranges trend north east to south west and form a series of parallel ridges • The GRCP is dominated by open woodland composed of *Corymbia dichromophloia* (Variable-barked Bloodwood), *Eucalyptus miniata* (Darwin Woollybutt) and *Eucalyptus tetrodonta* (Darwin	• Dust from mining activities in the Project Area may result in increased dust levels in the GRCP which may physically effect vegetation • Increased fire frequency/intensity due to Project activities may favour the establishment of weeds and prevent the regeneration of native species in the GRCP • Fauna displaced due to clearing in the Project Area may increase resource competition in the GRCP	• Self-imposed Development Exclusion Boundary which provides a buffer zone between the GRCP and the area to be directly impacted by the Project. This will lessen the intensity or severity of impacts associated with vibration, noise and odour • Implementation of management controls for fire and emissions such as noise, light, vibration, dust and odour • Improved public access to the GRCP through DPaW managed roads, day use areas and camp grounds	• Implementation of environmental management plans and strategies will help to avoid or minimise indirect impacts to the GRCP • Active environmental management by DPaW will likely combine to stabilise, if not enhance, the conservation values of the GRCP • No significant impacts to the GRCP anticipated • Carefully monitored noise and vibration levels due to blasting and use of vehicles and

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
	Stringybark) with *Triodia bitextura* (Curly Spinifex) and sorghum grasses (Strategen 2010)	• Increased noise and vibration levels due to blasting and use of vehicles and machinery may impact fauna in the GRCP or contribute to the displacement of fauna from the Project Area to the adjacent GRCP, subsequently increasing ecological pressure on those species that already occur in GRCP • Increased traffic and personnel may contribute to weed encroachment • Restriction of public access to the GRCP due to closure of informal GRCP access tracks within the Project tenements may reduce recreational value of the GRCP		machinery, minimal impact on fauna in the GRCP or displacement of fauna from the Project Area to the GRCP • No increase in weed abundance from increased traffic and personnel • Closure of informal GRCP access tracks within the Project tenements will have little impact to public access and recreational value
Physical Factors				
Surface Water – Relevant to the Project site and immediate surrounds				
• Maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected • Ensure that emissions do not adversely affect environmental values or the health,	• The Project Area is located in the upper portions of the Knox Creek and Keep River Catchments; all surface flows within the Project Area tend south east towards these watercourses. No significant creeks or defined drainage systems occur within the Project Area; the ephemeral Border and Knox Creeks are	• Localised modification of flow paths due to diversionary works to protect site infrastructure • Ponding of water upstream of infrastructure • Changes to surface hydrology resulting from creation of the dewatering evaporation basin for containment of runoff and	• All infrastructure situated in areas where flooding is likely will be raised to a height of at least 1 m above the floodplain level to withstand 1 in 100 year, 72 hour flood events • Runoff from the upstream catchment will be diverted around critical infrastructure by the site enveloping alignment of the haul road. The haul road has been designed to function as a surface water diversion bund and will offer a 2.8 m	• Project designed to minimise impacts to surface water • Implementation of environmental management plans and strategies will help to avoid or minimise impacts • No significant impact to surface water quantity or quality as a result of Project operations • No predicted increase in

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	located 3.5 km to the north and south respectively, and the Keep River (which Knox Creek flows into) is situated 4.6 km to the south east • Throughout the wet season the Project Area is subject to waterlogging and surface flooding conditions. During intense rainfall events (i.e. a 1 in 100 year, 72 hour flood event) the water level is likely to rise approximately 1 m above ground level and remain for extended periods	dewatering • Increased erosion due to alterations of natural flow paths • Sedimentation or contamination of surface water due to Project activities or design • Pollution of surface water due to the inappropriate storage of hydrocarbons, process chemicals and other dangerous goods	flood protection barrier which will minimise the potential of overtopping during a flood in excess of the 1 in 100 year, 72 hour flood event • The TSF is designed to accommodate at least a 1 in 100 year, 72 hour flood event, nevertheless the associated TSF evaporation basin has been sized to contain water from the TSF generated during a 1 in 100 year, 72 hour flood event • Creation of the dewatering evaporation basin for capture and storage of runoff from within the haul road envelope and dewatering not required for processing • Stockpiles will be placed to act as surface water diversion bunds • Flood bunds will be constructed around site infrastructure such as the landfill facility to divert clean water away and contain any potentially sediment laden or contaminated surface waters within the work area • Haul road envelope and surface water diversion bunding will divert clean runoff from the surrounding environment away from the internal infrastructure areas to ensure this water does not become sediment laden or contaminated • Installation of appropriately designed and located culverts to minimise potential for water ponding • Appropriately designed and located sediment trapping devices will be installed to ensure that sediment laden	erosion • No anticipated sedimentation or contamination of surface water due to Project activities • No or only minor spills of hydrocarbons, process chemicals and other dangerous goods may occur, therefore, greatly reducing the risk of environmental harm

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			waters do not enter the adjacent environment • Water from the ROM pad and plant site will drain into collection sumps and be transferred to the process circuit • Potentially contaminated surface water (e.g. from workshop wash down facilities) will pass through a treatment system such as a triple interceptor or coalescing plate separator • Implementation of management controls for the handling and storage of hydrocarbons and process chemicals • Surface water monitoring program; quality will be assessed in relation to guideline trigger values and baseline data	
Groundwater – Relevant to the Project site and immediate surrounds				
• Maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected • Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and	• Within the Project Area two aquifers have been found to occur, variability in hydraulic conductivity suggests that these are faulted/fractured rock aquifers • Groundwater levels are highest at the southern end of the Project tenements where they range from 14.4 m AHD to 8.2 m AHD adjacent to Knox Creek • Groundwater is generally neutral pH and brackish. The cation/anion balance of the groundwater shows no dominant water type other	• Pollution of groundwater due to the inappropriate storage of hydrocarbons and process chemicals • Contamination of groundwater due to Project activities or design • Contamination of groundwater due to inadequate closure planning for mine voids and TSF • Unsustainable abstraction of groundwater • Excessive dewatering drawdowns outside of the Project Area	• Implementation of management controls for the handling and storage of hydrocarbons and process chemicals • Implementation of TSF management and monitoring strategies • Ensure appropriate licences are obtained for water abstraction on the site • No extraction of groundwater beyond that permitted under the water licence • A monthly monitoring programme will be carried out to assess water levels associated with the production bores and vegetation health in proximity; data to be reported in AER • Report annual water use to the	• Appropriate storage of hydrocarbons and process chemicals, will reduce the risk of groundwater pollution • Implementation of environmental management plans and strategies will help to avoid or minimise impacts • Drawdown is not anticipated to be extensive with the drawdown impact area limited to the immediate vicinity of the pits • The groundwater aquifers are rainfall recharged and

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
acceptable standards	than an overall predominance associated with sodium, magnesium, calcium, sulphate and bicarbonate • The groundwater flow gradient beneath the Project Area is towards Border Creek. Therefore groundwater from the Project Area will not flow towards the ORIA – Weaber Plains Project	• Possible impacts to groundwater dependant ecosystems	appropriate regulatory authority • Water demands to be offset through use of water from dewatering activities for processing and the recycling of process waters • Minimisation techniques for water use incorporated into the OEMP • Bores and associated pipelines will be inspected regularly to ensure any leaks are detected and repaired promptly • Development of comprehensive closure strategies for the TSF and pit voids • Establish a groundwater monitoring program; quality will be assessed in relation to guideline trigger values and baseline data	therefore not anticipated to be affected by long term water extraction • No impacts to groundwater dependent ecosystems are anticipated as it is unlikely that troglofauna will occur and regional representation of stygofauna is not likely to be threatened by the localised impact of the Project • No impacts to flora and vegetation are anticipated as drawdown will be limited to the immediate vicinity of the pits • There is expected to be no significant impact on regional groundwater resources or groundwater quality as a result of Project operations
Pollution and Emissions Management				
Mining Waste and Potential Contaminants – Relevant to the Project site				
• Ensure that mining waste is suitably managed such that it does not adversely affect environmental values or the health, welfare and amenity of people and land uses in the vicinity of	Geochemical characterisation has identified that: • The majority of the waste rock can be classified as NAF with a low potential to produce ARD • There is a localised presence of PAF materials within the proposed mine voids	Contamination of soils, surface water and groundwater through: • Generation of ARD • Release of suspended sediment laden runoff into the environment	• Block modelling and scheduling carried out to enable NAF and PAF materials to be successfully delineated and segregated during mining and subsequently managed • On site NAGpH testing carried out as part of grade control and visual inspection of drill chips and blasted ground conducted to determine expected PAF intersection	• Implementation of environmental management plans and strategies and correct handling techniques for PAF materials will help to avoid or minimise impacts • No significant impacts are anticipated as a result of mining wastes at the Project

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
the Project	• There is a low risk of MD		• Ensure expected intersection with PAF materials is communicated to appropriate personnel • PAF waste will either be placed into an in-pit waste dump or in-pit sump specifically designed for that purpose • Kinetic test work will be undertaken to confirm NAF waste rock characterisation remains the same as operations progress • Sufficient volume of competent NAF dolomite will be segregated for later use in rehabilitation to stabilise the post-mine land surfaces • Appropriately designed and located sediment trapping devices will be installed to ensure that sediment laden waters do not enter the adjacent environment • Surface water monitoring program; water quality will be assessed in relation to guideline trigger values and baseline data	operations
Tailings Characterisation and Storage (TSF Design, Construction and Management) – Relevant to the Project site				
• Ensure that processing waste is suitably managed such that it does not adversely affect environmental values or the health, welfare and amenity of people and land uses in the vicinity of the	• Tailings will be discharged and stored within a purposed built above ground paddock style TSF • Geochemical characterisation classified the tailings as NAF, with elevated carbonate content and a highly alkaline pH. This together with the low content of available oxyanions	• Contamination of soils, surface water or groundwater through: ▪ Tailings seepage ▪ Leaching of poor quality water and subsequent indirect effects on the surface environment manifested as vegetation stress or death due to changes in soil chemistry and groundwater	• Implement appropriate design, planning and management measures • TSF designed in accordance with the DMP *Guidelines on the Safe Design and Operating Standards for Tailings Storage (1999)* and assigned a hazard rating of Low, Category 2, with the probability of embankment failure assessed as low • TSF design and construction materials	• Tailings materials contain elevated carbonate content and are classified as NAF; as such ARD seepage is not anticipated • Metalliferous seepage is not anticipated as the source rocks do not contain mobile enriched metals and the subsequent risk of elevated metals content

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
Project	metals and metalloids, results in a low potential for ARD or MD to occur. Analysis of the tailings materials also identified Tl	quality ▪ Accidental release (e.g. overtopping) of poor quality water/tailings slurry • Fauna utilising the TSF and associated TSF evaporation basin as a water source	will minimise the potential for seepage; the flow volume from the facility is expected to be less than 5 m^3/d • Kinetic test work will be undertaken to confirm tailings characterisation remains the same as operations progress • Prior to TSF construction, remnant sterilisation drill holes will be sealed with bentonite to prevent flow from the TSF into the subsurface geology through preferential pathways • TSF positioned within the haul road envelope which will act as flood diversion bunding to protect the TSF from the potentially damaging effects of stormwater runoff • Pipelines will be located within the haul road safety bunding which will serve to contain spills or leaks • The TSF will not be used for water storage; water will be removed via decant structures and pumped into the adjacent TSF evaporation basin. Both the TSF and associated TSF evaporation basin will have the capacity to cater for a 1 in 100 year, 72 hour flood event • Risk assessment carried out into the potential environmental effects in the unlikely event of a significant overflow from the TSF • Implement comprehensive monitoring and inspection program • Avifauna will be discouraged from utilising the TSF using 'Scare Guns' (blast cannons) and reflective material placed	within the tailings solution is low • Tl levels are within limits that will allow material to be effectively managed within the TSF and avoid any hazard to the environment or human health • Overflow risk assessment suggests that it is only the process chemicals sodium hydrogen sulphide and xanthates that may impact organisms and then only when the overflow is minimally diluted in proximity of the TSF • Implementation of environmental management plans and strategies will help to avoid or minimise impacts • No significant impacts are anticipated as a result of tailings storage

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			around the periphery • Analysis of bird feathers collected from TSF for traces of heavy metals • Fencing will be erected around the Project Development Envelope (following the firebreaks) as part of the destocking process which will keep macro fauna away from the TSF. Barbed wire will not be used	
Concentrate Emissions – Relevant to the Project site and immediate surrounds, Wyndham Port and the community of Wyndham				
• Ensure emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	• The Project will produce approximately 45,000 tpa of concentrate for export. Concentrate will be transported from the Project site to Wyndham Port in sealed containers via road train; there will be an average of 12 return truck movements per week. Shipping will occur once per month • The concentrate to be produced by the Project is of Ag Pb Zn composition with a lead grade of around 64 % • The concentrate will be transported as a Class 6.1 lead compound, soluble, N.O.S. (UN 2291, packaging group III) with a subsidiary environmental hazard (Class 9) classification for marine transport	Impacts at the Project site and/or Wyndham Port include: • Adverse effects to human health • Pollution of the terrestrial and/or marine environments • Degradation of terrestrial and/or marine habitats • Loss of terrestrial and/or marine flora and fauna	• A range of rules and procedures will be implemented at all stages of the concentrate handling process • Minimal direct handling of concentrate by utilising a predominantly mechanised system • Storage and handling of concentrate will comply with relevant regulations • SMPL propose to use “Rotabox” (or similar) shipping containers for the collection, storage and transport of concentrate; there will be no requirement for internal bags or packaging • “Rotabox” containers are purpose built, stackable, bulk ore containers that can be fully sealed with lockable lids that include a weather resistant seal • Use of containers eliminates the requirement for stockpiling of concentrate both at the Project site and port facility	• Avoidance of open concentrate stockpiles • Use of containerised system and implementation of environmental management plans and strategies will help to avoid or minimise impacts • No adverse effects to human health are anticipated • No predicted pollution or degradation of terrestrial and/or marine environments • No predicted loss of terrestrial and/or marine flora and fauna • No significant impacts are anticipated as a result of concentrate storage and handling

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			• Container design has taken into account the key material handling characteristics of the concentrate and the containers are built to comply with ISO1496-1:1990 *Series 1 Freight Containers Specification and Testing (Part 1)* • Concentrate will be loaded directly into containers – the loading system will be integrated in to the final stage of the production process • Container loading dock will be situated within a covered concrete bunker • Containers will be inspected prior to leaving the Project site and upon arrival at Wyndham Port • Concentrate will be transferred directly into the ships hold using a container rotation system specifically designed to minimise the chance of spillage and fugitive dust emissions • Locks and lids will only be removed from the containers immediately prior to unloading of the concentrate • Shipping will be carried out to current world standards • Produce and implement POEMP	
Marine Environment – Relevant to marine environment in the vicinity of Wyndham Port				
• Ensure emissions do not adversely affect environmental values or the health, welfare and amenity of	• Wyndham Port is situated on the eastern bank of the West Arm Estuary of the Cambridge Gulf • Wyndham Port is fully	• Pollution of the marine environment and degradation of marine habitats • Loss of marine flora and fauna • Pollution of the terrestrial	• All relevant actions undertaken at Wyndham Port must comply with the *Dangerous Goods Safety Act 2004*, specifically the *Dangerous Goods Safety (Goods in Ports) Regulations 2007*	• Avoidance of open concentrate stockpiles • Use of containerised system and implementation of environmental management

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
people and land uses by meeting statutory requirements and acceptable standards	operational; no new infrastructure will be required to facilitate SMPL operations and current dredging schedules will not need to be altered • Wyndham Port is currently listed as a contaminated site under the *Contaminated Sites Act 2003* however the land is deemed suitable for industrial or commercial use and is not in the vicinity of Project operations • The waters surrounding Wyndham Port have a high turbidity which limits the number of species that can utilise the environment. An appraisal of the Commonwealth and Western Australian legislation in conjunction with an assessment of available habitat revealed that 36 protected species have the potential to occur; of these only 16 have actually been recorded in the area	environment and degradation of habitat in proximity to Wyndham Port • Loss of terrestrial flora and fauna	• The *Dangerous Goods Safety (Goods in Ports) Regulations 2007* require port operators to comply with AS 3846-2005 *The Handling and Transport of Dangerous Cargoes in Port Areas* • A range of rules and procedures will be implemented at all stages of the concentrate handling process • Utilisation of a container system which is predominantly mechanised eliminates the requirement for stockpiling of concentrate at Wyndham Port • Concentrate will be transferred directly into the ships hold using a container rotation system specifically designed to minimise the chance of spillage and fugitive dust emissions • Moisture content levels in the concentrate will be monitored to ensure optimum conditions for dust control during ship loading. • Quarterly monitoring of soil and marine sediments at Wyndham Port for Ag, Pb and Zn • Shipping will be carried out to current world standards	plans and strategies will help to avoid or minimise impacts • No significant impacts are anticipated as a result of concentrate storage, handling and ship loading • There is little threat posed to the marine environment through pollution • Marine flora and fauna are not predicted to decline • The terrestrial environment in the vicinity of Wyndham Port is not expected to become polluted
Dust Emissions – Relevant to the Project site and immediate surrounds, Wyndham Port and the community of Wyndham				
• Ensure emissions do not adversely affect environmental values or the health, welfare and amenity of	Dust may be generated by the Project in a number of ways during construction and ongoing operations. Key emission sources will include:	• Fauna, flora and vegetation on site and in the immediate vicinity may be adversely affected by an increase in dusty conditions	• Onsite dust sampling program established to measure baseline dust fall • Comprehensive dust monitoring program will be implemented upon	• Implementation of environmental management plans and strategies will help to avoid or minimise • No significant dust impacts are

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
people and land uses by meeting statutory requirements and acceptable standards	• Vegetation and topsoil removal • Earthworks • Wind erosion of cleared areas and stockpiles • Wheel generated dust from travelling on unsealed roads • Drilling and blasting activities • Extraction, transfer and crushing of ore • Road side dust mobilisation from concentrate haulage trucks	• Adverse health impacts for the workforce on site and at Wyndham Port if staff are exposed to unacceptable levels of dust • Road side dust mobilisation as a result of ore haulage through the community of Wyndham may become a health risk, cause annoyance and reduce the amenity of the township • Potential impacts to adjacent sensitive receptors	commencement of construction • Visual monitoring of dust will be regularly conducted and activities will be halted if adverse conditions result in excessive dust generation • Photographic monitoring points of vegetation adjacent to high dust generating sources will be established • Weather conditions will be assessed prior to blasting and blasting will not be undertaken during unfavourable conditions • Utilisation of a water cart for dust suppression of roads, stockpiles etc. • Dust suppression systems on the crusher, process conveyors and all ore transfer points • Water, or where appropriate dust suppressants, will be used to minimise dust generation from cleared areas where fugitive dust is recognised as a problem • All vehicles on site will be confined to designated routes with speed limits enforced • All road edges will be clearly defined to control their locations • Speed restrictions will apply to all concentrate haulage trucks whilst travelling on site, through the township of Wyndham and whilst at the Wyndham Port facility • In the event that airborne dust cannot be managed to an acceptable level in a	anticipated as a result of Project operations • Dust is not considered likely to cause health or amenity issues to neighbouring residents, agricultural land or conservation reserves

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			particular work area, PPE requirements will be adopted and enforced	
Hydrocarbons, Process Chemicals and other Dangerous Goods – Relevant to the Project site				
• Manage hydrocarbons, process chemicals and other dangerous goods in a manner that minimises environmental impacts to ensure affects to soil, groundwater or surface water quality are avoided	• Substances required for the operation of the Project will include: ▪ Diesel fuel ▪ Oil ▪ Lubricants ▪ Gasses, reagents and process chemicals ▪ Explosives ▪ Radiation	• Contamination of soils, surface water or groundwater • Adverse effects to fauna and fauna habitats	• All hydrocarbon storage areas will be designed in accordance with *AS/NZS 1940:2004 –Storage and Handling of Flammable and Combustible Liquids* and have MSDS's located at storage sites • Self-bunded fuel storage tanks to be installed • Oils and lubricants will be stored in a weatherproof sea container • Provide a suitable level of training to staff and contractors identified to be involved in hydrocarbon management to ensure they are aware of SMPL's requirements for use, storage and disposal • Ensure spill response equipment is available and procedures are communicated effectively • Bioremediation facility will be established to treat contaminated soil in situ • Appropriate licences and requirements of the *Dangerous Goods Safety Act 2004* will be implemented wherever necessary • Bunded, purpose built storage and reagent handling facilities will be incorporated into the process plant and specific handling, storage and spill response procedures will be	• As a result of the implementation of management measures, no adverse effects to faunal habitats or contamination of soils, surface water or groundwater is anticipated as a result of hydrocarbons, process chemicals or other dangerous goods

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			implemented • Explosives will be stored in a dedicated explosives magazine in compliance with the *Dangerous Goods Safety Act 2004*, the *Dangerous Goods Safety (Explosives) Regulations 2007* and Australian Standard *AS 2187.1:1998, Explosives – Storage, transport and use, Part 1* • Disposal of dangerous goods will be in accordance with MSDS's and any requirements from DER	
Non-mineral Waste – Relevant to the Project site				
• Manage non-mineral wastes generated by the Project in a manner that minimises environmental impacts to ensure that wastes do not affect groundwater or surface water quality, nor result in soil contamination	Various forms of non-mining or process wastes will be produced: • Putrescibles, plastics, glass and aluminium from the office and crib room facilities • General litter from human presence • Paper and cardboard from office and warehouse activities • Scrap metal • Tyres • Wood from pellets and packaging • Hydrocarbon wastes, particularly waste oil • Chemical packaging products. • Laboratory wastes • Medical wastes • Sewage related wastes	• Contamination of soils, surface water or groundwater • Faunal habitats could be adversely affected • Encourage feral species and increase pest activity	• Waste streams have been identified and appropriate segregation and disposal methods will be adopted • Due to the relatively remote location of the Project site full recycling programs may be inhibited, however recycling is a preference and all options will be explored • The "Reduce, Reuse, Recycle and Recover" principles will be employed to minimise disposal requirements • Good housekeeping and rubbish disposal practices will be established to avoid attracting feral animals, pests and other wildlife throughout operation of the Project • Waste storage areas will be appropriately signposted, regularly inspected and kept clean • A 'no littering' policy will be	• Implementation of environmental management plans and strategies will help to avoid or minimise impacts • No significant impacts are anticipated as a result of non-mineral waste

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			implemented • For wastes which cannot be recycled, a landfill facility will be established on site. The landfill will be constructed and managed in accordance with DER licence conditions • Construct and manage bioremediation facility in accordance with the *Contaminated Sites Management Series Guideline for Bioremediation of Hydrocarbon Contaminated Soils in Western Australia* (DEC, 2004) • Sewage will be treated using a bio-sewage system that will conform to the standards of SWEK and DoH requirements	
GHG Emissions – Relevant to the Kimberley Region				
• To minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions	GHG emissions will be generated by the Project in a number of ways during construction and ongoing operations; the key emission sources will include: • Land clearing • Combustion of fuel by diesel powered generators, machinery, equipment and vehicles	• Over the duration of the Project life from 2013 to 2027, it is estimated that the Project will emit up to 596,104t CO_2-e of emissions • Overall, Australia's total direct annual emissions for 2009/2010 were 560.8 Mt t CO_2-e and Australia's direct annual emissions from the mining sector in 2009/2010 were 65.1 Mt t CO_2-e. By comparison, the annual operation of the Project is projected to represent approximately 0.005 % of	• GHG emissions will be kept as low as practicable at all times in accordance with the objectives outlined in *EPA Guidance Statement No. 12: Minimising Greenhouse Gases (2002)* • Disturbance footprint and vegetation clearing minimised • Site layout designed for maximum efficiency • Implement management strategies for procurement • Maintenance of all vehicles, plant and equipment will be in accordance with manufacturers' specifications and relevant standards to retain high levels of	• Given the low GHG emissions expected from the annual operation of the Project and the mitigating measures described above, no significant impacts from GHG emissions are anticipated

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
		Australia's total emissions and 0.9 % of Australia's total direct mining emissions respectively	energy efficiency • Exhaust controls will be fitted to equipment in keeping with Australian design rules and good industry practice • Energy efficient equipment will be incorporated into the processing plant • Controlled regrowth of low vegetation will be allowed in areas where it will not cause adverse operational safety impacts in order to absorb and compensate CO_2 emitted from vegetation clearing • Development of key performance indicators for efficiency and GHG intensity • Regular monitoring, auditing and reporting on energy and resource usage and GHG emissions from all relevant activities with a view to progressively improving energy efficiency and investigation of renewable sources (e.g. solar generation) where feasible • Continual evaluation of the success of any abatement measure undertaken, and investigation and adoption of new opportunities as they become available	
Other Emissions (Noise, Vibration, Light and Odour) – Relevant to the Project site and immediate surrounds, Wyndham Port and the community of Wyndham				
• To protect the amenity of nearby residents from noise impacts resulting from activities associated with the Project by ensuring	• The Project Area and surrounds are currently largely undisturbed with most noise sources being natural with very occasional vehicle noise from the Weaber Plain Road. There is no artificial lighting aside	• Fauna on site and in the immediate vicinity may be adversely affected by an increase in noise, vibration, odour and light emissions • Noise and vibration emissions	• Concentrate haulage trucks will only operate during daylight hours • Speed restrictions will be enforced and a ban on exhaust braking will be applied for concentrate haulage trucks whilst travelling through Wyndham township	• Impacts during construction and operations are not anticipated to be significant as the nearest fixed sensitive receptor (residential) is approximately 25 km away from the Project site and the

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
noise levels meet statutory requirements and acceptable standards • To avoid or manage potential impacts from light overspill and comply with acceptable standards • To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	from a few scattered lights for agricultural purposes outside of the Project Area • Noise, vibrations, light and odour may be generated by the Project in a number of ways during construction and ongoing operations, the key emission sources will include: ▪ Project construction ▪ Drilling and blasting activities ▪ Extraction, transfer, crushing and processing of ore ▪ Transportation of concentrate ▪ On site landfill facility ▪ Lighting required for the 24 hour operation of the processing plant	may lead to occupational health and safety impacts for the workforce on site and at Wyndham Port • Noise and vibration emissions may impact on the Wyndham community as a result of ore haulage trucks passing through the town • Light emissions may impact on users of the Weaber Plain Road during hours of darkness as a result of the 24 hour operation of the crushing and processing facilities • Odour emissions from the processing plant and landfill may result in occupational health and safety impacts for the workforce on site	• Trucks will be serviced and maintained to system requirements and relevant standards to retain an appropriate sound power level • All complaints regarding noise emissions will be investigated and mitigating measures implemented where required • Blasting will be designed to minimise noise projection and comply with noise standards • Blasting will only occur during daylight hours • Construction activities will be carried out in accordance with *AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites* • Operational activities will comply with the standards for operational noise set by the *Environmental Protection (Noise) Regulations 1997* • New generators will be used and they will have modern noise suppression devices attached • Vehicles, plant, equipment and generators will be serviced and maintained to system requirements to retain an appropriate sound power level • Mechanical plant will be fitted with noise suppression devices maintained to manufacturers specifications. Internal combustion engines will be fitted with a suitable muffler in good repair • Where necessary, mitigation measures such as earthen bunds and noise walls	Weaber Plain Road experiences only very occasional use by pastoralists or members of the public for recreational purposes • Hauling concentrate only during daylight hours will result in no significant impact of vehicles on fauna • Little effect will be experienced by communities as haulage trucks will travel common haulage routes • Management plans will be in place to prevent odour emissions from the processing plant and landfill

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			will be used • Wearing of appropriate PPE will be enforced to reduce noise impacts on workers • Frequency modulated reversing alarms will be installed on all relevant equipment • Consideration will be given to the location of fixed and mobile lighting such that light overspill is limited where practicable • All lighting will be directed inwards at the site to result in a "glow" being visible from the Weaber Plain Road rather than direct light • 'Bug Yellow' fluorescent lighting (or similar) will be used to limit attraction of flying insects to permanently lit areas • Shrouding will be used where practicable to reduce light overspill • Site speed limits will be adjusted to suit conditions during the hours of darkness to provide increased driver reaction time should fauna be "stunned" in vehicle head lights • Waste material at the landfill will be covered in accordance with the schedule identified in the DER licence to reduce odour emissions	

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
Social Surroundings				
Visual Amenity – Relevant to the Project site and immediate surrounds				
• To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as practical	The assessment of visual amenity is subjective in that each person has a different perspective on what is, or what is not, visually appealing. The visibility and appearance of a development can be assessed by considering: • Visual magnitude • Visual contrast • Duration	The alteration of the landscape associated with the Project development may detract from the visual amenity of the area. The potential visual amenity impacts could result from: • Creation of the mine pit voids, stockpiles and TSF • Clearing of native vegetation and ground disturbance associated with construction and mine site infrastructure development • Dust generation during construction and mining operations • Light generation for 24 hour operation of the processing facility	• Vegetation clearing during construction and operations will be minimised by appropriate planning, design and layout of infrastructure. There will be strict controls and clear delineation of development boundaries • The Project has been designed to maximise the use of pre-cleared and disturbed areas to minimise clearing of vegetation • Where practical, infrastructure will be placed such that it is screened by existing vegetation or topographic features to minimise visual intrusion on the landscape • Vegetation screening will be planted where appropriate • Landform heights and slopes designed to ultimately blend into the surrounding landscape • Access road to the site will be curved so the Project will not be directly visible from the Weaber Plain Road • Progressive rehabilitation and revegetation will be undertaken with the aim of re-establishing suitable local vegetation communities to blend into the landscape • Rehabilitation and closure concepts will consider visual amenity	• As a result of the management measures described and given the relative remoteness of the Project Area and comparatively small scale of the operation, no significant impacts to visual amenity are anticipated • Once Project closure occurs, land will be rehabilitated restoring visual amenity • Dust will be kept to a minimum through the use of dust suppressants and water carts • The processing facility will not be visible from the Weaber Plain Road

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
			• Backfilling of pit voids wherever possible; a pit lake will form in the C pod pit void	
Aboriginal Heritage – Relevant to the Project site and immediate surrounds				
• To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation	• No heritage sites have been identified within the Project Area to date and the TO's and MG Corporation approve the development of the Project • Although the Project impact footprint has been cleared by extensive heritage assessments there remains the potential for unknown sites of significance or value to be located in the area	• Disturbance to Aboriginal heritage sites and values through physical development of the Project • Impacts to water sources used by indigenous groups in the immediate area and downstream as a result of dewatering activities	• Project footprint altered following ethnographic survey to avoid a limestone hill of Aboriginal heritage significance • Aboriginal heritage assessments will be undertaken prior to any future developments in areas outside of the Project's Aboriginal heritage clearance area • All employees and contractors will be inducted regarding cultural awareness; this will inform personnel of their legal obligations with regards to heritage sites, provide instruction on their duty to look out for cultural heritage material and the appropriate course of action to be followed if new sites are identified • ACHMP developed to allow adequate management of known and unknown heritage values which may be located in the Project Area • Development of a MOU with the MG Corporation whose traditional lands the Project site lies within • Ensure clearing only occurs in areas that have been surveyed for Aboriginal heritage significance by competent personnel • Aboriginal heritage will be included in the Environmental Clearance Permit (ECP)	• No significant impacts to Aboriginal heritage are anticipated given the extensive heritage assessments carried out and management measures that will be implemented • No impact to indigenous water sources are anticipated due to Project activities as no natural standing water bodies are present in the Project Area. Additionally, drawdown as a result of dewatering is not expected to extend beyond the Project tenements or have any lasting effect on the groundwater aquifers

EPA Objective	Existing Environment or Context	Potential Impact	Environmental Management	Predicted Outcome
Other				
Closure and Rehabilitation – Relevant to the Project site and immediate surrounds				
• To ensure as far as practicable that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values	• SMPL intends to leave the site upon cessation of the Project in a safe and stable condition such that the tenements can be relinquished without any future liability for the company or the community	• Adverse impacts to flora, fauna, soil quality, ground and surface water quality and quantity, visual amenity and economic and social impacts due to poor rehabilitation • Adverse impacts to rehabilitation efforts due to poor quality soil • Poor closure planning resulting in the insufficient allocation of funds and/or resources for closure, particularly in the event of unforseen closure	• Mine closure planning has been initiated and a framework of concepts, targets and predicted outcomes has been produced • A MCP will be developed in accordance with the *DMP/EPA 'Guidelines for Preparing Mine Closure Plans' (June 2011)* • Where appropriate rehabilitation will occur progressively throughout the life of the Project • Implementation of soil management strategies from commencement of land clearing operations	• Given the closure and rehabilitation concepts, the proposed development of a MCP and the potential for future use of the site following mine closure, SMPL consider the residual impacts of the mining operation to be suitably acceptable over the long term • No predicted adverse impacts are expected on flora, fauna, soil quality, ground and surface water quality and quantity, visual amenity and economic and social impacts due to poor rehabilitation • Poor soil quality is unlikely to impact on rehabilitation efforts • Sufficient funds and/or resources will be allocated for closure and unforseen closure

7.2 ENVIRONMENTAL IMPACTS AND MANAGEMENT STRATEGIES

7.2.1 Key Environmental Factor: Flora and Vegetation

7.2.1.1 Management Objective

SMPL is committed to maintaining the ecological integrity of the Project Area and immediate surrounds that are not directly impacted during construction; the principle objectives for the management of flora and vegetation are to:

- Maintain the abundance, diversity, geographic distribution and productivity of flora species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge
- Protect Priority species and species of conservation significance
- Control the extent of clearing activities
- Reuse of vegetation and topsoil during rehabilitation
- Prevent infestations and routinely treat pest plant species (weeds)

7.2.1.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing flora and vegetation include:

- *EPBC Act*
- *EP Act*
- *Wildlife Conservation Act 1950*
- *Conservation and Land Management Act 1984*
- *Mining Act 1978*
- *Bush Fires Act 1954*
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*
- EPA Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia (2000)
- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (2002)
- EPA Guidance Statement No. 51: Terrestrial Flora and Fauna Surveys for Environmental Impact Assessment in Western Australia (2004)

7.2.1.3 Context

As described in Section 6.1.8, the flora and vegetation assessment identified eight vegetation units; the condition of the vegetation ranged from Excellent to Completely Degraded. The Project tenements support two areas that may be classified as the ‘Monsoon vine thickets of limestone ranges’ which are a Priority 1 PEC. A total of 334 taxa (species, subspecies and varieties) from 69 families and 201 genera have been recorded in the Project Area. No DRF were located, however 16 flora of conservation significance are known to occur.

Potential impacts to flora and vegetation could result from:

- Clearing of approximately 573 ha of native vegetation
- Introduction or spread of weeds
- Fire
- Dust
- Vegetation death from use of brackish water for dust suppression
- Changes in surface hydrology

These direct and indirect impacts can potentially occur throughout the life of the Project and may result in the removal of individuals and partial loss of populations of species of Priority flora or of conservation significance. The principal impact will be the clearance of native vegetation.

7.2.1.4 Management Measures

Clearing of Native Vegetation

Approximately 573 ha of native vegetation will be cleared to accommodate Project infrastructure such as open pits, plant site, TSF, roads, ROM pad and evaporation basins (Figure 2-1 and Table 2-14). Potential impacts resulting from this clearing include:

- Loss of individual conservation interest flora species
- Loss of sections of vegetation communities
- Degradation of various flora and vegetation habitats

Development of management strategies has focused primarily on avoiding impacts to flora and vegetation through site selection and secondly on mitigating and managing unavoidable impacts. Table 7-3 identifies the management measures to be implemented to prevent or mitigate the impacts of land clearing on native flora and vegetation.

Table 7-3: Land Clearing Management Strategies for Flora and Vegetation

Project Phase	Management Strategy
Planning and Design	• Implementation of CEMP and OEMP Strategy 1 (Appendix 1 and 2 respectively, Volume 2) • Flora and vegetation surveys carried out over an area larger than the disturbance footprint to enable an informed assessment of potential impacts and to put those potential impacts in a local and regional context • Working within the constraints of engineering and economic feasibility, the development has been designed to avoid direct impact to flora of conservation significance where possible and to maximise use of pre-cleared/disturbed areas, therefore minimising clearing requirements • Positioning of the plant site and associated ROM pad (Figure 2-1) is constrained by the geotechnical requirement that it is constructed off the floodplain and on competent material. As such, it is located on an old MRWA borrow pit/quarry and the site of the old Sorby Hills core shed and pastoralists mustering base camp • The western topsoil stockpile (Figure 2-1) is required to be placed within the haul road bunding to avoid significant erosion and subsequent loss of topsoil viability. If placed elsewhere within the haul road envelope the stockpile would impede drainage which would increase the possibility of ponded conditions within the envelope and potentially result in the loss of topsoil viability due to erosion and/or partial submersion • To maintain biological diversity in the Project Area and to preserve the two areas of the Priority 1 PEC 'Monsoon vine thickets of limestone ranges' the mine plan was tailored and a self-imposed Development Exclusion Boundary established. The Development Exclusion Boundary and Priority 1 PEC locations are indicated on Figure 6-37 • All required licences and permits will be obtained prior to clearing activities commencing
Site Preparation	• Ground disturbance will be prohibited unless it is authorised through the correct procedure and permitting process prior to ground disturbing activities commencing • The boundaries of approved clearing envelopes will be clearly delineated on plans and on the ground to ensure only the approved clearing is undertaken • Machinery operators will discuss clearing requirements with supervisors prior to commencing the work • Conduct clearing in a manner that facilitates the re-use of surface soils and vegetation debris for rehabilitation activities • Vegetation that is to be removed shall be either directly placed on disturbed areas to reduce erosion or stockpiled for later use in rehabilitation • Topsoil and vegetation debris will be stockpiled for future rehabilitation use • Stockpiles of surface soil and vegetation debris will be located to avoid impeding on critical surface drainage lines • Retention of nesting hollows, provision of artificial nest boxes and establishment of monitoring programs as described in the Gouldian Finch Management Plan (Appendix 4, Volume 2)
Post – Clearing	• Following disturbance, cleared areas and stockpiles will be surveyed, documented on the Site Plan and reported in the AER • Cleared areas no longer required will be rehabilitated as soon as practicable. Progressive rehabilitation will be conducted throughout the Project life and revegetation continued after cessation of production • Bare, compacted soils and previously disturbed areas that are not required shall be ripped and re-contoured in order to promote seed germination • All temporary construction infrastructure and facilities will be removed for rehabilitation • Planning for soil management should see that surface soil is utilised prior to 5

Project Phase	Management Strategy
	years after removal, wherever possible
PEC's	• All habitats identified as 'Monsoon vine thickets of limestone ranges' will be avoided (i.e. Development Exclusion Boundary) • Visual monitoring will be undertaken annually and photographic references taken
Staff Management/Training/Awareness	• Ensure all staff are appropriately inducted and trained in the environmental aspects applicable to their positions • Ensure clearing and habitat preservation are included in training and induction programs • Establish a system to monitor compliance with environmental requirements

Weeds

Increased human activities including vegetation clearing and the introduction of vehicles, machinery and equipment for construction and operations have the potential to spread or introduce weed species through transport of weed propagules unless weed hygiene procedures are implemented. The potential impacts of weeds at the Project site are:

- Competition for resources with native flora
- Degradation of critical habitats for native flora
- Reduced success of rehabilitation

To assist in minimising the potential sources of weed infestations and containing, controlling and/or eradicating target weeds species from the Project Area the weed hygiene and management measures identified in Table 7-4 will be implemented throughout the life Project life.

Table 7-4: Management Strategies for Weeds

Aspect	Management Strategy
Introduction	• Implementation of CEMP and OEMP Strategy 1 (Appendix 1 and 2 respectively, Volume 2) • All machinery, vehicles and plant to be free of soil and vegetative matter upon arrival on site; an inspection will be carried out upon arrival to confirm this • A wash down facility will be available to facilitate the cleaning of vehicles and equipment on arrival and before the commencement of work if necessary. This will include provision for capturing all water and filtering water from solids (i.e. seeds) • Weed seeds and soil collected from the wash down filter system will be disposed of in a manner that does not allow viable seeds to enter the environment • Domestic waste to be disposed of in the correct manner to prevent seed invasion from food waste
Control	• Implementation of CEMP and OEMP Strategy 1 (Appendix 1 and 2 respectively, Volume 2) • Weed management and hygiene programs; SMPL will form a collaborative relationship with DPaW to ensure that weed management practices are consistent with DPaW policies and enable coordination of weed management within the Project (SMPL), Goomig Conservation park (DPaW) and the Goomig Environmental Management Entity acting on behalf of the farmers of the Goomig agricultural area.

Aspect	Management Strategy
	• Undertake weed mapping and maintain a weed inventory • Conduct regular site inspections to record any new observations of weeds or changes in weeds distributions • The Project Area will be destocked prior to commencement of operations, this will result in decreased weed proliferation through reduced spread and minimisation of trampling of native vegetation which allows disturbance strategists (weeds) to take hold • Staff induction will include information on weed identification and procedures to prevent the spread of weeds • Vehicles will be washed regularly at designated wash down bays to remove built up soil • All vehicles are to remain on designated tracks to avoid disturbance and seed or soil transfer • Minimisation of ground disturbance through a procedure and permitting process to minimise the opportunity for weed invasion • Vegetation and topsoil removed from areas with known weed presence will be stripped and stockpiled separately; This material will not be used for rehabilitation unless it has been appropriately treated • Post rehabilitation monitoring for weed invasion will be undertaken and, if required, weed control will be implemented • Active management to eradicate **Senna obtusifolia* (Priority 2)

Fire

Although native flora is adapted to fire and in some instances can be dependent on fire for activation of seed germination, too frequent or too hot bush fires can result in detrimental changes to the composition and diversity of the vegetation. Project operations may result in beneficial effects as natural fires in the area will be more controlled, however activities associated with the Project may result in an increased likelihood of accidental fire. Potential impacts on native flora and vegetation resulting from accidental fire at the Project site include:

- Death of individuals and/or populations of native flora
- Altered vegetation structure
- Increased spread of weeds
- Altered habitat unable to provide conditions for native flora species to recolonise

Table 7-5 identifies the fire management measures that will be implemented throughout the Project life to assist in the prevention and control of fires in the Project Area.

Table 7-5: Fire Management Strategies for Flora and Vegetation

Aspect	Management Strategy
Prevention	• Implementation of CEMP and OEMP Strategy 1 (Appendix 1 and 2 respectively, Volume 2) • Staff induction will include information on fire prevention and control • Procedure and permitting process for all hot work • Hot work will not be conducted in fire risk areas or on days deemed to have a high fire risk

Aspect	Management Strategy
	• Ensure facilities comply with Local Government fire prevention requirements • Correct storage and isolation of flammable substances • Implementation of safe smoking practices and appropriate disposal of cigarette butts • All fires will be investigated to prevent a re-occurrence wherever possible
Control	• Implementation of CEMP and OEMP Strategy 1 (Appendix 1 and 2 respectively, Volume 2) • Appropriate firebreaks will be created and maintained • Fire management at the landfill facility will be included in the Site Emergency Response Plan, or equivalent • Appropriate fire response equipment will be located near storage areas for flammable substances • All fires in and around the Project Area are to be reported immediately

Dust

Project operations have the potential to generate dust in a number of ways including wheel generated dust from travelling on unsealed roads, wind erosion of cleared areas and stockpiles, and dust emissions associated with blasting and the extraction, transfer and crushing of ore. Potential impacts on native flora and vegetation resulting from dust generated at the Project site include:

- Dust settling on foliage resulting in physical effects such as the blockage of stomata, shading and abrasion of leaf surfaces or cuticles which may cause dieback. Dust may also make plants less attractive to pollinators
- Chemical effects such as altered soil chemistry

SMPL will aim to minimise the potential for dust emissions through appropriate planning and control and will implement management measures to mitigate any potential dust impacts to the surrounding environment. The proposed management strategies are provided in Section 7.2.11.4.

Vegetation Death from use of Saline Water

The groundwater in the Project Area is brackish; this water will be utilised for dust suppression across the Project site. Damage may occur to vegetation and flora if groundwater is excessively used during dust suppression (i.e. due to over spraying); potential impacts on native flora and vegetation resulting from brackish water use at the Project site include:

- Physical effects such as saline scalding
- Chemical effects such as altered water (for plant uptake) and soil chemistry

Potential impacts to flora and vegetation resulting from the use of brackish water are expected to be minimal due to implementation of mitigating strategies described in Table 7-6.

Table 7-6: Groundwater Use Management Strategies for Flora and Vegetation

Aspect	Management Strategy
Use of water in dust suppression	• Implementation of OEMP Strategy 1 (Appendix 2, Volume 2) • Water sprayed onto 10 m wide haul roads will be contained within 1.8 m high bunding with a total crest width of 3.0 m • Equipment suitable for the task will be utilised for dust suppression • Water will be applied at an appropriate rate to minimise dust • Any saline water spills or leaks will be contained and cleaned up

Changes in Surface Hydrology

To avoid flooding during the wet season there is a requirement to raise some site infrastructure to 1 m above the floodplain; water diversion structures will also be required. This will result in the localised alteration of surface hydrology in the Project Area which could impact on the flora and vegetation that are adapted to the natural surface water fluctuations. To minimise the potential for increased ponding of water and to reduce disruption to natural flow paths appropriately located and designed culverts will be installed. The surface water hydrology and associated management measures are discussed in detail in Section 7.2.5.

7.2.1.5 Predicted Outcome

Given the mitigating measures described above, SMPL feel that potential impacts to flora and vegetation can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

7.2.2 Key Environmental Factor: Fauna

7.2.2.1 Management Objective

SMPL is committed to maintaining the ecological integrity of the Project Area and immediate surrounds; the principal objectives for the management of fauna are to:

- Maintain the abundance, diversity, geographic distribution and productivity of fauna species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge
- Avoid disturbance to known valuable fauna habitat
- Control the impact of clearing activities on fauna
- Avoid impacts to listed fauna species and other species of conservation significance

7.2.2.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing fauna include:

- *EPBC Act*
- *EP Act*
- *Wildlife Conservation Act 1950*
- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (2002)
- EPA Guidance Statement No. 20: Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia (2009)
- EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (2004)
- EPA Technical Guide: Terrestrial Fauna Surveys for Environmental Impact Assessment (2004)
- SEWPAC Draft *EPBC Act* Policy Statement No. 3.25: *Environmental Protection and Biodiversity Conservation Act 1999* Referral Guidelines for the Endangered Northern Quoll, *Dasyurus hallucatus* (2011)

7.2.2.3 Context

As discussed in Section 6.1.9, APM investigated the terrestrial fauna of the Project Area; the investigations revealed the potential for 12 ground dwelling fauna species of conservation significance to occur. Ornithological surveys in the region found five *EPBC Act* species of conservation significance within the vicinity of the Project Area and 2 species listed as Priority 4 by DPaW.

Potential impacts to fauna, including fauna of conservation significance, could result from:

- Clearing of approximately 573 ha of native vegetation

- Introduced flora and fauna species
- Vehicle strike leading to fauna death
- Indirect impacts associated with the Project such as fire, noise and vibration, artificial lighting or contaminated surface water

These direct and indirect impacts can potentially occur throughout the life of the Project and may result in the loss of individuals of species of conservation significance. The principal impact will be the clearance of native vegetation leading to the loss of fauna and fauna habitat.

No habitats or landforms likely to promote endemism occur within the Project Area. Therefore it has been determined that there is little or no potential for impact on SRE Fauna.

7.2.2.4 Management Measures

Clearing of Native Vegetation

Clearing of vegetation is an unavoidable impact of the establishment of a new project. Up to 573 ha of native vegetation will be cleared to accommodate the proposed Project. Clearing is a significant threat to terrestrial fauna due to the consequent loss of habitat, as many species have specific habitat requirements. Potential impacts to fauna resulting from clearing for the Project include:

- Loss of individuals of fauna species
- Localised reduction in biodiversity and ecological function
- Loss and degradation of fauna habitats
- Displacement of fauna into surrounding areas where competition may be present from established individuals

Development of management strategies has focused primarily on avoiding impacts to fauna through site selection and secondly on mitigating and managing unavoidable impacts. Table 7-7 identifies the management measures that will be implemented to prevent or mitigate the impacts of land clearing on native fauna.

Table 7-7: Land Clearing Management Strategies for Fauna

Project Phase	Management Strategy
Planning and Design	• Implementation of CEMP and OEMP Strategy 2 (Appendix 1 and 2 respectively, Volume 2) • Development and implementation of a Gouldian Finch Management Plan (Appendix 4, Volume 2) which will include an assessment of the potential impacts and risks to distribution, population levels and habitat • Whilst clearing in non-breeding Gouldian Finch habitats may occur throughout the year, clearing of vegetation within Gouldian Finch breeding habitat will be avoided during the breeding and nesting season (December – June). • Working within the restraints of engineering and economic feasibility, the development has been designed to maximise use of pre-cleared/disturbed areas which are of lower value for fauna • Maximising the use of pre-cleared/disturbed areas also minimises clearing requirements • To maintain biological diversity, ecological function and the most valuable

Project Phase	Management Strategy
	habitats for threatened species such as the Gouldian Finch the mine plan has been tailored and a self-imposed Development Exclusion Boundary established • PEC's preserved by the implementation of the self-imposed Development Exclusion Boundary • All required licences and permits will be obtained prior to clearing activities commencing
Site Preparation	• Ground disturbance will be prohibited unless it is authorised through the correct procedure and permitting process prior to ground disturbing activities commencing • The boundaries of approved clearing envelopes will be clearly delineated on plans and on the ground to ensure only the approved clearing is undertaken • Clearing will commence with a raised blade to provide fauna an opportunity to move away from the clearing activities unharmed • Retention of nesting hollows, provision of artificial nest boxes and establishment of monitoring programs as described in the Gouldian Finch Management Plan (Appendix 4, Volume 2) • If trenching is required SMPL will consult with DPaW to ensure best management practices are adopted
Post – Clearing	• Cleared areas will be rehabilitated as soon as practicable; this will include replacing vegetation as this provides refuge for fauna • Following rehabilitation areas will be monitored and treated for weed invasion if necessary to establish higher value fauna habitat in rehabilitated areas
Priority Ecological Communities	• All habitats identified as 'Monsoon vine thickets of limestone ranges' are to be avoided (i.e. Development Exclusion Boundary) • Visual monitoring will be undertaken annually and photographic references taken • Samples of surface detrital material will be collected annually and analysed for traces of toxins associated with mining and tailings
Staff Management/Training/Awareness	• Ensure all staff are appropriately inducted and trained in the environmental aspects applicable to their positions • Ensure clearing and habitat preservation are incorporated into training and induction programs • Establish a system to monitor compliance with environmental requirements • Driving will only take place on designated tracks and speed limits will be adhered to at all times to minimise vehicle and fauna interactions

Loss of Fauna of Conservation Significance

Activities associated with the Project, such as clearing of native vegetation and increased vehicular movements may impact on fauna of conservation significance present in the Project Area. Potential impacts to fauna of conservation significance resulting from Project construction and operations include:

- Reduction in abundance of fauna of conservation significance in area of disturbance with consequential increased risk to the viability of remaining populations
- Loss of individuals of fauna species of conservation significance due to vehicular impact
- Displacement of fauna of conservation significance into surrounding areas where competition may be present from established individuals

The Project is not anticipated to significantly impact any MNES; however the Project was referred to SEWPaC under the *EPBC Act* for formal assessment where it was deemed 'not a controlled action', as discussed in Section 1.4.2. Although disturbance in the Project Area will have localised impact on bird species, the regional impact will be made less significant if other areas providing a greater array of critical habitats, such as Parry Lagoons, are actively maintained and managed as conservation reserves. The signing of the Ord Final Agreement has resulted in the establishment of six reserves in the surrounding ranges and the Packsaddle Swamp Conservation Area. In total, this area covers some 188,200 ha. Within these reserves, habitat identical to that which exists within the Project Area will be preserved. Additionally, the Register of National Estate reserves of Point Springs and the Keep River National Park extension, which are in proximity to the Project Area, are other areas that support EPBC listed Threatened and Migratory bird species that are not specifically dependant on wetland habitats.

Furthermore, as part of the ORIA – Weaber Plains Project, the Weaber Plain area will have 10,805 ha set aside as a buffer zone and conservation area; this area will be destocked to improve its habitat integrity. The Environmental Impact Statement for the ORIA – Weaber Plains Project (Strategen 2011) identifies that within the ORIA – Weaber Plains Project buffer zone more than 75 % of habitat suitable for EPBC listed wetland species will be preserved and that approximately 30 % of habitat for remaining non-wetland specific birds (mainly small passerines) will also be conserved. The buffer area represents almost 50 % of the total area outlined in the ORIA – Weaber Plains Project.

A greater target of habitat preservation and management will be achieved for the Project; within the 1,782 ha Project Area (tenements M80/197 and M80/286) only 573 ha will be impacted, therefore 1,209 ha (67 %) will be retained. Within the area not targeted for impact a range of avifauna habitats are well represented from foothills that may support species such as Northern Shrike-tit, to the floodplains that support the more abundant Eastern Great Egret and Cattle Egret. Additionally, the Development Exclusion Boundary has been created specifically to enhance and maintain valuable avifauna habitat and two areas of Priority 1 PEC ('Monsoon vine thicket of limestone ranges'). The Development Exclusion Boundary has been designed around the base of the Sorby Hills, the interzone with Knox Creek Plain and some areas of densely vegetated grasslands.

During the ornithological survey carried out by APM in April, 2011, three Gouldian Finch individuals were recorded at the base of the Sorby Hills, exactly where the species would be expected to occur at that time of the year. This record suggests that similar flocks of Gouldian Finches could occupy other foothills in the local area. Survey work under taken by Dr Sarah Pryke of the Save the Gouldian Fund has confirmed this to be the case with a number of individuals recorded in the north western extent of the Project Area. The species is strongly dependant on *Sorghum* sp. grasslands for food and individuals are usually found foraging in close proximity to fresh water. Their ecology is very well documented through studies in suitable areas of the NT (Tidemann and Woinarski 1994).

The design and layout of the Project has been structured around maintaining the required habitat for the Gouldian Finch, with the Development Exclusion Zone allowing quality breeding habitat in the Sorby Hills to remain undisturbed. A number of the existing permanent freshwater sources are also forecast to remain undisturbed. Additionally, management of fire (Table 7-5) and feral animal control (Table 7-9) may enhance the feeding and breeding habitats of the finch in the Project Area.

To further avoid or mitigate impacts to local Gouldian Finch populations, SMPL has developed a Gouldian Finch Management Plan (Appendix 4, Volume 2) that involves the provision of artificial nest boxes to compensate for potential loss of nesting habitat. With the implementation of this management plan there are immediate benefits to the Gouldian Finch as this species have been shown to preferentially use nest boxes for breeding over natural tree hollows (Brazill-Boast *et al*. 2012).

The National Recovery Plan for the Gouldian Finch suggests several actions that can be taken to achieve the following five specific objectives:

1. Specific fire regimes aimed at improving Gouldian Finch population trends are implemented at key sites and their effectiveness tested

2. Improved grazing, feral herbivore and fire management systems are in place at key off-reserve sites within Gouldian Finch range

3. Trends in population and health indices for Gouldian Finches are stable or improving at key sites

4. Reintroduction methodology and factors limiting Gouldian Finch survival are refined through trial reintroductions at Queensland sites

5. The national recovery program is operating with high levels of community participation

The Gouldian Finch Management Plan for the Project is compliant with the National Recovery Plan through the implementation of a fire regime which will be beneficial for the Gouldian Finch, reducing grazing pressure by destocking and implementing an annual population monitoring regime.

The overall objective of the National Recovery Plan for the Gouldian Finch is to improve the conservation status of the Gouldian Finch by population increases. Recent research by Gouldian Finch specialist Dr Sarah Pryke and her colleagues has shown that the provision of custom-built nest boxes can improve the breeding success and density of this species and the Save the Gouldian Fund uses and advises others to use nest-boxes as a management strategy. While this method is not specifically mentioned in the National Recovery Plan it is consistent with the overall objective of increasing population numbers.

Other Gouldian Finch Management Plans that have been created for development projects in the region (e.g. ORIA – Weaber Plains Project and Ridges Iron Ore Project) have also included the installation of nest-boxes to offset the removal of potential nesting trees.

Prior to initiating the Gouldian Finch Management Plan, SMPL are committed to undertaking further survey work for the Gouldian Finch to gain more baseline data on population dependency on the Project Area as it currently exists. An assessment of local populations of Gouldian Finch, comprising the monitoring of all remnant water bodies in the Project Area for two hours after sunrise for five consecutive mornings was carried out in October 2012. During the course of the survey three Gouldian Finches were recorded in the vicinity of the natural water body at Discovery Hill in the Development Exclusion Zone.

In addition to the Gouldian Finch, a number of other fauna species of conservation significance were identified. Table 7-8 identifies the conservation significant fauna likely to be present within the Project Area, the potential impact of the Project on the habitat in which they were recorded and the management strategies that will be employed to mitigate those impacts.

Table 7-8: Potential Impacts and Management for Fauna Species of Conservation Significance

Fauna Species	Level of Conservation Significance[1]	Habitat	Potential Impact	Management Strategies for Impact Mitigation
Mammals				
Short-tailed Mouse *Leggadina lakedownensis*	CS2 - Priority 4	Predominantly cracking clay soils with sparse *Bauhinia* woodland.	Potential loss and fragmentation of habitat.	Clearing requirements for the Project minimised.
Birds				
Gouldian Finch *Erythrura gouldiae*	CS1 – Endangered, *EPBC Act* and *Wildlife Conservation Act 1950*	Non-breeding habitat consists of tropical savanna woodlands with suitable grass species for feeding. This type of habitat occurs at the base of the Sorby Hills. Breeding habitat consists of rocky hills with hollow-bearing smooth-barked *Eucalyptus* and *Corymbia species,* such as at the northern end of the Sorby Hills.	Potential loss of habitat and nesting hollows.	Implementation of Development Exclusion Zone to protect suitable breeding habitat. Creation of a Gouldian Finch Management Plan which incorporates active habitat management and retention of nesting hollows.
Cattle Egret *Ardea ibis*	CS1 – Migratory, *EPBC Act*	Grassland surrounding freshwater bodies.	Potential loss of habitat.	Active management of existing man-made water bodies in the Project Area, exclusion of cattle and reduction of wildfires.
Great Egret *Ardea alba*	CS1 – Migratory, *EPBC Act*	Freshwater bodies.	Potential loss of habitat.	Active management of existing man-made water bodies in the Project Area, exclusion of cattle and reduction of wildfires.
Rainbow Bee-eater *Merops ornatus*	CS1 – Migratory, *EPBC Act*	Usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water.	Minor loss of habitat.	Clearing requirements for the Project minimised.
Magpie Goose *Anseranas semiplamata*	CS1 - Other Matters, *EPBC Act*	Grasslands surrounding freshwater bodies.	Potential loss of habitat.	Active management of existing man-made water bodies in the Project Area, exclusion of cattle and reduction of wildfires.
Bush Stone-curlew *Burhinus grallarius*	CS2 - Priority 4	Open woodlands, edges of forest and nearby inland water	Minor loss of habitat.	Clearing requirements for the Project minimised.

Fauna Species	Level of Conservation Significance[1]	Habitat	Potential Impact	Management Strategies for Impact Mitigation
		sources.		
Australian Bustard *Ardeotis australis*	CS2 - Priority 4	Dry plains, grasslands and savannah woodlands.	Minor loss of habitat.	Clearing requirements for the Project minimised.
Reptiles				
Freshwater Crocodile *Crocodylus johnstoni*	CS1 – Other Matters, *EPBC Act* and *Wildlife Conservation Act 1950*	Freshwater rivers, billabongs and dams. It was not observed in the Project Area, but is ubiquitous throughout the local area.	Potential loss of habitat. Impact unlikely to be significant.	Active management of existing man-made water bodies in the Project Area, exclusion of cattle and reduction of wildfires.

[1] Classification of species of conservation significance is described by APM:

- Conservation Significance 1 (CS1): Species listed under State or Commonwealth Acts
- Conservation Significance 2 (CS2): Species not listed under State or Commonwealth Acts, but listed as priority species by DPaW

Whilst not recognised under WA or federal legislation, three reptile species of conservation significance under NT legislation (*Territory Parks and Wildlife Conservation Act 2000*) were recorded in the region:

- Northern Death Adder (*Acanthopis praelongus*)
- Yellow-spotted Monitor (*Varanuspanoptes* subsp. *panoptes*)
- *Ctenotus rimacola* subsp. *camptris*

Introduced Flora and Fauna

Project activities including vegetation clearing, the introduction of vehicles, machinery and equipment, creation of surface water bodies and domestic operations have the potential to spread or introduce weed species and may increase the incidence of feral animals in the Project Area. The potential faunal impacts of introduced flora and fauna at the Project site are:

- Competition for resources with native fauna
- Degradation of critical habitats for native fauna
- Direct predation of native fauna by feral fauna species leading to increased mortality
- The presence of weed species may decrease habitat value and reduce the success of rehabilitation

Specific management actions identified to assist in minimising the potential sources of weed infestations and containing, controlling and/or eradicating target weed species from the Project Area have been discussed in Section 7.2.1.4.

As discussed in Section 6.1.9.6, SMPL is conscious that the creation of surface water bodies (i.e. evaporation basins) at the Project has the potential to provide habitat for Cane Toads which are a threat to native wildlife, however it is not envisioned that the surface water bodies will significantly add to the Cane Toad population of the area. Given the lack of effective Cane Toad control or eradication measures nationally SMPL are limited in the contribution they can make to Cane Toad control. However SMPL can contribute to Cane Toad management by providing quantitative data at a site specific level over a reasonably long period of time; these data may then be used by research groups that are actively working on Cane Toad control on a regional scale. SMPL will also liaise with 'Toad Busters' and provide 'in kind' support to the group's annual collection effort.

Mitigation methods that will be implemented to reduce the risks of introducing feral fauna to the Project Area and assist in minimising their potential impacts are described in Table 7-9.

Table 7-9: Management Strategies for Feral Fauna

Aspect	Management Strategy
Planning/Design	• Implementation of CEMP and OEMP Strategy 2 (Appendix 1 and 2 respectively, Volume 2) • Barriers will be installed around waste storage facilities • Site stormwater management to avoid ponding away from designated areas
Cane Toads	• Bi-annual Cane Toad monitoring • Bi-annual survey of indicator species • Implementation of newly developed successful control programs where possible
Housekeeping	• Good housekeeping and rubbish disposal practice will be implemented • Regular landfill covering to discourage feral animal species • Reduce animal access to water sources by maintaining taps and pipes to avoid leaks and drips
Staff Management/Training/Awareness	• Pets will not be permitted on site • Site personnel will be discouraged from feeding wildlife (native and feral species)

Indirect Impacts

Activities associated with the Project such as artificial lighting, use of machinery, blasting, surface water alterations, TSF and changed fire regimes may indirectly impact on fauna present in the area. Potential indirect impacts to fauna resulting from the Project include:

- Disturbance to individuals and/or populations of native fauna
- Death of individuals and/or populations of native fauna
- Loss or degradation of critical habitat
- Altered abundance and composition of prey species

Altered fire regimes can pose a threat to fauna. Fire management measures that will be implemented to assist in the prevention and control of fires in the Project Area are detailed in Table 7-5.

If incorrectly managed, contaminated surface water (including the TSF) may also pose a hazard for fauna; mitigation and management measures for surface water quality are discussed in detail in Section 7.2.5.4. Fauna management strategies relating to the TSF are described in Section 7.2.8.4.

Some aspects of the Project will be operational 24 hours per day resulting in the requirement of artificial illumination of some work areas. Light pollution may attract some species of fauna causing them to be disorientated. In addition, insects disorientated or attracted to light sources may in-turn attract insectivorous species and thus increase frequency of fauna-human interactions in these locations. Subject to safety conditions, lighting on site will be minimised and with further management measures implemented (Section 7.2.15.4) light overspill is not expected to be a significant impact.

Noise and vibration pollution from activities such as blasting and machinery operation may disrupt fauna species due to the fear response of wildlife to new stimuli. Over time however it is anticipated that most species will either habituate to the noise and vibration disruption associated with the Project or move a suitable distance away from the source of disturbance so that it no longer causes them distress. Due to the relatively large areas of habitat that will remain undisturbed it is not expected that the movement of some individuals away from noise and vibration sources will cause a significant impact to local wildlife populations. Noise and vibration emissions and associated management strategies are discussed further in Section 7.2.15.4.

7.2.2.5 Predicted Outcome

Given the mitigating measures described above, SMPL feel that the potential impacts to fauna can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

7.2.3 Key Environmental Factor: Conservation Areas

7.2.3.1 Management Objective

SMPL is committed to maintaining the ecological integrity of the Project Area and immediate surrounds; the principal objectives for the management of potential indirect impacts on the GRCP as a result of Project activities are to:

- Protect the environmental values of areas identified as having significant environmental attributes
- Apply environmental management strategies to reduce indirect impacts

7.2.3.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing the conservation area include:

- *EPBC Act*
- *EP Act*
- *Wildlife Conservation Act 1950*
- *Conservation and Land Management Act 1984*
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*
- EPA Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia (2000)
- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (2002)
- EPA Guidance Statement No. 51: Terrestrial Flora and Fauna Surveys for Environmental Impact Assessment in Western Australia (2004)

7.2.3.3 Context

The proposed GRCP is located adjacent to the Project Area as illustrated by Figure 1-1; the Project tenements and GRCP share a common boundary of approximately 1 km. The GRCP has been proposed by the WA Government to offset the clearing of vegetation and fauna habitat for the ORIA.

Due to the proximity of the GRCP to the Project Area the potential exists for Project activities to indirectly impact the GRCP. Indirect impacts could result from:

- Increased dust levels from mining activities in the Project Area
- Altered fire regimes
- Fauna displaced from the Project Area may increase competition in the GRCP
- Increased noise and vibration levels due to blasting and use of vehicles and machinery

- Increased lighting levels from the Project Area may contribute to altered species composition
- Increased traffic and personnel may contribute to weed encroachment
- Increased traffic may result in an increase in fauna road deaths
- Restriction of public access to the GRCP due to closure of informal GRCP access tracks within the Project tenements

7.2.3.4 Management Measures

SMPL is committed to ensuring that indirect impacts to the GRCP are avoided where possible or otherwise minimised. SMPL will maintain regular communication with DPaW and a formalised communication protocol will be established during Project approvals consultation.

The key management strategy is the placement of the self-imposed Development Exclusion Boundary which provides a buffer zone between the GRCP and the area to be impacted by the Project. The Development Exclusion Zone is 0.3 km at its narrowest and 2 km at its widest point. The spatial relationship between the Project Area, Development Exclusion Zone and the GRCP is illustrated in Figure 7-1. The Development Exclusion Zone will minimise the indirect impacts on the GRCP.

The evaporation basins have the potential to increase feral animal populations in the area; however, the management measures outlined in Table 7-9 will reduce the likelihood of this occurring.

To minimise the potential for indirect impacts to the GRCP occurring due to weeds, fire, feral fauna, dust and noise, vibration and light emissions, strict environmental management measures will be implemented throughout the life of the Project. Management measures for the control and minimisation of weeds, fire, feral fauna, dust and noise, vibration and light emissions at the Project are provided in Sections 7.2.1, 7.2.2, 7.2.11 and 7.2.15 respectively. Communication and cooperation protocols will be established with DPaW in relation to fire management.

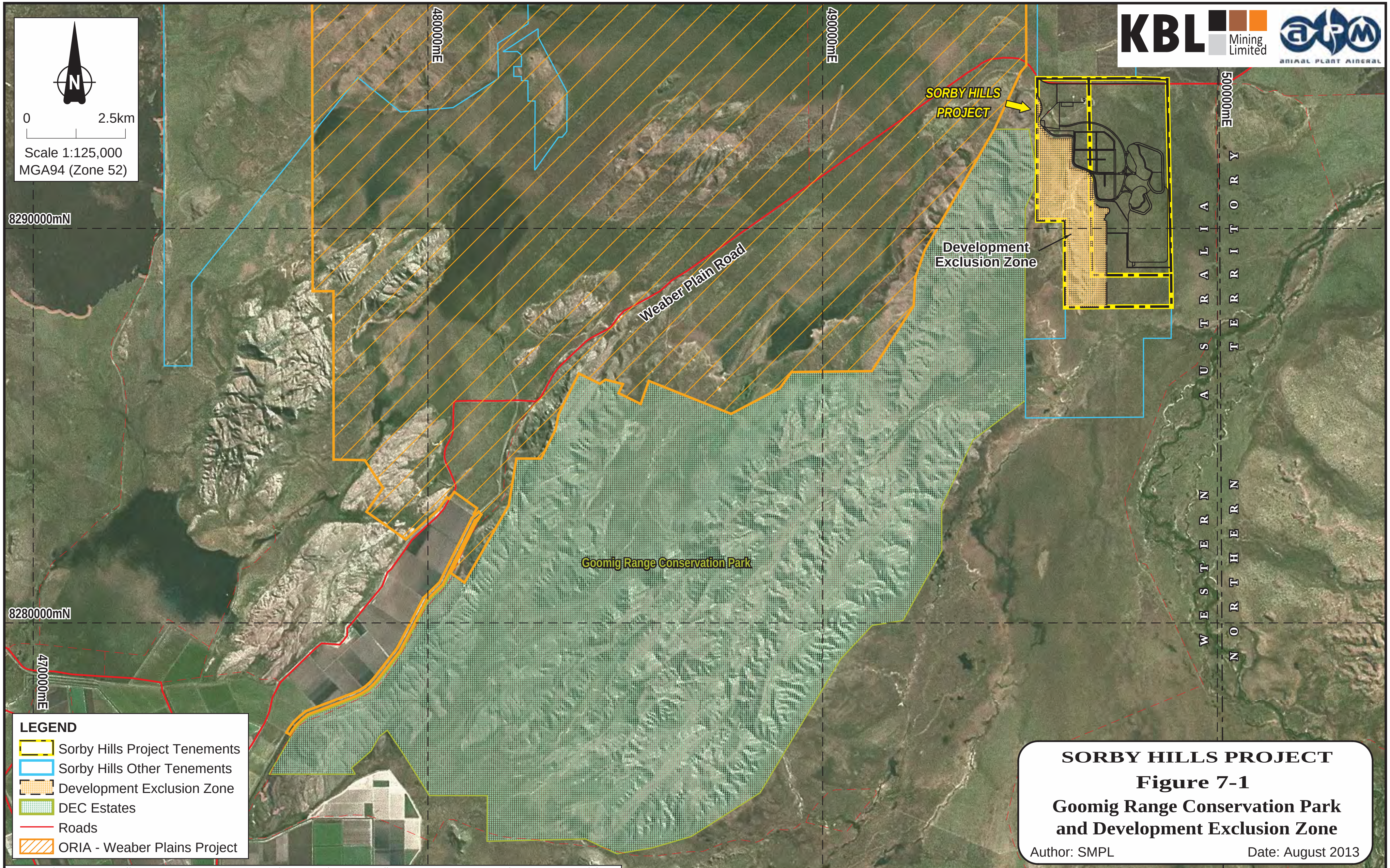
One of the values identified for the GRCP by DPaW (Graham and White 1999) is recreational value. Historically access into the GRCP has been difficult due to inadequate tracks; however access was available through the Project tenements on the Sorby Hills side of the ranges. Due to safety and security reasons the tracks existing on Project tenements will no longer be available to the public inhibiting use of the GRCP for recreation. However DPaW has suggested the potential for creating a loop scenic drive as well as day use areas and camping grounds in the southern area of the ranges (Graham and White 1999). This will allow for improved public access and management of public use of the GRCP, negating the need for use of the historical access tracks within the Project tenements. Internal management will be implemented by SMPL to ensure that SMPL staff and contactors utilise public facilities responsibly when entering the proposed GRCP.

7.2.3.5 Predicted Outcome

It is anticipated that the implementation of the Project's environmental management plans and strategies will help to avoid or minimise indirect impacts to the GRCP. Additionally, active environmental management within the GRCP by DPaW, will likely combine to stabilise if not enhance the conservation values of the GRCP. Consequently SMPL feel that potential indirect impacts to the

GRCP can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_701.dgn



Source: Infrastructure - Coffey, Tenements - DMP, Topography - Geoscience Australia, DEC Estates - DEC, Ord Stage 2 - KBL Mining

SORBY HILLS PROJECT

Figure 7-1

Goomig Range Conservation Park and Development Exclusion Zone

Author: SMPL

Date: August 2013

7.2.4 Key Environmental Factor: Subterranean Fauna (Stygofauna and Troglofauna)

7.2.4.1 Management Objective

SMPL is committed to maintaining the ecological integrity of the Project Area and immediate surrounds; the principal objective for the management of subterranean fauna is to:

- Maintain the abundance, diversity, geographic distribution and productivity of fauna species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge

7.2.4.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines with governing subterranean fauna include:

- *EPBC Act*
- *EP Act*
- *Wildlife Conservation Act 1950*
- EPA Guidance Statement No. 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (2007)
- EPA Guidance Statement No. 54a (Draft): Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia (2007)

7.2.4.3 Context

As discussed in Section 6.1.9.7 an assessment was undertaken to provide an understanding of the subterranean fauna of the Project Area (Appendix 27, Volume 3). The assessment revealed that the habitat present in the Project Area is not favourable for troglofauna and is unlikely to contain significant troglofauna communities. It was therefore determined that there is little or no potential for the Project to impact on troglofauna.

Stygofauna are known to occur in the area and it is possible that the Project may impact local populations through the excavation of ore and dewatering activities during the mining process; based on the findings of the subterranean fauna assessment (Appendix 27, Volume 3) it is considered unlikely that the localised impact will have a significant effect on regional populations or threaten the persistence of any stygofauna species. SMPL will however minimise mine pit disturbance areas and dewatering activities where possible.

7.2.4.4 Predicted Outcome

Given the findings of the subterranean fauna assessment, no significant impacts to subterranean fauna are anticipated, therefore SMPL feel that the limited potential impacts to subterranean fauna can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

7.2.5 Key Environmental Factor: Surface Water

7.2.5.1 Management Objective

SMPL is committed to maintaining the environmental values of the Project Area and immediate surrounds; the principal objectives for the management of surface water quantity and quality are to:

- Maintain to the extent practicable the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected
- Ensure that discharges do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards
- Maintain the integrity and ecological functions of surface water bodies

7.2.5.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing surface water include:

- *Rights in Water and Irrigation Act 1914*
- *Dangerous Goods Safety Act 2004*
- *Waterways Conservation Act 1976*
- *Dangerous Goods Safety (Storage and Handling of Non Explosives) Regulations 2007*
- DoW: Water Quality Protection Note 28 – Mechanical Servicing and Workshops (2006)
- DoW: Water Quality Protection Note 68 – Mechanical Equipment Washdown (2006)
- WRC State Wide Policy No. 5: Environmental Water Provisions Policy for Western Australia (2000)
- ANZECC/Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ): Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
- AS/NZS 5667.1:1998 – Water Quality – Sampling – Guidance on the Design of Water Sampling Programs, Sampling Techniques and Preservation and Handling of Samples
- AS/NZS 1940:2004 – Storage and Handling of Flammable and Combustible Liquids
- CSIRO: Floodplain Management in Australia – Best Practice Principles and Guidelines (2000)

7.2.5.3 Context

As previously described in Section 6.1.4, no significant creeks or defined drainage systems occur within the proposed Project Area. Throughout the wet season the Project Area is subject to waterlogging and surface ponding conditions. During intense rainfall events (i.e. a 1 in 100 year, 72 hour flood event) the water level is likely to rise approximately 1 m above ground level and remain for extended periods.

The potential surface water impacts that could result from Project operations include:

- Localised modification of flow paths due to diversionary works to protect site infrastructure
- Ponding of water upstream of infrastructure
- Changes to surface hydrology resulting from creation of the dewatering evaporation basin for containment of runoff and excess water from dewatering activities
- Increased erosion due to alterations of natural flow paths
- Sedimentation or contamination of surface water due to Project activities or design
- Pollution of surface water due to the inappropriate storage of hydrocarbons, process chemicals and other dangerous goods

7.2.5.4 Management Measures

To maintain surface water quality and to ensure that impacts on water quantity are minimised throughout the life of the Project, strict management measures will be implemented. These strategies are described below and will be incorporated into the construction and operational EMP's for the Project (Appendix 1 and 2 respectively, Volume 2).

Flooding

Flooding in the Project Area was analysed and discussed in the SWC surface water and flood assessment undertaken for the Project; the findings of the assessment are summarised below and the full report is available in Appendix 10 (Volume 3).

The Project Area is situated within the large alluvial floodplain on the eastern side of the Pincombe Ranges and Sorby Hills. The alluvial floodplain saturates during the wet season, with water typically flooding a depth of 20 – 30 cm. The clayey soils, which exhibit shrink – swell properties are likely to become saturated to 0.5 m depth following the onset of the wet season, and swell such that they form an effective 'clay-liner' across the floodplain (i.e. negligible infiltration after swelling).

Any additional water landing on the floodplain (i.e. rainfall) floods the surface, and then either slowly flows to Knox Creek and then Keep River to the south east or evaporates. Based on the water retention properties listed in the SWC Soil Characterisation Report (Appendix 4, Volume 3), the clayey alluvial soils have a total storage capacity of 0.7 m^3/m^3 (i.e. 700 mm/m). If it is assumed that the surface 0.5 m of clay becomes saturated then 350 mm of water is consumed during the saturation process. Using the long-term (since 1944) monthly rainfall data (Table 7-10) all of the December and January rainfall is likely to be consumed in saturating the clayey alluvial soils; leaving the remaining 339 mm of rainfall from a worst case scenario to flood the surface of the floodplain.

Table 7-10: Long-term Monthly Rainfall Data for the Sorby Hills Region Wet Season

	December	January	February	March
Rainfall (mm)	145	203	208	133

If a worst case scenario is taken and all rainfall (i.e. 689 mm) landing on the upstream north west and west catchments reports to the floodplain (i.e. no infiltration or loss of water), then an additional 4,182,230 m^3 of water will enter the floodplain in the vicinity of the Project. This volume of water equates to an additional 1,394 mm of water entering the site, and when combined with the water already on the floodplain will result in a total flood height of 1.72 m.

If it is assumed that the upstream catchments have a 50 % runoff coefficient (i.e. 50 % of all rainfall runs off the catchment; equates to 344.5 mm) then an additional 2,088,080 m^3 of water will enter into the floodplain area in the vicinity of the Project. This will result in a flood water depth of 1.03 m.

In the more realistic scenario, whereby only 30 % of the total rainfall runs off from the upstream catchments (equivalent to 1,256,490 m^3), then the flood water depth will only be 0.75 m. It is important to note that in the above scenarios, the volume of water running off the upstream catchments in the 50 % runoff coefficient (344.5 mm) is equivalent to approximately 80 % of all rainfall falling in a 1 in 100 year, 72 hour flood event running off the catchment surface. Given that appreciably less water will likely runoff, it is considered that the flood level of 1.03 m represents a maximum value.

Therefore all infrastructure situated in areas where flooding is likely will be raised to a height of at least 1 m above the floodplain level. Geotechnical designs and plans for the raised infrastructure, which are based on a 1 in 100 year, 72 hour flood event, are described in Sections 2.5 and 2.7 with further information available in Appendix 9 (Volume 3). In addition, roadwork bunding is required to a level of 1.8 m above the road heights of 1 m for trucks to travel safely, which therefore results in a total height of 2.8 m; this will provide adequate protection to infrastructure from flood events in excess of the 1 in 100 year, 72 hour flood.

It is acknowledged by SMPL that the ORIA – Weaber Plains Project may affect the hydrology of the Weaber Plain; SMPL will continue their ongoing liaison with the ORIA – Weaber Plains Project development partners with regards to joint monitoring and assessment of the Weaber Plain Hydrology.

Projected future climate change for the Project area is discussed in Section 6.1.3.2; modelled scenarios predict that it is most likely that rainfall will remain similar to what it is currently, however predictions based on the 90th percentile at medium to high emissions scenarios suggest that rainfall in the Project area could potentially increase by up to 10 %. As discussed above, the total height of the haul road will be 2.8 m; this is more than adequate protection for a 1 in 100 year, 72hour flood event and will easily cater for a potential 10 % increase in rainfall.

Stormwater Runoff and Erosion

Diversionary works will be required to divert runoff from the upstream catchment around critical infrastructure. The proposed site enveloping alignment of the haul road, in conjunction with the proposed location of the waste rock stockpiles to the east of the pits and surface water diversion bund (Figure 2-1) will provide protection for the TSF and associated TSF evaporation basin, pits and waste stockpiles. Expected surface water drainage patterns are shown on Figure 7-2.

The haul road has been designed to function as a surface water diversion bund and will offer a 2.8 m flood protection barrier (1 m high road embankment plus 1.8 m safety bunds) which will minimise the potential of overtopping during a flood in excess of the 1 in 100 year, 72 hour flood event. Surface drainage of the haul road wearing layer will be towards the interior of the surrounded area, pipe culverts will be installed through the edge bunds to facilitate drainage of this runoff in a controlled manner. The natural topography of the ground encompassed by the haul road falls from west to east; to minimise the potential for ponding of water within the haul road envelope, culverts will be installed along the eastern extent of the embankment as shown by Figure 2-1. Each set of culverts will comprise four 30 cm diameter barrels, the culverts will discharge eastwards, with the flow entering the dewatering evaporation basin.

The TSF and associated TSF evaporation basin will be positioned within the haul road envelope and will therefore utilise the haul road for flood water protection. The positioning of the TSF evaporation basin away from the northern portion of the haul road will allow surface runoff from within the haul road envelope to flow around the TSF evaporation basin to the stormwater culverts. A freeboard of 0.3 m to 0.5 m is commonly adopted across Australia (CSIRO 2000); the Project's TSF will be constructed with an embankment height of 6.9 m and a freeboard of 1.5 m, both these measures are designed to accommodate at least a 1 in 100 year, 72 hour flood event, nevertheless the TSF evaporation basin has been sized to contain water from the TSF generated during a 1 in 100 year, 72 hour flood event; storm water will be decanted from the TSF and directed to the TSF evaporation basin. Additionally an engineered spillway for the TSF evaporation basin will be constructed at the location indicated in Figure 2-1. The spillway may be activated in the unlikely event of a storm greater than the design event (1 in 100 year, 72 hour flood event) in order to prevent overtopping of the TSF evaporation basin embankment which would result in scour and subsequent embankment breach. The spillway will be lined with rock riprap and geofabric and will be constructed to a depth of 70 cm.

As discussed in Section 6.1.3.2 rainfall in the Project area could potentially increase by up to 10 % due to predicted future climate change, it is anticipated that the positioning of the TSF and associated TSF evaporation basin within the 2.8 m high haul road envelope in addition to the TSF and associated TSF evaporation basin design (which accommodates at least a 1 in 100 year flood event and provides the TSF with a 1.5 m freeboard) will provide adequate protection for a potential increase in rainfall.

A water balance diagram for the TSF and associated TSF evaporation basin is shown in Figure 2-11. Further information regarding TSF and associated TSF evaporation basin design is provided in Sections 2.5 and 2.7.5 and the Coffey infrastructure design report (Appendix 9, Volume 3).

The waste rock stockpiles adjacent to E pod have been placed to act as a surface water diversion structure for the pits. Waste rock will be placed along the perimeter of the topsoil and clay stockpiles to provide erosion protection for the material within; there is sufficient waste rock to form armouring some 60 m in width. As the stockpiles occupy a large area defined drainage paths for runoff are required. A single cross fall will be incorporated into the stockpiles such that runoff is directed eastwards and therefore away from the pits, a maximum inclination of 10 ° will be used to minimise erosion. A dish drain will be included along the eastern extent of the topsoil and clay stockpiles to capture the eastward flow and utilise the adjacent waste rock for scour protection. This channel will discharge into the dewatering evaporation basin. Appropriately designed sediment traps will be installed and the dish drain will be monitored for siltation. The placement of stockpiles is further described in Section 2.2 and the Coffey infrastructure design report (Appendix 9, Volume 3).

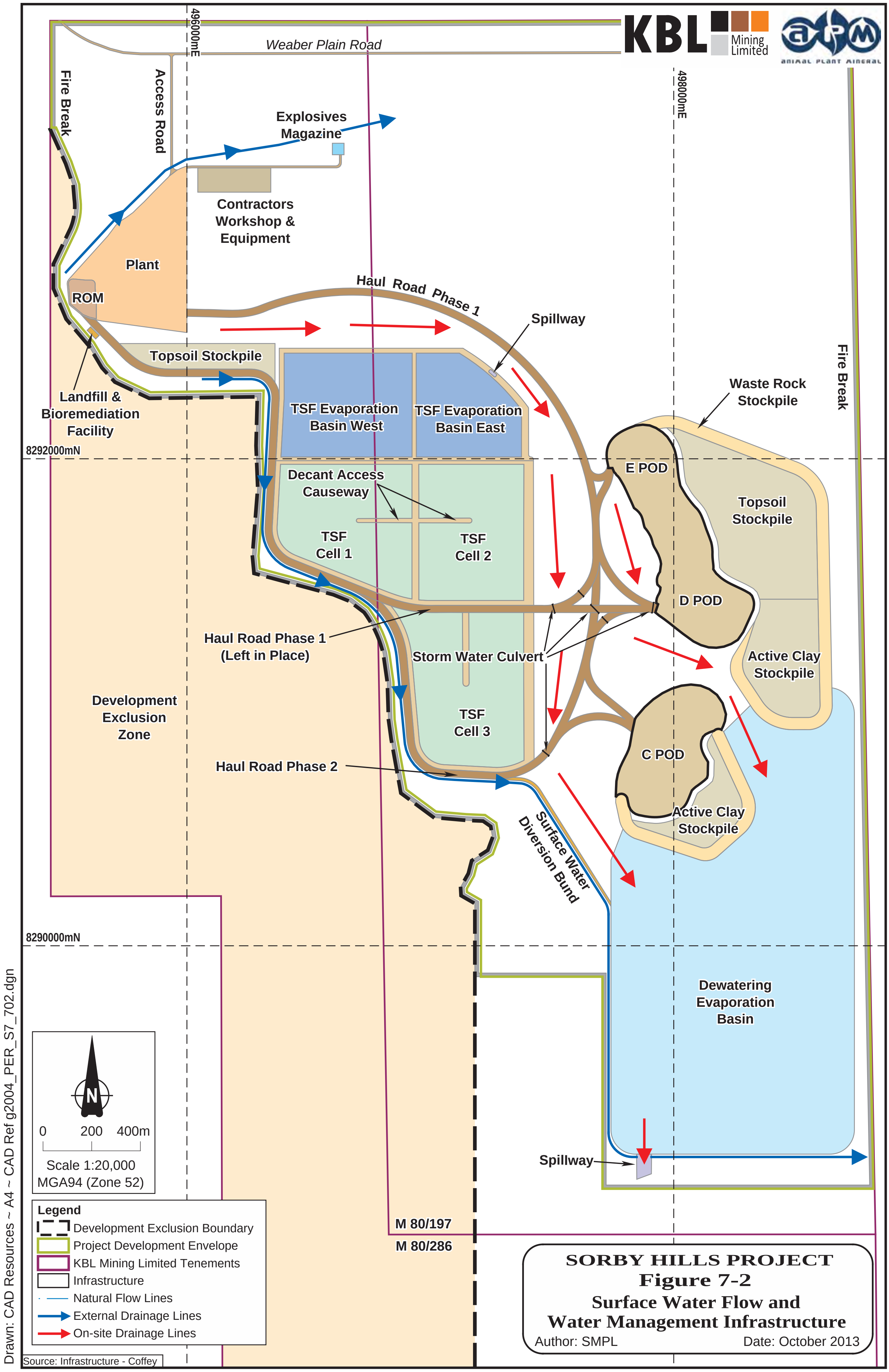
Surface water impacts to PEC's are not anticipated as the two PEC areas are situated within the Development Exclusion Zone (Figure 6-37) and the modification of flow paths to protect site infrastructure will be very localised (Figure 7-2). Furthermore, surface water flow in the area is towards the south east, away from the PEC areas and there will be no upstream (north west of the two PEC areas) obstruction as a result of the Project (Figure 6-37).

Dewatering Evaporation Basin

A dewatering evaporation basin will be created in the south eastern corner of the Project Area for the capture and storage of runoff from within the haul road envelope and excess water extracted during dewatering of the pits; excess water is that which is not utilised in the process plant as top up process water. The dewatering evaporation basin will cover approximately 150 ha inclusive of associated stockpiles and access tracks.

The evaporation basin will be defined by perimeter containment bunding; the surface water diversion bund to the west will ensure that runoff generated to the west of the Project site will not be captured. The location of the dewatering evaporation basin and associated spillway is indicated in Figure 2-1. The containment bunds will be constructed to a height sufficient to ensure clearance above a 1 in 100 year, 72 hour flood event. The spillway may be activated in the unlikely event of a storm greater than the design event (1 in 100 year, 72 hour flood event) in order to prevent overtopping of the embankment which would result in scour and subsequent embankment breach. The spillway will be lined with rock riprap and geofabric.

The dewatering evaporation basin has been designed to accommodate excess dewatering water on a daily basis and seasonal rainfall and runoff from within the haul road envelope; these will be the primary sources of water feeding into the basin. Water loss from the basin will be in the form of evaporation. Whilst there may be some seepage to groundwater, the impermeable nature of the surrounding material will reduce this to an insignificant volume; groundwater quality in the vicinity of the dewatering evaporation basin will be monitored at bores MB01 and MB03 (Figure 2-16) as part of the quarterly groundwater sampling program, as described in Section 7.2.6.4.



SORBY HILLS PROJECT

Figure 7-2

Surface Water Flow and Water Management Infrastructure

Author: SMPL   Date: October 2013

Sedimentation or Contamination due to Project Activities or Design

Strict control of sedimentation and management of potentially contaminated water flow will be implemented to maintain surface water quality. As described previously, the haul road envelope and surface water diversion bunding will divert clean runoff from the surrounding environment away from the internal infrastructure areas to ensure this water does not become sediment laden or contaminated. In addition, flood bunds will be constructed around other site infrastructure, including the waste landfill facility, to divert clean water away and contain any potentially sediment laden or contaminated surface waters within the work area. Potentially contaminated surface water within work areas, such as waste water from washdown areas at workshops, will pass through a treatment system such as a triple interceptor or coalescing plate separator. Water from the ROM pad and plant site will drain into sediment basins (Appendix 36, Volume 3) and be transferred to the process circuit. Appropriately designed and located sediment trapping devices will be installed to ensure that sediment laden waters do not enter the adjacent environment.

Surface water contamination risk predominantly relates to hydrocarbon and process chemical storage, handling and disposal, and management of the TSF and associated pipelines. Management measures for the storage and handling of hydrocarbons, process chemicals and other dangerous goods are detailed in Section 7.2.12. Strategies relating to the management of the TSF and associated pipelines are described in detail in Section 7.2.8.4.

Surface Water Monitoring

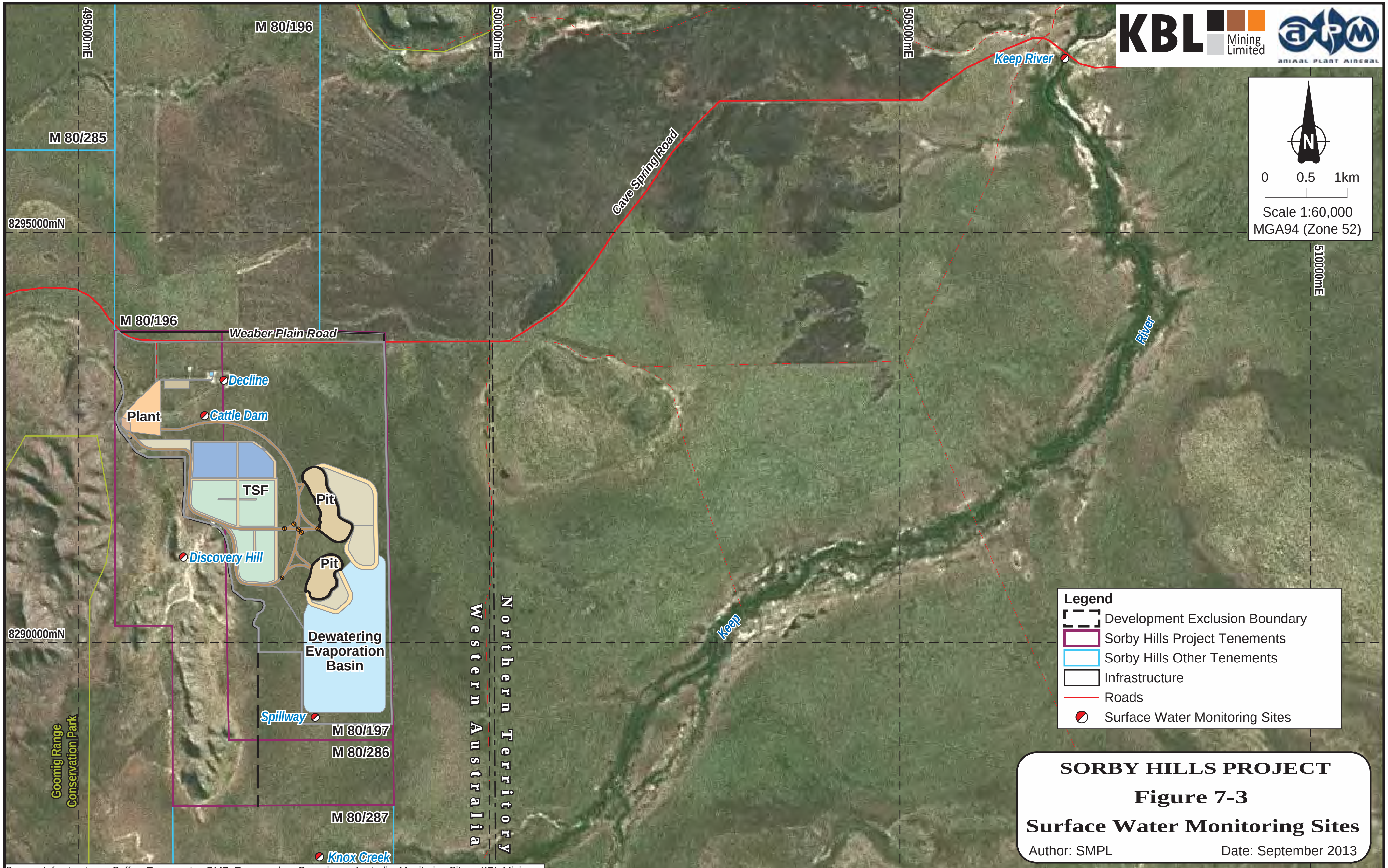
The water sampling program established to collect baseline data from the Keep River and Knox Creek (described in detail in Section 6.1.4.1) will be continued throughout the life of the Project to monitor surface water quality. Surface water samples will be collected from the Keep River on a quarterly basis. Sampling at Knox Creek will be expanded to include two sites, one upstream and one downstream of the location where runoff from the Project enters. These two sites will be monitored monthly throughout the wet season (when flowing). The sampling program will also include several additional sites within the Project Area; surface water monitoring sites are illustrated in Figure 7-3. Water from the Dewatering Evaporation Basin spillway will be sampled in the event of discharge.

Water quality results will be compared to the guideline trigger values set out by the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)* and baseline data as described in Section 6.1.4.1.

7.2.5.5 Predicted Outcome

As a result of the management measures described above, SMPL feel that potential impacts to surface water can be effectively managed to avoid significant residual impacts and meet the EPA’s objectives.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_703.dgn



SORBY HILLS PROJECT

Figure 7-3

Surface Water Monitoring Sites

Author: SMPL Date: September 2013

Source: Infrastructure - Coffey, Tenements - DMP, Topography - Geoscience Australia, Monitoring Sites - KBL Mining

7.2.6 Key Environmental Factor: Groundwater

7.2.6.1 Management Objective

SMPL is committed to maintaining the environmental values of the Project Area and immediate surrounds; the principal objectives for the management of groundwater quantity and quality are to:

- Maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected
- Promote efficient water use and sustainable abstraction of groundwater
- Identify and implement opportunities for the reclamation and reuse of water from mine dewatering
- Maintain the integrity and ecological functions of surrounding groundwater dependant systems

7.2.6.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing groundwater include:

- *Rights in Water and Irrigation Act 1914*
- *Dangerous Goods Safety Act 2004*
- *Dangerous Goods Safety (Storage and Handling of Non Explosives) Regulations 2007*
- WRC: Environmental Water Provisions Policy for Western Australia: State-wide Policy No. 5 (2000)
- DoW: Operational Policy No. 5.12: Hydrological Reporting Associated with a Groundwater Licence (2009)
- ANZECC/ARMCANZ: Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
- AS/NZS 5667.1:1998 – Water Quality – Sampling – Guidance on the Design of Water Sampling Programs, Sampling Techniques and Preservation and Handling of Samples
- AS/NZS 1940:2004 – Storage and Handling of Flammable and Combustible Liquids

7.2.6.3 Context

An assessment of the hydrogeology of the Project Area (Section 6.1.5 and Appendix 7, Volume 3) identified two groundwater aquifers and determined the groundwater to be brackish. As the open cut pits will intersect the water table, dewatering will be required for the operation. Dewatering will occur as a continuous process throughout the life of the mine using extraction bores on the periphery of the pit and an in-pit sump; it is anticipated that a maximum of 2.678 ML/day will be extracted. The water produced by the dewatering operation will be used in the processing facility (0.227 ML/day) and for dust suppression purposes (0.1 ML/day), thereby offsetting requirements from the borefield; as discussed previously (Section 7.2.5); excess water will be directed to the dewatering evaporation basin.

Potential groundwater impacts that could result from Project operations include:

- Pollution of groundwater due to the inappropriate storage of hydrocarbons and process chemicals
- Contamination of groundwater or change in groundwater chemistry due to Project activities or design
- Contamination of groundwater due to inadequate closure planning for mine voids and TSF
- Unsustainable abstraction of groundwater
- Excessive dewatering drawdowns outside of the Project Area
- Possible impacts to groundwater dependant ecosystems

As discussed in Section 6.1.5 there is no possibility of groundwater moving from the Project towards the ORIA – Weaber Plains Project; groundwater from the Project Area will flow towards Border Creek. Hence, the ORIA – Weaber Plains Project would not be impacted in the unlikely event of groundwater contamination resulting from Project activities.

7.2.6.4 Management Measures

SMPL aims to minimise impacts to groundwater quality and quantity through appropriate planning and management. The proposed management strategies are described below and will be incorporated into the construction and operational EMP's for the Project (Appendix 1 and 2 respectively, Volume 2).

Contamination or Change in Groundwater Chemistry

Inappropriate management of the TSF and associated pipelines could result in contamination of groundwater. Strategies relating to the management of the TSF to minimise this possibility are described in detail in Section 7.2.8.4. The storage and handling of hydrocarbons and process chemicals also poses a groundwater contamination risk. Management measures will include storing hydrocarbons and other potential contaminants in sealed and bunded areas and training personnel in spill response. The management of hydrocarbons, process chemicals and other dangerous goods is discussed in detail in Section 7.2.12.

Whilst abstraction of groundwater from aquifers has the potential to alter the groundwater chemistry, this is not expected to occur as a result of the Project. An existing cattle dam situated within the Project Area has been continuously fed from a groundwater bore on site for a number of years and provides an accurate reflection of groundwater chemistry after long term extraction. Surface water sample results (Appendix 28, Volume 3) from the dam have been compared to the Project's baseline groundwater sampling results (Table 6-8). Both sample sets have been tested for the same suite of contaminants (Table 6-4). The majority of measured contaminant levels from the cattle dam fall within the measured ranges for the baseline groundwater results, the exceptions are alkalinity, calcium, EC, bicarbonate, hardness, magnesium and TDS. Where the values differ, the cattle dam values are lower than those of the groundwater. Therefore, the relatively short term extraction of groundwater for the Project is not anticipated to impact on groundwater chemistry as long term extraction for the cattle dam has had a relatively minor affect.

The groundwater quality of the bore feeding the dam will be sampled during the next rounds of groundwater monitoring conducted for the Project to further confirm that minimal changes are noted due to extraction.

Unsustainable Abstraction of Groundwater and/or Excessive Drawdown

Over the life of the Project the pit will reach approximately 70 m below the level of the surrounding floodplain. Pit dewatering will be required; extraction of groundwater through dewatering has the potential to reduce pressure and groundwater flow in affected aquifers. The maximum daily volume of groundwater to be pumped to dewater the pits during mining is anticipated to be 2.678 ML/day.

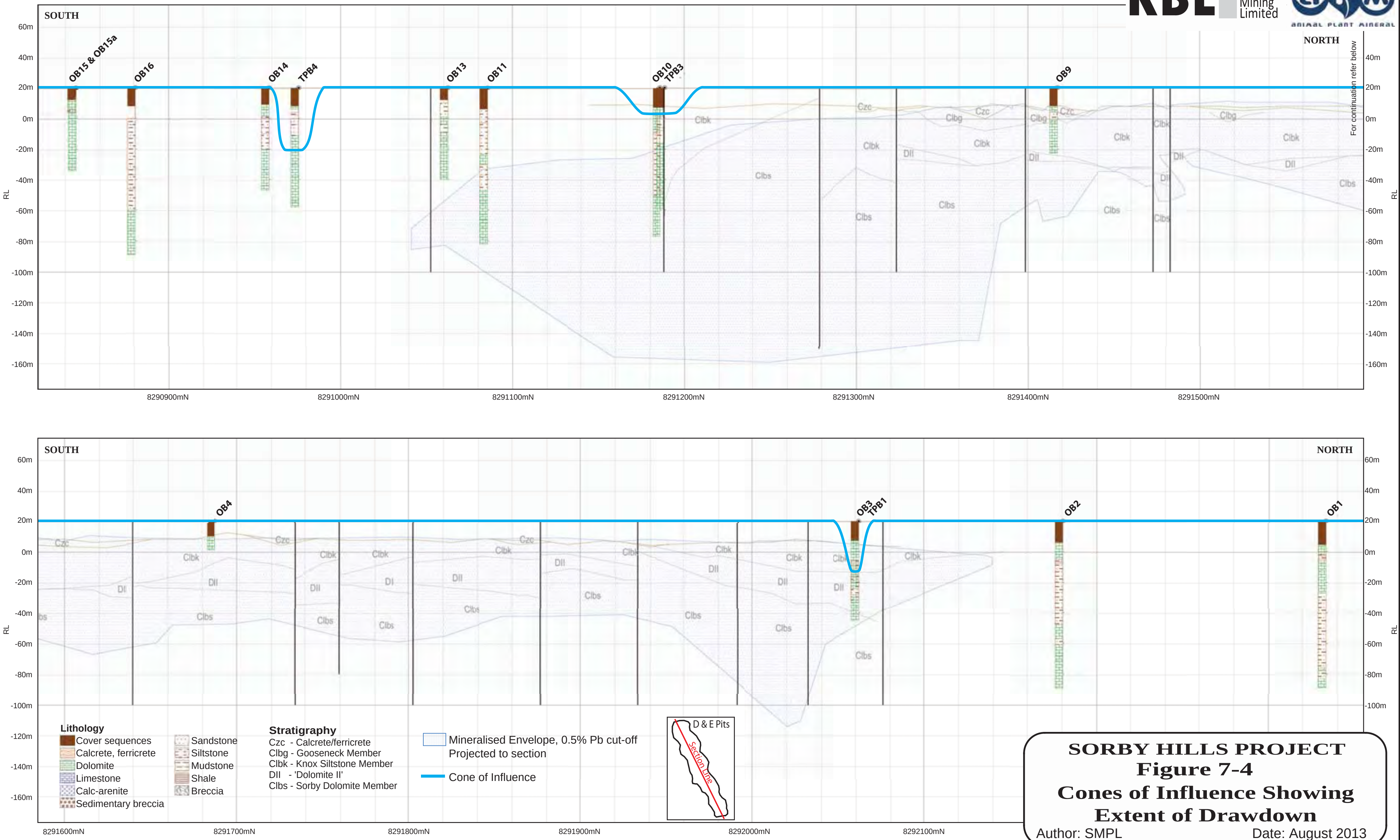
As discussed in Section 6.1.5, AGEC carried out a hydrogeological assessment of the Project Area (Appendix 7, Volume 3), as part of the assessment pump testing was carried out to analyse drawdown and recovery. Drawdown as a result of Project activities is not anticipated to be extensive as the impact area during pump testing did not extend beyond a 500 m radius, therefore limiting the drawdown impact area to the immediate vicinity of the pits; the maximum drawdown response is shown in Figure 7-4 and Figure 7-5. Additionally, the groundwater aquifers that will be dewatered for Project operations are rainfall recharged and are therefore not anticipated to be affected by long term water extraction.

Due to the limited drawdown that will accompany Project activities and rainfall recharge of affected aquifers there is expected to be no significant impact on regional groundwater resources, including the Keep River. Management strategies will however be implemented to minimise impacts resulting from abstraction at the Project site (Table 7-11). Additionally, the extent of the cone of depression resulting from groundwater drawdown will be monitored as part of the Project's proposed groundwater monitoring program (as discussed in Section 6.1.5 and below). Bore locations are indicated on Figure 2-16; additional bores will be installed around the pits to accurately monitor drawdown. These additional bore locations will be selected in consultation with the DoW.

Table 7-11: Management Strategies for Groundwater Abstraction

Aspect	Management Strategy
Abstraction	• Implementation of CEMP and OEMP Strategy 6 (Appendix 1 and 2 respectively, Volume 2) • Ensure current licences are amended and appropriate licences obtained for water abstraction on the site • No extraction of groundwater beyond that permitted under the water licence • A monthly monitoring programme will be carried out to assess water levels associated with the production bores and vegetation health in proximity; data to be reported in AER • Report annual water use to the appropriate regulatory authority • Water demands to be offset through use of water from dewatering activities for processing and the recycling of process waters • Minimisation techniques for water use incorporated into the OEMP • Bores and associated pipelines will be inspected regularly to ensure any leaks are detected and repaired promptly

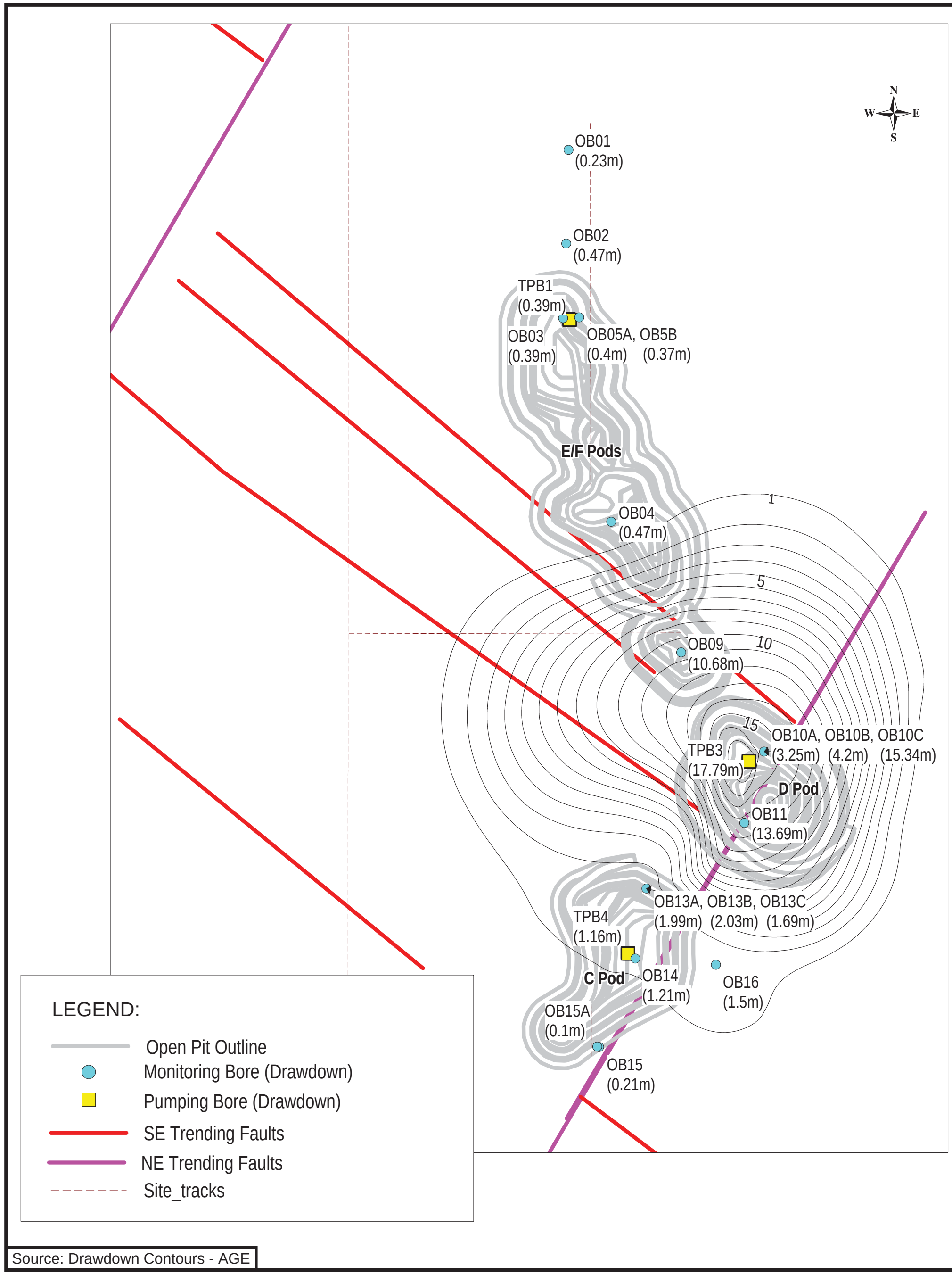
Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_704.ai



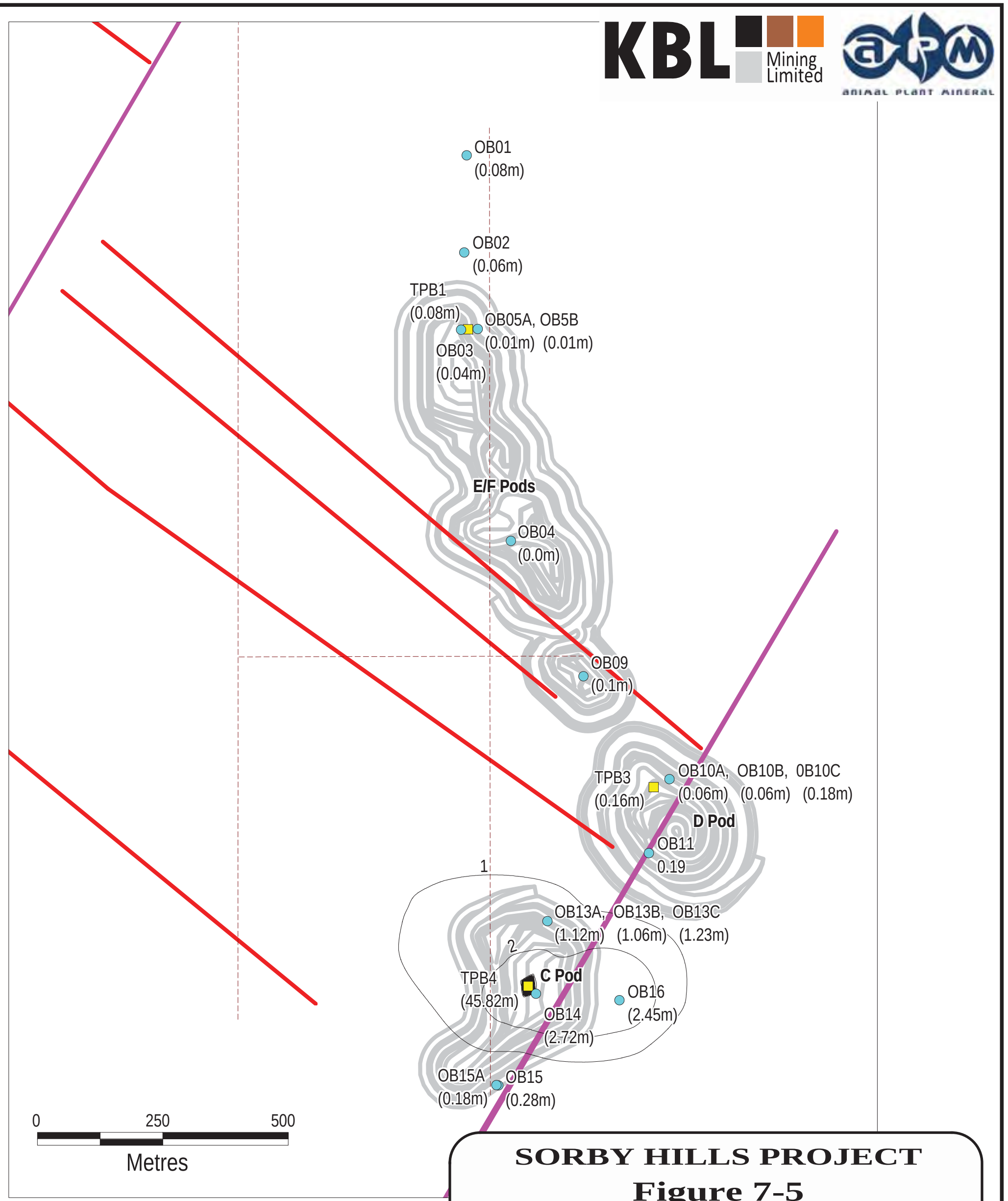
SORBY HILLS PROJECT
Figure 7-4
Cones of Influence Showing Extent of Drawdown
Author: SMPL Date: August 2013

Source: SMPL

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_705.ai



Source: Drawdown Contours - AGE



SORBY HILLS PROJECT
Figure 7-5
Groundwater Drawdown Contours

Author: SMPL Date: August 2013

Disposal of Excess Water

No water will be disposed directly into the surrounding natural water systems therefore no impacts are anticipated as a result of the Project. Excess dewatering will be directed into the dewatering evaporation basin or TSF evaporation basin if make-up water is required for processing; management of the storage of this water has been discussed in Section 7.2.5.4.

Groundwater Dependant Ecosystems

Groundwater drawdown may have the potential to impact on groundwater dependent ecosystems however no impacts are anticipated as a result of Project activities. As discussed in Section 6.1.9.7 it is unlikely that troglofauna will occur in the Project Area and stygofauna are not likely to be threatened by the localised impact of the Project. Flora and vegetation can be vulnerable to changes in the water table, impacts may result in loss of susceptible species of flora and vegetation and changes in overall vegetation composition of the area. However no impacts to flora and vegetation, including the Priority 1 'Monsoon vine thickets of limestone ranges', are anticipated as drawdown will be limited to the immediate vicinity of the pits. Strategies established to minimise groundwater abstraction are identified in Table 7-12. No additional management strategies will be adopted for groundwater dependant ecosystems, however SMPL will limit dewatering activities where possible.

Groundwater Monitoring

The quarterly groundwater sampling program established to collect baseline data for the Project site (described in detail in Section 6.1.5) will be continued throughout the life of the Project to monitor groundwater levels and quality. Groundwater monitoring sites are located within the Project Area and regionally, as illustrated in Figure 2-16 and Figure 2-17 respectively. SMPL will broaden both the local and regional groundwater monitoring programs; additional bore locations will be selected in consultation with the DoW. Water quality results will be compared to the guideline trigger values set out by the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)* and baseline data.

7.2.6.5 Predicted Outcome

Given the mitigating measures described above, SMPL feel that potential impacts to groundwater can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

7.2.7 Key Environmental Factor: Mining Waste and Potential Contaminants

7.2.7.1 Management Objective

SMPL is committed to maintaining the environmental values of the Project site and immediate surrounds; the principal objectives for the management of mining waste and potential contaminants are to:

- Ensure that mining waste is suitably managed such that it does not adversely affect environmental values or the health, welfare and amenity of people and land uses in the vicinity of the Project
- Develop an understanding of the mining wastes to be produced and the physical Project environment such that any potential contamination impacts are clarified

7.2.7.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing mining waste and potential contaminants include:

- *Contaminated Sites Act 2003*
- *Mining Act 1978*
- *EP Act*
- DMP: Guidelines for Mining Proposals in Western Australia (2006)
- DMP: Environmental Notes on Mining – Acid Mine Drainage (2009)
- Environment Australia: Best Practice Environmental Management in Mining: Managing Sulphide Mine Wastes and Acid Drainage (1997)
- Australian Mineral Industry Research Association (AMIRA) International: ARD Test Handbook (2002)
- EPA Position Statement No. 7: Principles of Environmental Protection (2007)
- ANZECC/ARMCANZ: Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
- DER: Identification and Investigation of Acid Sulphate Soils and Acidic Landscapes Guidelines, Acid Sulphate Soils Guideline Series (2009)
- DER: Assessment Levels for Soil, Sediment and Water, Contaminated Sites Management Series (2010)

7.2.7.3 Context

Geochemical characterisation has identified that:

- The majority of the waste rock can be classified as NAF with a low potential to produce ARD

- There is a localised presence of PAF materials within the proposed mine voids
- There is a low risk of MD

Inappropriate management of mineral waste could result in the contamination of the surrounding environment including soils, surface water and groundwater through:

- Generation of ARD
- Release of suspended sediment laden runoff into the environment (management measures discussed in Section 7.2.5.4)

7.2.7.4 Management Measures

PAF Waste Management

Waste materials characterisation carried out for the Project by SWC (Appendix 5, Volume 3). To enable PAF materials to be successfully delineated and segregated during mining and subsequently managed block modelling and scheduling has been used to determine expected PAF locations, volumes and interception timeframes. Block modelling indicates that PAF materials occur in the southern section of E pod as shown by Section 8291700 mN on Figure 6-35. Scheduling indicates that PAF materials will be intersected in year 4 of mining (Table 7-12).

Table 7-12: PAF and NAF Volumes and Interception Timeframes

Year	Total Tonnes (Mt)	Ore (Mt)	Total Waste (Mt)	NAF Waste (Mt)	PAF Waste (Mt)
1	3.59	0.41	3.18	3.18	
2	2.58	0.4	2.18	2.18	
3	1.34	0.4	0.94	0.94	
4	1.4	0.4	1.00	0.93	0.07
5	1.41	0.4	1.01	1.01	
6	1.39	0.4	0.99	0.99	
7	1.39	0.4	0.99	0.99	
8	1.4	0.4	1.00	1.00	
9	1.27	0.4	0.87	0.87	
10	1.29	0.4	0.89	0.89	
11	1.41	0.4	1.01	1.01	
12	1.45	0.4	1.05	1.05	
13	1.27	0.4	0.87	0.87	
14	1.11	0.4	0.71	0.71	
15	0.18	0.1	0.08	0.08	

PAF management will be implemented through the Sorby Hills OEMP (Appendix 2, Volume 2). On-site NAGpH testing will be carried out to closely define expected PAF intersection; NAGpH testing will be continually undertaken alongside the routine grade control process which will be conducted two to three months prior to blast-hole drilling; NAGpH testing will have a 24 hour turnaround time for results from the on-site laboratory. NAGpH testing will therefore be undertaken in advance of mining and will be used for material movement planning purposes prior to excavation taking place.

Additionally, appropriately trained personnel will carry out visual inspections of drill chips and blasted ground for PAF materials prior to material movement commencing.

Immediately following excavation, PAF materials will either be placed into a pre-prepared in-pit waste dump or an in-pit sump in D pod. Should the in-pit sump be the preferred option, PAF materials will immediately be placed below the water table thus preventing oxidation and acidification. The waste dump would be constructed utilising materials with sufficient buffering capacity to neutralise all potential acidity. As PAF materials are not expected to be mined until year 4 (Table 7-12) there will be sufficient time and NAF waste material available (Table 7-13) to prepare the in-pit waste dump should this be the preferred option. Upon cessation of mining the water table will be allowed to rise thus placing the PAF materials below the water level which will prevent oxidation and acidification post closure. D pod is expected to fill rapidly following cessation of dewatering activities with the water level expected to recover to within 2 m of static groundwater level within approximately 4 years (Appendix 29, Volume 3).

SMPL believe that both the waste dump and sump are viable options for the effective management of PAF material at the Project. Both options will be explored and assessed in conjunction with the DMP as part of the Mining Proposal process.

Table 7-13 outlines the management strategies to be implemented to ensure correct handling and management of mining waste.

Table 7-13: Management Strategies for PAF

Aspect	Management Strategy
PAF Waste	• Implementation of OEMP Strategy 7 (Appendix 2, Volume 2) • Ensure block modelling is completed prior to commencement of mining and the mining schedule is regularly updated • NAGpH testing to determine expected PAF intersection • Visual inspections of drill chips and blasted ground for PAF materials prior to material movement commencing • Ensure expected intersection with PAF materials is communicated to appropriate personnel • PAF waste will either be placed into an in-pit waste dump or in-pit sump in D pod • Upon cessation of mining PAF materials will be left within the in-pit waste dump or sump and the water table allowed to rise thus placing PAF materials below the water table to prevent oxidation and acidification post closure

NAF Waste Management

Block modelling and scheduling will enable NAF materials to be successfully delineated and segregated during mining and subsequently managed. As described previously in Section 2.2 the majority of NAF waste will be consumed during the construction of infrastructure, excess waste will be temporarily stockpiled or directly backfilled into mine pit voids. Towards the end of the mine life stockpiled NAF waste will be used in rehabilitation to stabilise post-mine land surfaces; closure and rehabilitation management is discussed in detail in Section 7.2.18.

Table 7-14 outlines the management strategies to be implemented to ensure correct handling and management of mining waste.

Table 7-14: Management Strategies for NAF

Aspect	Management Strategy
NAF Waste	• Implementation of OEMP Strategy 7 (Appendix 2, Volume 2) • Ensure block modelling is completed prior to commencement of mining and the mining schedule is regularly updated • Utilisation of NAF material to prepare PAF in-pit waste dump (if required) prior to Year 4 of mining • Kinetic test work will be undertaken to confirm NAF waste rock characterisation remains the same as operations progress • Kinetic test work will begin upon commencement of grade control drilling, which will provide the first suitable material for testing • Sufficient volume of competent NAF dolomite will be segregated for later use in rehabilitation to stabilise the post-mine land surfaces

7.2.7.5 Predicted Outcome

As a result of the management measures described above, no contamination of soils, surface water or groundwater is anticipated as a result of mining waste; SMPL consequently feel that the potential impacts posed by the Project can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

7.2.8 Key Environmental Factor: Tailings Characterisation and Storage

7.2.8.1 Management Objective

The principal objectives for the management of the tailings and potential contamination are to:

- Ensure that processing waste is suitably managed such that it does not adversely affect environmental values or the health, welfare and amenity of people and land uses in the vicinity of the Project
- Develop an understanding of the tailings materials to be produced and the physical Project environment such that any potential contamination impacts are clarified
- Create a TSF that is physically stable in the long term and can be successfully rehabilitated

7.2.8.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing tailings and potential contaminants include:

- *Contaminated Sites Act 2003*
- *Mines Safety and Inspection Act 1994*
- *Mining Act 1978*
- *EP Act*
- DME: Safe Design and Operating Standards for Tailings Storage (1999)
- DMP: Environmental Notes on Mining: Acid Mine Drainage (2009)
- Environment Australia: Best Practice Environmental Management in Mining: Managing Sulphidic Mine Wastes and Acid Drainage (1997)
- AMIRA International: ARD Test Handbook (2002)
- EPA Position Statement No. 7: Principles of Environmental Protection (2007)
- ANZECC/ARMCANZ: Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
- DER: Identification and Investigation of Acid Sulphate Soils and Acidic Landscapes Guidelines, Acid Sulphate Soils Guideline Series (2009)
- DER: Assessment Levels for Soil, Sediment and Water, Contaminated Sites Management Series (2010)

7.2.8.3 Context

Tailings produced by the Project will be discharged and stored within a purposed built above ground paddock style TSF. Geochemical characterisation (Section 6.1.7.2 and Appendix 5, Volume 3) classified the tailings as NAF, with an elevated carbonate content and a highly alkaline pH. This together with the low content of available oxyanions metals and metalloids, results in a low potential for ARD or MD to occur. Analysis of the tailings materials also identified Tl in concentrations that exceed appropriate criteria values of 1 mg/kg for the protection of the Environment and Human Health based on the *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* (1999).

Inappropriate construction and management of a TSF can impact on the natural environment through:

- Contamination of soils, surface water and groundwater due to:
    - Tailings seepage
    - Leaching of poor quality water and subsequent indirect effects on the surface environment manifested as vegetation stress or death due to changes in groundwater quality
    - Accidental release (e.g. overtopping) of poor quality water/tailings slurry
- Fauna utilising the TSF and associated TSF evaporation basin as a water source

7.2.8.4 Management Measures

Appropriate design, planning and management measures will be implemented to ensure the potential impacts from TSF operation are minimised. The proposed management strategies are described below and will be incorporated into the construction and operational EMP's for the Project (Appendices 1 and 2 respectively, Volume 2). Closure planning for the TSF will be discussed in Section7.2.18.

Seepage and/or Leaching of Poor Quality Water

As discussed in Section 2.5 and Appendix 9 (Volume 3), the TSF design and materials selected for construction will minimise the potential for seepage from the facility; the flow volume from the facility is anticipated to be less than 5 m^3/d.

Current test work has determined that tailings materials contain elevated carbonate content and are classified as NAF; as such no specific management strategies are required for potential ARD seepage. In addition, no management strategies are required for potential metalliferous seepage as the source rocks do not contain mobile enriched metals and the subsequent risk of elevated metals content within the tailings solution is low. Kinetic test work will however be undertaken to confirm that tailings characterisation will remain the same in the longer term.

Although the levels of Tl recorded exceed guideline values they are within limits that will allow material to be effectively managed within the TSF and avoid any hazard to the environment or human health. Tl forms cation-hydrolysis complexes in solution (i.e. positively charged species) and hence any Tl released into the TSF will be rapidly adsorbed onto mineral surfaces. Absorption of Tl will significantly minimise its mobility and potential for release into the environment. Furthermore, the reducing properties of the TSF will cause Tl to form insoluble complexes, come-out of solution and be retained in the TSF. Whilst no specific management strategies will be required for Tl, it will be assessed as part of ongoing kinetic test work and levels of Tl will be continually assessed as part of the surface and groundwater monitoring programs for the Project as described in Sections 7.2.5.4 and 7.2.6.4.

Prior to TSF construction, remnant sterilisation drill holes in the location of the TSF will be sealed with bentonite to prevent flow from the TSF into the subsurface geology through preferential pathways.

Accidental Release of Poor Quality Water or Tailings Material

Accidental release of water or tailings material could potentially result from:

- TSF embankment failure
- Damage to pipelines
- Overtopping of the TSF embankments

Section 2.5 provides a detailed description of the design of the TSF and associated infrastructure. Sections 6.1.4 and 7.2.5.4 discuss the hydrology of the Project Area and related management measures.

The TSF has been designed in accordance with the DMP *Guidelines on the Safe Design and Operating Standards for Tailings Storage (1999)* and has been assigned a hazard rating of Low, Category 2, with the probability of embankment failure assessed as low. In addition, the TSF will be positioned within an envelope created by the haul roads which will act as flood diversion bunding to protect the TSF from the potentially damaging effects of stormwater runoff.

The tailings delivery pipeline and return water pipeline will be positioned within the haul road safety bunding as indicated by Figure 2-9; the safety bunds (1.8 m high) will serve to contain any spill of tailings slurry or return water should a leak occur. Due to the flat nature of the site the longitudinal fall of the haul road is limited therefore separate catch pits for any spilt liquid are not required as the storage capacity within the length of the haul road is adequate to provide containment. Spills or leaks will be cleaned up promptly; contaminated material will be placed into the TSF.

Potential overtopping of the TSF embankment will be mitigated through decantation of excess water. The TSF will not be used for the storage of water; water will be removed via decant structures and pumped into the adjacent TSF evaporation basin for storage and evaporation. Both the TSF and associated TSF evaporation basin will have the capacity to cater for a 1 in 100 year, 72 hour flood event therefore the potential for overtopping of the TSF embankment is minimal. Nevertheless, SMPL commissioned ToxConsult Pty Ltd (ToxConsult) to conduct a desktop study investigating the potential environmental effects in the unlikely event of a significant overflow from the TSF. The findings of the investigation are discussed below and the full report is provided in Appendix 37 (Volume 3).

The ToxConsult assessment was carried out following national and international guidance for conducting environmental risk assessments and was undertaken in two stages. Stage 1 consisted of an initial screening assessment to identify chemicals of potential concern (CoPC); chemical concentrations in the tailings supernatant[2] were compared to water quality guidelines for the

[2]The tailings will consist of a waste slurry (called gangue) which is composed of unwanted minerals, water and flotation reagents produced during ore processing. Once pumped into the TSF the solids settle out leaving an overlying liquid (supernatant). It is the supernatant, rather than the settled solids, that would be released from the TSF after combining with large volumes of rainwater if an overflow were to occur.

protection of freshwater organisms. Those chemicals or minerals whose predicted concentrations exceeded the water quality guidelines were designated CoPC and subjected to further evaluation (Stage 2). The CoPC identified by Stage 1 were:

- Ethyl xanthate
- Butyl xanthate
- Sodium hydrogen sulphide
- Pb
- Zn

During Stage 2 of the investigation the potential for the CoPC to constitute an environmental risk was qualitatively evaluated by considering:

- Their environmental fate
- The applicability of the water quality guidelines for the anticipated exposures and organisms at the Project Area
- Their toxicity to terrestrial plants and animals present in the Project Area

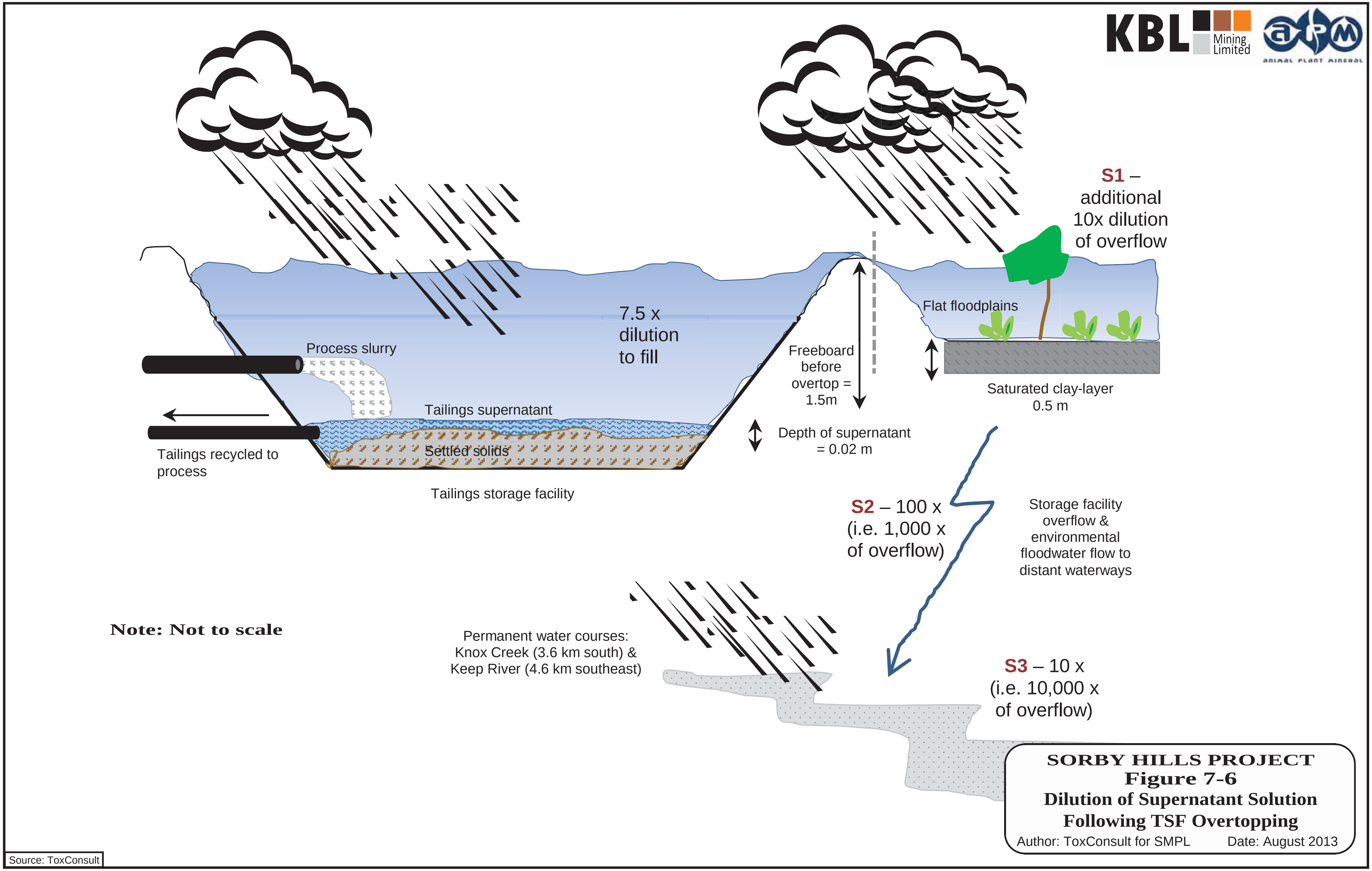
Dilution is an important factor when considering the risk posed by the potential overtopping of the TSF. A minimum of 7.5 x dilution of the chemicals in the supernatant would be required to fill the TSF to the brim. Any overflowing supernatant/floodwater mix would be further diluted by water surrounding the TSF (as previously described in Section 6.1.4, flooding is likely in the Project Area following periods of intense rainfall). If the TSF overflow were then to migrate to permanent waterways, it would be subjected to additional dilution from other environmental flows and water inside the waterway. The assessment for potential environmental impact was therefore conducted for three scenarios which consider assessment locations that are stepped away from the TSF according to designated dilutions. The scenarios are described below and illustrated in Figure 7-6.

Scenario One (S1): Immediate surrounds of the TSF represented by an environmental dilution of 10 x the overflow.

Scenario Two (S2): Area between the immediate surrounds of the TSF and permanent waterways represented by a minimum environmental dilution of 1,000 x the overflow. As the diluted TSF overflow migrates away from the TSF and mixes with the surrounding waters accumulated over the floodplain it will become progressively diluted.

Scenario Three (S3): Permanent waterways of Knox Creek and Keep River represented by a dilution of 10,000 x the overflow. By the time the TSF overflow reaches the creek and river markedly more dilution is anticipated to have occurred. In addition the receiving waters will have significantly swelled.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_706.ai



SORBY HILLS PROJECT
Figure 7-6
Dilution of Supernatant Solution Following TSF Overtopping

Author: ToxConsult for SMPL   Date: August 2013

The ToxConsult risk assessment indicates there may be potential for toxicity to sensitive aquatic organisms such as crustaceans or algae from ethyl xanthates and sodium hydrogen sulphide if an overflow were to occur and if the organisms were present in the ponded water of the floodplain. Such effects are likely to be confined to organisms inhabiting areas in the immediate vicinity of the TSF (i.e. areas subject to only a 10 x environmental dilution). The risk decreases as the environmental dilution increases, and thus as the migratory distance from the TSF increases. Hence the likelihood of adverse impacts on permanent waterways is much lower than in the immediate vicinity of the TSF. Other low organism groups such as stygofauna, as well as higher organisms including terrestrial plants, amphibians, mammals and birds are not expected to be adversely affected.

Overall, the assessment suggests that it is only the process chemicals sodium hydrogen sulphide and xanthates that may impact organisms and then only when the overflow is minimally diluted in proximity of the TSF. Relative to the entire floodplain this is a very small area and is an area in which the ecosystem is likely to already be affected by construction and maintenance activities for the TSF. If susceptible organisms are present, and if they are affected, the impact of substances in the tailings overflow water on the viability of populations within the wider floodplain ecosystem will be negligible compared to that which occurs with the periodic flooding of the plain.

Monitoring

A comprehensive monitoring and inspection program will be developed to monitor for potential problems during the operation of the TSF. Monitoring will include:

- Daily inspections of TSF pipelines to check for damage and/or leaks
- Daily inspections of survey pins to check for embankment movements
- Bore monitoring for water levels and quality

New and existing bores will be utilised to assess groundwater levels and quality throughout the operation of the TSF. Existing bores TPB4 and OB15a will be lost to the development of C pod and they will be required to be replaced with a new bore (MB01). Two additional bores (MB02 and MB03) will also be constructed to monitor seepage. Existing bore WBS7001 is located within the proposed divider wall of the TSF evaporation basin; this bore will be retained to enable observation of the groundwater level and water quality directly beneath the TSF evaporation basin. Groundwater bore locations are presented in Figure 2-16. Groundwater levels will be recorded monthly and groundwater quality will be analysed quarterly through the groundwater monitoring program as described in Section 7.2.6.4.

Fauna

Construction of the TSF will impact upon a small number of natural water sumps that hold water into the dry season and some flooded grassland feeding habitat. The TSF has the potential to become a target habitat for foraging waders and shore birds that seasonally occupy the Project Area. Moreover, wader species may have a protracted reliance on the TSF toward the end of the dry season if the facility continuously provides a source of water and shallow muddy banks that harbour freshwater invertebrate species.

Available lead can bioaccumulate and cause toxic effects in plants and invertebrates living in contaminated media. Wildlife may be exposed to harmful amounts of lead from ingesting contaminated water, sediment and soil particles. A variety of other wildlife species may be at risk, including fish, amphibians, reptiles, mammals and other bird species, either because they forage on plants growing in contaminated media, they consume animals that have accumulated lead in their tissues or they incidentally ingest the contaminated media. The earthworm is relatively tolerant of metal pollution and therefore can survive in contaminated soil (Neuhasuser*et al*. 1986). This is an ecological problem as the organism is an important food source for many wildlife species.

To avoid or mitigate potential impacts, bird species will be discouraged from utilising the TSF. This will be achieved by decanting water from the TSF to reduce the presence of free standing water and utilisation of visual and sound devices to scare birds. Devices that can be used for this purpose include LPG gas guns, radio, flashing or rotating lights, scarecrows, reflective mirrors or tape, helium or air-filled balloons, and predator models or kites. Habituation is the main drawback of all types of scaring, birds can quickly become accustomed to noise or visual cues and start to ignore them (Tracey *et al*. 2007). The best results for scaring are achieved when:

- A combination of techniques are used
- Scaring starts before birds get established at the TSF
- The timing and placement of devices are changed frequently, but not at regular intervals (Tracey *et al*. 2007)

The following suggestions may improve or prolong the effectiveness of scaring:

- Combine a mix of visual and sound devices
- Use of loud sounds as these are more aversive than quiet sounds
- Use of sounds with a wide frequency range as these are more aversive than pure tones
- Loud sounds produced by simple cheap methods may be just as effective as sounds produced by expensive devices
- Visual devices are most effective if they incorporate movement such as flashing or flapping
- Devices are more effective when used for the shortest time necessary for a response; discontinue their use when birds stop utilising the TSF or when the device is no longer effective
- Adult birds are generally more easily scared than juveniles
- Broadcast alarm and distress calls can be effective but can result in habituation, as for other sounds, some are species-specific and may cause a 'mobbing rather than a flight response' (Tracey *et al*. 2007)

As an early indicator of potential bioaccumulation of Pb in waterbird and wader species, bird feathers from these species will be collected from around the TSF quarterly and analysed annually for traces of heavy metals. Feathers are commonly used as bio-indicators of environmental pollution, the measure of heavy metals taken in through food or accumulated through atmospheric pollution are both easily assessed using well established laboratory techniques.

Overall, the construction of the TSF will directly impact a relatively small area of fauna habitat that is well represented locally. Fencing will be erected around the Project Development Envelope (following the firebreaks) as part of the destocking process which will keep macro fauna away from the TSF. Water birds will be monitored and discouraged from entering or remaining in the TSF. Table 7-15 outlines the management strategies to be implemented to discourage birds from the TSF.

Table 7-15: Management Strategies for Migratory Birds Utilising the TSF

Aspect	Management Strategy
Discouraging migratory birds from using the TSF	• Implementation of OEMP Strategy 8 (Appendix 2, Volume 2) • Water will be decanted from the TSF to reduce presence of free standing water • SMPL will employ the use of bird scaring devices to discourage birds from utilising the TSF, a combination of visual and noise producing techniques will be used • Scaring will begin upon commencement of TSF use to ensure birds are discouraged before they are able to become established at the TSF • A program will be implemented to ensure that the timing and placement of scaring devices is changed frequently but not at regular intervals • Continual traffic on enveloping haul road to discourage birds and other fauna from utilising TSF
Monitoring	• Annual heavy metal analysis of bird feathers collected around the TSF •

7.2.8.5 Predicted Outcome

As a result of the management measures described above, no contamination of soils, surface water or groundwater is anticipated as a result of tailings storage and management. SMPL consequently feel that the potential impacts posed by the Project can be effectively managed to avoid significant residual impacts and meet the EPA’s objectives.

7.2.9 Key Environmental Factor: Concentrate Emissions

7.2.9.1 Management Objective

Maintaining the environmental values of the Project site, Wyndham Port and their immediate surrounds, and the wellbeing of employees and the community of Wyndham is a key focus for SMPL. The principal objective for the management of concentrate emissions is to:

- Ensure that concentrate emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards

7.2.9.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing concentrate emissions include:

- *EP Act*
- *Contaminated Sites Act 2003*
- *Dangerous Goods Safety Act 2004*
- *Mines Safety and Inspection Act 1994*
- *Occupational Health and Safety Act 1984*
- *Dangerous Goods Safety (Goods in Ports) Regulations 2007*
- *Dangerous Goods Safety (Storage and Handling of Non Explosives) Regulations 2007*
- *Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007*
- National Occupational Health and Safety Commission (NOHSC):1003 (1995) Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment
- EPA Guidance Statement No. 18: Prevention of Air Quality Impacts from Land Development Sites (2000)
- National Environment Protection (Ambient Air Quality) Measure (2003)

7.2.9.3 Context

The Project will produce approximately 45,000 tpa of Ag Pb Zn concentrate for export through the port of Wyndham. Concentrate will be transported from the Project site to Wyndham Port in sealed containers via road train; there will be an average of 12 return truck movements per week. Concentrate containers will be placed in a dedicated laydown area for short term storage prior to ship loading, shipping will occur once per month.

The Australian Dangerous Goods Code (ADGC) and other international dangerous goods codes (such as the IMDG Code) require that goods be assigned a dangerous goods class according to the most significant risk presented by the goods. As discussed in Section 2.6.1 and Appendix 11 (Volume 3), the concentrate will be transported as a Class 6.1 lead compound, soluble, N.O.S. (UN 2291, packaging group III) with a subsidiary environmental hazard (Class 9) classification for marine transport.

Wyndham Port is currently listed as a site with potential contamination under the *Contaminated Sites Act 2003*. This classification relates to the area surrounding an old Ni, Pb and Zn transit shed which is not located in the vicinity of the areas to be utilised by the Project and should therefore not impact on Project operations.

Inappropriate handling, storage and management of concentrate could result in exposure of personnel, members of the public and the environment during:

- Onsite processing and production of concentrate
- Transfer of concentrate into containers for transport
- Transport of concentrate from the Project site to Wyndham Port
- Transfer of concentrate from containers to ships at Wyndham Port

Potential exposure could result in:

- Adverse effects to human health
- Pollution of the terrestrial and/or marine environments
- Degradation of terrestrial and/or marine habitats
- Loss of terrestrial and/or marine flora and fauna

7.2.9.4 Management Measures

SMPL is committed to minimising its impact on the environment, members of the public and personnel and aims to minimise the potential for concentrate emissions through appropriate planning and management. SMPL will endeavour to achieve minimal direct handling of concentrate by utilising a predominantly mechanised system and a range of rules and procedures will be implemented at all stages of the concentrate handling process to minimise potential for accidental release into the environment. The proposed storage, handling and transport methods are discussed in Section 2.6 with more details provided in the transport logistics statement presented in Appendix 12 (Volume 3). The proposed management strategies are provided in Table 7-16 and are incorporated into the OEMP for the Project (Appendix 2, Volume 2).

Table 7-16: Management Strategies for Handling, Storage and Transport of Concentrate

Aspect	Management Strategy
Licensing	• SMPL and all its contractors responsible for handling and storing concentrate will be required to obtain a Dangerous Goods Licence under the *Dangerous Goods Safety (Storage and Handling of Non Explosives) Regulations 2007* • Drivers of any vehicles transporting containers carrying SMPL concentrate will be required to obtain a Dangerous Goods Drivers Licence under the *Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007* • All relevant actions undertaken at Wyndham Port must comply with the *Dangerous Goods Safety Act 2004*, specifically the *Dangerous Goods Safety*

Aspect	Management Strategy
	(Goods in Ports) Regulations 2007 • Port operators are currently guided by the IMDG Code administered by the United Nations International Maritime Organisation (IMO). • *The Dangerous Goods Safety (Goods in Ports) Regulations 2007* require Port operators to comply with *AS 3846-2005 The Handling and Transport of Dangerous Cargoes in Port Areas* (which is based on the IMDG Code)
Education and Awareness	• Concentrate handling will be incorporated into Strategy 9 of the OEMP (Appendix 2, Volume 2) • Implementation of POEMP (Appendix 3, Volume 2) • Site induction will provide an overview of concentrate handling procedures and management for all personnel • Work place specific inductions for relevant personnel. This will provide clear instruction to employees as to the correct management actions to follow whilst handling concentrate or concentrate containers • All operators involved in ship loading will be trained to ensure correct operation of machinery • Ship loading training and procedures will include spill prevention measures and clean up actions
Container use and design	• SMPL propose to use "Rotabox" (or similar) shipping containers for the collection, storage and transport of concentrate; there will be no requirement for internal bags or packaging. "Rotabox" containers are purpose built, stackable, bulk ore containers that can be fully sealed with lockable lids that include a weather resistant seal • Use of containers eliminates the requirement for stockpiling of concentrate both at the Project site and Wyndham Port • The container design has taken into account the key material handling characteristics of the concentrate and the containers are built to comply with ISO1496-1:1990 Series 1 *Freight Containers Specification and Testing (Part 1)* • Containers will be labelled with safety information including relevant dangerous goods classification information and placard
Container filling	• Prior to use containers will be visually inspected to ensure integrity • Moisture content of the concentrate will be at least 7 % and will be confirmed during routine on site lab analysis of concentrate physical parameters • Concentrate will be loaded directly into containers; the loading system will be integrated in to the final stage of the production process • Container loading dock will be situated within a covered concrete bunker • Load cells will be installed in the loading dock at site to control the quantity and weight of concentrate placed into each container • Once the containers have been filled to the desired level with concentrate they will be removed from the loading dock and a lid immediately applied and locked in accordance with the manufacturer's specifications to ensure that concentrate cannot escape
Short term storage and cleaning of containers	• After filling, any concentrate or concentrate dust will be removed by vacuum or wash down from the exterior of the sealed containers prior to them being placed in the designated licensed (dangerous goods) storage area • No container will be stored in a way that compromises the integrity of the container • Containers will be stored upright and stacked no more than two high • Weekly inspections of storage areas will be conducted to ensure any hazards are identified
Transport of containers from site to port	• Concentrate haulage will be completed by a specialist contractor • A truck weighbridge will be in operation to ensure no overloading occurs

Aspect	Management Strategy
	• All vehicles transporting concentrate containers will pass through the wash down facility; wash down water will be collected in a sump and transferred to the processing facilities • Containers will be individually inspected prior to transport off site • A chain of custody form will be completed and signed for each truck carrying concentrate containers • Speed restrictions will apply to all concentrate haulage trucks • Trucks will follow the designated transport route at all times • Driving will be carried out in accordance with road conditions and closure notices • Along route soil and dust monitoring will be conducted at quarterly intervals • Moisture content levels in the concentrate will be monitored to ensure optimum conditions for dust control during ship loading and acceptable upper limits of moisture for ship transport • Transport of concentrate will be halted in the event of adverse weather conditions • In the unlikely event of a spill during transport, emergency response will take place according to the Emergency Response Plan of the specialist transport contractor. Dangerous Goods transport operators are required to have an Emergency Response Plan under the *Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007*
Port operations	• On arrival at Wyndham Port every container will be inspected to check the integrity of the container walls, door seals and locking bolt • Containers will be stacked in accordance with best practice and no more than two high • Only the designated hardstand area with wash down facilities and sumps at Wyndham Port will be utilised by SMPL for container storage • The sealable lids of the transport containers provide security from variation in moisture content level during transport and short term storage at the port • Moisture content will be at least 7 % (maximum 10 %) to meet shipping requirements • Concentrate will be transferred directly into the ships hold using a rotation system specifically designed to minimise the chance of spillage and fugitive dust emissions • Locks and lids will only be removed from the containers immediately prior to unloading of the concentrate • To contain any concentrate residue (expected to be minimal due to smooth internal design of the containers) lids will be replaced and locked immediately after unloading • Emptied containers will washed down and taken back to SMPL's designated storage area • Concentrate residues from any wash down facility will be collected in a sump and back hauled to the Project processing facilities in sealed containers • Emptied containers will also be inspected for transport damage. Damaged containers will be set aside and returned separately to site for repair before reuse
Shipping	• Shipping will be carried out to current world standards in line with the regulations and standards set out by the Australian Maritime Safety Authority which represents Australia at the IMO

Modelling and Monitoring of Fugitive Concentrate Dust during Ship Loading

The potential exists for fugitive concentrate dust to be produced during the transfer of concentrate from transport containers into the ships hold. However the specialised containers and mechanised container loading system proposed to be used by SMPL (Section 2.6.3 and Appendix 12, Volume 3) is anticipated to minimise the risk of fugitive concentrate dust emissions during port operations.

SMPL commissioned Air Assessments to provide advice and assistance for the compilation of a fugitive concentrate dust monitoring program and concentrate dust management strategies for Project operations at the port. To facilitate this, Air Assessments conducted an appraisal of the proposed loading system at Wyndham by analysing Wyndham climatic data and investigating the use of rotating container systems with similar cargos at other ports. This enabled emission factors to be derived and likely impacts to be assessed. The findings of the assessment and suggested management strategies, including suggested monitoring requirements, have been incorporated into the Project's POEMP (Appendix 3, Volume 2), SHECMS and OEMP (Appendix 2, Volume 2).

Although monitoring strategies are not yet finalised it is anticipated that monitoring at the port will include fugitive dust, dust deposition and occupational monitoring (full details provided in the POEMP (Appendix 3, Volume 2). A record of all monitoring observations will be kept and a log of subsequent actions (as appropriate) will be maintained. Observations and actions will also be reported to the appropriate regulatory authority as required.

7.2.9.5 Predicted Outcome

Given the mitigating measures described above, no fugitive concentrate emissions are anticipated. SMPL consequently feel that the potential impacts posed by the Project can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

7.2.10 Key Environmental Factor: Marine Environment

7.2.10.1 Management Objective

The principal objectives for the management of the marine environment are to:

- Ensure that activities do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards
- Maintain the integrity and ecological functions of marine environment surrounding Wyndham Port

7.2.10.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing the marine environment include:

- EPA Environmental Assessment Guideline No. 3: Protection of Benthic Primary Producer Habitats in Western Australia's Marine Environment (2009)
- ANZECC/ARMCANZ: Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
- Government of Western Australia: State Water Quality Management Strategy (2004)
- Government of Western Australia: State Environmental (Cockburn Sound) Policy (2005)
- DER: Pilbara Coastal Water Quality Consultation Outcomes (2006)
- DER: Contaminated Sites Management Series – Assessment Levels for Soil, Sediment and Water (2010)

7.2.10.3 Context

Wyndham Port is situated on the eastern bank of the West Arm Estuary of the Cambridge Gulf. The Project is currently expecting to have 11 cargo ships leave Wyndham Port per year; this would only equate to a 2.4 % increase in annual ship movements within Wyndham Port. No new infrastructure will be required to facilitate SMPL operations at the port and current dredging schedules will not need to be altered.

Wyndham Port is currently listed as a contaminated site under the *Contaminated Sites Act 2003* however the contaminated land is deemed suitable for industrial or commercial use and is not in the vicinity of Project operations; the contaminated sites listing will therefore not impact on operations relating to the Project.

A desktop review conducted for the development of the Project's POEMP (Appendix 3, Volume 2) indicates that the waters surrounding Wyndham Port have a high turbidity which limits the number of species that can utilise the environment. An appraisal of the Commonwealth and Western Australian legislation in conjunction with an assessment of available habitat revealed that 36 protected species have the potential to occur; of these only 16 have actually been recorded in the area.

Potential impacts to the marine environment could result from:

- Accidental discharge of concentrate during handling and ship loading
- Accidental discharge of concentrate and/or oil spill during shipping
- Increased vessel movements

7.2.10.4 Management Measures

A desktop review of the marine environment and a risk assessment for the proposed port operations has been undertaken as part of the POEMP (Appendix 3, Volume 2). The proposed management strategies for potential impacts are described below, included in the POEMP and will be incorporated into the OEMP for the Project (Appendix 2, Volume 2).

Concentrate Handling and Ship Loading

The concentrate produced by the Project and exported through Wyndham is not classified as an environmentally hazardous substance for the purpose of road transport however it is classifiable as an environmentally hazardous substance for the purpose of marine transport. If managed inappropriately the handling of concentrate at Wyndham Port could have the potential to impact on the environment through accidental discharge.

The potential impacts that would result from discharge of concentrate include:

- Pollution of the marine environment and degradation of marine habitats
- Loss of marine flora and fauna
- Pollution of the terrestrial environment and degradation of habitat in proximity to Wyndham Port
- Loss of terrestrial flora and fauna

Several protected marine reptiles are listed as potentially occurring within the Wyndham Port area, however all of these occur in low densities and the individuals recorded are generally transient due to the turbid nature of the water. Two species of pipefish, four species of seahorse and two species of sawfish also have the potential to occur in the area. If an accidental discharge were to occur, these fish and seahorse species would run a high risk of exposure and, depending on their sensitivity, might suffer mortality. However to date, there are no records of these fish and seahorse species occurring in the Wyndham Port area.

Numerous bird species have been recorded feeding on the mudflats and mangal areas adjacent to Wyndham Port, including the EPBC listed Eastern Great Egret, White-bellied Sea-eagle and Rainbow Bee-eater. The birds themselves would not be directly impacted by an accidental discharge of concentrate; however, the discharge could potentially contaminate their feeding habitat and result in Pb ingestion. Pb will bio-concentrate in the body and high concentrations of Pb in the body can result in organ failure and subsequent death. Additionally the degradation of habitat and ensuing reduction in food availability could force birds to move to other areas. However mudflat and mangal habitat is common throughout the region and several local areas support marine bird assemblages similar to the one found at Wyndham Port; the RAMSAR listed Lower Ord and Parry Creek Floodplain area is less than 10 km away and provides very large tracts of undisturbed habitat for any individual birds that might be displaced.

If accidental discharge of concentrate were to occur during on-shore handling the potential exists for fugitive concentrate to settle on the soil and vegetation in the immediate surroundings of the port. Pb is strongly adsorbed to soil and will generally be retained in the topsoil; terrestrial animals could ingest the Pb during feeding (ingestion of Pb from soil or flower surfaces) or preening (ingesting metals brushed off the vegetation) resulting in concentration of Pb in the body.

Development of management strategies for the avoidance of impacts from accidental discharge during concentrate handling and ship loading has focused primarily on the design and implementation of a predominantly enclosed and mechanised system for concentrate handling and transfer to ships. This system and associated transportation management measures are described in detail in Sections 2.6 and 7.2.9.4 and in the POEMP (Appendix 3, Volume 2).

In addition to the utilisation of the containerised system, moisture content levels in the concentrate will be monitored to ensure optimum conditions for dust control during ship loading and to meet export requirements. The moisture content of the concentrate will be at least 7 % (with a maximum of 10 % to meet export shipping requirements) and will be confirmed during routine on site lab analysis of concentrate physical parameters prior to dispatch. The sealable lids of the transport containers provide security from variation in moisture content level during transport. Concentrate management is discussed in detail in Section 7.2.9.4.

Shipping and Vessel Movements

Impacts to the marine environment due to increased shipping activities and vessel movements at Wyndham Port could result from:

- Vessel collision
- Vessel grounding
- Vessel strike of marine animals

The potential for vessel collision at Wyndham Port is low as the port is currently operating below capacity. In addition, the potential for collision has been reduced by the implementation of the following strategies by CGL:

- There is only one harbour master who has overall command of the shipping
- All vessels over 500 gross registered tonnes must have pilotage in and out of the port. As the port only operates one pilot boat there can only be one cargo ship moving through the port at any one time

Recreational vessels are however allowed to enter the port without pilotage; therefore it is possible that human error or engine failure may result in a collision. However due to the relatively small size of most recreational vessels when compared to the large size of cargo ships it is likely that the cargo ship would suffer only minor damage and as a result of the protective double hull there would be a very low possibility of a concentrate spill occurring.

Kimberley Metals Group (KMG) operates a Barge Loading Facility (BLF) on the eastern bank of the West Arm Estuary approximately 2 km north of Wyndham Port. KMG utilise a transhipment arrangement to transfer iron ore from the BLF to larger ships anchored in deeper water approximately 1.2 km from the BLF. One ship is loaded approximately every two weeks, four barges and two tugs are used in the transhipment operation with a frequency of approximately 12 to 16 barges per ship. The potential for vessel collision between SMPL and KMG vessels is low as both KMG and CGL operate a pilot boat and KMG do not ship frequently which results in a low chance of a SMPL vessel and KMG ship moving within the West Arm Estuary at the same time.

There is potential for vessel grounding by pilot error or engine failure due to the high rate of sediment deposition in the West Arm Estuary causing siltation of the deep water channel. However, due to the soft sediment (rocky areas are too deep for grounding) and the minor wave action in the estuary there is a low risk that the cargo ship might break while grounded and the ship will most likely float off the sandbar undamaged on the following high tide.

In the unlikely event of a vessel collision or grounding, concentrate discharge or oil spill could result. A concentrate or oil spill from a vessel has the potential for a large volume of concentrate or oil to be released into the aquatic environment where it would not easily be contained or remediated. Concentrate and oil from spills may have negative environmental impacts on fauna and fauna habitat.

Vessel strikes can contribute to the mortality of marine animals, particularly where vessels are moving at high speeds as there is insufficient time for individuals to avoid fast moving vessels. The ships used for the Project that are entering, manoeuvring or leaving the port will be travelling at low speed which should give most animals the opportunity to take evasive action.

With approximately 446 commercial ship movements, including KMG operations, through the West Arm Estuary annually it is not envisioned that the additional 11 ships required per year for the Project will significantly increase the likelihood of oil spills, groundings or vessel strikes with wildlife.

Marine Environment Monitoring and Baseline Data

SMPL is committed to minimising impacts to the marine environment. To ensure the protection of marine environmental values and the maintenance of marine environment quality, ecosystem integrity and seafood safe for eating SMPL will conduct soil and sediment sampling at Wyndham Port. Due to the tidal influence at the port, water sampling will not provide a reliable baseline or record of potential contamination and will therefore not be conducted. Heavy metals are however known to accumulate in sediments therefore allowing potential contamination to be detected by sampling of this kind.

Soil and sediment sampling will commence prior to SMPL concentrate loading at Wyndham Port to acquire baseline information; monitoring will continue at quarterly intervals throughout the life of SMPL operations at the port. The sampling methodology will be in line with the method currently used by CGL (CGL 2011) with consideration of the EPA *State Environmental (Cockburn Sound) Policy (2005).*

The monitoring program will measure levels of Ag, Pb and Zn with respect to assessment criteria based on baseline data, consideration will also be given to relevant soil and sediment quality guideline levels derived from the DEC *Contaminated Sites Management Series – Assessment Levels* *for Soil, Sediment and Water (2010)* as outlined in Table 7-17. Marine sediment samples will be taken from six locations and land based soil samples will be collected at four locations as illustrated by Figure 7-7. Laboratory analysis will be carried out by a NATA accredited test centre.

The key objectives of the monitoring program are to protect human health and the environment by ensuring that management practices for concentrate handling at the port are adequate. Failure to meet the assessment criteria will result in a management review of the control measures for concentrate handling at the port and will trigger investigation and clean up, contingency actions or work stoppage in addition to ecotoxicological sampling of sediment filter feeders such as mussels and mud crabs in the mangroves adjacent to the port.

All results for sampling conducted at the port will be included in the Project's AER submission to the DMP.

Table 7-17: Soil and Sediment Quality Guideline Levels

Soil Quality Assessment Criteria		
Metal	***Ecological Investigation Level (mg/kg)***	***Health Investigation Level (mg/kg)***
Lead	600	1,500
Silver	N/A	N/A
Zinc	200	35,000
Sediment Quality Assessment Criteria		
Metal	***Interim Sediment Quality Guideline – Low (mg/kg dry weight)***	***Interim Sediment Quality Guideline – High (mg/kg dry weight)***
Lead	50	220
Silver	1	3.7
Zinc	200	410

The *Low Interim Sediment Quality Guideline* is a threshold concentration below which the frequency of adverse effects is expected to be very low. The *High Interim Sediment Quality Guideline* concentration represents a concentration above which adverse biological effects are expected to occur more frequently.

7.2.10.5 Predicted Outcome

As a result of the management measures described above, SMPL feel that potential impacts to the marine environment can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_ME_707.dgn

SORBY HILLS PROJECT

Figure 7-7

Port Sediment and Soil Sampling

Author: SMPL Date: August 2013

7.2.11 Key Environmental Factor: Dust Emissions

7.2.11.1 Management Objective

The environmental values of the Project site, Wyndham Port and their immediate surrounds, and the wellbeing of employees and the community of Wyndham is a key focus for SMPL. The principal objectives for the management of dust emissions are to:

- Ensure that dust emissions generated by the Project do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards
- Minimise to reasonable and practicable limits, dust generated by construction and operational activities

7.2.11.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing dust emissions include:

- *EP Act*
- *Mines Safety and Inspection Act 1994*
- EPA Guidance Statement No. 18: Prevention of Air Quality Impacts from Land Development Sites (2000)
- National Environment Protection (Ambient Air Quality) Measure (2003)
- DER: A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities (2011)
- DER: A Guideline for the Development and Implementation of a Dust Management Program (2008)
- World Health Organisation (WHO): Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulphur Dioxide: Summary of Risk Assessment, Global Update (2005)
- DEC New South Wales: Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2005)
- AS/NZS 3580.10.1:2003 – Methods for Sampling and Analysis of Ambient Air; Method 10.1: Determination of Particulate Matter – Deposited Matter – Gravimetric Method
- AS/NZS 3580.9.6:2003 – Methods for Sampling and Analysis of Ambient Air – Determination of Suspended Particulate Matter – PM_{10} High Volume Sampler with Size Selective Inlet – Gravimetric Method
- AS/NZS 3580.9.3:2003 – Methods for Sampling and Analysis of Ambient Air – Determination of Suspended Particulate Matter – Total Suspended Particulate Matter (TSP) – High Volume Sampler Gravimetric Method

- AS 2800 – 1985 – Ambient Air – Determination of Particulate Lead – High Volume Sampler Gravimetric Collection – Flame Atomic Absorption Spectrometric Method.
- AS 2923 – 1987 – Ambient Air – Guide for Measurement of Horizontal Wind for Air Quality Applications
- AS/NZS 3580.1.1:2007 – Methods for the Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment.

7.2.11.3 Context

Dust is an issue associated with many mining developments and may be generated by the Project in a number of ways during construction and ongoing operations. The key emission sources will include:

- Vegetation and topsoil removal
- Earthworks
- Wind erosion of cleared areas and stockpiles of waste and topsoil material
- Wheel generated dust from travelling on unsealed roads
- Drilling and blasting activities
- Extraction, transfer and crushing of ore
- Road side dust mobilisation from concentrate haulage trucks

The relatively short-term nature of site construction activities means that the potential for dust generation will vary depending on the level of activity, the specific operation and the meteorological conditions at the time. In contrast the activities associated with the operational phase of the Project will be of a more routine nature and dust emissions will therefore remain relatively steady.

Dust is formed of airborne particulate matter (PM) which is commonly classified by size expressed as equivalent aerodynamic diameter (EAD) in micrometres (µm):

- Total Suspended Particles (TSP) – diameter ≤50 µm
- PM_{10} – diameter ≤10 µm
- $PM_{2.5}$ – diameter ≤2.5 µm

The chemical composition of dust particles will depend on the nature of the source material, for example wind borne dust from a cleared area will reflect the composition of the underlying soil type. Sections 6.1.6 and 6.1.7 and Appendices 4 and 5 (Volume 3) characterise the soils and materials present in the Project Area.

The impacts of dust are influenced by particle size, chemical composition and concentration. Particles with an EAD less than 50 µm (but greater than 10 µm) are typically associated with adverse aesthetic affects; these particles are often termed “nuisance dust” settling on surfaces and causing soiling and discolouration. These particles may however be inhaled and become trapped in the upper respiratory tract (just behind the nose and mouth) causing irritation of the mucosal membranes (eyes, nose and throat). More serious human health affects tend to be associated with particles with an EAD of less than 10 µm which are small enough to be inhaled into the lower respiratory tract (airways and lungs). Contaminated dust, such as dust generated during metal ore handling, may contain contaminants attached to the dust particles. For very fine particles that are inhaled deep into the lungs the contaminants can be absorbed into the blood stream which may result in adverse health effects.

The potential impacts that may arise from dust generation during Project operations include:

- Fauna, flora and vegetation on site and in the immediate vicinity may be adversely affected by an increase in dusty conditions
- Adverse health impacts for the workforce on site and at Wyndham Port if staff are exposed to unacceptable levels of dust
- Road side dust mobilisation as a result of ore haulage through Wyndham which may become a health risk, cause annoyance and reduce the amenity of the township
- Potential impacts to adjacent sensitive receptors such as the ORIA – Weaber Plain Project and GRCP

7.2.11.4 Management Measures

SMPL is committed to minimising impacts on air quality that may be caused through dust generation and has developed comprehensive management strategies for the Project which include dust control, mitigation and monitoring.

Dust Monitoring and Baseline Data

An onsite dust sampling program has been established for the Project to measure dust fall (i.e. dust that settles out of the air). The program utilises dust deposition gauges and has been designed in accordance with *AS/NZS 3580.10.1:2003 – Methods for Sampling and Analysis of Ambient Air*.

Dust samples have been collected from six deposition gauges and analysed at a NATA accredited test centre on a monthly basis since August 2011 to compile a baseline data set for the Project Area, the results are presented in Table 7-18 and Appendix 38 (Volume 3); monitoring locations are presented in Figure 7-8a. Upon commencement of Project construction, dust sampling sites 1, 2 and 4 would become engulfed; these sampling sites were therefore relocated in February 2013 to new positions outside of the infrastructure footprint as shown on Figure 7-8b. Sampling will commence at these sites following the current wet season, which will enable continuous data collection at all sampling sites throughout the life of the Project, including prior to construction. The baseline data collected across the site prior to construction commencing will provide over one years' worth of data allowing for seasonal variations in dust conditions to be observed.

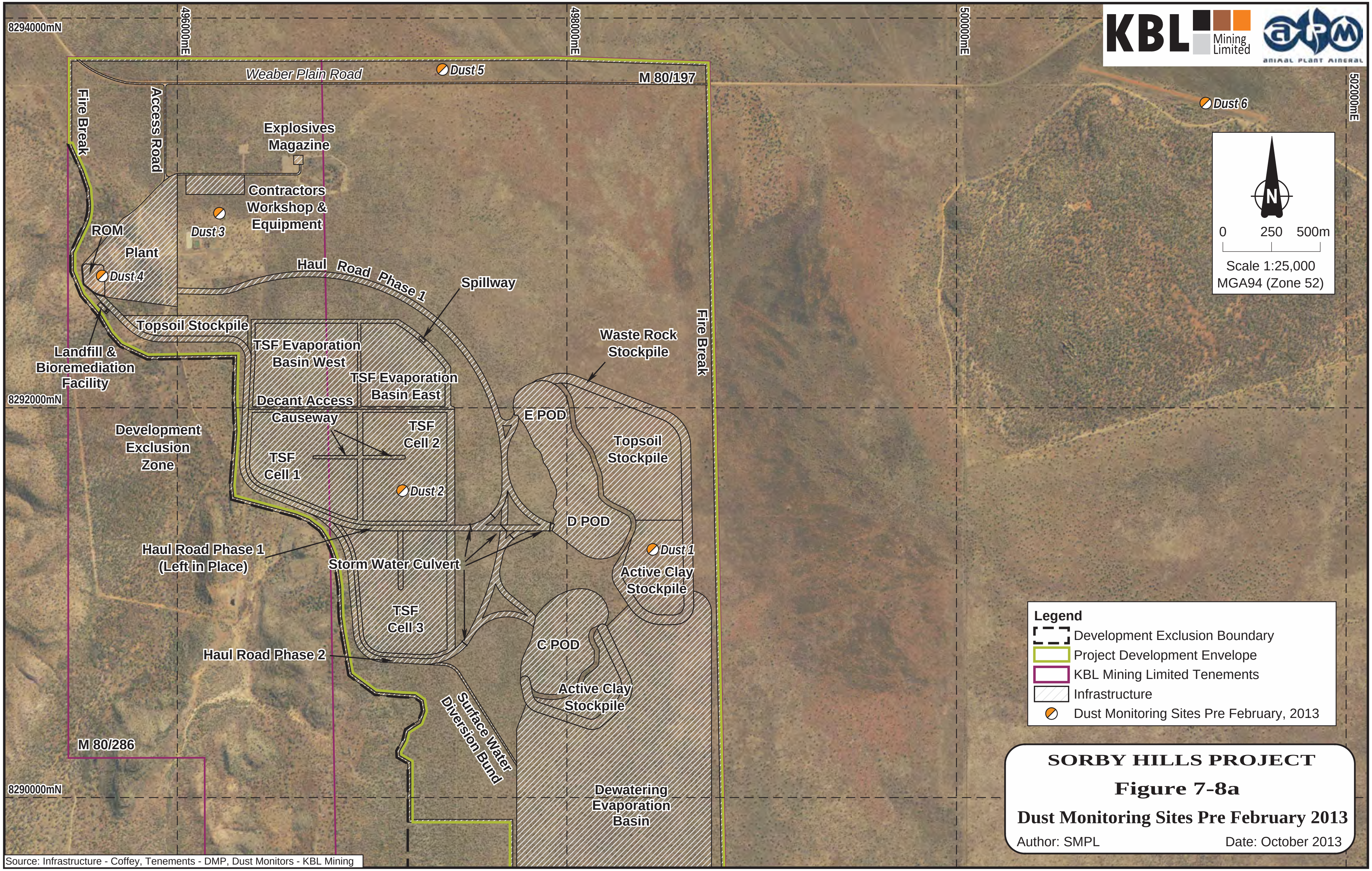
Table 7-18: Baseline Dust Fall Results

Dust Component	Sample ID	Date Tested													
		31/08/11	3/10/11	4/11/11	6/12/11	20/01/12	20/02/12	21/03/12	22/04/12	22/05/12	23/06/12	20/07/12	20/08/12	19/09/12	22/10/12
Ash [g/m2/mth]	DST 1	< 0.1	1.8	53	1.7	0.3	2.2	14	0.7	< 0.1	0.5	< 0.1	< 0.1	< 0.1	1.9
	DST 2	< 0.1	2.4	280	0.3	0.3	0.2	0.4	1.3	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.8
	DST 3	< 0.1	11	180	0.1	3.3	0.4	< 0.1	1	0.9	0.1	< 0.1	< 0.1	< 0.1	3.1
	DST 4	< 0.1	83	660	0.3	0.6	0.6	< 0.1	0.7	< 0.1	0.1	< 0.1	< 0.1	< 0.1	0.9
	DST 5	< 0.1	4.7	560	0.1	1.3	2.5	< 0.1	< 0.1	0.8	0.2	0.7	0.1	0.8	3.3
	DST 6	0.1	0.6	120	0.1	5.7	2.9	< 0.1	0.1	0.4	< 0.1	0.1	< 0.1	< 0.1	1.2
Insoluble solids [g/m2/mth]	DST 1	0.4	< 0.1	250	17	0.9	2.9	16	2	0.6	1.1	0.2	0.1	0.2	4.4
	DST 2	0.3	< 0.1	470	5.2	1.1	1.3	1	3.3	0.5	0.4	0.2	0.1	0.7	1.7
	DST 3	0.3	< 0.1	310	3.3	12	1.1	0.5	3.1	5.6	0.4	0.3	0.5	0.4	4.6
	DST 4	0.2	0.7	870	2.2	0.6	2.1	0.6	2.7	0.5	0.3	0.2	0.1	0.2	1.5
	DST 5	0.1	< 0.1	700	3.4	1.3	7.6	0.7	0.5	2.1	0.4	1.1	0.6	1.8	4.7
	DST 6	0.3	< 0.1	240	1.6	5.7	12	0.5	0.9	1.4	0.2	0.3	0.2	0.5	2
Soluble solids [g/m2/mth]	DST 1	1.3	1.3	< 0.1	16	< 0.1	3.9	1.6	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.8
	DST 2	2	1.9	130	1.4	< 0.1	1.6	1.9	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.5
	DST 3	1.1	1.8	310	2.2	6	< 0.1	1.3	< 0.1	1.6	< 0.1	< 0.1	< 0.1	< 0.1	0.3
	DST 4	1.2	< 0.1	160	1.1	1.3	0.9	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.6
	DST 5	0.5	2.1	200	< 0.1	1.8	7.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.3
	DST 6	< 0.1	1.7	290	0.4	3.9	7	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.6
Total solids [g/m2/mth]	DST 1	1.7	1.3	250	33	0.9	6.9	18	2	0.6	1.1	0.2	0.1	0.2	5.2
	DST 2	2.3	2	590	6.6	1.1	2.9	2.9	3.3	0.5	0.4	0.2	0.1	0.7	2.3
	DST 3	1.4	1.9	620	5.4	18	1.1	1.8	3.1	7.2	0.4	0.3	0.5	0.4	4.9
	DST 4	1.4	0.7	1000	3.3	1.9	3.1	0.8	2.7	0.5	0.3	0.2	0.1	0.2	2.1
	DST 5	0.6	2.1	910	3.4	3	15	0.7	0.5	2.1	0.4	1.1	0.6	1.8	5
	DST 6	0.3	1.8	530	2	9.5	19	0.5	0.9	1.4	0.2	0.3	0.2	0.5	2.6

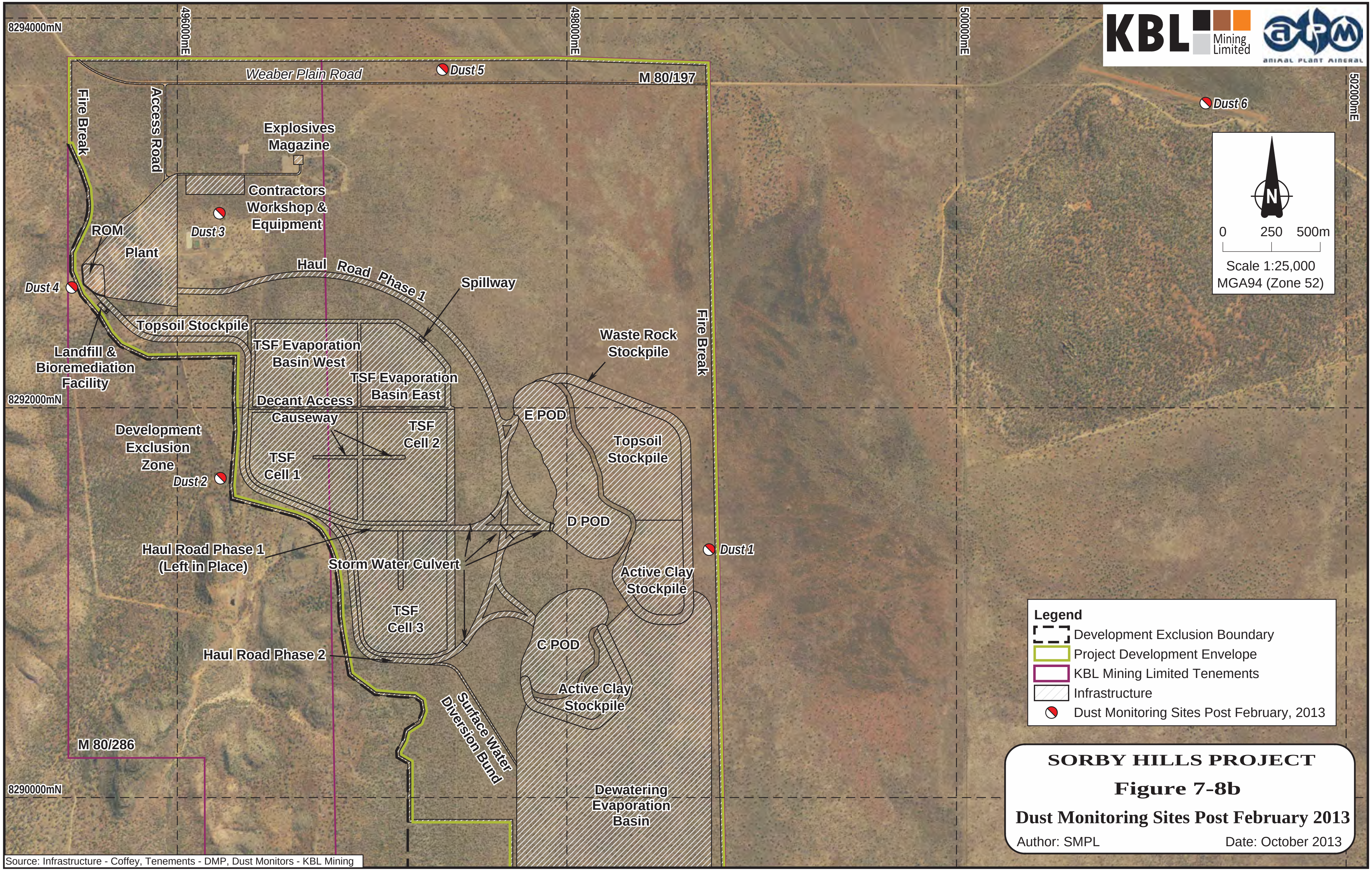
Dust Component	Sample ID	Date Tested													
		31/08/11	3/10/11	4/11/11	6/12/11	20/01/12	20/02/12	21/03/12	22/04/12	22/05/12	23/06/12	20/07/12	20/08/12	19/09/12	22/10/12
Volatile solids (550 °C) [g/m2/mth]	DST 1	-	-	-	-	0.7	0.8	1.9	1.4	0.6	0.6	0.1	0.1	0.2	2.6
	DST 2	-	-	-	-	0.8	1.1	0.7	2	0.5	0.3	0.2	0.1	0.5	0.9
	DST 3	-	-	-	-	8.3	0.7	0.5	2.1	4.6	0.3	0.2	0.5	0.4	1.5
	DST 4	-	-	-	-	< 0.1	1.5	0.6	2	0.5	0.3	0.1	0.1	0.2	0.6
	DST 5	-	-	-	-	< 0.1	5.1	0.7	0.5	1.3	0.2	0.3	0.4	1	1.4
	DST 6	-	-	-	-	< 0.1	8.8	0.5	0.8	0.9	0.2	0.2	0.2	0.5	0.8
Volume (Total) [mL]	DST 1	200	200	1800	3600	1600	3500	4300	460	480	200	200	200	200	320
	DST 2	200	200	1700	3800	1500	3100	3700	550	440	200	200	200	200	600
	DST 3	200	200	1900	4100	1800	3100	4000	320	200	200	200	200	200	500
	DST 4	200	200	1600	4300	1700	3500	4300	230	200	200	200	200	200	340
	DST 5	200	200	1600	4200	1700	3700	4300	460	400	200	200	200	200	320
	DST 6	200	200	980	3900	1900	2800	4300	700	200	200	200	200	200	380

Limit of Reporting - 0.1 for all analyses
Dust values for 4/11/11 are considered outliers as they are markedly different to the remainder of the results (error could have occurred during sample collection or analysis)

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_708A.dgn



Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_708b.dgn



Upon commencement of operations and throughout the life of the Project a comprehensive monitoring program will come into effect which will measure levels of TSP, PM_{10} and $PM_{2.5}$ in addition to the dust fall monitoring. The monitoring program will measure the significance of these dust emissions with respect to relevant air quality criteria as outlined in Table 7-19 and baseline data. It will be important to use baseline data in addition to assessment criteria as some baseline results for dust fall in the Project Area exceed guideline values. The key objectives of the monitoring program are to protect human health and the environment by ensuring that on site management practices for dust are adequate. Failure to meet the assessment criteria will result in a management review of the control measures for dust and may trigger contingency actions or work stoppage.

Table 7-19: Air Quality Assessment Criteria

Air Quality Parameter	Type	Averaging Period	Maximum Allowable Level	Standard
Deposited Dust				
Deposited Dust	Nuisance	30 Days	4 $g/m^2/mth$ (maximum total deposited dust level)	• Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, DEC NSW (2005)
			2 $g/m^2/mth$ (maximum increase in deposited dust level)	• Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, DEC NSW (2005)
Suspended Particulates				
TSP	Nuisance and Health	Annual Average	90 $\mu g/m^3$	• Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, DEC NSW (2005)
PM_{10}	Health	24 Hours	50 $\mu g/m^3$	• National Environment Protection Measure (NEPM) (Ambient Air Quality), NEPC (2003) • A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities, DER (2011)
		Annual Average	20 $\mu g/m^3$	• Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulphur Dioxide: Summary of Risk Assessment, Global Update, WHO (2005)
$PM_{2.5}$	Health	24 Hours	25 $\mu g/m^3$	• NEPM (Ambient Air Quality), NEPC (2003) • A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities, DER (2011)
		Annual Average	8 $\mu g/m^3$	• NEPM (Ambient Air Quality), NEPC (2003) • A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities, DER (2011)

SMPL will set up a dust monitoring program at Wyndham Port in conjunction with CGL when shipping for the Project commences.

Dust Control and Mitigation

SMPL aims to minimise the potential for dust emissions through appropriate planning, control and mitigation measures. Management measures for dust will significantly reduce any potential impacts to the surrounding environment. The proposed management strategies are provided in Table 7-20 and are incorporated into the construction and operational EMP's for the Project (Appendices 1 and 2 respectively, Volume 2).

Table 7-20: Management Strategies for Dust

Aspect	Management Strategy
Clearing	• Clearing of vegetation will be minimised as far as practicable and areas will only be cleared as required to reduce areas susceptible to dust lift-off • Rehabilitation will be undertaken on non-operational exposed surfaces as soon as practicable after they are no longer required • Vegetative cover will be established over all long term topsoil stockpiles not regularly used
Blasting	• Weather conditions will be assessed prior to blasting and blasting will not be undertaken during unfavourable conditions which include: ▪ Wind speeds in excess of 14 kph (at 10 m above ground level) ▪ Temperature inversions conditions in excess of 3 °C/100 m with wind speeds in excess of 7 kph ▪ Unfavourable wind directions relative to sensitive premises such as administration buildings • Climatic conditions deemed unfavourable will be assessed and regularly reviewed upon commencement of operations
Material Handling	• The largest practical truck size will be used to reduce the number of movements necessary to transport ore material • Drop heights between excavators and trucks will be reduced to minimise dust creation • Tailgates will be fitted to all haul trucks to minimise fugitive dust escape from loaded trucks • Drop heights when loading ore to the primary crusher hopper will be minimised • Correct moisture content of ore and concentrate during crushing, process and handling will be maintained • Regular belt cleaning on process conveyors to prevent potential dust sources building up
Dust Suppression	• Utilisation of a water cart to adequately dampen haul roads, the ROM pad, stockpiles, roads, laydown areas and car parks • Dust suppression systems on the crusher, process conveyors and all ore transfer points • Water, or where appropriate dust suppressants, will be used to minimise dust generation from cleared areas where fugitive dust is recognised as a problem
Traffic Management	• All vehicles on site will be confined to designated routes with speed limits enforced • All road edges will be clearly defined to control their locations • Obsolete roads will be closed, ripped and revegetated • The development of minor roads will be limited • Speed restrictions will apply to all concentrate haulage trucks whilst travelling

Aspect	Management Strategy
	on site, through the township of Wyndham and whilst at Wyndham Port
Health	• In the event that airborne dust cannot be managed to an acceptable level in a particular work area, PPE requirements will be adopted and enforced • Personal dust monitoring of staff members in higher risk work areas will be undertaken as part of the Health Surveillance Program for the Project
Monitoring	• Comprehensive dust monitoring program will be implemented upon commencement of operations • Immediate review of dust management practices and work stoppage if performance criteria are exceeded • Visual monitoring of dust will be regularly conducted and activities will be halted if adverse conditions result in excessive dust generation • Complaints management system implemented and complaints recorded and acted upon promptly • Photographic monitoring points of vegetation adjacent to high dust generating sources will be established

Sensitive Receptors Outside of the Project Area

Dust is not considered likely to cause health or amenity issues to neighbouring residents, agricultural land or conservation reserves due to the Project's relatively remote location and favourable wind speeds and directions in relation to sensitive receptors.

Currently the nearest developed agricultural land, which is part of the ORIA, and closest residence are located 21 km and 25 km to the south west respectively. The GRCP and the proposed ORIA – Weaber Plain Project are situated to the west of the Project site.

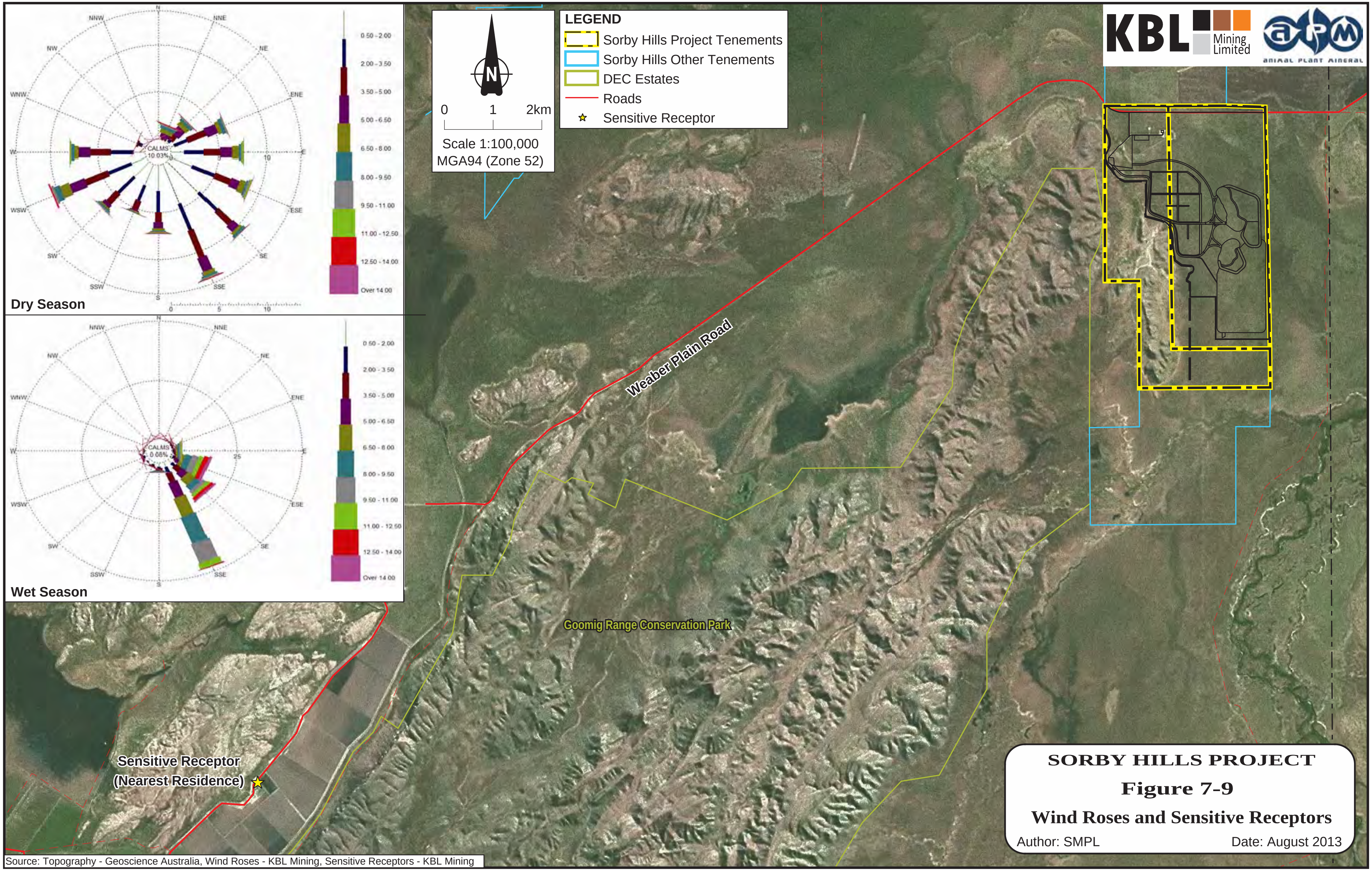
The Project's onsite weather station has recorded wind direction and speed since its installation in September 2011. Wind roses for the Project site indicate that wet season wind directions are variable changing between westerly to north easterly and dry season wind directions are relatively constant with prevailing south easterly winds. The overall prevailing wind direction toward the north west is relatively favourable with respect to the sensitive receptors as shown by Figure 7-9.

The wind roses also show that the majority of wind speeds experienced (all directions) in the Project Area are less than 14 kph, these winds are considered light when compared to the Beaufort Wind Scale which is provided in Table 7-21. DAFWA defines erosive winds as those that are strong enough to begin the saltation (particle movement) process and sets the erosive wind value at approximately 28 kph. The Beaufort Wind Scale indicates that dust will be raised by winds ranging between 20 kph and 29 kph. The data collected for the site therefore indicates that the Project Area is not in a region that regularly experiences strong winds and the risk of significant dust generation from erosive winds can be considered to be low.

7.2.11.5 Predicted Outcome

Impacts to sensitive receptors outside of the Project Area as a result of dust are not anticipated to be significant due to the favourable wind directions, low wind speeds and the implementation of dust management measures. SMPL consequently feel that potential impacts posed by the Project can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_709.dgn



Source: Topography - Geoscience Australia, Wind Roses - KBL Mining, Sensitive Receptors - KBL Mining

Table 7-21: Beaufort Wind Scale

Beaufort Scale Number	Descriptive Term	Wind Speed (kph)	Description on Land
0	Calm	0	Smoke rises vertically.
1-3	Light winds	19 or less	Wind felt on face; leaves rustle; ordinary vanes moved by wind.
4	Moderate winds	20 to 29	Raises dust and loose paper; small branches are moved.
5	Fresh winds	30 to 39	Small trees in leaf begin to sway; crested wavelets form on inland waters.
6	Strong winds	40 to 50	Large branches in motion; whistling heard in telephone wires; umbrellas used with difficulty.
7	Near gale	51 to 62	Whole trees in motion; inconvenience felt when walking against wind.
8	Gale	63 to 75	Twigs break off trees; progress generally impeded.
9	Strong gale	76 to 87	Slight structural damage occurs e.g. roofing dislodged; larger branches break off.
10	Storm	88 to 102	Seldom experienced inland; trees uprooted; considerable structural damage.
11	Violent storm	103 to 117	Very rarely experienced - widespread damage.
12+	Hurricane	118 or more	Very rarely experienced - widespread damage.

Modified from the BOM (http://www.bom.gov.au/lam/glossary/beaufort.shtml)

7.2.12 Key Environmental Factor: Hydrocarbons, Process Chemicals and other Dangerous Goods

7.2.12.1 Management Objective

The principal objectives for the management of hydrocarbons, process chemicals and other dangerous goods are to:

- Manage hydrocarbons, process chemicals and other dangerous goods in a manner that minimises environmental impacts to ensure affects to soil, groundwater or surface water quality are avoided
- Manage hydrocarbons, process chemicals and other dangerous goods in compliance with relevant standards and legislation

7.2.12.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing hydrocarbons, process chemicals and other dangerous goods include:

- *EP Act*
- *Dangerous Goods Safety Act 2004*
- DEC: The Contaminated Sites Management Series guideline: Bioremediation of hydrocarbon-contaminated soils in Western Australia (2004)
- AS/NZS 1940:2004 – Storage and Handling of Flammable and Combustible Liquids

7.2.12.3 Context

Substances required for the operation of the Project will include:

- Diesel fuel
- Oil
- Lubricants
- Gasses, reagents and process chemicals
- Explosives
- Radiation sources

The potential impacts that may arise from inappropriate storage and management of hydrocarbons, process chemicals and other dangerous goods at the Project include:

- Contamination of soils, surface water or groundwater
- Adverse effects to faunal habitats

7.2.12.4 Management Measures

Strict management measures will be implemented to ensure that impacts from hydrocarbons, process chemicals and other dangerous goods are minimised throughout the life of the Project. These strategies are described below and will be incorporated into the construction and operational EMP's for the Project (Appendices 2 and 3 respectively, Volumes 3).

Hydrocarbons Storage and Management

Diesel will be stored in four 50 KL self-bunded fuel tanks (see Figure 7-10) expected to be refilled approximately weekly by a diesel fuel delivery from Wyndham. Appropriately registered and qualified fuel transport companies will be used for diesel deliveries with procedures in place. Refuelling of vehicles from the diesel fuel tank will be controlled by a fuel management system. Fuel usage of each mobile vehicle on site will be recorded separately. The refuelling area will be bunded with a catchment sump in one corner. The overflow from the sump will be filtered through triple interceptors fitted with environ filters, or equivalent technology, to ensure no hydrocarbons escape to the environment. Waste oil will be disposed of by utilising a specialist contractor that collects and recycles waste oil. SMPL will have a mobile equipment refuelling procedure that will include spill response requirements and also have spill response kits at designated refuelling areas. Training in spill response will be undertaken for applicable staff. Generators will be appropriately bunded to minimise and potentially eliminate the occurrence of fuel leakage.

Oils and lubricants will be located at the site workshop and stored in a sea container specifically designed and modified for that purpose (see Figure 7-10 for an example). The base of the sea container will act as a bund for the quantity of oil stored within. Utilisation of the sea container will result in all oils being stored in a weatherproof enclosure which avoids possible ground/soil contamination from overtopping during heavy rain events. A spill kit will be available in the workshop area and spill response procedures will be implemented if necessary.

All hydrocarbon storage areas will be designed in accordance with *AS/NZS 1940:2004 –Storage and Handling of Flammable and Combustible Liquids* and have MSDS's located at storage sites. Hydrocarbon management procedures, including incident prevention and management, will also be outlined in the site induction and any personnel involved in the activities will be adequately trained.

Soil contaminated by incidental hydrocarbon spills will be removed and placed in a purpose built bioremediation facility; clean soil, once validated, will be reused on site. The bioremediation facility and its operation are described in detail in Section 7.2.13.4.

Table 7-22 identifies the management measures that will be implemented to prevent or mitigate impacts resulting from the use and storage of hydrocarbons at the Project site.

Table 7-22: Management Strategies for Hydrocarbons Use and Storage

Aspect	Management Strategy
Procedures and Training	• Implementation of CEMP and OEMP Strategy 12 (Appendices 1 and 2 respectively, Volumes 3) • Provide a suitable level of training to staff and contractors identified to be involved in hydrocarbon management to ensure they are aware of SMPL's requirements for use, storage and disposal • Ensure spill response equipment is available and procedures are communicated effectively to staff involved with hydrocarbon use in their work areas • Development of an incident management system, with corrective action processes, to facilitate continuous improvement of hydrocarbon storage, handling and disposal
Refuelling	• Ensure diesel generators are bunded • Install bund and collection sump at the vehicle refuelling area • Implement procedures for refuelling of mobile equipment
Storage	• Storage of hydrocarbons to be in accordance with AS/NZS 1940:2004 • Self-bunded fuel storage tanks to be installed • Oils and lubricants to be stored in weatherproof sea container • An inventory of hydrocarbons and quantities will be maintained and reported to the appropriate authority, as required • Regular inspections of storage areas will be conducted to identify any leaks or issues with hydrocarbon storage areas • MSDS's will be located at storage areas and will be regularly maintained.
Disposal	• Develop a bioremediation facility to treat contaminated soil in situ

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_710.ai

KBL Mining Limited

animal plant mineral

(a)

(b)

SORBY HILLS PROJECT
Figure 7-10
Example of Self-Bunded Fuel Tanks (a) and Hydrocarbon Storage Containers (b)

Author: SMPL Date: October 2012

Source: SMPL

Process Chemicals and Other Dangerous Goods Storage and Management

The use of process chemicals and other dangerous goods is required for the operation of the Project. Appropriate licences and requirements of the *Dangerous Goods Safety Act 2004* will be implemented wherever necessary.

The use of reagents and process chemicals will be managed to mitigate contamination. Bunded, purpose built storage and reagent handling facilities will be incorporated into the process plant and specific handling, storage and spill response procedures will be implemented.

Fireproof dangerous goods cabinets installed in the workshop, laboratory and process plant will be clearly signposted and noted on site emergency plans. There will be an inventory system in place to record stocks of dangerous goods and up-to-date MSDS's kept for all process chemicals and other dangerous goods that will possibly be used on the site. Segregation requirements will be considered when storing dangerous goods.

Gas cylinders will be stored in appropriate dedicated areas and procedures implemented to ensure correct handling and storage.

Explosives will be stored in a dedicated explosives magazine in compliance with the *Dangerous Goods Safety Act 2004*, the *Dangerous Goods Safety (Explosives) Regulations 2007* and *AS 2187.1:1998, Explosives – Storage, transport and use, Part 1*. Explosives will be stored remote from the mine site and process plant.

Radioactive sources will be required in the laboratory and process plant. Radioactive sources will be operated under DoH Licence conditions and will only be used in an appropriate facility within the laboratory by approved personnel.

A risk assessment will be conducted and authorisation from senior management obtained prior to any new dangerous goods being used on site.

All personnel who will handle process chemicals, gas cylinders or explosives will be adequately trained. Specific measures to reduce the impacts of such substances on site are included in Table 7-23.

Table 7-23: Management Strategies for Process Chemicals and other Dangerous Goods

Aspect	Management Strategy
Procedures and Training	• Implementation of CEMP and OEMP Strategy 12 (Appendices 1 and 2 respectively, Volume 2) • Develop procedures on the handling and storage of process chemicals and dangerous goods on site, incorporating spill response requirements • Provide a suitable level of training to staff and contractors identified to be involved in dangerous goods use, storage and disposal to ensure they are aware of SMPL's requirements and procedures
Storage	• Specifically designed, labelled storage areas will be identified and installed, with consideration to segregation requirements • A stock inventory will be maintained • Appropriate fire response equipment will be located near storage areas • Regular inspections of storage areas will be conducted • Explosives will be stored in a magazine in compliance with relevant standards and regulations

Aspect	Management Strategy
Disposal	• Disposal of dangerous goods will be in accordance with MSDS's and any requirements from DER

7.2.12.5 Predicted Outcome

As a result of the management measures described above, no adverse effects to faunal habitats or contamination of soils, surface water or groundwater is anticipated as a result of hydrocarbon, process chemical or other dangerous goods management. SMPL consequently feel that potential impacts posed by the Project can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

7.2.13 Key Environmental Factor: Non-mineral Waste

7.2.13.1 Management Objective

The principal objectives for the management of non-mineral wastes and potential contamination are to:

- Manage non-mineral wastes generated by the Project in a manner that minimises environmental impacts to ensure that wastes do not affect groundwater or surface water quality, nor result in soil contamination.
- Manage non-mineral wastes generated by the Project in compliance with relevant standards and legislation

7.2.13.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing non-mineral waste and potential contaminants include:

- *EP Act*
- *Health Act 1911*
- *Dangerous Goods Safety Act 2004*
- DEC: The Contaminated Sites Management Series guideline: Bioremediation of hydrocarbon-contaminated soils in Western Australia (2004)
- AS/NZS 1940:2004 – Storage and Handling of Flammable and Combustible Liquids

7.2.13.3 Context

Various forms of non-mining or process wastes will be produced by all phases (construction, operation and closure) of the operation and have the potential to impact on the environment if not appropriately managed. Wastes include:

- Putrescibles, plastics, glass and aluminium from the office and crib room facilities
- General litter from human presence
- Paper and cardboard from office and warehouse activities
- Scrap metal
- Tyres
- Wood from pellets and packaging
- Hydrocarbon wastes, particularly waste oil
- Chemical packaging products
- Laboratory wastes

- Medical wastes
- Sewage related wastes
- Batteries

The potential impacts that may arise from inappropriate storage and management of non-mineral wastes at the Project include:

- Contamination of soils, surface water or groundwater
- Faunal habitats could be adversely affected
- Encourage feral species and increase pest activity

7.2.13.4 Management Measures

Strict management measures will be implemented to ensure that impacts from non-mineral waste are minimised throughout the life of the Project. These strategies are described below and will be incorporated into the construction and operational EMP's for the Project (Appendices 1 and 2 respectively, Volume 2).

Waste Disposal

Non-mineral waste types relevant to the Project and their intended disposal methods are provided in Table 7-24. Due to the relatively remote location of the Project site full recycling programs may be inhibited, however recycling is a preference and all options will be explored.

Table 7-24: Non-mineral Waste Types and Disposal Methods

Waste Type	Disposal Method
General domestic waste such as food scraps and non-recyclable crib room and office rubbish	Collected in designated bins around the Project site and transported to the on-site landfill facility for disposal.
Paper and cardboard	Collected in designated bins and recycled where possible or disposed of in on-site landfill facility.
Plastic (recyclable)	Collected in designated bins and transported to an appropriate waste management facility where possible.
Plastic (non-recyclable)	Mixed with general domestic waste for disposal at the on-site landfill facility.
Scrap metal	Segregated and collected by a scrap metal merchant as required.
Tyres	Stored in a dedicated area of the landfill facility and recycled or removed from site by a specialist licenced waste management contractor operating from Darwin. Some tyres will be used around the site for traffic management purposes on haul roads, intersections and pit ramps.
Wood from pellets and packaging	Unbroken pellets returned to supplier where possible. Broken pellets buried in the on-site landfill facility where an alternative recycling opportunity is unavailable.
Hydrocarbons including waste oil, oil filters, oily rags and hydrocarbon contaminated material	Storage and handling of hydrocarbons will be in accordance with relevant regulations and standards and appropriate licences will be obtained as discussed in Section7.2.12. Waste hydrocarbons will be stored in designated, appropriately bunded area, and returned to supplier or removed regularly by a specialist contractor for off-site licenced disposal or recycling. Soil contaminated by incidental hydrocarbon spills will be removed and placed in a purpose built on-site bioremediation facility.

Waste Type	Disposal Method
Chemicals and chemical packaging products	Storage and handling of dangerous goods will be in accordance with relevant regulations and standards and appropriate licences will be obtained as discussed in Section 7.2.12. Waste chemicals and packaging products will be disposed of through a licenced waste contactor in accordance with product MSDS's. MSDS's for key chemicals that will be used at the Project are included in Appendix 8 (Volume 3).
Laboratory Wastes	Removed from site by a specialist licenced waste management contractor operating from Darwin.
Medical wastes	Placed in dedicated medical waste container and disposed of at Kununurra hospital.
Construction waste	Inert material disposed of in on-site landfill facility; controlled waste removed from site by a specialist licenced waste management contractor operating from Darwin.

General Waste Management Measures

SMPL is committed to reducing and recycling waste materials where possible and to disposing of waste streams in an acceptable manner. Waste management strategies to be implemented are described in Table 7-25.

Table 7-25: Management Strategies for Non-mineral Waste

Aspect	Management Strategy
Education and Awareness	• Waste management will be incorporated into CEMP and OEMP Strategy 13 (Appendices 1 and 2 respectively, Volume 2); this will include staff awareness programs, inspection requirements, storage requirements and waste reduction techniques • All employees and contractors will be inducted regarding waste management and proper waste practices for the Project • A suitable level of training will be provided to staff and contractors specific to their work areas to ensure they are aware of SMPL's requirements for waste collection, segregation, recycling and disposal • Waste will be considered in procurement process
Recycling	• The "Reduce, Reuse, Recycle and Recover" principles will be employed to minimise disposal requirements • A waste segregation system will be established
Housekeeping	• The construction site will be maintained in accordance with good industry housekeeping practices • Good housekeeping and rubbish disposal practices will be established to avoid attracting feral animals, pests and other wildlife throughout operation of the Project • Waste storage areas will be appropriately signposted, regularly inspected and kept clean • A 'no littering' policy will be implemented
Monitoring	• Waste storage areas will be regularly inspected
Reporting	• An inventory of waste products and quantities will be maintained and reported to the appropriate authority as required

Landfill Facility

For wastes which cannot be recycled, a landfill facility will be established on site. The location of the landfill is illustrated in Figure 2-1. The landfill will be constructed in accordance with DER licence conditions. Over the life of the Project 330 t of waste is expected to be generated; the landfill will operate as a trench and fill process with progressive trench development. The landfill site will cover an area of 0.10 ha.

Selection of landfill site has been determined to reduce surface water and groundwater interactions; as such the landfill will be located above the 1 in 100 year, 72 hour flood event limit and there will be at least 3 m separation between the base of the landfill trenches and the water table.

The landfill facility will be managed in accordance with DER Licence requirements. The management strategies that will be implemented are shown in Table 7-26.

Table 7-26: Management Strategies for Landfill Facility

Aspect	Management Strategy
Landfill Facility	• Construct and manage Landfill Facility in accordance with DER Licence conditions • Landfill management will be incorporated into CEMP and OEMP Strategy 13 (Appendices 1 and 2 respectively, Volume 2) • Only approved wastes will be disposed into the landfill facility. Wastes such medical wastes, hydrocarbons and other chemicals will not be disposed of at the facility • The facility will be fenced • Wastes will not be disposed within 35 m of the boundary fence • A 3 m wide firebreak will be created within the boundary fence of the facility • Fire management at the landfill facility will be included in the Site Emergency Response Plan, or equivalent • The tipping area will not be greater than 30 m in length or 2 m above ground level in height. It will also be at least 100 m from a surface water body, at least 3 m above the highest groundwater level and not within the 1 in 100 year, 72 hour flood event flood plain • Stormwater will be diverted away from the tipping area • Water that comes in contact with waste material will be retained on site • Dust suppression techniques, such as the use of a water cart, will be implemented as required • The waste material will be covered in accordance with the schedule identified in the DER Licence. This is to reduce food supply to feral animals (e.g. cats and wild dogs), breeding of insects and minimise the generation of odour. It is anticipated that waste pits will be covered at least weekly

Bioremediation facility

Hydrocarbon spills may occur over the life of the Project; these spills can result in localised areas of contamination. Possible sources of hydrocarbon contamination include hydrocarbon storage areas, refuelling spills, poor housekeeping, waste management in workshops and general plant and equipment leaks and spills. Any soil contaminated by incidental hydrocarbons spills will be removed and placed in an on-site bioremediation facility. To ensure spills are minimised all hydrocarbons will be stored and handled in accordance with the management strategies discussed in Section 7.2.12.

The bioremediation facility will be designed and constructed in accordance with the *Contaminated Sites Management Series Guideline for Bioremediation of Hydrocarbon Contaminated Soils in Western Australia* (DEC 2004) and built to the specifications shown in Figure 7-11.

The bioremediation facility will comprise two cells which will be rotated per treatment cycle, this will allow for one cell to be open whilst the second cell is closed for treatment. The treatment cells will be 10 m by 10 m in size and each cell will have a maximum effective treatment depth of approximately 0.3 m. This will enable approximately 30 m^3 of contaminated material to be processed per cell, per treatment cycle; in optimal conditions treatment will last approximately 2 months. Treatment of the soil will require a specifically designed product containing microbes to be applied to the contaminated soil within the treatment cells to remove toxic pollutants. The product will be a blend of naturally occurring micro-organisms that have a strong ability to remediate hydrocarbon contaminated soil and sludge as well as oil contaminated water. Treated soil will be analysed for total hydrocarbons prior to removal from the bioremediation facility.

The location of the bioremediation facility is illustrated in Figure 2-1. A number of aspects and site characteristics were considered prior to selecting the bioremediation facility location, these include:

- Site selected to reduce surface water and groundwater interactions; as such the site is located approximately 500 m from the nearest surface water body, above the 1 in 100 year, 72 hour flood event limit and there will be at least 3 m separation between the base of the treatment cells and the water table
- The site is flat or only gently sloping
- The site is located away from potential discharge pathways
- The site is located in an area with soils of high clay content and low permeability
- The site is at least 50 m from odour sensitive receptors (office and crib areas)

The management strategies that will be implemented for the bioremediation facility are provided in Table 7-27.

Table 7-27: Management Strategies for Bioremediation Facility

Aspect	Management Strategy
Bioremediation Facility	• Construct and manage Bioremediation Facility in accordance with the *Contaminated Sites Management Series Guideline for Bioremediation of Hydrocarbon Contaminated Soils in Western Australia* (DEC 2004) • Bioremediation Facility management will be incorporated into OEMP Strategy 13 (Appendix 2, Volume 2) • The facility will be fenced to prevent access by unauthorised personnel • Appropriate warning signage will be installed • Stormwater will be diverted away from the area • The base and bunding of the facility will be appropriately lined • Leachate will be directed to, and contained within a sump with adequate capacity; leachate will be recycled back into the bioremediation area • Dust suppression techniques, such as the use of a water cart, will be implemented as required

Sewage

Project amenities will be required to support up to 64 personnel; if not managed appropriately sewage could be a major health and environmental issue. To ensure the potential impacts from sewage are minimised, management measures will be applied throughout the Project life. The strategies that will be implemented are shown in Table 7-28.

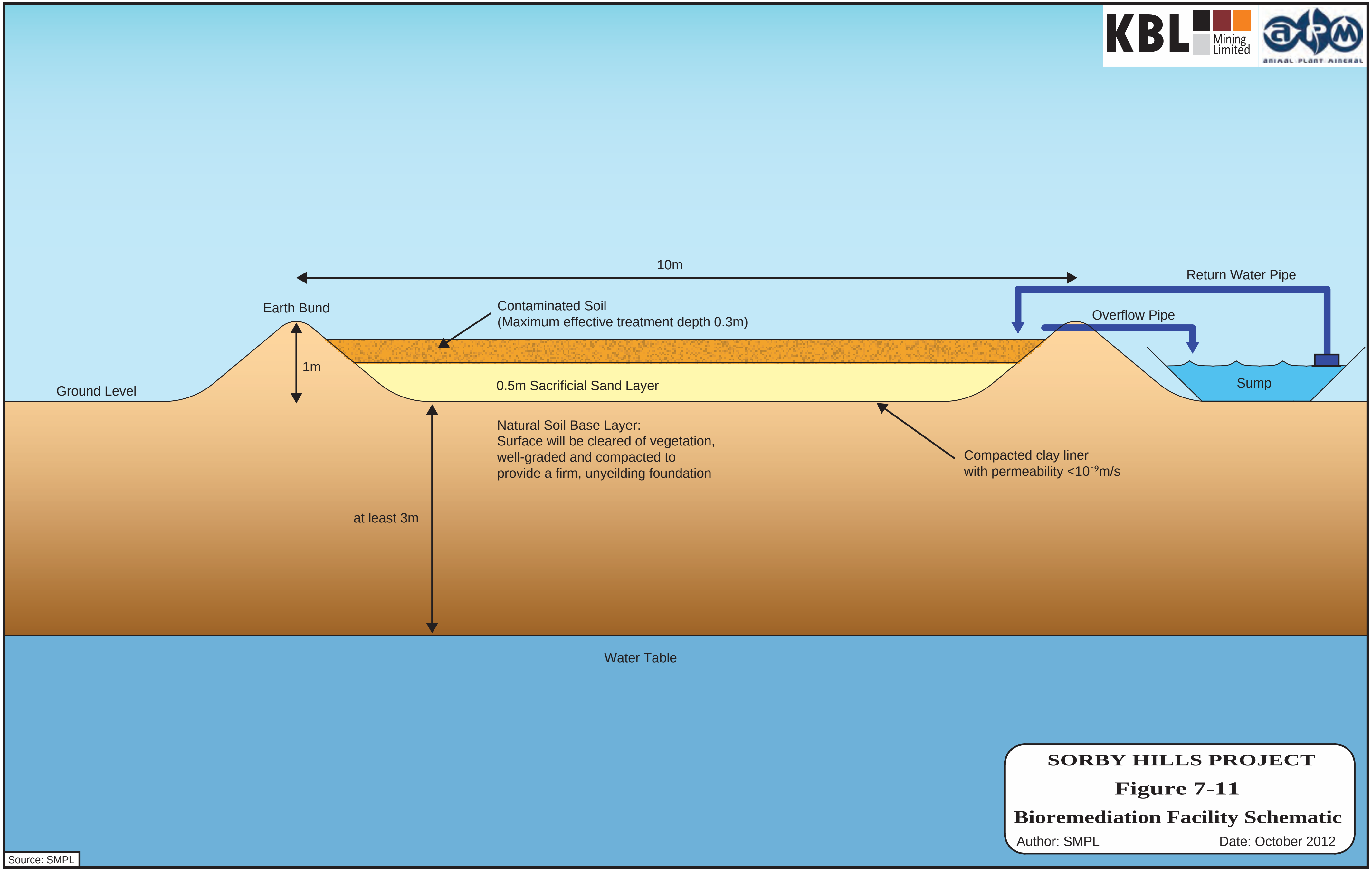
Table 7-28: Management Strategies for Sewage

Aspect	Management Strategy
Sewage	• Sewage will be treated using a bio-sewage system that will conform to the standards of SWEK and DoH requirements • Sewage management will be incorporated into CEMP and OEMP Strategy 13 (Appendices 1 and 2 respectively, Volume 2) • Sewage management facilities will be inspected regularly • Facilities will be managed in a manner that complies with legislative conditions, prevents pollution and preserves the amenity of the area

7.2.13.5 Predicted Outcome

Given the mitigating measures described above, SMPL feel that the potential impacts posed by the Project can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_711.ai



SORBY HILLS PROJECT

Figure 7-11

Bioremediation Facility Schematic

Author: SMPL Date: October 2012

Source: SMPL

7.2.14 Key Environmental Factor: Greenhouse Gas Emissions

7.2.14.1 Management Objective

SMPL is committed to reducing the GHG impact of the Project. The principal objective for the management of GHG emissions is to:

- Minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative impacts

7.2.14.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing GHG emissions include:

- *EP Act*
- *Environmental Protection Amendment Act 2003*
- *National Greenhouse and Energy Reporting Act 2007*
- EPA Guidance Statement No. 12: Minimising Greenhouse Gases (2002)

7.2.14.3 Context

The GHG Effect

The GHG effect is a natural phenomenon that warms the Earth and enables life to be supported, however excessive production and release of GHG's by humans is hypothesised to lead to increased temperatures over and above the natural order.

Policy

In 1997 the United Nations Framework Convention on Climate Change produced the Kyoto Protocol which is aimed at limiting GHG emissions; Australia ratified the protocol in 2007. The protocol was developed to work by setting a limit to individual mandatory GHG emission targets using 1990 as a baseline level. GHG's identified and managed under the Kyoto Protocol are:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Sulphur hexafluoride (SF_6)
- Hydrofluorocarbons (HFC's)
- Perfluorocarbons (PFC's)

In July 2009 the Department of Climate Change and Energy Efficiency released the Australian policy on climate change which aims to reduce emissions, encourage design and technology to reduce GHG emissions and reduce the impact of climate change in a global context.

In July 2011 the Australian Federal Government unveiled the Clean Energy Future Legislative Package which commits Australia to reduce carbon pollution by 5 % from 2000 levels by 2020. The package will place a liability on carbon emissions that, over time, will encourage investment in lower carbon intensity technologies.

The Western Australian government has developed the Western Australian Greenhouse Strategy as part of a response to the State's significant increase in GHG emissions over the past 20 years. This strategy aims to establish a realistic and effective long term commitment to addressing climate change and ensure that all sectors contribute to solutions.

Project Emissions

GHG emissions will be generated by the Project in a number of ways during construction and ongoing operations; the key emission sources will include:

- Land clearing
- Combustion of fuel by diesel powered generators, machinery, equipment and vehicles

SMPL commissioned Parsons Brinkerhoff Australia Pty Ltd (PB) to undertake a comprehensive GHG assessment for the construction and operation of the Project. The results of the assessment are discussed in this Section and the full report is provided in Appendix 39 (Volume 3) for reference.

The GHG assessment divided the Project into two main phases:

- Construction Phase (including vegetation clearing[3])
- Operational Phase

The main GHG associated with the Project is CO_2 which is emitted during the combustion of carbon intensive fuels. Emissions are reported in terms of carbon dioxide equivalent (CO_2-e) values which take into account the relative contributions of CO_2 and other GHG's. A summary of the Project emissions is provided in Table 7-29.

Table 7-29: Summary of Direct GHG Emissions

Activity/Phase	Duration	Total Direct GHG Emissions (t CO_2-e)
Construction and Vegetation Clearing	16 weeks	196,404
Operation	14 years	399,700
Total		***596,104***

Over the duration of the Project life from 2013 to 2027, it is estimated that the Project will emit up to 596,104 t CO_2-e of emissions. The largest source of emissions will be from the Project's operational phase. The operational phase, which consists of mining, processing and transportation

[3]The PB GHG assessment was completed prior to finalisation of the Project design and layout, as such the emissions assessment for the vegetation clearing component is based on a disturbance area of 767 ha. Following completion of the GHG assessment the Project design was amended resulting in a reduced disturbance area of approximately 573 ha, therefore the land clearing and total direct GHG emissions for the Project are overstated.

will result in GHG emissions of approximately 28,550 t CO_2-e per year, and will therefore produce 399,700 t CO_2-e over the 14 year operational life; the key emission source during operations will be the use of mining equipment which will account for approximately 94 % of total annual emissions.

The total emissions generated by the construction phase of the Project are estimated to be 196,404 t CO_2-e. The main emission source during construction will be the GHG emissions associated with the net loss of carbon sequestration resulting from vegetation clearing (195,733 t CO_2-e). Other significant GHG emissions sources during the construction phase will be from stationary diesel consumption used for power generation, and transport and stationary diesel consumption in the construction equipment fleet.

Overall, Australia's total direct annual emissions for 2009/2010 were 560.8 Mt t CO_2-e and Australia's direct annual emissions from the mining sector in 2009/2010 were 65.1 Mt t CO_2-e. By comparison, the annual operation of the Project is projected to represent approximately 0.005 % of Australia's total emissions and 0.9 % of Australia's total direct mining emissions respectively.

7.2.14.4 Management Measures

SMPL is committed to minimising the release of GHG's to maintain an acceptable state of air quality. There are a number of mitigation measures that can be implemented to reduce emissions associated with construction and operational activities, these measures are generally a combination of appropriate maintenance of equipment and the promotion of a culture of operating equipment efficiently. The proposed management strategies in relation to GHG's for the Project are provided in Table 7-30 and are incorporated into the construction and operational EMP's for the Project (Appendices 1 and 2 respectively, Volume 2).

Table 7-30: Management Strategies for GHG Emissions

Aspect	Management Strategy
Education and Awareness	• Site induction will provide an overview of the efficient use of energy with regards to driving habits and mobile equipment efficiency
Guidelines	• GHG emissions will be kept as low as practicable at all times in accordance with the objectives outlined in *EPA Guidance Statement No. 12: Minimising Greenhouse Gases* (2002)
Planning	• Minimise disturbance footprint and vegetation clearing • Design site layout for maximum efficiency
Procurement	• Materials with a lower content of embodied energy will be sourced for construction where possible • Recycled materials such as HDPE pipe material will be used where practicable • Materials and labour will be sourced locally where possible to minimise transportation • Contracts for construction and maintenance services will specify: ▪ Use of equipment and vehicles with GHG emission ratings of a minimum of 7.5 for passenger vehicles and 6 for light commercial vehicles ▪ Use of biofuels where feasible to reduce GHG emissions from plant and equipment ▪ Implement energy efficient guidelines for construction work, such as minimal idling time for machinery or complete shut off
Plant, vehicles and Equipment	• Maintenance of all vehicles, plant and equipment will be in accordance with manufacturers' specifications and relevant standards to retain high levels of

Aspect	Management Strategy
	energy efficiency • Exhaust controls will be fitted to equipment in keeping with Australian design rules and good industry practice • Energy efficient equipment will be incorporated into the processing plant
Rehabilitation	• Controlled regrowth of low vegetation will be allowed in areas where it will not cause adverse operational safety impacts in order to absorb and compensate CO_2 emitted from vegetation clearing • Rehabilitation following operations will result in the re-creation of the carbon capture ability of rehabilitated areas
Monitoring	• Development of key performance indicators for efficiency and GHG intensity • Regular monitoring, auditing and reporting on energy and resource usage and GHG emissions from all relevant activities with a view to progressively improving energy efficiency and investigation of renewable sources (e.g. solar generation) where feasible • Continual evaluation of the success of any offset or abatement measure undertaken, and investigation and adoption of new opportunities as they become available

7.2.14.5 Predicted Outcome

Given the low GHG emissions expected from the annual operation of the Project and the mitigating measures described above, no significant impacts from GHG emissions are anticipated. SMPL consequently feel that the potential impacts posed by the Project can be effectively managed to avoid significant residual impacts and meet the EPA’s objectives.

7.2.15 Key Environmental Factor: Other Emissions

7.2.15.1 Management Objective

The principal objective for the management of noise, vibration, light and odour emissions is to:

- Ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards

7.2.15.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing noise, vibration, light and odour emissions include:

- *Environmental Protection (Noise) Regulations 1997*
- *National Environment Protection (Ambient Air Quality) Measure (2003)*
- EPA Guidance Statement No. 8 (Draft): Environmental Noise (2007)
- EPA Guidance Statement No. 18: Prevention of Air Quality Impacts from Land Development Sites (2000)
- ANZECC Guidelines: Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990)
- AS 4282-1997 - Control of the Obtrusive Effects of Outdoor Lighting
- AS 2436-1981 – Guide to Noise Control on Construction, Maintenance and Demolition Sites
- British Standard (BS) 7385-2:1993 – Evaluation and Measurement for Vibration in Buildings: Guide to Damage Levels from Ground Bourne Vibration

7.2.15.3 Context

The Project Area and surrounds are currently largely undisturbed with most noise sources being natural (e.g. birds, insects and wind) with very occasional vehicle noise from the Weaber Plain Road. There is no artificial lighting aside from a few scattered lights for agricultural purposes (e.g. sheds) outside of the Project Area. Existing noise and vibration levels are expected to be consistent with rural background levels.

Noise, vibrations, light and odour may be generated by the Project in a number of ways during construction and ongoing operations, the key emission sources will include:

- Project construction
- Drilling and blasting activities
- Extraction, transfer, crushing and processing of ore
- Transportation of concentrate

- On site landfill facility
- Lighting required for the 24 hour operation of the processing plant

Noise, vibration, odour and light emissions have the potential to impact:

- The workforce on site and at Wyndham Port
- The community of Wyndham
- Weaber Plain Road users

The potential impacts that may arise from noise, vibration, odour and light generation at the Project include:

- Fauna on site and in the immediate vicinity may be adversely affected by an increase in noise, vibration, odour and light emissions
- Noise and vibration emissions may lead to occupational health and safety impacts for the workforce on site and at Wyndham Port
- Noise and vibration emissions may impact on the community of Wyndham as a result of ore haulage trucks passing through the township
- Light emissions may impact on users of the Weaber Plain Road during hours of darkness as a result of the 24 hour operation of the crushing and processing facilities
- Light emissions may lead to the death of nocturnal fauna as a result of vehicles travelling during hours of darkness during nightshift
- Odour emissions from the processing plant and landfill may result in occupational health and safety impacts for the workforce on site

The relatively short-term nature of site construction activities means that the potential for emission generation will vary depending on the level of activity and the specific operation. In contrast the activities associated with the operational phase of the Project will be of a more routine nature and emissions will therefore remain relatively steady.

Upon commencement of operations noise and vibration will be generated from fixed and mobile equipment and vehicles 24 hours per day, 7 days per week, and from periodic blasting. Lighting will be required every night for 24 hour crushing and processing activities and odours may emanate from the processing facility and/or landfill.

Emissions impacts during construction and operations are not anticipated to be significant as the nearest fixed sensitive receptor (residential) is approximately 25 km away from the Project site and the Weaber Plain Road experiences only very occasional use by pastoralists or members of the public for recreational purposes. Potential impacts to the natural values (fauna) of the Project Area are addressed in Section 7.2.2.4. Noise generated by concentrate haulage trucks passing through Wyndham is expected to be the key emissions impact.

7.2.15.4 Management Measures

SMPL is committed to minimising the release of emissions throughout the life of the Project. Noise, vibration, light and odour emissions will be kept as low as practicable at all times and will remain within the levels permitted by statutory requirements and relevant standards.

Concentrate Haulage

Due to the relatively remote location of the Project Area the principal noise and vibration impact resulting from Project operations is expected to be caused by concentrate haulage trucks travelling through the township of Wyndham. Truck movements will however be minimal with only 12 return movements per week expected. To ensure that impacts from haulage trucks are minimised strict management measures will be implemented as detailed in Table 7-31.

Table 7-31: Management Strategies for Ore Haulage Trucks

Aspect	Management Strategy
Noise and Vibration from Ore Haulage Trucks	• Concentrate haulage will be incorporated into OEMP Strategy 15 (Appendix 2, Volume 2) • Concentrate haulage trucks will only operate during daylight hours • Speed restrictions will be enforced and a ban on exhaust braking will be applied for concentrate haulage trucks whilst travelling through Wyndham • Trucks will be serviced and maintained to system requirements and relevant standards to retain an appropriate sound power level • Trucks will be appropriately operated by competent and trained operators to minimise excess noise and vibration • All complaints regarding noise emissions will be investigated and mitigating measures implemented where required

Blasting

Noise and vibration emissions released during blasting activities are not anticipated to impact surrounding communities or land users due to the relatively remote location of the Project Area. Nearby fauna species may be disrupted, however it is not expected that noise and vibration from Project activities will significantly impact local wildlife populations as discussed in Section 7.2.2.4.

Blasting may however lead to:

- Structural damage to site buildings
- Amenity impacts on the workforce

Guidelines regarding noise and vibration levels for blasting based on the impacts to human comfort for off-site receptors have been established and set out by the *Environmental Protection (Noise) Regulations 1997* and the EPA in *Guidance Statement No. 8 (Draft) Environmental Noise (2007)*. The guidelines are summarised in Table 7-32; the parameters are defined in terms of impact on air blast (pressure) which is measured in decibel Linear (dB(L)) and ground vibration measured as Peak Particle Velocity (PPV) in millimetres per second (mm/s).

Table 7-32: Blasting Emission Criteria for Human Comfort

Blasting Parameter	Time Period	Maximum Level for 9 out of 10 Blasts*	Maximum Level
Air Blast dB(L)	Monday to Saturday 07:00 to 18:00	120	125
	Sunday and Public Holidays 07:00 to 18:00	115	120
	Any day 18:00 to 07:00	-	90
Ground Vibration mm/s	Any day 07:00 to 18:00	5	10
	Any day 18:00 to 07:00	0.5	0.1

* Maximum level for 9 in any 10 consecutive blasts (regardless of interval between each blast) when received at any other premises

Whilst the *Environmental Protection (Noise) Regulations 1997* and EPA *Guidance Statement No. 8 (Draft) Environmental Noise (2007)* identifies criteria for human comfort at residential receivers there are no equivalent criteria for building damage. However *BS 7385-2:1993 Evaluation and Measurement for Vibration in Buildings: Guide to Damage Levels from Ground Bourne Vibration* suggests that a PPV of 15 mm/s is suitable to prevent damage to un-reinforced or light framed buildings.

To ensure that impacts from blasting noise and vibration are minimised strict management measures will be implemented as detailed in Table 7-33.

Table 7-33: Management Strategies for Blasting

Aspect	Management Strategy
Noise and Vibration from Blasting	• Blasting will be incorporated into OEMP Strategy 15 (Appendix 2, Volume 2) • Blasting will be designed to minimise noise projection and comply with noise standards • Blast Noise and Vibration Monitoring Program will be implemented to verify compliance with blast emission criteria • Blasting will only occur at designated blast times during daylight hours • All complaints regarding blast noise and vibration emissions will be investigated and mitigating measures implemented where required

Further Noise, Vibration, Light and Odour Management Strategies

To ensure that further impacts from noise, vibration, light and odour are minimised throughout the life of the Project, strict management measures will be implemented. The proposed strategies are provided in Table 7-34 and are incorporated into the construction and operational EMP's for the Project (Appendices 1 and 2 respectively, Volume 2).

Table 7-34: Management Strategies for Noise, Vibration, Light and Odour Emissions

Aspect	Management Strategy
Noise and Vibration	• Construction activities will be carried out in accordance with *AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites* • Operational activities will comply with the standards for operational noise set by the *Environmental Protection (Noise) Regulations 1997* • New generators will be used and they will have modern noise suppression devices attached • Vehicles, plant, equipment and generators will be serviced and maintained to system requirements and relevant standards to retain an appropriate sound power level • Machinery and mobile equipment will be appropriately operated by competent and trained operators to minimise excess noise and vibration • Mechanical plant will be fitted with noise suppression devices maintained to manufacturers specifications. Internal combustion engines will be fitted with a suitable muffler in good repair • Where necessary, mitigation measures such as earthen bunds and noise walls will be used • Wearing of appropriate PPE will be enforced to reduce noise impacts on workers • Noise and vibration performance criteria will be incorporated into purchasing requirements for relevant equipment and machinery • Frequency modulated reversing alarms will be installed on all relevant equipment
Light	• Consideration will be given to the location of fixed and mobile lighting such that light overspill is limited where practicable • All lighting will be directed inwards at the site to result in a “glow” being visible from the Weaber Plain Road rather than direct light • ‘Bug Yellow’ fluorescent lighting (or similar) will be used to limit attraction of flying insects to permanently lit areas • Shrouding will be used where practicable to reduce light overspill • Site speed limits will be adjusted to suit conditions during the hours of darkness to provide increased driver reaction time should fauna be “stunned” in vehicle head lights
Odour	• Waste material will be covered in accordance with the schedule identified in the DER Licence; it is anticipated that waste pits will be covered at least weekly • Odour emissions will be considered and best practice used to select processing chemicals that will have least impact
Consultation	• Stakeholder consultation will be continued throughout the life of the Project • All complaints regarding emissions will be investigated and mitigating measures implemented where required

7.2.15.5 Predicted Outcome

Given the mitigating measures described above, no significant impacts from noise, vibration, light or odour emissions are anticipated. SMPL consequently feel that the potential impacts posed by the Project can be effectively managed to avoid significant residual impacts and meet the EPA’s objectives.

7.2.16 Key Environmental Factor: Visual Amenity

7.2.16.1 Management Objective

SMPL is committed to maintaining the visual amenity of the Project site. The principal objective for the management of visual amenity is to:

- Ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as much as reasonably practical

7.2.16.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing visual amenity include:

- EPA Guidance Statement No. 33: Environmental Guidance for Planning and Development

7.2.16.3 Context

The assessment of visual amenity is subjective in that each person has a different perspective on what is, or what is not, visually appealing. The visibility and appearance of a development can be assessed by considering:

- ***Visual magnitude:*** The extent of the development (i.e. its size and presence on the landscape)
- ***Visual contrast:*** A comparison between the existing features on the landscape and those that are proposed
- ***Duration:*** The period of time the proposed development and associated changes to the natural environment are expected to remain

The alteration of the landscape associated with the Project may detract from the visual amenity of the area. The potential visual amenity impacts could result from:

- Creation of the mine pit voids, stockpiles and TSF
- Clearing of native vegetation and ground disturbance associated with construction and mine site infrastructure development
- Dust generation during construction and mining operations
- Light generation for 24 hour operation of the processing facility

7.2.16.4 Management Measures

Given the relative remoteness of the Project Area and the comparatively small scale of the operation visual amenity impacts are not expected to be significant however to ensure that impacts to visual amenity are minimised throughout the life of the Project mitigation measures will be implemented. Mitigation will be based upon:

- Planning (e.g. location and topography)
- Design (e.g. size, shape and materials used)

- Treatments (e.g. colour and screening such as vegetation planting)

The proposed mitigation measures for visual amenity impacts are provided in Table 7-35 and are incorporated into the construction and operational EMP's for the Project (Appendices 1 and 2 respectively, Volume 2). Proposed management measures for vegetation clearing, dust generation and artificial lighting are described in Sections 7.2.1.4, 7.2.2.4, and 7.2.15.4. Management strategies and concepts relating to mine closure and rehabilitation (Section 7.2.18) are also directly relevant.

Table 7-35: Management Strategies for Visual Amenity

Aspect	Management Strategy
Planning and Design	• Vegetation clearing during construction and operations will be minimised by appropriate planning, design and layout of infrastructure. There will be strict controls and clear delineation of development boundaries • The Project has been designed to maximise the use of pre-cleared and disturbed areas to minimise clearing of vegetation • Where practical infrastructure will be placed such that it is screened by existing vegetation or topographic features to minimise visual intrusion on the landscape • Vegetation screening will be planted where appropriate • Landform heights and slopes designed to ultimately blend into the surrounding landscape • There will be no waste rock dump or permanent stockpiling of waste material • There will be no stockpiling over 1.8 m in height • Access road to the site will be curved so the Project will not be directly visible from the Weaber Plain Road
Operations and Closure	• Progressive rehabilitation and revegetation will be undertaken with the aim of re-establishing suitable local vegetation communities to blend into the landscape • Rehabilitation and closure concepts will consider visual amenity • Backfilling of pit voids wherever possible; a pit lake will form in the C pod pit void

7.2.16.5 Predicted Outcome

As a result of the management measures described above and given the relative remoteness of the Project Area and comparatively small scale of the operation, no significant residual impacts to visual amenity are anticipated. SMPL consequently feel that the potential impacts posed can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

7.2.17 Key Environmental Factor: Aboriginal Heritage

7.2.17.1 Management Objective

SMPL is committed to building relationships and working cooperatively with local indigenous groups throughout the life of the Project. The principal objectives for the management of Aboriginal heritage are to:

- Ensure that changes to the biophysical environment do not adversely affect historical and cultural associations
- Ensure the Project complies with the requirements of relevant legislation
- Protect areas of Aboriginal heritage significance from disturbance or deterioration

7.2.17.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing Aboriginal heritage include:

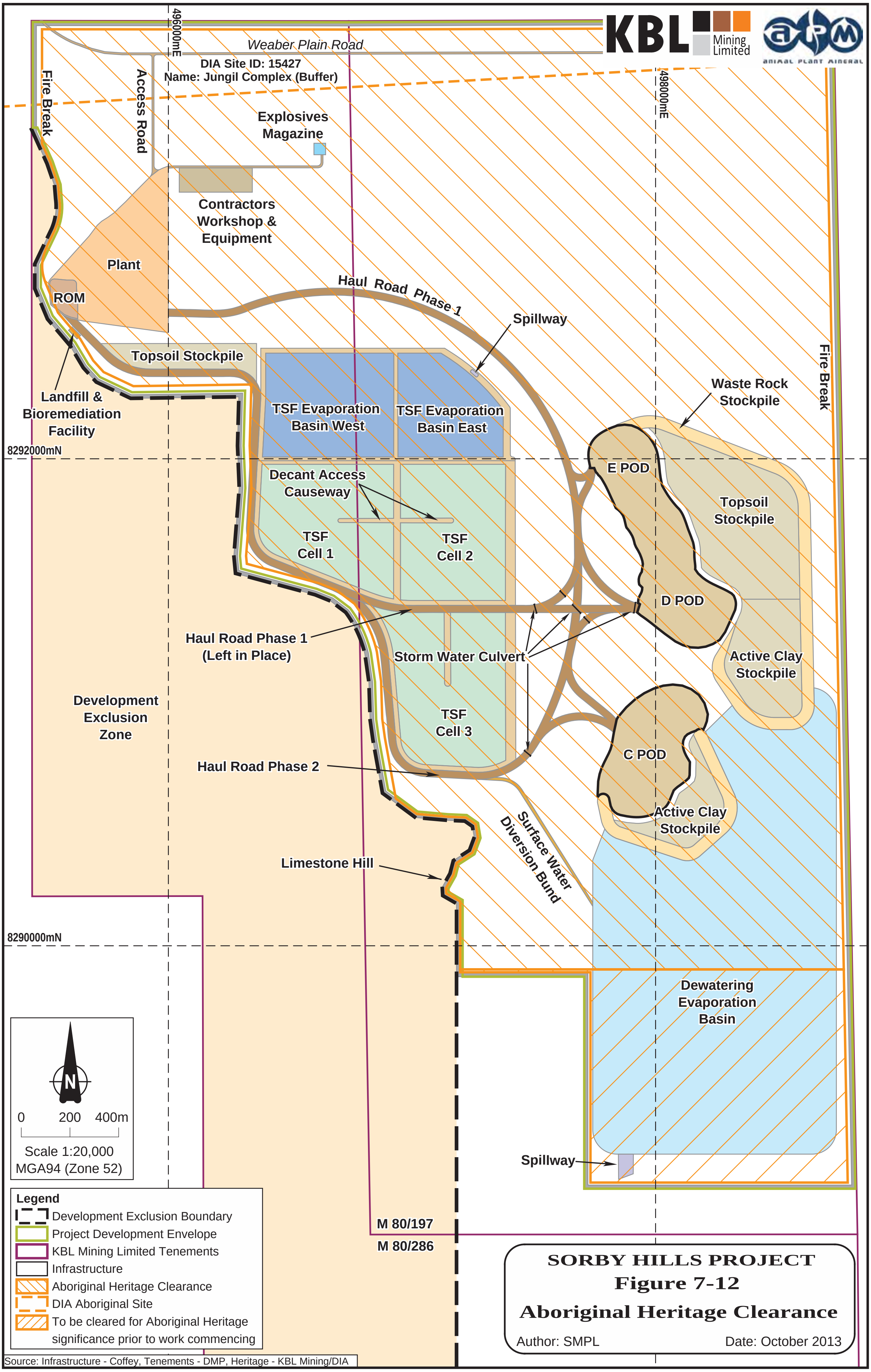
- *Aboriginal Heritage Act 1972*
- *Native Title (State Provisions) Act 1999*
- EPA Guidance Statement No. 41: Assessment of Aboriginal Heritage (2004)
- DIA: Section 18 Notice of Application for Ministers Consent to Use Land: Notes and Guidelines (2006)
- DIA: Guidelines for Preparing Reports for Applications to the Aboriginal Cultural Material Committee under Section 18 of the *Aboriginal Heritage Act 1972* (2005)

7.2.17.3 Context

Desktop Aboriginal heritage and detailed on-ground archaeological and ethnographic assessments have been conducted for the Project and are discussed in Section 6.1.10 and provided in Appendices 30, 31, 32 and 33 in Volume 3. No heritage sites have been identified within the Project Area to date and the TO's and MG Corporation approve the development of the Project. The areas surveyed and given clearance for development to date are illustrated in Figure 7-12. The area not currently cleared for Aboriginal Heritage significance (Figure 7-12) will be assessed and given clearance prior to works commencing.

The potential impacts to Aboriginal heritage and indigenous groups resulting from the Project operations include:

- Disturbance to Aboriginal heritage sites and values through physical development of the Project
- Impacts to water sources used by indigenous groups in the immediate area and downstream as a result of dewatering activities



SORBY HILLS PROJECT
Figure 7-12
Aboriginal Heritage Clearance

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_712.dgn

7.2.17.4 Management Measures

SMPL recognises the importance of the protection of Aboriginal heritage and its responsibilities in respect to the *Aboriginal Heritage Act (1972)*; SMPL is committed to consulting with the relevant Aboriginal groups regarding any future changes to the Project Area.

Heritage Sites and Values

Although the Project impact footprint has been cleared by extensive heritage assessments there remains the potential for unknown sites of significance or value to be located in the area which could be impacted by Project activities unless management measures are implemented. To ensure the potential impacts from the Project are minimised SMPL has developed an ACHMP which is provided in Appendix 5 (Volume 2). Proposed management strategies for the protection of Aboriginal heritage and values in the Project Area are provided in Table 7-36, the ACHMP and are incorporated into the construction and operational EMP's for the Project (Appendices 1 and 2 respectively, Volume 2).

Table 7-36: Management Strategies for Aboriginal Heritage

Aspect	Management Strategy
Planning	• Project footprint altered following ethnographic survey to avoid a limestone hill of Aboriginal heritage significance • Aboriginal heritage assessments will be undertaken prior to any future developments in areas outside of the Project's Aboriginal heritage clearance area (Figure 7-12)
Education and Awareness	• All employees and contractors will be inducted regarding cultural awareness; this will inform personnel of their legal obligations with regards to heritage site, provide instruction on their duty to look out for cultural heritage material and the appropriate course of action to be followed if new sites are identified
Disturbance to heritage sites	• ACHMP developed to allow adequate management of known and unknown heritage values which may be located in the Project Area • Development of a MOU with the MG Corporation whose traditional lands the Project site lies within; the MOU will detail strategies for TO employment whose tasks would include the monitoring of ground disturbing works for Aboriginal Heritage Sites • Ensure clearing only occurs in areas that have been surveyed for Aboriginal heritage significance by competent personnel • Aboriginal heritage will be included in the Environmental Clearance Permit (ECP) process

Water Sources

No impact to indigenous water sources are anticipated due to Project activities as no natural standing water bodies are present in the Project Area. Additionally, as discussed in Sections 6.1.5 and 7.2.6.4, drawdown as a result of dewatering is not expected to extend beyond the Project tenements or have any lasting effect on the groundwater aquifers.

7.2.17.5 Predicted Outcome

No significant impacts to Aboriginal Heritage are anticipated given the extensive heritage assessments carried out and mitigating measures described above. SMPL consequently feel that the potential impacts posed can be effectively managed to avoid significant residual impacts and meet the EPA's objectives.

7.2.18 Key Environmental Factor: Closure and Rehabilitation

7.2.18.1 Management Objective

SMPL is committed to the successful rehabilitation of all mining related disturbances on the Project site; this commitment is articulated through the principal objectives for the management of closure and rehabilitation which are to:

- Ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values
- Ensure that mine closure and rehabilitation meets legislative requirements and conditions of project approvals
- Achieve construction of landforms that are geotechnically stable, geochemically non-polluting and compatible where practicable with the surrounding landscape
- Re-establish self-sustaining ecosystems compatible with post-mining land uses
- Protect public safety
- Ensure aesthetic values are considered and measures adopted to reduce visual impacts on the landscape as much as reasonably practicable
- Protect the safety of fauna
- Provide a site back to the community that enhances the feeding habitat of the *EPBC Act* listed Gouldian Finch
- Undertake monitoring until the completion criteria are achieved to the satisfaction of the responsible authority

7.2.18.2 Applicable Standards, Legislation and/or Guidelines

Relevant standards, legislation and guidelines governing closure and rehabilitation include:

- *Soil and Land Conservation Act 1945*
- *Contaminated Sites Act 2003*
- EPA/DMP: Guidelines for Preparing Mine Closure Plans (2011)
- EPA Guidance Statement No. 6: Rehabilitation of Terrestrial Ecosystems (2006)
- ANZECC/ARMCANZ: Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
- Commonwealth of Australia: Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (2006)

7.2.18.3 Context

The mining industry and the wider community recognise that mining is a short term land-use and as such the permanent isolation of land from beneficial post-mining land-uses is unacceptable and should be avoided. It is only through the demonstration of successful closure that mining is sustainable over the long-term and that the mining industry will continue to be permitted access to extract natural resources. SMPL intends to leave the site upon cessation of the Project in a safe and stable condition such that the tenements can be relinquished without any future liability for the company or the community.

At present the end land use for the site will be pastoralism however stakeholder consultation will continue throughout the life of the Project and the end land use may be negotiated and evolve over time; for example interest has been expressed in a final land use for agriculture.

The potential impacts relating to the rehabilitation and closure of the Project include:

- Adverse impacts to flora, fauna, soil quality, ground and surface water quality and quantity, visual amenity and economic and social impacts due to poor rehabilitation

- Adverse impacts to rehabilitation efforts due to poor quality soil

- Poor closure planning resulting in the insufficient allocation of funds and/or resources for closure, particularly in the event of unforseen closure

7.2.18.4 Management Measures

SMPL is committed to the rehabilitation of the Project to a state that is safe, stable, non-polluting and capable of supporting an ecosystem appropriate to the location. Planning for mine closure is a critical component of environmental management for the Project. Leading practice requires that mine closure planning should start prior to mining commencing and should continue throughout the life of the mine until final closure and relinquishment.

To ensure closure and rehabilitation is successful, planning has been initiated and a framework of concepts, targets and predicted outcomes has been produced for the Project as described below. SMPL will also develop a MCP in accordance with the DMP/EPA '*Guidelines for Preparing Mine Closure Plans'* (June 2011). The MCP will ensure that the Project can be closed, decommissioned and rehabilitated in an ecologically sustainable manner. The MCP will be submitted to the DMP alongside the Mining Proposal for assessment during the final stages of project approval. The MCP will be regularly reviewed and revised throughout the life of the Project to allow for incorporation of new information. At this time closure planning is targeted towards the current agreed end land use of pastoralism. Closure and rehabilitation plans and concepts will be refined to reflect any changes made to the agreed final land use during ongoing stakeholder consultation and negotiation.

Given the proximity of the Project to the GRCP, DER has requested the opportunity to review the Project's MCP. As a key stakeholder DER will be provided with the opportunity to review the MCP.

Rehabilitation and Closure Concepts

The current proposal for the Project will see the operational phase run for approximately 10 years resulting in the disturbance and eventual rehabilitation of 573 ha of native vegetation. The major features of the Project are the mine pit voids, TSF, processing plant and infrastructure. Where appropriate rehabilitation will occur progressively throughout the life of the Project commencing during the construction phase, for example areas that are no longer required will be revegetated as they become available. Due to the need for continual use of many of the disturbed areas throughout the Project life, the bulk of rehabilitation works will occur during the decommissioning and closure phases of the Project.

Pit Voids

The combined D and E pods will be backfilled with waste rock as described in Section 2.2.3. SMPL acknowledge DER's preference for pit voids to be backfilled however it will not be possible to completely backfill C pod due to the extraction of materials resulting in insufficient material being available at closure; C pod will therefore be partially backfilled leaving a pit of approximately 16 ha. Upon completion of mining and cessation of dewatering the vacant C pod pit will naturally fill up with a combination of groundwater and rainwater runoff and form a pit lake. A pit lake water balance and water quality evolution investigations (mass balance and PHREEQC) for the Project (Appendix 29, Volume 3) predicts that the C pod void will fill up to within 2 m of the static groundwater level within approximately 8 years and is expected to be of suitable quality for irrigation purposes. Although contaminant levels (including salinity) are expected to increase marginally in the C pod void due to evaporative concentration, the influx of rainfall will act as a dilution factor and the C pod pit lake is not expected to trigger any long term irrigation guidelines (*ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality)* or, with the exception of Aluminium, exceed drinking water guidelines over time.

The water quality of the pit lake is expected to be comparable to that of the natural water bodies in the Sorby Hills area. Due to the elevated carbonate content of the source host rock it is anticipated that the alkalinity levels will be sufficient to neutralise acidity released during the mining process, resulting in a low potential for either acidic or neutral MD to occur within the newly formed pit lake.

Abandonment bunding and fencing will be constructed around the perimeter of the pit lake to prevent macro fauna access.

TSF

Upon cessation of processing the TSF will require decommissioning, closure and rehabilitation. SMPL's current TSF closure landform design is store and release, however SMPL are also considering options for the final landform to be water shedding. SMPL will liaise with the DMP regarding the final TSF design whilst developing the Sorby Hills Mining Proposal and Mine Closure Plan.

Current closure concepts for the Project's TSF will see the downstream slopes of the embankments covered with growth medium, contour ripped, seeded with native species and fertilised as appropriate.

Once tailings deposition has been completed and the top surface of the tailings has gained some bearing capacity it will be capped with a 0.5 m layer of mine waste (NAF waste rock). A layer of geogrid may be required between the finished tailings surface and NAF waste rock layer if development of adequate shear strength of the tailings has not occurred at the time of closure. The NAF waste rock layer will minimise dust generation from the dried tailings and provide support for growth medium whilst also creating a capillary break that will prevent upward migration of saline water from the tailings surface. A 25 cm thick growth medium layer will be placed on top of the NAF waste capping to facilitate revegetation. At final closure, the decant structures of the three TSF cells will be sealed.

The rehabilitated surface of the cells will follow the concave grade of the finished tailings surface and will therefore have the capacity to store stormwater. To minimise potential effects to vegetation on the rehabilitated surface, the TSF will be revegetated with species tolerant of periodic inundation. To accommodate for stormwater in a 1 in 100 year, 72 hour flood event, the crest of the TSF perimeter embankment will be raised by 80 cm during closure, exploiting the 8 m wide crest. This will be achieved using centreline construction techniques on the Stage 2 crest as shown on Figure 7-13 and will result in a rehabilitated crest width of 4 m. The quantities of materials required for the closure and rehabilitation of the TSF are shown in Table 7-37. Further details on TSF closure are provided in the Coffey infrastructure design report (Appendix 9, Volume 3).

Table 7-37: Material Quantities Required for TSF Closure

Material	Cell 1	Cell 2	Cell 3
NAF Waste Capping	135,000m^3	125,000m^3	180,000m^3
Growth Media	70,000m^3	65,000m^3	90,000m^3
Geogrid	270,000m^3	250,000m^3	355,000m^3
TSF Perimeter Embankment Raising		25,000m^3	

Soil Quality

The soil materials of the Project Area were investigated by SWC to gain an understanding of their physical and chemical nature and to identify any key issues for handling and management of soils during mining and rehabilitation. The findings of the soil assessment are discussed in Section 6.1.6 and the full report is included as Appendix 4 (Volume 3).

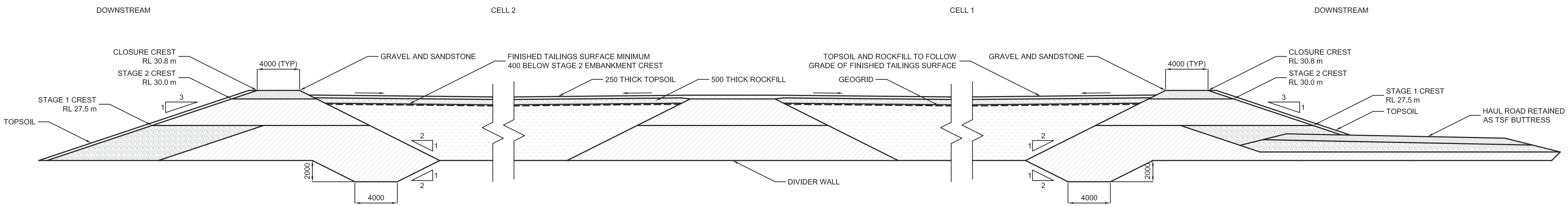
The Project Area is dominated by a single SMU of cracking clay which consists of two principal materials: greyish brown cracking clay and brown clay.

Topsoil and alluvium stripped from development areas will be an important resource for rehabilitation works. During removal, the surface 25 cm of soil will be segregated and set aside as topsoil due to its elevated mineral nutrition, the greyish brown cracking clay material from 25 cm – 80 cm will be set aside as a growth medium for revegetation due to its favourable characteristics for this purpose. Material extracted from the lower surface 80 cm – 110 cm will be used as subsoil as it retains good moisture retaining capabilities that are considered favourable for rehabilitation processes.

Below 110 cm (i.e. brown clay material), structural instability, very high alkalinity, EC and sodicity, and the distinct possibility of sodium carbonates (some of which are toxic to plants) present the material as a poor growth medium, therefore this material has not been designated for use in rehabilitation.

To ensure the impacts to soil profiles are minimised throughout the life of the Project, strict management measures will be implemented. The proposed strategies are provided in Table 7-38 and are incorporated into the construction and operational EMP's for the Project (Appendices 1 and 2 respectively, Volume 2).

Drawn: CAD Resources ~ A4 ~ CAD Ref g2004_PER_S7_713.ai



TSF CLOSURE
TYPICAL SECTION

SORBY HILLS PROJECT
Figure 7-13
TSF Closure Cross Section

Author: Coffey for SMPL

Date: October 2012

Source: Coffey

Table 7-38: Management Strategies for Soil

Aspect	Management Strategy
Clearing and stripping	• Adhere to clearing principles outlined in Table 7-3 and Table 7-7 • Soil will only be stripped as part of the construction and mining schedule • Soil stripping will not be conducted in high wind conditions to avoid unnecessary loss of soil
Storage and stockpiling	• Ensure the surface 25 cm is segregated as topsoil • Ensure 25 cm – 80 cm is segregated as a growth media • Ensure 80 cm – 110 cm is segregated as subsoil • All soil stockpiles will be clearly marked and an inventory compiled of the soil volumes • Soil stripping will not be conducted after rain where practical • Height of stockpiles will be controlled to minimise biological deterioration and risk of erosion and will be determined by characteristics and purpose • Stockpiles will be located away from major creek lines and appropriate erosion controls constructed • Should evidence of significant wind or water erosion present on the stockpiles, immediate mitigation measures will be implemented to improve the stability of the stockpiles • Topsoil removed from areas with known weed presence will be stripped and stockpiled separately, this material will not be used for rehabilitation unless it has been appropriately treated • Topsoil and subsoil stockpiles will be seeded with provenance correct seed to promote vegetation growth, thereby reducing the incidence of erosion. This will also have the additional benefit of increasing soil organic matter levels and soil seed banks for use in rehabilitation
Soil use	• Best efforts will be made to practice direct return of topsoil. That is, where possible, topsoil removed from one area will be immediately placed in another area that has already been prepared for rehabilitation. This method provides substantial benefits in retaining soil structure and maintaining viability of seed and microbial activity • Where direct return of topsoil is not practicable, topsoil stockpiles will be managed to prevent deterioration of seed, nutrients, microbes and soil structure
Contaminated Soil	• Soil contaminated by localised hydrocarbon spills will be remediated at the onsite bioremediation facility (Section 7.2.13.4)
Sampling and analysis	• A soil sampling and analysis program will be implemented and conducted during both the operational and decommissioning stages of the mine. This will ensure that all contaminated material is identified and remediated throughout operations or during the closure process • In accordance with requirements of the *Contaminated Sites Act 2003* a soil testing program will be implemented at the end of the decommissioning stage to ensure all contaminated soil has been removed prior to final rehabilitation

7.2.18.5 Predicted Outcome

Given the closure and rehabilitation concepts described above and the potential for future use of the site following mine closure, SMPL feel that the potential impacts of the mining operation can be effectively managed to avoid significant residual impacts and meet the EPA's objectives over the long term.

8 CONCLUSION

8.1 ENVIRONMENTAL AND SOCIAL MANAGEMENT COMMITMENTS

SMPL's key objectives are to implement the Project in a sustainable manner and mitigate environmental impacts to the extent reasonably practicable by the application of appropriate management measures over the life of the Project. Fulfilment of these objectives depends upon sound environmental knowledge of the Project Area and surrounds. Environmental studies undertaken for the Project have provided a good understanding of the distribution, diversity and abundance of biological taxa and conservation values. The findings have contributed to Project planning and design and will continue to contribute to ongoing operations, rehabilitation and ultimately decommissioning and closure.

SMPL's commitment to sound environmental management is reflected in the following formal commitments for the Project:

Commitment 1: Environmental Management System

SMPL will develop a SHECMS to ensure environmental management is effectively integrated into Project operations and that planning, implementation and review processes achieve continuous improvement. The SHECMS will be developed in accordance with the principles of AS/NZS ISO14001:2004 and AS/NZS 4801:2001, and will provide a structured approach to managing risks and potential impacts arising from the Project.

Commitment 2: Environmental Management Plans

Documented management plans will be established, maintained and incorporated into the Project's environmental management system to ensure the desired environmental outcomes are achieved. The following management plans have been identified as required:

- Construction Environmental Management Plan
- Operational Environmental Management Plan
- Port Operations Environmental Management Plan
- Gouldian Finch Environmental Management Plan
- Aboriginal Cultural Heritage Management Plan

The Project's environmental management plans will be dynamic documents, undergoing regular reviews and updates to maintain relevance. In addition, SMPL will develop further management plans as required for issues identified through the operation and ongoing management of the Project.

Commitment 3: Ongoing Consultation with Key Stakeholders

Stakeholder consultation has been an important aspect of the Project to date and will continue to be an integral factor in the overall environmental management. SMPL will endeavour to update the public and key stakeholders on the progress of the development throughout the life of the Project.

Commitment 4: Environmental Offsets Reporting

SMPL has identified a number of environmental values, including one critical value (biodiversity) that may be compromised by the clearing of 573 ha of native vegetation. These environmental values have been assessed in the context of the Project. Mitigation measures, management and offsets have been discussed in detail in Appendix 6 (Volume 2).

Commitment 5: Rehabilitation and Closure Strategy

Planning for mine closure is a critical component of environmental management for the Project. A MCP will be developed in accordance with the DMP/EPA '*Guidelines for Preparing Mine Closure Plans'* (June 2011). The MCP will be regularly reviewed and revised throughout the life of the Project to allow for incorporation of new information.

8.2 ENVIRONMENTAL OUTCOME

SMPL believe that through environmentally responsible development the Project's environmental objectives can be achieved and residual environmental impacts will be suitably acceptable. The Project will be undertaken in accordance with the Principles of Environment Protection as set out by Section 4A of the *EP Act.* These principles have been incorporated into the planning and development of the Project through the commissioning of comprehensive biological surveys and other specialist environmental assessments; the findings of these surveys and assessments have been utilised to:

- Develop the least environmentally impacting design for the Project through minimisation of the impact footprint and provision of the self-designated Development Exclusion Zone to retain habitat of high value and provide a buffer between the Project and the GRCP
- Identify and consider the likely impacts of the proposal on the environmental values of the Project Area
- Produce comprehensive, Project specific, management plans and mitigation strategies

SMPL has made a range of environmental commitments with respect to all aspects of the Project to show their commitment to constructing and operating the Project in an environmentally responsible and sustainable manner.

SMPL is dedicated to minimising and mitigating environmental impacts associated with construction and operation of the Project that cannot be practicably avoided. SMPL will consult and comply with relevant authorities where applicable to ensure environmental standards are achieved.

Through the findings of surveys and assessments and the implementation of comprehensive management plans it is anticipated that the Project will provide environmental benefits to the area, including:

- Increased scientific knowledge
- Improved fire management in and around the Project Area
- Retention of valuable habitat for species of conservation significance such as the Gouldian Finch

Additionally, the Project will provide social and economic benefits locally and State wide through:

- A significant positive influence on the economy of the Kimberley Region and considerable localised positive impact on business and employments opportunities for Kununurra, Wyndham and local indigenous communities
- Provision of social support for local communities
- Increased government revenue locally and State wide

It is SMPL's intent that the application of the management and mitigation strategies described in this RER will enable development of the Project with no significant adverse effect to the environment. SMPL believe that this will be achieved by ensuring protection of environmental values through comprehensive environmental management.

SMPL considers that development of the Project in the environmentally responsible manner described will not only ensure environmental protection but also deliver net environmental, economic and social benefits to the local and regional community and State as a whole.

9 STUDY TEAM

A multi-discipline team was assembled to prepare the Project's PER and subsequent RER document. This includes SMPL personnel and experienced environmental practitioners that are providing advice to SMPL and undertaking the relevant environmental investigations in conjunction with other specialist consultants as required. The Project team personnel are listed in Table 9-1.

Table 9-1: Study Team

Proponent Study Team	
Key Personnel	***Title***
Edgar Newman	Project Manager
Lubor Hon	Project Engineer
Dr Adam McKinnon	Project Geoscientist

PER Preparation			
Specialist Consultant	***Key Personnel***	***Title***	***Role***
Animal Plant Mineral Pty Ltd	Dr Mitchell Ladyman	Director and Principal Biologist	Co-author
	Sharon Arena	Principal Environmental Advisor	Co-author
	Corinne Chambers	Consultant Environmental Scientist	Co-author
	Dr Margot Oorebeek	Senior Consultant Biologist	Co-author
	Shane McAdam	Graduate Biologist	Co-author

PER Participants: Specialist Consultants and Individuals				
Company	***Project***	***Key Personnel***	***Title***	***Role***
Air Assessments	Concentrate Dust Assessment	Owen Pitts	Director and Senior Air Pollution Scientist	Author
Animal Plant Mineral Pty Ltd	Terrestrial Fauna Assessments	Dr Mitchell Ladyman	Director and Principal Biologist	Co-author
		Dr Margot Oorebeek	Senior Consultant Biologist	Co-author
		Anna Price	Senior Consultant Environmental Scientist	Field Surveyor
		Tony Smith	Senior Consultant Environmental Scientist	Field Surveyor
		Dr Steven Reynolds	Ornithologist	Ornithological Surveyor
		George Swann	Kimberley Expert Ornithologist	Ornithological Surveyor
		Bob Bullen	Bat Expert	Data Analyst
		Shane McAdam	Graduate Biologist	Field Surveyor/Assistant
	Flora and Vegetation Assessments	Dr Mitchell Ladyman	Director and Principal Biologist	Co-author
		Dr Chris Hancock	Botanist	Co-author
		Anna Price	Senior Consultant Environmental Scientist	Co-author; Field Surveyor
		Corinne Chambers	Consultant Environmental Scientist	Co-author; Field Surveyor
		Brian Vincent	Senior Consultant Botanist	Co-author; Field Surveyor
		Nadia Danti	Graduate Botanist	Field Surveyor
		Dr Russell Barrett	Kimberley Expert Botanist	Field Surveyor / Taxonomist

PER Participants: Specialist Consultants and Individuals				
Company	***Project***	***Key Personnel***	***Title***	***Role***
		Shane McAdam	Graduate Biologist	Field Surveyor/Assistant
	Marine Environment Assessment	Dr Mitchell Ladyman	Director and Principal Biologist	Co-author
		Dr Margot Oorebeek	Senior Consultant Biologist	Co-author
Australasian Groundwater and Environmental Consultants	Hydrogeological Assessment	Duncan Irvine	Principal Hydrogeologist	Author
Bennelongia Pty Ltd	Subterranean Fauna Assessment	Sue Osborne	Principal Biologist	Author
CAD Resources	Geotechnical Drafting	Adam White	Director	Draftsman
Cambridge Gulf Ltd	Stevedoring – Port Operations	Steve Forest	Port Manager	Port Contact
Coffey Mining Pty Ltd	Geotechnical Engineering	Harry Warries	Mining Engineer	Project Manager
	TSF Design	Clive Saunders	Principal Tailings Engineer	Author
	Pit Design and Mine Scheduling	Ramin Rakhsha	Specialist Mining Engineer	Author
Greg Carver	Aboriginal Heritage - Archaeological Assessment	Greg Carver	Archaeologist	Surveyor and Author
Land Access Solutions	Aboriginal Heritage - Desktop Analysis	Phil Czerwinski	Anthropologist	Author

PER Participants: Specialist Consultants and Individuals				
Company	***Project***	***Key Personnel***	***Title***	***Role***
Mintupela Pty Ltd	Aboriginal Heritage - Ethnographic Survey	Dr Kim Doohan	Principal	Author
		Joh Bornman	Principal	Co-author
Mount Isa Mines Ltd	Geotechnical Assessment	M.C. Bridges	Rock Mechanics Geologist	Author
Parsons Brinkerhoff Pty Ltd	Greenhouse Gas Assessment	Christopher Royal	Senior Climate Change and Resource Efficiency Consultant	Co-author
		Alyce Sala Tenna	Environmental Scientist	Co-author
POAGS Bulk Logistics	Transport and stevedoring logistics and port management	Steve Timmins	Project Development Manager	Author
Soil Water Consultants	Geochemical Characterisation	Adam Pratt	Director	Field Surveyor and author
	Pre-Mine Soil Characterisation	Adam Pratt	Director	Field Surveyor and author
	Deposit Surface Flows Analysis	Adam Pratt	Director	Field Surveyor and author
	Pit Lake Water Quality and Water Quality Evolution	Joe Powers	Water Resource Engineer	Author
ToxConsult	Environmental Risk Assessment of TSF Overflow	Tarah Hagen	Environmental Toxicologist and Risk Assessor	Author

PER Participants: Specialist Consultants and Individuals				
Company	***Project***	***Key Personnel***	***Title***	***Role***
Toxikos	Dangerous Goods Classification for Sorby Hills Concentrate	Tarah Hagen	Associate, Ecotoxicology and Risk Assessment	Author
Yawoorroong Miriuwung Gajerrong Yirrgeb Dawang Aboriginal Corporation	Aboriginal Heritage - Site Survey	Dominique Reeves	Lawyer	Author

10 GLOSSARY

Term	Expansion/Definition
Acid	Substance with pH less than 7.0; the lower the pH the higher the corrosive ability of the substance.
Acid Formation	The process whereby acid is formed by the oxidation of minerals (particularly sulphides) exposed to air and water.
Acidic	Having a pH less than 7.0.
Alkaline	Substance with a pH greater than 7.0; the higher the pH the greater the corrosive ability of the substance.
Amenity	The desirability of an area.
Amphibians	Animals (such as frogs) adapted to live on land and in water but where breeding and development into an adult is dependent on water.
Aquifer	A water-bearing layer of sediment or rock.
Background	The conditions (e.g. noise levels, bird populations) already present in an area before the commencement of a specific activity (e.g. a mining operation).
Best Practice	A process, technique, or use of technology or equipment that has a proven record of success.
Biodiversity	The diversity of different species of plants, animals and microorganisms, including the genes they contain, in the ecosystem of which they are part.
Blasting	Detonation of explosive charge in a mine to assist in the removal of hard rock.
Bore	A well, usually with a diameter less than 20 cm, sunk into the ground and from which water is pumped.
Bund	An earth, rock, or concrete embankment constructed to prevent the inflow or outflow of liquids, the transmission of noise or the movement of vehicles/machinery for safety reasons.
Catchment	The entire land area from which water (e.g. rainfall) drains to a specific water course or water body.
Clay	A discrete group of minerals, belonging to the layered silicate group of less than 2 microns in diameter.
Concentrate (ore)	Product produced by metal ore mines.
Concentration	The amount of a substance per unit of mass or volume of the medium in which it occurs.
Conservative	A prediction, assumption, or measurement that errs on the side of caution.
Contractor	Specialist brought in to perform a specific task, such as the construction of mine infrastructure or the excavation (mining) of the open pit.
Cross Section	A two-dimensional diagram of an object presented as if the object had been cut across its length.
Crusher	Component of an ore-processing plant where ore is mechanically crushed into smaller pieces.
Density	The mass of a substance divided by its volume.
Deposition	The laying down of particulate material.
Drawdown	A reduction in water level and/or pressure level in an aquifer as a result of ground water extractions.
Drilling	The action of boring holes (usually less than 30 cm in diameter and up to several hundred metres deep) into the ground, typically to establish water bores or to investigate the geology found at depth.

Term	Expansion/Definition
Ecosystem	An interacting system of animals, plants, other organisms and non-living parts of the environment.
Emission	A discharge of a substance (e.g. dust) into the environment.
Environment	A general term for all the conditions (physical, chemical, biological and social) in which an organism or group of organisms (including human beings) exists.
Ephemeral	Not permanent, e.g. a stream that only flows seasonally or after rainfall or a lake that periodically dries out.
Erosion	The wearing away of the land surface (whether natural or artificial) by the action of water, wind and ice.
Excavator	Machine used to excavate holes and move soil, earth, or rocks.
Exothermic	Cold blooded animal requiring an external heat source to regulate its internal temperature.
Fauna	A general term for animals (birds, reptiles, marsupials, fish etc.).
Feasibility Study	A preliminary technical and economic study to assess the viability of a project.
Feed	Material being fed into a process.
Flocculant	A chemical used to cause flocculation.
Flocculation	The process where a colloid comes out of suspension and can then be separated from the liquid.
Flora	A general term for plants.
Foraging	Searching for food over a wide area.
Formation	A large stratigraphic sequence of rock beds (such as sandstone, shale, limestone, etc.) generally deposited over a distinct geological period (e.g. during a glacial period).
Galena	A grey mineral, principally lead sulphide, which is the chief ore of lead.
Gangue	Commercially worthless or uneconomic material associated with a wanted mineral (e.g. ore).
Grade	The concentration of ore (e.g. iron ore) either in an individual rock sample or averaged over a specified volume of rock.
Grader	Machine used to smooth a soil or rock surface.
Gradient	Rate of change of a given variable (such as temperature or elevation) with distance.
Greenhouse Gases	Carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons.
Ground Vibration	Vibration transmitted through the ground due to machinery and equipment use or blasting.
Groundwater	All water occurring below the land surface.
Habitat	The particular local environment occupied by an organism.
Haul Trucks	Heavy vehicles used for the transportation of ore or waste rock.
Hydrology	The study of surface water, particularly its movement in streams, rivers.
Hydrogeology	The study of the distribution and movement of groundwater in soil and rocks.
Infrastructure	The supporting installations and services that supply the needs of a project.
Introduced	Introduced to a particular environment; exotic.
Invertebrates	Commonly, animals without a backbone (jellyfish, worms, molluscs, etc.).
Irrigation	The artificial flooding of agricultural land to promote cultivation.
Landform	A specific feature of a landscape (such as a hill) or the general shape of the land.

Term	Expansion/Definition
Leach	Dissolution and removal of a soluble substance from a soil or a rock, e.g. the leaching of salt (by water) from a soil or the leaching of gold (by cyanide) from a rock.
Metallurgical	Pertaining to metals, particularly their extraction from ore.
Mineralisation	The occurrence of metals or ore-bearing minerals within a rock sequence.
Model	A mathematical simulation of a natural or artificial system used to predict how the system will change with time, particularly where external changes have been imposed upon it (such as from mining operations).
Monitoring	Systematic sampling and analysis to record changes over time.
Native	Belonging to, or found naturally, in a particular environment.
Natural	Existing in, or formed by, nature.
Neutral	Neither acidic nor basic (e.g. a pH equal to 7.0).
Nominal	Very small or insignificant.
Nutrients	Generally refers to nitrogen and phosphorus, which are essential for biological growth.
Open Cut Pit	Large hole excavated in an open cut mining operation to remove the ore.
Operational Phase	The period of the mining project during which pit excavation and ore extraction takes place.
Operations	Mining and ore processing activities.
Ore	A mineral or mixture of minerals containing a metal in sufficient amounts for its extraction to be profitable.
Ore Processing	The mechanical and chemical process by which a metal is extracted from an ore.
Ore Body	A solid mass of ore that is geologically distinct from the rock that surrounds it and that is commercially extractable.
Overburden	Material that overlies a deposit of ore.
Oxidation	The process by which an element or compound undergoes a chemical reaction involving the removal of electrons; often involves a reaction with oxygen to form an oxide (e.g. the rusting of iron).
Passive	Performing a function without electrical or mechanical action or movement.
Perimeter	Outer boundary.
Permeability	The ability of a rock or soil to allow fluid to pass through it.
Pit	See open cut pit.
Pit Water	Water inflow into the pit from incident rainfall or groundwater seepage from pit walls.
Pod	Ore body within the SMPL tenements.
Potable Water	Water of quality suitable for human consumption.
Precipitation	In meteorology, precipitation is any product of the condensation of atmospheric water vapour that falls under gravity i.e. rain, hail and snow. In chemistry, precipitation is the process of changing from a dissolved compound into a solid, insoluble compound.
Progressive Rehabilitation	Rehabilitation of mined or disturbed areas as soon as practicable during the life of the mine.
Rainfall Event	Period of rainfall.
Receptor	Humans, flora or fauna which may be impacted or a designated place at which impact may occur (e.g. a dwelling).
Recharge	The addition of water to an aquifer, directly from the surface, indirectly from the unsaturated zone or by discharge from overlying or underlying aquifer systems.

Term	Expansion/Definition
Rehabilitation	The restoration of a landscape and especially the vegetation following its disturbance.
Reptiles	Exothermic vertebrates, including lizards, snakes, turtles, and crocodiles.
Residual Impacts	Impacts from an activity (e.g. mining) that remain after mitigation measures are applied.
Resource	Minerals in the ground, but not necessarily commercially extractable.
Richness (of fauna or flora)	A measure of the number of species in a given area or assemblage.
ROM pad	The stockpile of freshly mined ore used to feed the mill and process plant.
Rotabox	A container system with lockable lids which utilises a crane operated rotating tipping system for transferring product into ships holds.
Runoff	The portion of precipitation that flows from a specific area as surface water.
Scree	Small, loose rocks that gather on a slope and often at the bases of cliffs.
Seepage	The subsurface movement of fluid or the emergence of a subsurface flow at the ground surface.
Sequence (geological)	Layers of (predominantly) sedimentary rocks sourced from a common geological environment or period.
Slurry	Mixture of fluid and solid.
Species	A taxonomic grouping of organisms which are able to interbreed with each other but not with members of other species.
Sphalerite	A mineral of zinc sulphide which is the chief ore of zinc.
Stockpile	A pile used to store material (such as topsoil) for future use.
Stockpiled	Stored in a stockpile.
Storage Capacity	The maximum volume of liquid able to be retained in a structure or container (e.g. the tailings storage facility).
Stripping	Removal of vegetation, topsoil, growth media and subsoil.
Stygofauna	Subterranean fauna are primarily invertebrate species that inhabit caves and the many small voids and tunnels that occur within some unconsolidated and rocky substrates; species living within the saturated zone below the water table are called stygofauna.
Substrate	An underlying layer.
Supernatant	Liquid lying above solids formed as a result of sedimentation or precipitation.
Sump	Pit sunk to collect water.
Surface Water	Water flowing over, or contained on, a landscape (e.g. runoff, streams, lakes).
Suspended Solids	Solids held in suspension by the turbulent flow of a fluid.
Tailings	By-product of the metal extraction process consisting of crushed rock from which the metal or ore minerals have been extracted and a liquid fraction or portion composed of water and residual chemicals used in the extraction process.
Topography	Physical relief and contour gradient of a region.
Topsoil	Upper layer of soil, usually containing more organic material and nutrients than the material beneath it.
Troglofauna	Subterranean fauna are primarily invertebrate species that inhabit caves and the many small voids and tunnels that occur within some unconsolidated and rocky substrates; species living above the water table are referred to as troglofauna.
Variable	Not constant, subject to change.
Velocity	Speed in a given direction.
Volant	Flying or capable of flying.

Term	Expansion/Definition
Waste Rock	Uneconomic rock extracted from the ground during a mining operation to gain access to the ore.
Water Balance	The sum of the inputs and outputs and changes in storage levels of water in a given locality.
Water Quality	Degree of the lack of contamination of water.
Water Table	The surface of the groundwater, below which soil and rock are saturated.
Watercourse	Stream or river, running water.
Weathering	The in-situ physical disintegration and chemical decomposition of materials at or near the earth's surface.
Weed	Any plant, most commonly non-indigenous or endemic to the area, that survives in an area where it is harmful or troublesome to the desired land use.
Wetland	A low-lying area regularly inundated or permanently covered by shallow water.
Wind Erosion	Weathering of exposed soil, earth, or rock surfaces by the abrasive action of wind-blown particles (e.g. grains of sand).

11 REFERENCES

APM. (2009). Ridges Iron Ore Project: *Wyndham Port Biological Assessment*. Biological Assessment Survey undertaken for Kimberley Metals Group Pty Ltd.

Australian Government. (2011). *Australian Natural Resources Atlas*. Available Online <http://www.anra.gov.au/topics/vegetation/extent/wa/ibra-victoria-bonaparte.html> (Accessed August 2011).

Australia's Virtual Herbarium (2012) *Australia's Virtual Herbarium.* Available http://www.anbg.gov.au/chah/avh/avh.html > (Acccessed June 2012)

Beard, J.S. (1975). *Pilbara*. Explanatory Notes to Sheet 5 Vegetation Survey of Western Australia 1: 1,000,000 series. University of W.A. Press, Nedlands.

Beard, J.S. (1979). *Vegetation Survey of Western Australia - Kimberley: 1:1,000,000 Vegetation Series Map and Explanatory Notes*, University of W.A. Press, Perth.

Brazill-Boast, J., Pryke S.,R. and Griffith, S.,C. (2010). Nest-site utilisation and niche overlap in two sympatric, cavity-nesting finches. *Emu* **110**: 170-177.

BoM (2010) Kimberley Research Station Climate Data Site Number 002014 http://www.bom.gov.au/climate/averages/tables/cw_002038.shtml. Accessed August 2010

CGL (2011) Annual Environment Report for Wyndham Port

CSIRO (2000). Floodplain Management in Australia – Best Practice Principles and Guidelines, CSIRO Publishing, Collingwood.

Department of Agriculture and Food. (2009). *Rangeland Land System Mapping for Western Australia* dataset.

Department of Parks and Wildlife. (2012). NatureMap: Mapping Western Australia's biodiversity. Available <http://naturemap.dec.wa.gov.au/default.aspx> (Accessed June 2012)

Department of Lands, Planning and Environment. (2000). *Recommendations by the Environment and Heritage division for Ord river irrigation scheme stage 2*. Biodiversity Assessment Report

Department of Sustainability, Environment, Water, Population and Communities. (2011). EPBC Act *Protected Matters Search Tool.* Available Online <http://www.environment.gov.au/epbc/pmst/index.html> (Accessed June 2011).

Ecologia Environmental Consultants (Ecologia) (1997). *Ord Irrigation Area – Stage 2 M2 development area terrestrial biological assessment*. Prepared for the Department of Industry and Resources.

FloraBase (2012) *Western Australian Flora*. Available <http://florabase.dec.wa.gov.au> (Accessed February 2012) Western Australian Herbarium, Department of Environment and Conservation, Perth.

Fox, I. D., Neldner, V. J., Wilson. G.W. and Bannink, P.J. (2001). *The Vegetation of the Australian Tropical Savannas*. Environmental Protection Agency, Brisbane.

Garbrecht, J.D., Van Liew, M. W., and Brown, J. O. (2004). Trends in precipitation, streamflow and ET in the Great Plains. *Journal of Hydrologic Engineering*, **9**(5):360-367.

Government of Western Australia. (2009). *Cane Toad Strategy for Western Australia 2009-2019*. Available at http://www.dec.wa.gov.au/management-and-protection/animals/cane-toads.html

Graham, G. & White, K. (eds). (1999). Discussion document on the proposed conservation areas associated with Ord Stage 2 Development – Kununurra, W.A. (unpublished).

Horner, P. (2007). *Systematics of the snake-eyed skinks*, *Cryptoblepharus Wiegmann* (Reptilia: Squamata: Scincidae) – *an Australian-based review*. The Beagle, Records of the Museums and Art Galleries of the Northern Territory, Supplement **3**: 21–198.

Johnstone, R,.E. & Storr, G.,M. (2004) *Handbook of Western Australian Birds: Volume 2: Passerines* (Blue-winged Pitta to Goldfinch), Western Australian Museum, Perth.

Keighery, B.J. (1994). *Bushland Plant Survey. A guide to plant community survey for the community*. Wildflower Society (Inc.), Western Australia.

Kimberley Toadbusters. (2011). Kimberley Toadbusters Distribution Map. Available at http://www.canetoads.com.au/googmap.htm. Accessed January 2012.

(Kinhill) (2000). *Ord River Irrigation Area Stage 2 – Proposed Development of the M2 Area, Environmental Review and Management Program/Draft Environmental Impact Statement* prepared for Wesfarmers Sugar Company Pty Ltd, Marubeni Corporation and Water Corporation of Western Australia, January 2000.

McDonald, R.,C., Isbell, R.,F. (2009). *Soil Profile*. In Australian Soil and Land Survey Field Handbook. 3rd edition. CSIRO Publishing, Melbourne.

McKenzie, N.L., Start, A.N., Burbidge, A.A., Kenneally, K.F. and Burrows, N.D. (2009). *Protecting the Kimberley; a synthesis of scientific knowledge to support conservation management in the Kimberley region of Western Australia. Part B: Terrestrial environments*. Department of Environment and Conservation.

Moro, D. (2001). Evaluation and cost-benefits of controlling house mice (*Mus domesticus)* on islands: an example from Thevenard Island, Western Australia. *Biological Conservation* **99**: 355 – 364.

Neuhasuser, E.F., R.C. Loehr & M.R. Malecki. (1986). *Contact and artificial soil tests using earthworms to evaluate the impacts of wastes in soil*. In Hazardous and industrial solid waste tesing: fouth symposium, ASTM STP 886. J.K. Petros, Jr., W.J. Lacy and R.A. Conway, eds. American Society forTesting and Materials, Philadelphia, PA. Pp. 192-203.

Phillips, B.,L., Brown, G.,P., Greenlees, M., Webb, J.,K. & Shine, R. (2007). Rapid expansion of the cane toad (*Bufo marinus*) invasion front in tropical Australia, *Austral Ecology*, **32**: 169–176.

Pilbara Flora (2010) *Flora and Vegetation Survey of Ord Stage 2 Agricultural Areas at Kununurra*. Flora and Vegetation Survey undertaken for Strategen Environmental Consultants Pty Ltd.

SEWPaC (2011) *Australia's Bioregions: Interim Biological Regionalisation of Australia (IBRA) 6.1.* Available <http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html> (Accessed July 2011).

Shedley, E. (2012) *Ord Irrigation Area Fauna Habitat Mapping Project. Assessment and mapping of suitable habitat for four threatened fauna species (Northern crested Shrike-tit, Red Goshawk, Gouldian Finch and Northern Quoll*. Department of Environment and Conservation, Kununurra.

Soil Water Consultants. (2012). Memo: Sorby Hills Pit Lake Water Balance and Water Quality Evolution. Prepared for Kimberley Metals Ltd.

Stratagen. (2011). *Ord River Irrigation Area Weaber Plain Development Project Draft; Environmental Impact Statement*. Landcorp. Available at www.dsd.wa.gov.au/documents/ORIA_Weaber_Plain_EIS.pdf

Tidemann, S.,C., J., Boyden, R., Elvish, J., Elvish & B., O'Gorman (1992). Comparison of the breeding sites and habitat of two hole-nesting estridid finches, one endangered, in northern Australia. *Journal of Tropical Ecology* **8**:373-388.

Tidemann, S.,C. & J.,C.,Z. Woinarski (1994). Moult characteristics and breeding seasons of Gouldian *Erythrura gouldiae*, Masked *Poephila personata* and Long-tailed Finches *P. acuticauda* in savannah woodland in the Northern Territory. *Emu* **94**:46--52.

Tidemann, S., C., Lawson, C., Elvish, R., Boyden, J. and Elvish, J. (1999). Breeding biology of the Gouldian finch *Erythrura gouldiae*, an endangered finch of northern Australia. *Emu* **99**: 191-199.

Tracey, J., Bomford, M., Hart, Q., Saunders, G. and Sinclair, R. (2007). *Managing Bird Damage to Fruit and Other Horticultural Crops*. Bureau of Rural Sciences, Canberra.

Tyler, M.J. (1997). *The Action Plan for Australian Frogs*. Environment Australia, Canberra.

Wilson, B.A., Brocklehurst, P.S., Clark, M.J. and Dickinson, K.J.M. (1990). *Vegetation Survey of the Northern Territory - Technical Report No. 49*, Conservation Commission of the Northern Territory, Darwin.

Wolanski, E., Spagnol, S. and Williams, D. (2004). The impact of damming the Ord River on the fine sediment budget in Cambridge Gulf, North Western Australia. *Journal of Coastal Research* **20**: 801-807.