WAROONA MINERAL SANDS PROJECT

PUBLIC ENVIRONMENTAL REVIEW

ILUKA

October 2005

INVITATION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

Iluka Resources Limited proposes to develop an open cut mineral sands mine, located approximately 1km north of the township of Waroona. The mine will include the construction of: 3 mine pits, solar drying dams, ore concentrator, upgrade to Peel Road and it's intersection with South West Highway and associated mine infrastructure. The life of the project is expected to be approximately 4 years.

In accordance with the Environmental Protection Act, a PER has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a **public review period of 4 weeks from Monday 31 October 2005, closing on Monday 28 November 2005**.

Comments from government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to government. If you are able to, the EPA would welcome electronic submissions in particular, emailed to the project assessment officer or via the EPA's Website (see address below).

Where to get copies of this document:

Printed copies of this document may be obtained from **Iluka Resources reception, Level 23, 140 St Georges Terrace, Perth WA 6000** at a cost of **$10**.

Copies may also be obtained from www.iluka.com

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in each report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name,
- address,
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: **Monday 28 November 2005**

The EPA prefers submissions to be sent in electronically. You can either e-mail the submission to the project officer at the following address:

nyomi.bowers@environment.wa.gov.au

OR

use the submission form on the EPA's website:

www.epa.wa.gov.au/submissions.asp and click on the EIA Assessment Submission option

OR

if you do not have access to e-mail then please post your submission to:

The Chairman
Environmental Protection Authority
PO Box K822
PERTH WA 6842

Attention: Nyomi Bowers

EXECUTIVE SUMMARY

Iluka Resources Limited (Iluka) proposes to establish a mineral sands mine 1 km north of the town of Waroona, approximately 140 km south of Perth. The Waroona Project is being developed to continue Iluka's existing mining and processing of titanium minerals and zircon. Under this project an existing concentrator will move from the Capel region to Waroona for four years to process ore from the Waroona mine. The Waroona orebody contains suitable quality material to process within the existing capacities of the Capel processing plant. This will allow continuation of titanium mineral and zircon production and supply to the market, with the associated economic benefits of this activity.

Project Description

Pre-production activities are proposed to commence in the 2nd quarter 2006, with production beginning in the 3rd quarter 2006 continuing for four years. Decommissioning and final rehabilitation will take a further three years.

Three pits will be mined progressively by dry mining techniques utilising a combination of scrapers, front end loaders, excavators and haul trucks. Ore will be fed to the screenplant and supplied as slurry to the concentrator. The concentrator will operate at a nominal 300 tonnes per hour ore throughput. Mining will occur during dayshift only, with the screenplant and concentrator operating continuously.

Heavy Mineral Concentrate (HMC) will be transported by road and treated at the existing Capel processing plant. Solar drying dams will be created on backfilled pits to dry the clay tails. Additional solar drying dam space is required off the mining path to provide sufficient drying area. Each pit will be backfilled with overburden on completion of mining. Pits will be progressively rehabilitated following mining, tailings and backfilling schedules.

The concentrator and screen plant will be located at the end of Peel Road. Workshops, fuel storage, raw water dam, offices and other infrastructure will be located in close proximity to the concentrator. The infrastructure has been placed to minimise visual impact and noise levels. The key characteristics of the proposal are outlined in the following table.

Characteristic	Description
MINE	
Life of Mine (Mine Production)	4 years
Size of Ore Body	10.8 million tonnes
Area of Disturbance	184 ha
Vegetation Disturbance	21.2 ha
Hours of Operation	7am – 7pm, Monday to Saturday
PROCESSING	
Equipment	Mining Unit
	Concentrator
Nominal Processing Rate	300 tonnes per hour
Hours of Operation	24 hours day, 7 days week

Characteristic	Description
Heavy Mineral Concentrate production	245,000 tonnes per year
OTHER	
Water Supply Sources	Superficial - 300 ML per year
	Purchased - 2000 ML per year
HMC Transport	126 return trucks (252 total journeys) per week

The mine will be staffed with approximately 20 on-site Iluka personnel and 40 earthmoving contractors. Administration, mine planning, mine geology, surveying, metallurgy, environmental and laboratory requirements will be supported by the existing Southwest operations.

Existing Environment

The Waroona Project Area is located on the eastern side of South West Highway, adjacent to the northern boundary of the township of Waroona. It is situated on the Swan Coastal Plain, which is bound by the present coastline to the west and the Darling Scarp to the east. The Darling Scarp is a fault scarp that defines the contact between the down-thrown Perth Basin and Archaean crystalline rocks of the Yilgarn Shield to the east.

The immediate surroundings of the Project Area have been largely cleared for agriculture. The existing residential development of the town of Waroona is adjacent to the southern boundary of the Project Area. Waroona is a community of approximately 2,300 people.

The Project Area is mainly private property owned by Iluka. There are several road reserves and a Crown Reserve within the Project Area. The Crown Reserve (No. 16307) is vested in the Shire of Waroona and is a disused amateur Speedway. Two small sections of the Project Area are on two other landowners property. Access agreements are being developed with these landowners.

Remaining vegetation along the eastern boundary is representative of the mosaic that comprises the Darling Scarp complex. Vegetation elements of the Guildford Complex exist on the flatter land of the Pinjarra Plain. Sandwiched between this and the Darling Scarp, on the Ridge Hill Shelf, is the remaining vegetation from the Forrestfield Complex.

The remnant vegetation consists of isolated vegetated remnants of which many are in poor condition as a result of grazing. The majority of the Project Area is cleared for agriculture with isolated trees remaining in paddocks. Areas of vegetation at sites 8, 9 and 16 were identified as very good condition on the Bush Forever Scale. These have similarities with Threatened Ecological Community (TEC) type 3b and 20b. CALM reviewed the vegetation studies and consider the vegetation TEC type 20b. In addition, these areas are part of the Forrestfield Complex and therefore have regional significance as less than 17.5% of the original area of Forrestfield Complex vegetation remains. In either case the better condition vegetation at these sites warrants consideration of the conservation values they represent.

No Declared Rare Flora were located in the Project Area. One Priority 3 species was identified in the Project Area. The closest Threatened Ecological Community is located 2 km northwest of the Project Area.

The extent of clearing and degraded nature of the vegetation limits the diversity and habitats suitable for native fauna. The scattered nature of remnant vegetation in the study area provides poor vegetation linkage between habitats. Large areas of land adjacent to the site on the Darling Plateau are likely to provide more significant fauna habitats than those present in the Project Area. One threatened species, Baudin's Black Cockatoo (flying over and feeding within the Project Area) and 2 priority species; the Quenda (evidence of activity near speedway) and the Forest Red-tailed Black Cockatoo (flying over and feeding within the Project Area) have been identified as using the Project Area during a recent survey. No fauna species rely exclusively on the native vegetation within the Project Area for habitat.

The Project Area is located within the south-east portion of the Waroona Sub-area of the Murray Groundwater Area. The major aquifer zones that occur locally are limited to the Yoganup Formation and the deeper sedimentary deposits of the Perth Basin. The Archaean bedrock that forms the Yilgarn Shield does not form significant aquifers nor does it contain significant groundwater resources.

The aquifer systems underlying the Project Area consist of the Superficial Aquifer, found within the Yoganup Formations (extending to 30 m depth), Leederville Aquifer (commencing from 10 – 30m to approximately 130 m); and Cattamarra Coal Measures (below 130 m depth).

Three watercourses; Nanga Brook, Ferraro Brook and Wealand Brook originate within the hinterland of the Darling Scarp and traverse the Project Area flowing westwards. There is minimal vegetation or ecological values along these watercourses due to clearing and grazing. They provide a water source for stock and gardens, and some aesthetic value for landowners. Social water users and uses along the brooks have been identified. Along the western boundary of the Project Area is a surface drainage expression referred to as Mullins Sumpland. This sumpland is thought to have appeared as a response to agricultural clearing. A drain has been installed by the landowner draining water to Nanga Brook. The sumpland has no ecological attributes.

Community Consultation

The Project Area is within close proximity to numerous residents north of the Waroona township. A detailed and comprehensive program of consultation has been undertaken since 2003.

Consultation sessions were conducted with a range of government agencies, community groups and individuals interested in, or affected by, the Waroona Project. Several community updates (newsletters) have been distributed to residents within the vicinity of the project and to other non-local stakeholders. Copies are also left at the Waroona Shire for interested residents. These provide an update of the mine planning, approvals process and Iluka's operations. The wide circulation of these updates has increased the knowledge of the project and has been integral to the identification of stakeholders.

The consultation conducted has allowed individuals, groups and agencies that will potentially be affected by the proposal to have their interests considered during the environmental impact assessment process. This ensures that issues raised are addressed both in this environmental review and following the implementation of the proposal.

Issues raised include noise, dust, local employment, community support, groundwater drawdown and post-mining landuse.

The proponent will continue to liaise closely with local authorities and the local community during the construction of the Project and will implement a consultation program which includes regular meetings with landowners in proximity to the mine, and community consultation as issues arise.

Environmental Factors and Management

Iluka has an environment, health and safety management system (EHSMS) in place to provide effective EHS management and continuous improvement in performance at all its mineral sands operations.

A number of environmental factors applicable to the Waroona Project were identified during the Scoping Study which was approved by the EPA. The key environmental factors are briefly outlined and summarised below. Table A summarises all the environmental factors identified during the preparation of the PER and addressed in this document.

Noise

Mining will only be conducted during day time hours (7am – 7pm) excluding Sundays. Processing will be conducted on a continuous basis 24 hours per day, 7 days per week. There are numerous residences surrounding the Project Area, with the majority on the south side of the Project. An acoustic model has been applied to predict sound pressure levels (SPL) at surrounding residences. The characteristics of the proposed equipment and their respective locations have been incorporated into the model, together with the topography of the surrounding area, to predict the environmental noise impact of the development. The eight cardinal wind directions have been modelled combined with the meteorological conditions likely to generate the highest noise levels for temperature, humidity, inversion and wind speed. These represent 'worst–case' conditions. The concentrator and screen plant are modelled operating from their proposed location. The mobile machinery is modelled operating under eight mining locations.

The SPL at the surrounding residences under the eight wind directions is predicted for each of eight different day time mining locations. Night time noise of the concentrator and screenplant is also modelled under the eight wind directions. The modelling shows that during the day time the noise limit of 45 dB(A) can be met under the majority of weather conditions and mining locations. Noise monitoring will detect the occasions when noise is likely to exceed the noise limit. During these periods, selected items of operating machinery will be relocated or shut down.

Night time noise is highest in a south-easterly wind direction with maximum noise levels of 42 dB(A). Further attenuation of the concentrator and screen plant will be undertaken and stockpiles utilised as noise bunds around the processing area in order to meet regulations.

All equipment, fixed and mobile, will be tested on commencement of operations. Noise will be monitored during the construction and initial mining phases. Weather conditions will be continuously monitored at the plant site. Noise will be monitored at several residential locations surrounding the Project Area.

Construction work will be conducted in accordance with Regulation 13 (Construction Sites) of the *Environmental Protection (Noise) Regulations 1997*. Construction mining activities will take place during day time only. Some activities may be conducted at the plant site during night time.

A noise management plan will be developed to enable monitoring and management during construction and mining operations. The noise modelling conducted to date shows that limits can be reached with the construction of bunds, attenuation of machinery noise and limiting machinery hours. The implementation of the Noise Management Plan will ensure Iluka complies with all legislative requirements relating to noise.

Dust

Baseline dust monitoring has been conducted at Waroona since September 2004. Monthly total insoluble dust levels have ranged from 0.2 to 2.3 $g/m^2/mth$ with an average of 0.81 $g/m^2/mth$. Particulate concentrations at the proposed mine locations are not available, however, background TSP and PM_{10} levels are available for nearby Wagerup as collected by Alcoa. These are considered to be representative of the area.

In order to ascertain the impact of fugitive sources due to wind erosion and operations at nearby sensitive receptors, the dispersion modelling system Calmet/Calpuff was used. Modelling of dust emissions from the site incorporates weather conditions, land use and roughness, mine plan data, operational activities, emission equations and background TSP and PM_{10} particle size distributions. Background 24-hour values of PM_{10} and TSP have been incorporated by using the 90^{th} percentile background concentrations of 21.8 and 26.5 $\mu g/m^3$ as determined at Wagerup. The 90^{th} percentile background concentration is considered a conservative measure.

Analysis of the conditions that lead to the highest concentrations offsite indicate that concentrations to the west north west are due to strong easterly winds in summer and wind erosion. The higher concentrations to the south are due to operational activities associated with moving the overburden and ore.

Modelled dust levels are shown to exceed both the TSP and PM_{10} limits at several residential locations. It should be noted that the modelling is indicative only and incorporates the limitations and assumptions that underlie the various particulate emissions rates. The model also incorporates conservative assumptions regarding the location of mining and the existing ambient dust levels. As such the results of the modelling highlight the need for a comprehensive dust management plan including feedback mechanisms and monitoring to ensure dust impacts are minimised.

Iluka will develop and implement a dust management plan involving standard practices to manage particulate emissions such that they do not cause environmental or human health problems. Dust control measures will include:

- minimising clearing and open area;
- not disturbing topsoil until required;
- regular watering and grading of roads;
- using biodegradable chemical suppressants;
- growing of temporary crops to bind soil & lift wind from surface;
- re-establishment of pasture as soon as possible after mining has been completed;
- using sprinkler systems and oversize material where appropriate;

- high wind warning system in summer to enable site to increase control mechanisms ahead of event; and
- sealing roads if deemed necessary.

To ensure continuous improvement is achieved, regular reviews of monitoring will be conducted and investigations of high results conducted and corrective actions will be implemented. Regular communications will be held with adjacent landowners and a complaints management system, including investigation, action and feedback, implemented.

Dust will be managed and monitored during operations. With the above mitigation techniques in place, there will be no adverse impacts from dust on environmental values or the health, welfare and amenity of people and land uses.

Vegetation, Fauna, Rehabilitation and Biodiversity

184 ha of land will be disturbed by the operation. This includes 12.6 ha of remnant native vegetation and 8.6 ha of planted native and non-native trees. The Project Area and surrounding areas have been extensively cleared for agricultural purposes. The majority of the remaining vegetation is degraded with little understorey species as a result of stock grazing. The small area (<0.5 ha) of very good condition vegetation at Site 16 will be impacted by clearing. Approximately 0.8 ha of Site 8 which also contains very good condition vegetation will also be impacted by clearing. No Declared Rare Flora or Priority Flora will be affected as a result of the Project.

The clearing of vegetation around the speedway will impact on any Quenda living in the area. The Quenda occurs widely in the Southwest of WA and despite declining greatly due to land clearing and fox predation, remains common. The clearing of the 2.9 ha area surrounding the speedway is unlikely to have an impact on the species generally (GHD, 2004). Similarly, other fauna present at the Speedway site do not rely exclusively on this area, so clearing will have minimal impact on populations. Attempts will be made to capture and relocate any Quenda to other areas onsite prior to mining with input from CALM.

Clearing associated with the project will also impact on the Marri trees used as food sources of Baudin's and Forest Red-tailed Black Cockatoos, and the hollows used by the Common Brushtail Possum. These impacts will be mitigated by the through utilising the seed from cleared feeding tress in the rehabilitation and mitigation works in areas that will be protected by conservation covenants and a trapping and relocation program for the possums. Trees will be inspected for evidence of cockatoo breeding prior to clearing taking place.

The fauna survey of the area found that the site has a low specific fauna value as it has disjointed isolated patches of land in a fragmented landscape. There will be minimal impacts on fauna as a result of the Waroona project.

The Forrestfield Complex is below 30% of the pre-settlement area and therefore this native vegetation has regional significance. In addition, the 0.5 ha of high condition vegetation at Site 16 and the area of 0.8 ha to be cleared at Site 8 contains flora that corresponds to the 3b or 20b TEC type.

Vegetation Mitigation Plan

Due to the regional significance of Sites 8 and 16 and the Forrestfield Complex, alternative mechanisms must be developed to address the impact on conservation values and the protection of biodiversity as required by element five of the EPA Position Statement for the Environmental Protection of Native Vegetation. These mechanisms have been developed broadly in line with the EPA Preliminary Version 2 Position Statement 9 – Environmental Offsets.

Improvements for and protection of vegetation remaining in the Project Area is proposed. The following mitigation sequence has been utilised:

1. Avoid – The proposal has been designed as far as possible to be constructed on cleared agricultural land. The clearing footprint of the northern mine pit has been modified to avoid the clearing of the majority of the potential TEC area at Site 8 and the original proposed location of the water dam moved from Ferraro Brook.

2. Minimise – Where clearing is unavoidable, infrastructure will be concentrated within designated cleared areas, e.g. the two crossings across Ferraro Brook. Access by employees and the public to vegetation at the site will also be restricted.

3. Rectify –The disturbed area will be rehabilitated following mining. Trial translocation of understorey flora from the Speedway site to the Sandslope will be conducted.

4. Reduce – adverse impacts are rectified as soon as possible. The impact will be eliminated following mining.

5. Offset – The enhancement and re-establishment of native vegetation at the site is outlined below.

Proposed offsets for vegetation clearing

Feature	Actions	Outcomes
Ferraro Brook and surrounds	Fence 50 m buffer area around Ferraro Brook to prevent stock access (total of 21.5 ha). Fence 5.5 ha of Guildford complex to the North of Ferraro Brook on Lot 265. Fence 1 ha of area between Site 9 and Ferraro Brook buffer area. Undertake weed control program in these areas. Infill plant the Brook with native riparian species. Infill plant areas either side of Ferraro brook with native upland species. Link Ferraro Brook to native vegetation blocks. Place CALM conservation covenant(s) on the Ferraro Brook area potentially for use as public open space.	Improve vegetation condition and diversity compared to pre-mining state in the brook and surrounds. Better vegetation linkages along Ferraro Brook and to native vegetation higher in the landscape and on Darling Scarp. Increased long term viability for values associated with the Brook. Increased protection for the vegetation in the brook area through protection by covenants.
Forrestfield and	Fence 14 ha Forrestfield block on Lot	Improve vegetation condition and

Feature	Actions	Outcomes
Darling complex vegetation blocks	478. Fence 45 ha Darling Scarp block on Lots 265 and 513 adjacent State Forest 14. Fence 17 ha Forrestfield block on Lot 513. Infill plant native species on all three blocks. Place CALM conservation covenants on these blocks allowing housing envelopes	diversity compared to pre-mining state. Better linkages between scarp and upland vegetation and Ferraro Brook. Increase in 50% of current Forrestfield complex vegetation in secure tenure. Increase in the area of Darling complex vegetation in secure tenure. Protection for Priority 3 DRF located on Lot 478. Protection of Darling Scarp vegetation in good condition on Lot 478.
Sandslope – Site 8 and 9	Fence 4 ha of the Forrestfield vegetation/potential TEC at Site 9 on Lot 283. Fence 2.9 ha of the Forrestfield vegetation/potential TEC at Site 8 on Lot 283. Infill plant a 20 m vegetation buffer around both sites where possible using upland species. Fence and infill plant native vegetation to connect these areas to Ferraro Brook. Trial translocation of understorey flora from the Speedway site. Place CALM conservation covenants on these two areas that prevent development or stocking.	Improved protection and management of the two areas. Improved vegetation condition and diversity compared to pre-mining state, with protection from weed invasions through buffer areas Increase in 8% of current Forrestfield complex vegetation in secure tenure. Protection of 6.9 ha of potential type 20b TEC offsetting the clearing of Site 16. Retention of flora associated with the Speedway site. Better linkages between the TECs and Ferraro Brook.
Mullins Sumpland	Reinstate soil profile at Mullins sumpland	Replace wetland values of Mullins sumpland

As part of the Vegetation Mitigation Plan a total area of 111 hectares including the Sandslope (Sites 8 and 9), Ferraro Brook and surrounds and three other vegetation blocks will be fenced to prevent stock access. Infill planting of local, native species and weed control will be conducted. CALM conservation covenants will be placed over these areas. A trial will be conducted translocating understorey flora from the Speedway site to the Sandslope area.

As an indication, the three Darling Scarp complex areas will allow development of building envelopes, with stocking or other clearing being restricted. The covenants placed over Sites 8 and 9 will prevent development, clearing or stocking within these areas. The Ferraro Brook area will be managed for uses including public open space and protected from clearing and stocking.

Buffers will be placed around Sites 8 and 9 to reduce the potential for weed invasion. These will be 20 m buffers and will be revegetated with species representative of the TEC type 20b.

The Proponent believes that the scale and location of the offsets contained within the Vegetation Mitigation Plan will have a significant benefit for local and regional conservation

outcomes. The area ofForrestfield complex vegetation that will be fenced, infill planted and receive protection by the placement of conservation covenants will increase the representation of this complex within secure tenure from 61 ha to 97 ha, an increase of 58%. This area protected will include 6.9 ha of the regionally significant Sandslope (Site 8 and 9) area that CALM considers representative of the type 20b TEC. The protection of Sites 8 and 9 and the management works that will be undertaken mean that a greater than "like for like" offset is being proposed. Fencing and infill planting of Ferraro Brook and widening of the vegetation corridor either side of the brook (21 ha area total) will have a major benefit in terms of both connectivity and viability for the values associated with the Brook. Replacing the wetland values represented by Mullins Sumpland will be incorporated into the closure plan for the mine.

Completion of the Waroona Project will allow for future growth of the Waroona township. The Shire of Waroona have initiated a planning study for a large area north of Waroona that includes the Iluka Project Area. The study purpose is to guide landuse and provide a long term plan for the area post-mining. The Shire Planning Study will allow Iluka to place roads and fences in a layout suitable to the future zoning of the area. Infrastructure such as power and water supplies may be able to be left in place, providing an asset to the community post-mining. Any future development of the area will require separate environmental approvals.

Iluka will rehabilitate the disturbed areas to agricultural landuse following mining. The backfilled pits will be contoured to suit the surrounding landscape. Subsoils and topsoils will be replaced and seeded with pasture species.

Groundwater

Groundwater abstraction through dewatering will be minimized to the level required to enable safe dry mining to occur. Abstraction volumes will be measured on a regular basis, compared to the model and reported according to licence requirements. Piezometers surrounding the minesite will continue to be monitored on a regular basis and reported annually.

Studies have been conducted on the impact of mining on the shallow groundwater resources (URS 2000, URS 2002) to characterise the pre-mining hydrology, simulate the mine dewatering schedule and model the groundwater contours during and after mining. Modelling indicates that the abstraction of groundwater over the lifespan of the mining operations will result in a cone of depression underneath the mining pits.

Parts of the mineral reserves to be mined are beneath the water table of the Superficial Aquifer. Therefore, as mining progresses, groundwater will ingress into the pit voids requiring dewatering to enable dry mining to occur. This water will be pumped to the raw water dam for use within the concentrator plant. It is estimated that up to a maximum of 300 ML of groundwater would be abstracted annually.

The modelling shows that groundwater abstraction of less than 1.1 ML/day is required for the majority of the mining area. The remaining mine area will have minimal (less than 0.02 ML/day) or no dewatering requirements. The cone of depression is limited to within the Iluka owned properties. There is no impact from drawdown predicted on neighbouring properties.

Surface Water

Groundwater dewatering will have some impact on groundwater contributions (baseflows) to the streams. In Nanga Brook it is estimated that there will be a reduction in baseflows of up to 35% causing reductions in annual streamflows of less than 1% (URS, 2005).

The Mullins Sumpland will be mined as part of the main pit. Flows from the sumpland contribute approximately 30 – 50% of flows at the confluence with Nanga Brook. Water flows from Mullins Sumpland to Nanga Brook will be substantially reduced by approximately 95% (URS, 2005). One landowner utilises the water from Mullins Sumpland. Alternative water supplies will be discussed with the landowner if required. Nanga Brook changes to a drain west of the highway and flows through two properties before joining Drakesbrook Drain. It is estimated that Nanga Brook provides up to 20% of flows at the confluence with Drakesbrook Drain. The reduction in flows in Nanga Brook is not anticipated to have an impact on social or ecological water users. No reduction in surface water flows in Wealand Brook or Ferraro Brook are anticipated.

Conclusion

The impact assessment shows that the Waroona Project can be conducted without causing significant environmental impacts. Noise modelling indicates the site can operate within noise limits under meteorological conditions likely to generate highest noise levels. Dust will be monitored and managed during operations to ensure emissions are within licence limits. Rehabilitation and restoration programs will improve current ecological values within the Project Area. The implementation of the Waroona Project will result in a net environmental benefit in the catchment.

Mining of the resource removes a planning constraint and allows for the future development of the Waroona township. Consideration of future zoning in closure planning will enable assets to be left for the community. The State and local community will benefit from the generation of employment, local expenditure and royalties resulting from the Project.

Table A: Environmental Factors and Management

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
BIOPHYSICAL					
Vegetation and Flora	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	The majority of the vegetation areas are degraded, lacking any understorey due to historical clearing and grazing. Two areas of vegetation were identified as very good condition on the Bush Forever Scale. These areas have similarities to TEC type 3b and 20b. Within the Project Area one priority species was identified. Several previously recorded TEC's are located 2 km north west of the Project Area.	Mining operations will require 184 ha of disturbance of which 12.6 ha is remnant vegetation and 8.6 ha is planted native and non-native vegetation. Two areas of <0.5 ha site 16 and 0.8 ha at site 8 containing vegetation in very good condition will be cleared. No clearing of identified Priority Species. No indirect impact through groundwater drawdown or surface water flows on the TEC's.	Native vegetation has been avoided where possible, including the modification of the northern mine pit to reduce clearing area. Clearing of native vegetation will be restricted to areas identified. Rehabilitation will include establishment of offsets for clearing, native vegetation corridors, restoration of existing degraded native vegetation and establishment of CALM conservation covenants. Specific measures to minimise impact include: • fencing Ferraro Brook and buffer area, Sites 8 and 9 with buffer areas and the remnant vegetation blocks; • undertake weed control within these areas; • infill plant these areas with native species, including riparian species around the brook and upland species in other areas • trial translocation of understorey flora from the Speedway site; and • placement of appropriate CALM Conservation Covenants over the identified blocks of remnant native vegetation.	Although there will be some loss of vegetation, implementation of proposed mitigation plan will improve the species diversity, condition and protection of vegetation sites, and result in net environmental benefit. The offsets package will replace the good condition vegetation at the site at a greater than 1:1 ratio. No impact on Priority Flora Species.
Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	There is little connectivity between the patches of vegetation within the Project Area. The area has low fauna value. Large areas of land adjacent to the site on the Darling Plateau are likely to provide more significant fauna habitats than those present in the Project Area. No fauna species rely exclusively on the native vegetation within the Project Area for habitat. The Quenda, *Isodon obesulus fasciventer*, a priority 5 species has been noted to be using Site 16 around the speedway. Flocks of Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), a threatened taxa, were observed flying over and feeding within the Project Area. A priority 3 species, Forest Red-tailed Black Cockatoo *(Calyptorhynchus banksii naso)* was also observed feeding within and flying over the Project Area.	Displacement of Quenda using habitat at Site 16 around speedway. Removal of some food resources for Baudin's and Forest Red-tailed Black-cockatoos and tree hollows used by various bird, mammal and reptile species.	Native vegetation has been avoided where possible. Clearing of native vegetation will be restricted to areas identified. The mitigation package includes several measures that will increase the protection of fauna habitat and enhance vegetation corridors between existing vegetation and the Darling Scarp. Specific measures to minimise the impact on fauna include: • preferentially retain trees identified with hollows on site; • inspect those trees within the clearing envelope with hollows for signs of bird nesting; • remove hollows from any suitable cleared trees and use within the rehabilitation and mitigation areas as fauna habitats; • protect Marri trees favoured by Baudin's Cockatoo as food sources from where practicable; • use seed from Marri trees favoured by Baudin's Cockatoo in the Vegetation Mitigation Plan. • prepare and implement a capture and relocation program for Quenda from the Speedway –Site 16 and the Common Brushtail Possum at Site 8.	Although there will be some loss of fauna habitat and food resources, implementation of proposed mitigation strategies will improve protection of fauna habitat and provision of vegetation corridors for native fauna species.

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Landform and Soils	To maintain the integrity, ecological functions and environmental values of the soil and landform.	The soils are associated with the Ridge Hill Shelf geology and subsequently consist of soils belonging to the Forrestfield Soil Associations. The Forrestfield Soil Associations consists primarily of sands and sandy gravels. A baseline investigation for Potential Acid Sulfate Soils (PASS) was conducted. No PASS were identified. Given the topographic, geomorphic, redoximorphic and hydrologic conditions occurring within the Project Area it is unlikely that any PASS will occur within the proposed Waroona minesite.	Disturbance to landforms will occur from the excavation of mining pits. Loss of nutrients and structure of soil horizon/profiles within mining area may occur.	Soil survey and classification of soils into Soil Material Management Units for handling during operations. Topsoils will be stripped and stockpiled for re-use. Mined overburden, clay and sand fines will be used to backfill mining voids to assist in recreating a soil profile similar in composition and structure to pre-mining profiles and landform. Pre-mining and post-mining agricultural productivity surveys will be conducted.	Environmental values, ecological function and integrity of soils are maintained.
Rehabilitation	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.	Refer above to vegetation, flora, fauna and soils and landforms.	Disturbance of some vegetation remnants on agricultural land.	Rehabilitation will restore agricultural systems and productivity. Restoration of degraded native vegetation not affected by mining will be conducted. The Waroona North Structure Plan will define potential post-mining landuse and zoning. Implementation of closure plan.	Reinstatement of landforms that are compatible with surrounding environment. Retainment of facilities that will assist post-mining landuse and zoning.
Biodiversity	To avoid adverse impacts on biological diversity, comprising the different plants and animals and the ecosystems they form at the levels of genetic diversity, species diversity and ecosystem diversity.	The majority of the Project Area has low biodiversity due to the historical grazing and agricultural use of the land. There is little connectivity between vegetation areas within and external to the Project Area.	Mining operations will require 184 ha of disturbance of which 12.6 ha is remnant vegetation and 8.6 ha is planted native and non-native vegetation. Less than 2 ha of this area is rated as in very good condition. This will have a local impact at a flora/fauna level with negligible impact on biodiversity.	Fencing and protection of 111 ha of vegetation. Infill planting of native species along Ferraro Brook and within other vegetation blocks. Trial translocation of vegetation from the Speedway site. Restoration of remnant vegetation will aim to increase the diversity of the vegetation communities. Restoration of Ferraro Brook will aim to increase species diversity and provide bank stability to reduce further erosion. Conservation covenants to protect remnant vegetation.	Restoration activities will extend the pre-mining vegetation cover and will create vegetation corridors assisting the biodiversity within the Project Area. Areas will be protected from clearing by conservation covenants.
Groundwater Systems (Quantity and Quantity)	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected. 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.	The major aquifer zones that occur locally are the superficial aquifer in the Yoganup Formation (<30m), the Leederville aquifer (10-30 – 130m) and the Cattamarra Coal Measures (>130m). Groundwater quality in the superficial aquifer and the shallow Leederville aquifer is fresh to brackish with salinity typically increasing with depth.	Pits will only extend below the water table in a few locations and dewatering volumes are anticipated to be minimal. Dewatering of the pits and abstraction from the superficial aquifer will result in drawdown of the water table. Impact is limited to the Project Area and is not anticipated to impact adjacent vegetation or water users. Potential for spillage of hazardous materials from mine operations results in contamination of groundwater.	Process water purchased from water supplier. Management plan for water resources that includes monitoring and reporting of groundwater levels, water abstraction rates and water usage. Hydrocarbons bunded according to relevant guidelines.	Beneficial uses of groundwater maintained. Groundwater quality will not be adversely affected by mine activities.

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Surface Water Systems (Quality and Quantity)	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected. 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.	The Project Area lies within the Harvey River Basement catchment area. Ferraro Brook traverses the Project Area. Nanga Brook and Wealand Brook are south and north of the Project Area respectively. Several small areas within the Project Area are classified as multiple use wetlands. Mullins Sumpland is an artificially induced expression of groundwater that drains to Nanga Brook. All the wetland areas are highly disturbed and have few wetland values or attributes other than hydrology. The stream landscapes are considered extremely degraded due to historic clearing of catchment vegetation, drain construction and unrestricted stock access.	Mullins Sumpland will be mined and surface water flows originating from this source will be reduced by approximately 95%. Baseflow contributions to Nanga Brook will reduce by less than 1% of annual flows. No impact on flows in Wealand Brook or Ferraro Brook. Excess water will be released in periods where dewatering exceeds site water requirements. Open area has the potential to result in uncontrolled runoff with high turbidity.	Provision of make-up water facilities to the surface water user of Mullins Sumpland if required. Any water discharges from mining operations will be licensed and regularly monitored. Control measures such as bunding, sumps and stormwater management systems implemented. Surface water monitoring program implemented including upstream and downstream of minesite.	Reduction in surface water flows from Mullins Sumpland. No impacts on flows in Nanga Brook, Wealand Brook or Ferraro Brook. Surface water quality will not be adversely affected by mine activities.
POLLUTION MANAGEMENT					
Dust	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.	Baseline dust monitoring has been conducted at Waroona since September 2004. Monthly total insoluble dust levels have ranged from 0.2 to 2.3 g/m^2/mth with an average of 0.81 g/m^2/mth. Particulate concentrations at the proposed mine locations are not available. However, background TSP and PM_{10} levels are available for nearby Wagerup as collected by Alcoa. These are considered to be representative of the area.	Potential dust generation on unsealed internal roads, stockpiles and open mine areas during dry, windy conditions. Modelling has been undertaken to predict dust resulting from mining and allow a dust management program to be developed. Modelled dust levels are shown to exceed both the TSP and PM_{10} limits at several residential locations. These exceedances are minimal and are partly a factor of using conservative assumptions. Analysis of the conditions that lead to the highest concentrations offsite indicate that concentrations to the west north west are due to strong easterly winds in summer and wind erosion. The higher concentrations to the south are due to operational activities associated with moving the overburden and ore.	Iluka will develop and implement a dust management plan involving standard practices to manage particulate emissions such that they do not cause environmental or human health problems. Dust control measures will include: • minimising clearing and open area; • not disturbing topsoil until required; • regular watering and grading of roads; • using biodegradable chemical suppressants; • growing of temporary crops to bind soil & lift wind from surface; • re-establishment of pasture as soon as possible after mining has been completed; • using sprinkler systems and oversize material where appropriate; • high wind warning system in summer to enable site to increase control mechanisms ahead of event; and • sealing roads if deemed necessary.	Dust will be managed and monitored during operations. With the proposed mitigation techniques in place, there will be no adverse impacts from dust on environmental values or the health, welfare and amenity of people and land uses.

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Noise	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	The environmental background noise levels were measured on two occasions with maximum daytime L_{A90} levels ranging between 45 - 55 dB(A) and minimum evening L_{A90} levels ranging between 21 - 34 dB(A).	Mining will occur in daytime hours only excluding Sundays. Processing will occur 24 hours a day. Noise modelling has shown that under the majority of weather conditions noise limits can be met.	Machinery numbers will be reduced under weather conditions likely to result in exceedance of noise limits. Prepare a noise management plan which includes: • hours of operation; • allowable noise levels of site machinery; • regular checking of noise levels of site machinery; • management of noise during construction; • management of noise during operations; and • monitoring and reporting of noise levels.	Compliance with statutory noise requirements.
Radiation	To ensure that radiological impacts to the public and the environment are kept as low as reasonably achievable and comply with acceptable standards.	The background radiation survey shows a range of 0.05 µGy/hour to 0.37 µGy/hour. This is consistent with typical natural radiation levels in the southwest region of WA.	Radioactive materials in the mineral monazite are concentrated from 0.1% in ore to 1-2% in HMC. HMC is able to be safely transported to Capel without specific safety requirements.	A pre-mining radiation survey has been undertaken. No monazite will be returned to Waroona. A post mining radiation survey will be conducted.	Post-mining radiation levels are the same or lower than pre-mining radiation levels. No impacts to the environment or public.
Light	To avoid or manage potential impacts from light overspill and to comply with acceptable standards.	Artificial light in the Project Area is restricted to vehicle movements on public roads, town lighting, residential lighting and farming activities.	24 hour processing will require lighting of mobile and fixed plant to enable a safe working environment.	Location of processing activities minimises the light overspill affecting adjacent residents. Focus lights internally to minimise light spill.	No significant adverse impacts from site lighting.
Non-process Waste	Ensure that wastes are managed and disposed of in a manner that does not result in long-term impacts on groundwater, surface water and the natural environment.	There is a large amount of scrap machinery and plant across the Project Area from farming operations.	Non-process waste generated by mining activities will create rubbish. There is the potential for reduced visual amenity and potential safety hazards created if not disposed property.	Avoid creation and reduce waste output. Implement re-use and recycling of waste. Ensure waste is disposed in a licensed landfill. Clean up existing debris.	No long term impacts on groundwater, surface water or the natural environment.
Process Waste	Ensure that waste streams from the process are returned to the mining pit in a manner consistent with closure objectives and end uses of the site.	NA	Sand and clay tailings are inert. Potential impacts from solar drying dams are related to risk of uncontrolled releases of clay fines.	Systems will be put in place to minimise the potential for spills. This includes regular checks and inspections, bunding of pipelines, maintenance of dam walls and provision of adequate freeboard for rainfall events.	No long term effects on groundwater, surface water or the natural environment.
Greenhouse Gases	To minimise emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions.	Iluka's Southwest operations have three concentrators and associated mining infrastructure. One of these will be relocated to Waroona.	Anticipated carbon dioxide emissions of 40 kt/annum mainly from electricity and diesel fuel consumption.	Energy efficiency techniques will be adopted to reduce unnecessary consumption.	There will be negligible increase in emissions from Iluka's activities.

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
SOCIAL ENVIRONMENT					
Transport	To ensure that traffic activities resulting from the Project can be managed to an adequate level of public safety and have minimal impact on surrounding landowners.	The key transport route is the South West Highway. The Project Area is located less than 2 km from the highway off Peel Road. Peel Road is a gravel no-though road to the Speedway reserve.	HMC will be transported to Capel. 18 return journeys will be required on a daily basis. This is an increase of approximately 1% on existing heavy vehicle movements.	The Peel Road – South West Highway intersection will be upgraded to MRWA requirements. Peel Road will be bituminised from the intersection to the minesite. This will mitigate dust from traffic and mud from vehicles wheels.	There will be minimal impact on current truck numbers and transport can be managed to an adequate level of public safety.
Visual Amenity	To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape to as low as reasonably practicable.	The Project Area is located in close proximity to residents. The landscape is undulating and some residents have extensive views that include the Project Area. Tree belts have been planted around the Project Area boundary near resident locations.	Some residents will be able to see components of the mining operation.	Visual impact has been mitigated through the mine planning process by locating infrastructure and stockpiles away from residential areas. Site perimeter bunding is proposed in key locations. Mining and rehabilitation of areas as soon as possible.	Visual impact has been reduced to as low as reasonably practical.
Aboriginal Heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	There are three ethnographic sites located within and immediately adjacent to the Project Area.	No ethnographic sites will be disturbed by the Project.	If during the course of development, artefact or skeletal material is uncovered, Iluka will report these discoveries under Section 15 of the *Aboriginal Heritage Act (1972-1980).*	No impact on known sites and process in place to ensure sites discovered during operations are reported.
European Heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	There are no heritage sites within the Project Area.	No heritage sites will be disturbed by the Project.	If during the course of development, heritage material is identified, the appropriate authorities will be notified prior to further disturbance.	No impact on known sites and process in place to ensure sites discovered during operations are reported.

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SUPPORTING DOCUMENTS and MANAGEMENT PLANS (provided on cd)

Document title	Author	Date
Air Dispersion Modelling of Fugitive Particulate – Waroona Mine	Air Assessments	June 2005
Environmental Noise Assessment of the Proposed Iluka Mineral Sands Mine at Waroona	SVT Engineering Consultants	June 2005
Iluka Resource Ltd. Environmental Assessment – Flora and Fauna Survey	GHD	December 2004
Soils of the Proposed Waroona Minesite – Desktop Study	Soil Water Consultants	July 2004
Waroona Mineral Sands Project - Baseline Aquatic Ecosystems Surveys and Preliminary Social Water Requirements	Wetland Research & Management	April 2005
Waroona Mineral Sands Project Ecological Water Requirements of Ferraro Brook – Intermediary Assessment	Wetland Research & Management	May 2005
Waroona Deposit – Impacts of Mining on Shallow Groundwater Resources	URS	July 2002
Baseflow Assessment, Nanga Brook, Waroona	URS	June 2005
Ethnographic and Archaeological Survey, Waroona Project (M70/735, M70/797, M70/798)	Carto-Cult	1997
Waroona Proposed Sand Mine – Vegetation Assessment	Mattiske Consulting	September 2005
Vertebrate Fauna Assessment – Waroona Mineral Sands Project Area	Ninox Wildlife Consulting	September 2005
Dust Management Plan	Iluka Resources	September 2005
Noise Management Plan	Iluka Resources	September 2005
Water Resources Management Plan	Iluka Resources	September 2005
Vegetation Mitigation Plan	Iluka Resources	September 2005

1. INTRODUCTION

1.1. The Project

Iluka Resources Limited (Iluka) propose to establish a mineral sands mining operation at Waroona, approximately 140 kilometres south of Perth (Figure 1). The project is located on three leases, M70/797, M70/1089 and M70/735 approximately 1 km north of the township of Waroona (Figure 2).

Three orebodies will be mined progressively utilizing open cut, dry mining techniques. The proposal will involve the disturbance of 184 ha of land by mining, stockpiling, plant and support infrastructure, raw water dam and solar drying dams. It is expected that the mining component of the project will be completed within 4 years of commencement, rehabilitation within a further 3 years. Most decommissioning and landform works will be completed within one year of completion of mining. Preproduction activities are proposed to commence in the second quarter of 2006, with production beginning in the third quarter of 2006.

Topsoils and subsoils will be removed and stockpiled for use in rehabilitation. The mining process will remove mineralised material, ore and non-mineralised material, overburden from the pit. Ore will be put through an on-site concentrator to separate the Heavy Mineral Concentrate (HMC) from the clay and sand. The concentrator will operate at a nominal 300 tonnes per hour (tph) throughput. The concentrator process utilises water and weight of the heavy minerals to separate out HMC. The HMC will then be transported by road to Iluka's Capel processing plants for further refining. The Project is an important component of Iluka's ongoing operations in Western Australia.

Overburden is initially stockpiled and then replaced in the mining void. Subsoils and topsoils are replaced and the mined areas progressively rehabilitated to agricultural land use.

The key characteristics of the project are set out in Table 1.

1.2. The Proponent

Iluka is an international mining and processing company, which has mineral production and processing operations in Australia and the United States. Iluka's major business activities are mining and processing titanium minerals, mining and processing zircon, coal mining (joint venture) and mineral exploration. Titanium minerals and zircon produced in Western Australia are used in every-day products such as paints, ceramics, cosmetics and food products.

Currently, Iluka's mining and mineral processing operations in Western Australia are located in the Capel and Eneabba-Geraldton regions. Iluka has successfully mined and rehabilitated many mineral sands deposits since the 1950's. Iluka employs a total of 1008 employees and contractors across it's Australian operations. The company generates approximately 200 million dollars of revenue across its operations.

Iluka has received several awards for environmental, community and operational performance, including a Golden Gecko for environmental performance in the Southwest WA

in 1999, a gold award for community engagement excellence for the Douglas Project in the Murray Basin in 2005 and the Australian Maintenance excellence award 2004.

The Waroona Project will be a continuation of Iluka's mining operations with mining and production of heavy mineral reserves at another Southwest site decreasing. Iluka is a signatory to the Australian Minerals Industry Enduring Value policy. The adoption of the Code signifies a corporate commitment to responsible environmental management.

The Proponent for the proposed Waroona Mineral Sands Project is Iluka Resources Limited (Iluka). The proponent can be contacted at:

Iluka Resources Limited

Level 23, 140 St Georges Terrace

PERTH WA 6000

ABN 34008675018

The nominated contact is:

Lisa Sadler, Senior Environmental Advisor

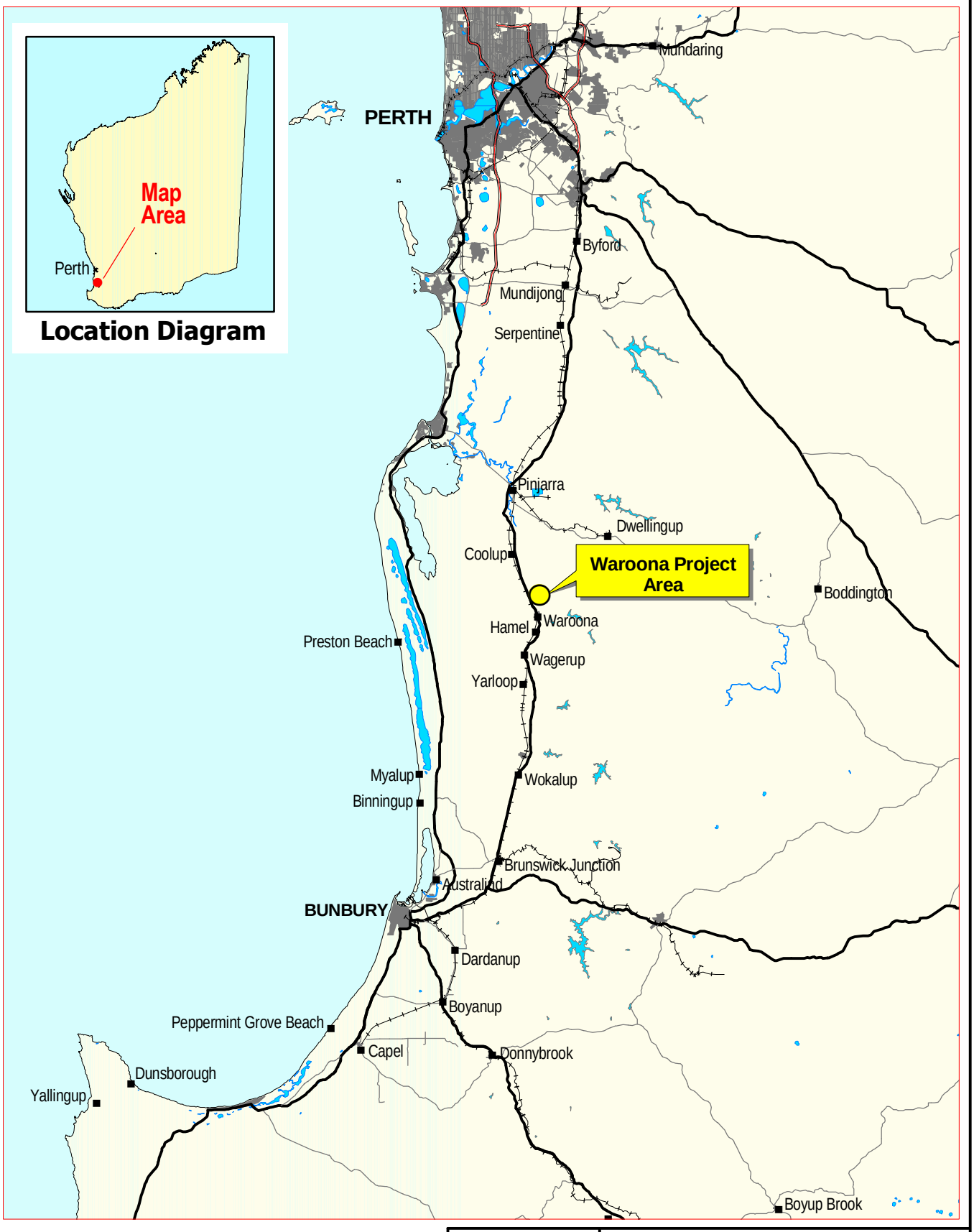
Tel: (08) 9360 4700

Fax: (08) 9360 4777

Email: lisa.sadler@iluka.com

Table 1: Key Characteristics of the Project

Characteristic	Description
MINE	
Life of Mine (Mine Production)	4 years
Size of Ore Body	10.8 million tonnes
Area of Disturbance	184 ha
Vegetation Disturbance	21.2 ha
Hours of Operation	7am – 7pm, Monday to Saturday
PROCESSING	
Equipment	Mining Unit
	Concentrator
Nominal Processing Rate	300 tonnes per hour
Hours of Operation	24 hours day, 7 days week
Heavy Mineral Concentrate production	245,000 tonnes per year
OTHER	
Water Supply Sources	Superficial - 300 ML per year
	Purchased - 2000 ML per year
HMC Transport	126 return trucks (252 total journeys) per week



ILUKA

WAROONA

REGIONAL LOCATION PLAN

ORIG :	L.Sadler		
DRAWN :	D.G.S.		
SCALE :	1 : 1,000,000		
DATE :	14 June 2005	DWG No : 131444 ver.01	FIGURE : 1

1.3. Purpose and Structure

The project was referred to the Environmental Protection Authority (EPA) on 6 January 2004. The EPA determined that the likely environmental impacts are sufficient to warrant assessment at the level of Public Environmental Review (PER) with a four week public review period. This level of assessment is typically applied to proposals of local or regional significance that raise a number of environmental factors, some of which are considered complex and require detailed assessment. The EPA advertised the level of assessment in The West Australian on 23 February 2004. A scoping report describing the project, surrounding environment and detail to be documented in the PER was prepared by the proponent and submitted to the EPA in May 2004 and was approved on 23 June 2004.

This PER aims to identify and assess the environmental effects of the proposal and to describe the management strategies the proponent will adopt to manage and minimise any adverse environmental affects.

The document provides the following information:

Section 1	Introduction	Provides background information relevant to the environmental assessment of the Project.
Section 2	Project Benefits and Evaluation of Alternatives	Describes economic, social and environmental benefits of the Project. Discusses alternatives to and within the Project.
Section 3	Project Description	Describes the key characteristics of the Project and a detailed description of its processes.
Section 4	Existing Environment	Describes the physical, biological and social characteristics of the Project Area.
Section 5	Community Consultation	Describes the community and government consultation program undertaken during the preparation of the PER.
Section 6	Environmental Management	Identifies the key environmental issues that could arise as a result of the implementation of the proposal and a summary of how each issue will be managed.
Section 7	Identification of Environmental Factors	Describes how environmental factors relevant to the proposal were identified.
Section 8	Biophysical Environment: Impact and Management	Summarises the proponent's biophysical environmental management commitments.
Section 9	Pollution Management	Summarises the proponent's pollution management commitments.
Section 10	Social Environment: Impacts and Management	Summarises the proponent's social environmental management commitments.
Section 11	Conclusion	Provides a summary of the project and environmental commitments.
Section 12	References	Provides a list of the references cited in the PER.

A range of technical studies have been completed in preparing this document. A number of management plans have been prepared for key environmental factors. The technical studies and management plans are provided as supporting documents on a compact disc at the back of the PER.

1.4. Land Tenure

The proposed minesite is located 140 km south of Perth within the Shire of Waroona to the east of the South Western Highway. The Waroona Deposit is located within mineral leases M70/735, M70/797and M70/1089 (Table 2).

The Project Area is shown in Figure 2 and includes some Crown Land vested in the Shire of Waroona for road reserves and recreation. All private land within the Project Area is owned by Iluka.

Table 2: Mining Leases Covering the Waroona Project Area

Mining Lease	Date Granted	Date of Expiry	Holder
M70/735	15 October 1996	14 October 2017	Iluka Resources Ltd
M70/797	15 October 1996	14 October 2017	Iluka Resources Ltd
M70/1089	25 September 2001	24 September 2022	Iluka Resources Ltd

1.5. Responsible Authorities

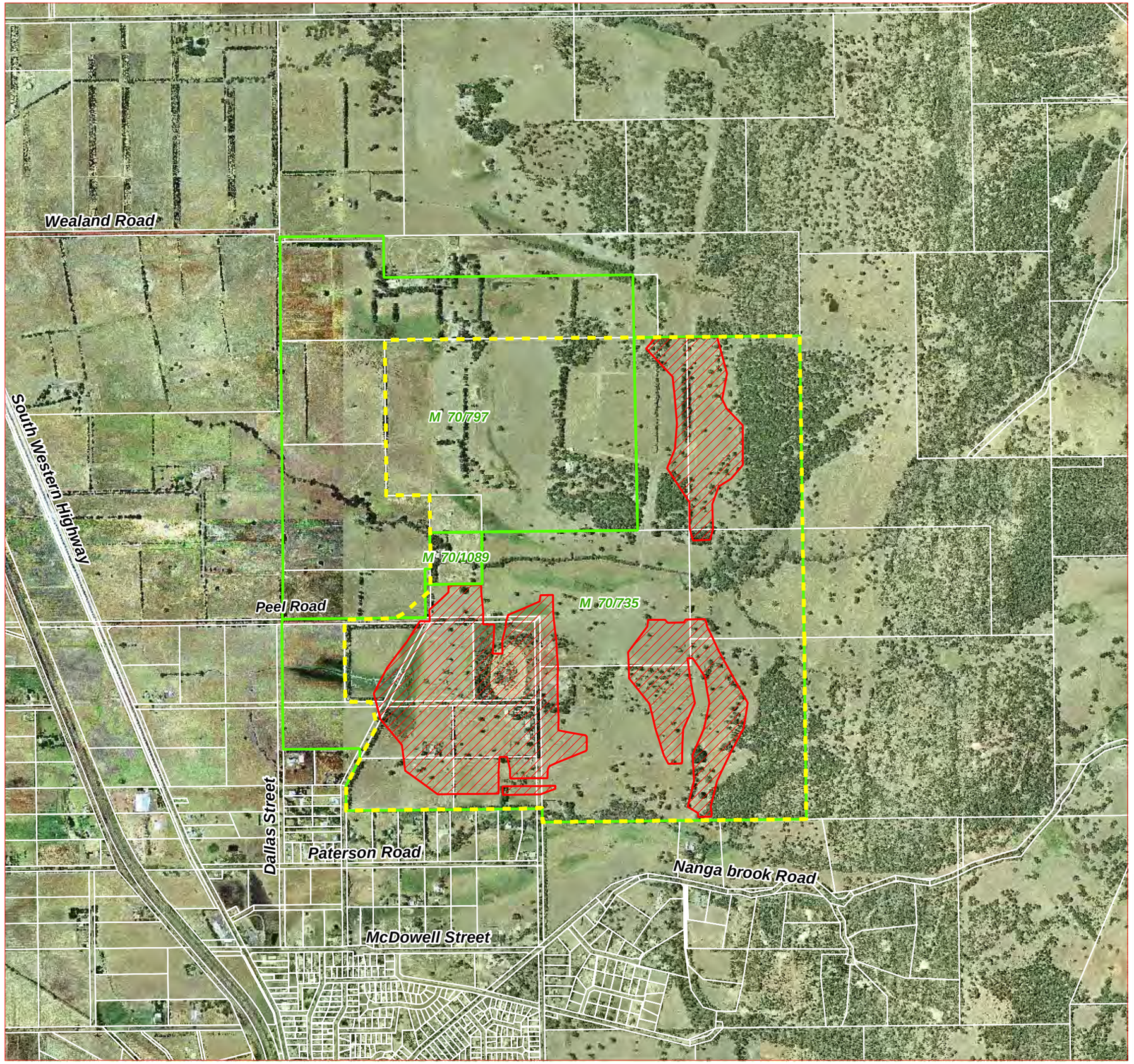
The main agencies with an interest in the environmental assessment and management of the proposed Waroona Project are:

- The Environmental Protection Authority (EPA);
- The Department of Environmental Protection (DoE);
- Department of Conservation and Land Management (CALM);
- The Department of Industry and Resources (DoIR);
- Department of Indigenous Affairs (DIA);
- Department of Agriculture (DoA);
- Main Roads of Western Australia (MRWA);
- Commonwealth Department of Environment and Heritage (DEH); and
- Shire of Waroona.

1.6. Relevant Legislation and Guidelines

The Proposal is being assessed under Part IV of the *Environmental Protection Act 1986* (WA) (as amended). If the Minister for the Environment decides that the proposal may proceed after considering the EPA assessment report on the proposal, the Minister will issue a statement that allows the proposal to be implemented and may contain conditions that will apply to the Project when implemented.

Irrespective of the approval from the Minister for the Environment, the Proponent will also need to comply with a range of legislation administered by State and Federal Government agencies. Relevant legislation includes those Acts and Regulations listed in Table 3 and also lists a range of policies and guidelines applicable to the Waroona Project.



REVISIONS

Ver.	ORIG	DESIGN	DATE	COMMENTS
01	L.S.	D.G.S.	14.06.05	Project area and tenements added
01	L.S.	D.G.S.	24.10.05	Northern pit updated

Legend

- Project area
- HM Reserves
- Iluka mining tenements

N

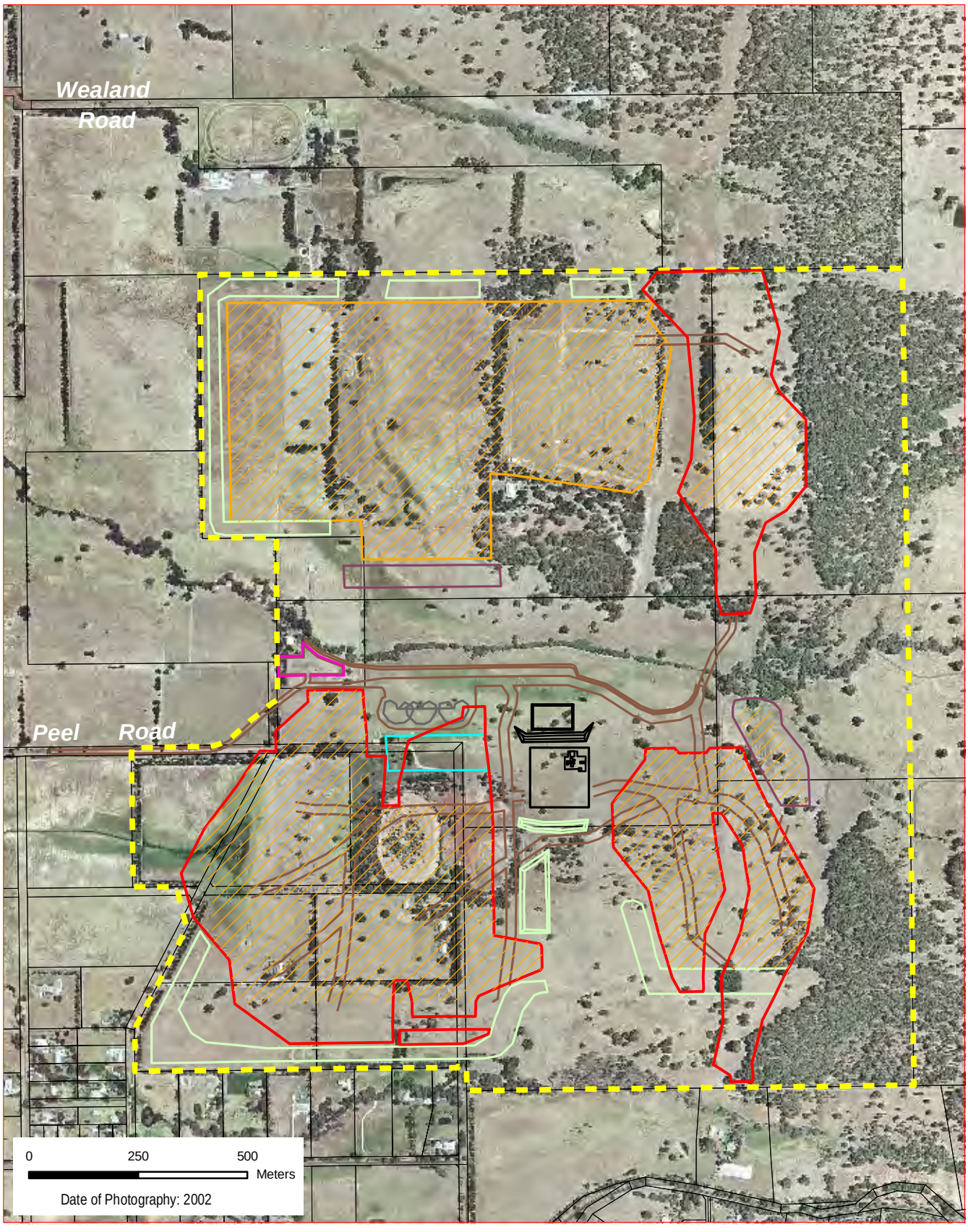
0 250 500 750 1,000 Meters

ILUKA

WAROONA

PROJECT AREA

ORIG:	L.Sadler		
DRAWN:	S.P.		
SCALE:	1:15,000		
DATE:	18 March 2005	DWG No: 149930 ver.02	FIGURE: 2



Legend

- Project area
- Pit Outlines
- Solar Drying Dams
- Topsoil Stockpile
- Overburden Stockpile
- Internal Mine Roads
- Clean Water Dam
- Concentrator and Mining Unit
- ILUKA Offices and Workshops

N

ILUKA

ORIG:	L.Sadler
DRAWN:	D.G.S.
SCALE:	1:12 500
DATE:	17 Oct. 2005

WAROONA

PROPOSED MINE LAYOUT

DWG No: 144916 ver.02

FIGURE: 3

Table 3: Regulatory and Policy Framework

Aspect	Title	Applicability
National Policies and Strategies	1996 National Strategy for the Conservation of Australia's Biological Diversity.	Applies to the clearing of remnant vegetation. Principles and objectives of the National Strategy aim to conserve biological diversity.
	1992 National Strategy for Ecologically Sustainable Development.	Provides guidelines for the use of natural resources in an ecologically sustainable manner.
	The National Environment Protection Measure (NEPM) for Air Quality.	A set of national air quality standards to apply in all States and Territories. These standards have been set by the Environmental Protection and Heritage Council (EPHC). The levels specified in the NEPM provide a benchmark and assist in the protection against air pollution.
National Legislation	*Environmental Protection and Biodiversity Conservation Act (1999)*	The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects the environment, particularly matters of National Environmental Significance. Approval is required for actions that are likely to have a significant impact on: a matter of national environmental significance; the environment of Commonwealth land; and the environment anywhere in the world (if the action is undertaken by the Commonwealth). An action includes a project, development, undertaking, activity, or series of activities. There are no matters of national environmental significance as described by the EPBC Act for the Waroona Project
State Legislation	*Environmental Protection Act 1986 (as amended)*	The Waroona Project is being formally assessed under Part IV of this Act. Any Works Approvals or Licences required for the project are issued under Part V of the Act.
	Environmental Protection (Noise) Regulations 1997	Represents the prescribed standards for noise under the Environmental Protection Act 1986. Acceptable noise levels for different times of the day are specified.

Aspect	Title	Applicability
State Legislation (cont)	*Environmental Protection (Clearing of Native Vegetation) Regulations 2004*	Represents the prescribed standards for clearing under the Environmental Protection Amendment Act 2003. Defines clearing and describes those instances where clearing is permitted by section 51C (c) of the Act.
	Mining Act 1978	Regulates onshore mining for minerals and the environmental obligations of tenement holders. Iluka holds several tenements that contain conditions relating to the environment.
	Mines Safety and Inspection Act 1994	Relates to the safety of mines and mining operations and the inspection and regulation of mines, mining operations and plant and substances supplied to or used at mines.
	Rights in Water and Irrigation Act 1914	Applies to the management of water resources and the equitable and efficient use of water resources.
	Aboriginal Heritage Act 1972	Relates to the protection and preservation of Aboriginal sites.
	Wildlife Conservation Act 1950	Applies to the protection of wildlife in Western Australia.
	Dangerous Goods Safety Act 2004	The Act relates to the safe storage, handling and transport of Dangerous Goods.
EPA Position Statements	Environmental Protection of Native Vegetation in Western Australia. Clearing of Native Vegetation, with Particular Reference to the Agricultural Area. EPA Position Statement No. 2 (EPA, 2000).	Applies to proposals to clear remnant native vegetation in Western Australia as it aims to protect biodiversity. Key criteria applied include: • the "threshold level" below which species loss appears to accelerate exponentially at the ecosystem level is regarded as being at a level of 30% of the pre-clearing extent of the vegetation type; and • a level of 10% of the original extent is regarded as being a level representing "endangered" and should be avoided.
	Terrestrial Biological Surveys as an Element of Biodiversity Protection EPA Position Statement No. 3 (EPA, 2002a).	Highlights the significance of biodiversity and the need to develop and implement best practice in terrestrial biological surveys.
EPA Position Statements (cont)	EPA Bulletin 966 on Clearing of Native Vegetation (EPA, 1999a).	Applies to the clearing of native vegetation within the agricultural region of Western Australia.

Aspect	Title	Applicability
	Environmental Protection of Wetlands. EPA Position Statement No. 4 (EPA, 2004).	Applies to proposals containing wetlands focussing on terrestrial wetlands with permanent or temporary inundation.
	Towards Sustainability. EPA Position Statement No. 6 (EPA, 2004).	Applies to all proposals. It discusses the concept of sustainability and draws attention to a range of global issues. It then introduces the reader to sustainability issues in a number of sectors such as natural resource management, delivery and use of energy, communities, transport, and the production and use of minerals.
	Principles of Environmental Protection. EPA Position Statement No. 7 (EPA, 2004).	Applies to all proposals. It includes Environmental, Social and Economic Considerations, the Precautionary Principle, Intergenerational Equity, Conservation of Biological Diversity and Ecological Integrity.
	Environmental Offsets. EPA Preliminary Position Statement No. 9 (EPA, 2005).	Applies to all proposals. Environmental offsets aim to ensure that significant and unavoidable adverse environmental impacts are counterbalanced by a positive environmental gain, with a goal of achieving a 'net environmental benefit'. Environmental offsets represent a 'last line of defence' for the environment, only being used when all other options to avoid and mitigate environmental impacts have been exhausted.
EPA Guidance Statements	Level of assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of the System 1 Region (Guidance Statement No. 10) (EPA, 2003)	Provides guidance about the assessment of proposals by the EPA that may potential impact on bushland within the *Bush Forever* area and regionally significant natural areas within the System 6 region and Swan Coastal Plain portion of the System 1 region. The guidance aims at ensuring that developments are compatible with the intent of the recommendations for and/or conservation values of these areas.
EPA Guidance Statements (cont)	Environmental Noise (Draft Guidance Statement No. 8) (EPA, 1998a).	Provides guidance about the assessment of noise emissions to proponents submitting proposals for environmental impact assessment. It assists proponents in determining whether noise emissions will require detailed analysis and provides guidelines for the derivation and presentation of technical information for assessment of noise impacts.

Aspect	Title	Applicability
	Guidance Statement for Minimising Greenhouse Gas Emissions (Guidance Statement No. 12) (EPA, 2002b).	Addresses the minimisation of greenhouse gas emissions from significant new or expanding operations.
	Prevention of air quality impacts from land development sites (Guidance Statement No. 18) (EPA, 2000).	Provides guidance on the control of dust and smoke from land development sites.
	Management of Surface Run-off from Industrial and Commercial Sites (Draft Guidance Statement No. 26) (EPA, 1999b).	Provides guidance for the protection of water resources from stormwater runoff carrying pollutants. This Statement also addresses groundwater and surface water contamination caused by stormwater runoff from industrial sites and the EPA's position on stormwater discharges to the environment.
	Linkage between EPA Assessment and management strategies, policies, scientific criteria, guidelines, standards and measures adopted by National Councils (Guidance Statement No. 34) (EPA, 1998).	Provides guidance on the linkage between EPA assessment and management strategies, policies, scientific criteria, guidelines, standards and measures adopted by National Councils, and provides background on the subject and guidance in relation to assessment.
	Assessment of Aboriginal Heritage (Draft Guidance Statement No. 41) (EPA, 2001).	Considers 'Aboriginal Heritage' as a relevant environmental factor in circumstances where they are linked directly to physical and biological attributes of the environment and when the protection and management of those attributes are threatened as a result of a proposed development. The Statement provides information that the EPA will consider when assessing proposals where Aboriginal Heritage is a relevant factor.
	Guidance to assist proponents in understanding the EPA's requirements in relation to the environmental condition on Environmental Management Systems (Draft Guidance Statement No. 43) (EPA, 2000).	Explains the EPA's requirements in relation to the Environmental Condition on Environmental Management Systems.
EPA Guidance Statements (cont)	Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (Guidance Statement No. 51) (EPA, 2004).	Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial flora and vegetation and their ecosystems.

Aspect	Title	Applicability
	Implementing Best Practice in Proposals Submitted to the Environmental Impact Assessment Process (Guidance Statement No. 55) (EPA, 2004).	Provides guidance on what the EPA means by the term 'best practice' when used in the EIA process.
	Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (Guidance Statement No. 56) (EPA, 2004).	Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial faunal biodiversity and its habitat.
Government Guidelines	Guidelines on the Safe Design and Operating Standards for Tailings Storage (DME, 1999).	Assists in the design, construction, management and decommissioning of Tailings Storage Facilities.
	Guidelines on the Development of an Operating Manual for Tailings Storage (DME, 1998).	Provides a consistent basis for the preparation of Operating Manuals for tailings storage to meet regulations covering the mining industry.
	Water Quality Protection Guidelines (Nos. 1-11), Mining and Mineral Processing (WRC, 1999).	Provide framework for dealing with water quality issues associated with mining and mineral processing.
	Mine Closure Guideline for Minerals Operations in Western Australia (The Chamber of Minerals and Energy of Western Australia Inc, 1999).	Provides a framework for closing a range of minerals industry operations to ensure a company does not leave itself, subsequent land owners or the State with unacceptable ongoing liability.
	Preparation of a Radiation Management Plan. Guideline RSG02 (DoIR, 1997).	Provides guidance on the development of a suitably detailed plan for the control and monitoring of radiation exposure and the management of radioactive wastes.
Industry Guidelines	Strategic Framework for Mine Closure (Australian and New Zealand Minerals and Energy Council [ANZMEC] and Minerals Council Australia [MCA], 2000).	Provides a set of objectives and principles designed to facilitate a broadly consistent framework for mine closure across Australia.

2. PROJECT BENEFITS & EVALUATION OF ALTERNATIVES

2.1. Project Benefits

Iluka Resources plans to continue its mining and processing operations in Western Australia. Continuation of mining and processing is dependent on the development of new minesites as mining at other sites ceases. The Waroona Project is part of Iluka's ongoing Southwest Operations, being a continuation of operations after the completion of mining at another Southwest operation. Continuation of mining and processing operations provides economic benefits including:

- Direct and indirect local and regional employment and training opportunities;
- Export earnings;
- Revenue to State and Federal Governments through taxes on earnings and through purchases; and
- Regional and national economic growth.

Mineral Sands mining is a temporary landuse which has the ability to provide maximum utilisation of natural resources. In applying sustainable development objectives to the project (Section 6.3 Sustainability) the mining area will be returned to a landform consistent with the surrounds and previous agricultural land use. Completion of mining will allow the Waroona Shire to plan for the area and allow for growth of the Waroona township. Financial support has been provided by Iluka for the Shire to evaluate opportunities for post-mining landuses (Section 6.4.1). This will result in flexibility in town planning for Waroona as any planning constraints arising from the presence of minerals are removed by mining. The mining potential of the area has been known for many years with Iluka taking exploration licences over the area in 1988 and mining leases in 1996. The tenements have prevented other development of the land. If development occurs without mining the land the most benefit is not made from available resources.

Mining will provide upgraded infrastructure (power, water, roads) in the immediate vicinity of the mine. Mining of the deposit also allows for a contribution to the natural environment. The Project Area is mostly cleared pasture land with scattered and isolated vegetation. It is proposed to improve this through fencing of remnant vegetation and linking isolated vegetation through native vegetation corridors within the Project Area. The agricultural potential of the Project Area will benefit through improved farm planning, windbreaks, fences and watering points (Sections 6.4.1 and 8.4).

The sustainable development approach to the Project allows for significant economic, environmental and social benefits to be achieved for the Project Area, Iluka and the community.

2.2. Evaluation of Alternatives

Several alternatives have been evaluated in the development of this proposal. These include:

- Options for locating the raw water dam on Ferraro Brook;
- Alternative transportation routes and cartage hours; and
- Mine planning strategies to minimise environmental impacts on adjacent landowners.

2.2.1. Location of Raw Water Dam

Two options were reviewed for the location of the raw water dam. These were locating the dam within the mine clearing area or on Ferraro Brook. The preferred option involves pre-mining an area of mine pit and creating the dam within the pit area (Figure 4). This reduces the overall clearing requirement and avoids impacts on the watercourse.

2.2.2. Alternative Transport Routes and Cartage Hours

HMC will be transported to Iluka's Capel processing plants. Rail and truck cartage were identified as potential transport methods. Rail transport has been eliminated as a viable option as it requires the establishment of a suitable spur line and rail loading facility and would still require truck transport to the rail head. This would need to be located close to the Project Area to minimise road cartage to the rail head. Unloading facilities at Capel and a significant upgrade to the southern section of rail line would also be required. The cost of finding a suitable location, developing the rail loading facility and rail freight costs would make the project unviable. Truck cartage direct from site to Capel is more appropriate for a short life span mining operation. Several different truck routes were considered (Figure 5). These were evaluated with assistance from MRWA and the Waroona Shire. Upgrades to roads not suitable for heavy haulage were ruled out based on impacts on landowners (cattle crossings, school bus services etc.) and cost. The designated MRWA truck haulage route is the South West Highway. This route is currently used by trucks and increases in existing traffic from Iluka's Waroona operations would be minimal (Sections 4.11 and 10.1).

Several different cartage hours scenarios were reviewed with the community, MRWA and Waroona Shire. These include carting 24 or 12 hours a day, 7 or 5 days per week. The more hours available for cartage, the more time between each truckload. No option received more support from the community than any other option and as such Iluka has selected 24 hours a day, 7 days a week cartage.

Legend

Clean Water Dam Options

N

0 100 200 300 Meters

Date of Photography: 2002

ILUKA

ORIG: L.Sadler

DRAWN: D.G.S.

SCALE: 1:5,000

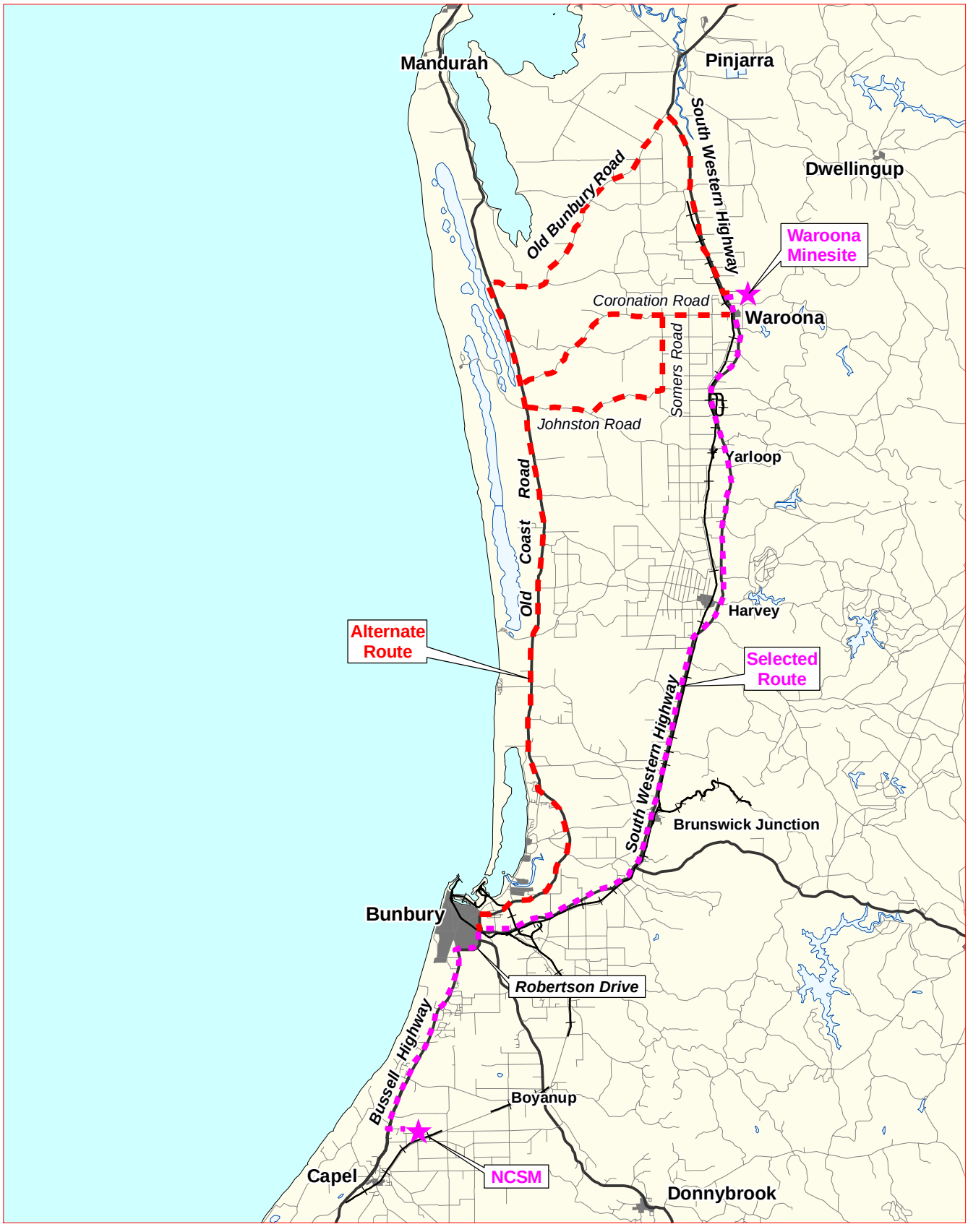
DATE: 17 Oct. 2005

DWG No: 149941 ver.01

FIGURE: 4

WAROONA

WATER DAM OPTIONS



Legend:

Transport route

N

0 10 20 30 km

ILUKA

CAPEL - PINJARRA

TRANSPORT OPTIONS

Waroona minesite to North Capel

ORIG:	L.Sadler		
DRAWN:	S.P.		
SCALE:	1:500 000		
DATE:	3 May 2005	DWG No: 149937 ver.01	FIGURE: 5

2.2.3. Mine Planning and Impact Mitigation

The site layout and mining schedule has been designed to minimise impacts on the surrounding community. Key impacts that can be minimised include noise, dust, visual amenity and light. Outcomes of the workshops and mine planning studies allowed the following to be taken into consideration in the mine plan. The resulting mine plan is shown in Figure 3.

- Concentrator, screenplant, workshops and offices to be located on south side of Ferraro Brook. This area is low-lying and distant from neighbouring properties. The hill to the south provides a visual, noise and light barrier.
- Topsoil stockpile bunds 3-5 metres high on the southern boundary of the Project Area providing a visual, noise and light barrier. Bunds to be grassed with a fence along top.
- Stripping of topsoil and subsoil material scheduled for wetter months. This minimises the potential for dust impacts.
- Commencing mining in South Pit A (Figure 7). This area will be backfilled immediately following mining and rehabilitation commenced within the first year. A topsoil bund will then be established over the backfilled area. This provides a visual, noise and light barrier for properties on the south side of Nanga Brook.
- No solar drying dams or overburden stockpiles located adjacent to residents in southern sections of Main Pit A and South Pit A (Figure 7).
- Mining to be restricted to daytime hours (7am to 7pm) excluding Sundays and public holidays. Concentrator and screenplant operation 24 hours per day.

3. PROJECT DESCRIPTION

The current mineable reserve of the Waroona Deposit is approximately 10.8 million tonnes with an average grade of 10% heavy mineral. The ore will be mined progressively from three open-cut pits using dry mining techniques. Dry mining involves using earthmoving equipment (excavators, trucks, scrapers) to remove the ore. Dewatering of groundwater inflows into the pit will be required to enable dry mining to occur. The site will be established and operated in a similar fashion to other Iluka operations in the Southwest. A typical process flow chart is shown in Figure 6.

The site layout has been designed to minimise potential impacts on surrounding residents. The site access will be located off Peel Road. No access will be available through Hill Street, Nanga Brook Road, Bradford Street or Dallas Street. The concentrator, screen plant, offices, workshops and water dams will be located on the southern side of the Ferraro Brook. This minimises the noise and visual impacts on Waroona residents. All solar drying dams will be located on selected areas shown in Figure 3. Topsoils, subsoil and overburden will be stockpiled as shown in Figure 3. Where possible, stockpiles are utilised for noise, visual and safety bunds. The concentrator has been cut in to the side of the hill to minimize noise outputs.

3.1. Construction

Construction will take four months commencing in April 2006. Activities proposed to be conducted during this period include:

- Upgrade of Peel Road and South West Highway intersection. Peel Road will be sealed from the highway to the site entrance. The intersection will be upgraded in consultation with MRWA.
- Development of Plant site. This will include levelling, drainage controls, bitumenising, installation of power supply and water supply lines and construction of water storage dams, fuel farm, workshop and offices.
- Relocation of concentrator and fixed mining equipment from Capel to Waroona. All equipment is dismantled and moved by road in accordance with MRWA, local shire and police requirements.
- Topsoil and overburden stripping as shown for quarter 2 and quarter 3 on the mining schedule.
- Construction of noise bunds.
- Mining and stockpiling of ore from the Main Pit in order to create the raw water dam in the resulting mining void.
- Testing of concentrator with dry and wet commissioning prior to commissioning.

Construction activities will be undertaken on a 12 hour day time operation, 6 days per week (no Sunday or Public holiday operations).

Exploration

Topsoil Removal

Overburden Removal

Ore Mining

Sand/clay Backfill

Overburden Replacement

Recontouring

Rehabilitation

Process Water Dam

Void Dewatering

Decant Water

To feed preparation

Mining Unit and Screens

Oversize to mining void

CONCENTRATOR

Flocculant

Recycle Water

Thickener

Overflow

Fines separation

Spiral Separation

Thickened Clay Fines

Secondary concentration

Mine Dewatering

Final Tails

HMC

Truck to Narngulu/Capel dry plant

To Mine Void

SEPARATION PLANT (Capel)

Magnetic Separation

Magnetic

ILMENITE

Non-Magnetic

Secondary Mineral Separation

Water

LEUCOXENE

RUTILE

ZIRCON

SAND TAILS

SALEABLE ILMENITE

To Mine Void

To Synthetic Rutile Plant

SYNTHETIC RUTILE PLANT (Capel)

KILN

Coal

Sulphur

Aeration

Water

Hydro-cycloning and acid leach

Drying

SYNTHETIC RUTILE

ILUKA RESOURCES

TYPICAL MINERAL SANDS PROCESS FLOW DIAGRAM

FIGURE 6

3.2. Mining Operations

Removal of overburden will be conducted using scrapers, excavators and trucks. Initial overburden will be stockpiled, however once mining operations commence, overburden will be replaced directly into the mining void where possible. A portion of the overburden will be used for construction of the site perimeter bunds, infrastructure pads and roads. The ore will be mined utilising an excavator and truck fleet. The trucks cart the ore to the centrally located stockpile. The mining area will be dewatered via a mobile electrical pump with water pumped to the raw water dam for use in production.

Mining will be conducted 12 hours per day, 6 days per week (no Sunday or public holiday operations).

Ore from Main Pit E will be removed and stockpiled during construction to enable building of the raw water dam (Figure 7). During operations, mining will move from South Pit A to the Main Pit A-D and back to South Pit B before mining the North Pit. Mining will be complete within 4 years of commencement.

Several areas are utilised for solar drying dams following mining. Placing solar drying dams on the backfilled mining path minimises the need for additional clearing and has been incorporated into the project design.

Rehabilitation includes the replacement of subsoils and topsoils, fencing and initial seeding. Further rehabilitation work is ongoing for approximately three years following mining. These activities involve minimal earthworks and generally include agricultural type activities such as fencing, seeding and tree planting.

3.3. Ore Processing

The ore often contains oversize material (small rocks, plant root material) that must be screened out. A screen plant will be relocated from an existing Iluka operation.

A front end loader is used to feed the ore from a stockpile to the screenplant. Water is added in the screen plant, turning the ore into a slurry and allowing the oversize material to be removed using screens. Oversize removed during screening will be returned to the mining void. The ore feed will then be pumped to the concentrator.

The ore will be processed through an on-site concentrator with an anticipated nominal throughput rate of 300 tonnes per hour. The concentrator is a series of pumps and spirals that use the natural physical properties of the mineral (it is more dense) to separate it from the tails to produce HMC. HMC will be stockpiled prior to being transported to Capel for further processing. The processing of ore through the concentrator produces sand tails and clay fines.

The clay fines (nominally the -53 μm fraction) separated out during the concentration process will be pumped to solar drying dams. The purpose of the solar drying dams is to allow separation and evaporation of water from the clay fines. The excess water will be decanted from the solar dams and returned to the raw water dam for reuse in the concentration process. When dry, the clay will be removed from the dams and returned to the mine void. A portion of the clay will be used as a soil conditioner in the rehabilitation process and sprayed over stockpiled material to bind the surface and assist in dust control.

The sand tails produced by the concentration process will be pumped to the mine void, dewatered at the pit edge and placed directly back into the mining void. Water used for pumping the sand tailings is returned to the raw water dam. The dry clay tails will be combined with the sand tails and overburden in the pit.

No by-product materials from secondary processing at Capel (for example, monazite) will be returned to Waroona.

The screenplant and concentrator will be operating 24 hours per day, 7 days per week.

3.4. Workforce

The proposed Waroona minesite will be staffed with approximately 20 on-site Iluka personnel and 40 earthmoving contractors. Administration, mine planning, mine geology, surveying, metallurgy, environmental and laboratory requirements will be supported by the existing Southwest operations. A number of contractors will also be employed from time to time to carry out specialised tasks including maintenance, engineering construction, fencing and rehabilitation.

If an Iluka vacancy arises, the position will be advertised both in the local newspaper and The West Australian. Local people will be encouraged to apply. Employees and contractors are expected to reside in surrounding towns and arrange their own travel to work.

3.5. Resource Requirements

3.5.1. Power

Electrical power requirements for the entire site are expected to be approximately 4 megawatt (MW) at 22 kilovolts (kV). Initial consultation with Western Power has identified that current infrastructure in the Waroona area is rated to carry this demand.

3.5.2. Fuel

Diesel fuel for machinery, vehicles and plant will be trucked by road to the site. As is current practice at other Iluka minesites, fuel will be stored in approved containment vessels and surrounded with an appropriate bund wall built according to the Water Quality Protection Guideline No. 10 Above Ground Chemical and Fuel Storage (WRC, 2000a).

3.5.3. Water

Process water requirements will preferentially be met by mine dewatering. Additional water will be sourced from Harvey Water, a water services provider, using the local irrigation resources and network. Annual process water demand is estimated to be 2,000 ML/annum. Of this, it is anticipated that up to 300 ML/annum will come from dewatering.

It is proposed that water suitable for drinking will be transported to site and stored in a potable water supply tank. Alternatively, bottled water may be utilised.

Offices and Workshop

access road - to South West Highway

HMC Stockpiles

Concentrator

Screen Plant

E

D

B

C

B

A

A

Legend

- Project area
- Main Pit
- South Pit
- North Pit

N

0 100 200 300 m

Year of photography: 2001

Ver.	ORIG	DESIGN	DATE	COMMENTS
02	L.S.	D.G.S.	17.10.5	Northern pit updated
01	L.S.	D.G.S.	14.6.5	Project area added

REVISIONS

ILUKA

WAROONA MINESITE

MINING PODS

ORIG: L.Sadler

DRAWN: S.P.

SCALE: 1:7,500

DATE: 21 March 2005

DWG No: 149942 ver.02

FIGURE: 7

4. EXISTING ENVIRONMENT

4.1. Regional Setting

The Waroona Project Area is located on the eastern side of South West Highway, adjacent to the northern boundary of the township of Waroona (Figure 1). It is situated on the Swan Coastal Plain, which is bound by the present coastline to the west and the Darling Scarp to the east. The Darling Scarp is a fault scarp that defines the contact between the down-thrown Perth Basin and Archaean crystalline rocks of the Yilgarn Shield to the east.

The coastal plain was formed by subsidence and marine erosion of the underlying Mesozoic sediments of the Perth Basin during successive marine transgressions. The scarp rises to an average of 300 m above the coastal plain and was the limit of major marine transgressions in the early Pleistocene and late Tertiary period. The coastal plain is 30 km wide in the vicinity of Waroona.

The Project Area is within the Peel Region, home to over 80,000 people (workforce around 35,000) of whom nearly 3,000 are unemployed (Peel Development Commission, 2004). Mining contributes around $3.4 billion of the $4.5 billion regional economy.

The immediate surroundings of the Project Area have been largely cleared for agriculture. The existing residential development of the town of Waroona is adjacent to the southern boundary of the deposit. Waroona is a community of approximately 2,300 people.

The Project Area is mainly private property owned by Iluka. There are several road reserves and a Crown Reserve within the Project Area. The Crown Reserve (No. 16307) is vested in the Shire of Waroona and is a disused amateur Speedway.

Ferraro Brook originates within the hinterland of the Darling Scarp and traverses the Project Area flowing westwards. Nanga Brook and Wealand Brook are located south and north if the Project Area respectively. There is minimal vegetation along these watercourses due to clearing and grazing. They do provide a water source for stock and gardens, and also provide some aesthetic value for landowners. Along the western boundary of the Project Area is a surface drainage expression referred to as Mullins Sumpland. This sumpland is thought to have appeared in response to agricultural clearing. A drain has been installed by the landowner draining water to Nanga Brook. The sumpland has no wetland values other than hydrology.

4.2. Climate

The Project Area has a Mediterranean-type climate with hot dry summers and cool wet winters. Evaporation generally exceeds rainfall during the period from October to April.

A weather station has been located at the site since 1991. Monthly temperatures and rainfall from 1991 to 2003 are shown in Table 4.

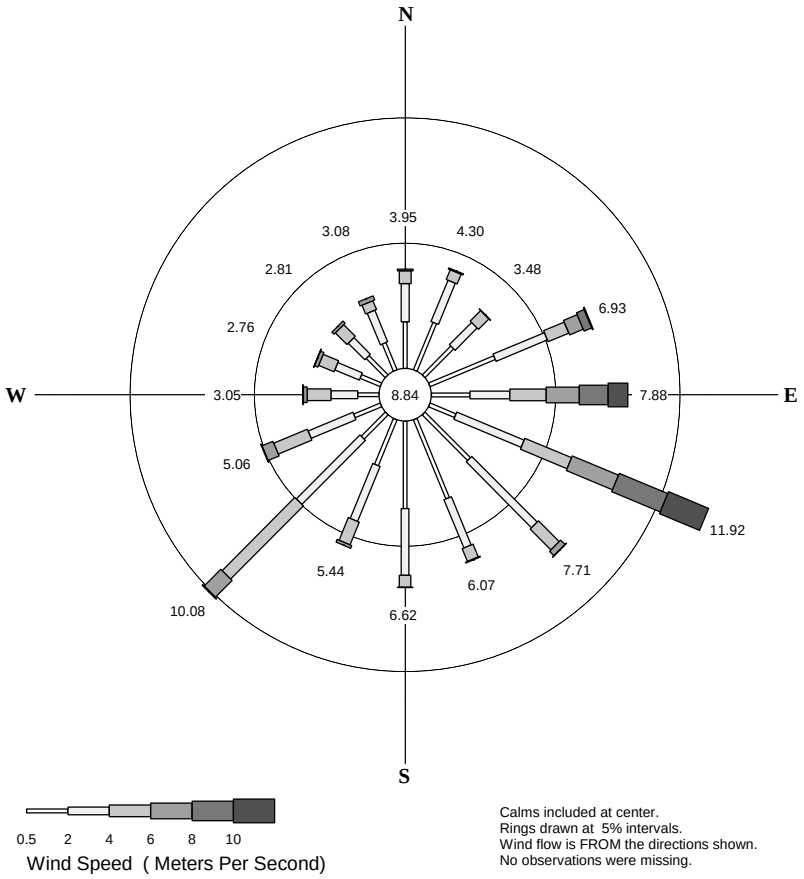
Table 4: Climate Data for Waroona (Iluka Waroona Weather Station)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average monthly max temp (^{o}C)	31.0	30.9	28.1	24.7	21.2	17.6	16.6	17.5	18.8	21.3	24.9	28.5
Average monthly min temp (^{o}C)	16.5	17.0	15.9	14.7	12.7	10.4	9.4	8.8	9.6	10.2	12.7	14.7
Monthly total rainfall (mm)	7.6	8.4	22.7	30.9	97.2	171.1	172.0	128.3	100.5	40.6	39.9	7.9

Data from the weather station has been used to analyse local weather conditions. Strong easterly and north-easterly winds are typical in summer. Winds during spring are mostly from the south west and south east, while winter winds are mainly north easterlies.

Figure 8 shows the annual wind rose data for July 2000/June 2001. This year is considered representative of average annual wind conditions at Waroona over the data record.

Figure 8: Annual Wind Rose at Waroona July 2000-June 2001



4.3. Geology

The Project Area is on the eastern fringe of the Southern Perth Basin. The Darling Fault forms the eastern limit of the basin and underlies the Waroona deposit. Eastern portions of the deposit overlie the Darling Escarpment while western portions overlie sediments of the Pinjarra Plain. The Waroona deposit formed on the Ridge Hill Shelf from mineral concentration caused by wave action on ancient shorelines. It is hosted within Pleistocene aged Yoganup Formation sands, deposited against the escarpment.

The key elements of the geological profile below the Project Area are shown in Figure 9 and described below:

- Colluvial Deposits: exist within the central and eastern portions of the Project Area. These deposits consist of silty and clayey sands with variable amounts of gravel and are a result of erosion and deposition occurring along the Darling Scarp to the east.
- Yoganup Formation: a succession of sandy clay and clayey sands with minor amounts of moderately sorted sand this is the predominant formation within the Project Area and extends to a depth of approximately 40 m. The entire profile is interspersed with iron-cemented ferricrete or laterised beds which occur over broad areas. The occurrence of iron-cementation is typically associated with historical water tables and preferred groundwater flow paths. Along the western margin of the Project Area, the Yoganup Formation is overlain by brown and grey mottled clays and sandy clays of the Guilford Formation.
- Leederville Formation: underlying the Yoganup Formation, to the west of the Darling Fault that occurs within the Project Area. The Leederville Formation includes various historic sedimentary environments and can extend to depths in excess of 1,000 m. The upper beds are comprised of mudstones and shales interbedded with sandy horizons. Ferruginised zones exist within weathered silt and sand beds.
- Archaean Bedrock: underlying the Yoganup Formation within the eastern margins of the Project Area. It consists of weathered and fresh granites, gneiss and dolerite.

4.4. Landform and Soils

A desktop study of the soils within the Project Area conducted by Soil Water Consultants (SWC, 2004) found that the soils are associated with the Ridge Hill Shelf geology and subsequently, consist of soils belonging to the Forrestfield Soil Association (Figure 10).

The Forrestfield Soil Association consists primarily of sands and sandy gravel. The Project Area occurs predominately within the Lotons Soil Type, with minor areas of the Gwindinup soil occurring along the margins of the mine boundary (SWC, 2004).

The Lotons soil type consists of moderate-deep yellow-brown surface sand that gradually alters to a gravely sandy loam at depth. The surface sands overlie yellow-brown and yellow-red mottled sandy clay subsoil and large lateritic boulders commonly occur at the duplex boundary. In contrast, the Gwindinup soil type has an absence of gravel and consists of deep to very deep yellow-brown sand (SWC, 2004).

Mapping of the exploration drilling data reveals that the soils in the Waroona Project Area exhibit considerable spatial (lateral and vertical) heterogeneity. A pre-mining soil assessment was conducted (SWC, 2005). This involved digging 6 m deep trenches in locations identified through the geological model. The soils are classified into Soil Material Management Units (SMMU) and management measures for stripping, handling, stockpiling and rehabilitation identified.

An agricultural productivity assessment will be conducted in spring prior to mining commencing. The productivity assessment determines the agricultural values and returns achieved by the property in its current pre-mining status.

4.4.1. Potential Acid Sulfate Soils

Potential Acid Sulfate Soils (PASS) are naturally occurring soils and sediments containing iron sulfide minerals or acidic products from the previous oxidation of sulfide minerals. Where iron sulfide minerals such as pyrite are located in undisturbed soils beneath a watertable, the materials are benign and non-acid forming. However, when these soils are drained, excavated or exposed to air by lowering of the watertable, the iron sulfide minerals oxidise releasing acid to the surrounding environment. This release of acid reduces the pH of the soil solution to pH levels typically <4, which can result in the structural degradation of the fabric and mineral structure of the soil, releasing potentially toxic concentrations of metals to groundwater (SWC, 2005).

A baseline investigation for Potential Acid Sulfate Soils (PASS) was undertaken by Soil Water Consultants (SWC, 2005). The investigation involved collection of 33 soil samples from 22 drill holes conducted across the Project Area and detailed field and laboratory analysis of soils to identify whether PASS were present. The geological model was utilised to target the location of drillholes to provide a representative sample of materials that will be encountered during mining including the more likely PASS areas.

The assessment showed that no PASS were identified from the soils collected. The soils collected are considered to be representative of the materials that will be encountered during mining. Given the topographic, geomorphic, redoximorphic and hydrogeologic conditions occurring within the Project Area it is unlikely that any PASS occur within the

proposed Waroona minesite (SWC, 2005). Further studies on ASS are proposed following discussion with DoE.

4.4.2. Radiation

All naturally occurring soils, rocks and minerals contain small amounts of the radioactive materials (radionuclides) Thorium and Uranium. The background gamma radiation level of the earth's surface is largely due to the presence of these elements. These radionuclides are not soluble and do not break free from the sand. The reason they are still present is due to the decay half life (time taken to lose their radioactivity) being millions of years.

Natural background levels within the South West region of WA are typically in the order of 0.2 to 0.3 micrograys per hour (uGy/h), however this does vary from location to location based on the soils and minerals present in the area. For example the Darling Scarp which consists of granite materials, may have a higher background radiation level than more sandy type soils.

Mineral sands do naturally contain more radionuclides than clays and 'yellow sands'. Throughout the mineral sands mining process, controls are in place to prevent any potential alteration to the natural background radiation of mining areas. "Pre mining" and "post mining" radiation surveys are conducted. This ensures that the natural background radiation levels remain unchanged as a result of the mining process. A pre mining background radiation survey has been conducted for the Waroona Project Area. The levels range from 0.05 to 0.37 uGy/h.

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Job No.	44047-021-562
Prep. By	JM
Chk'd By	IGB
Revision No.	0
	12 Mar 02
	12 Mar 02

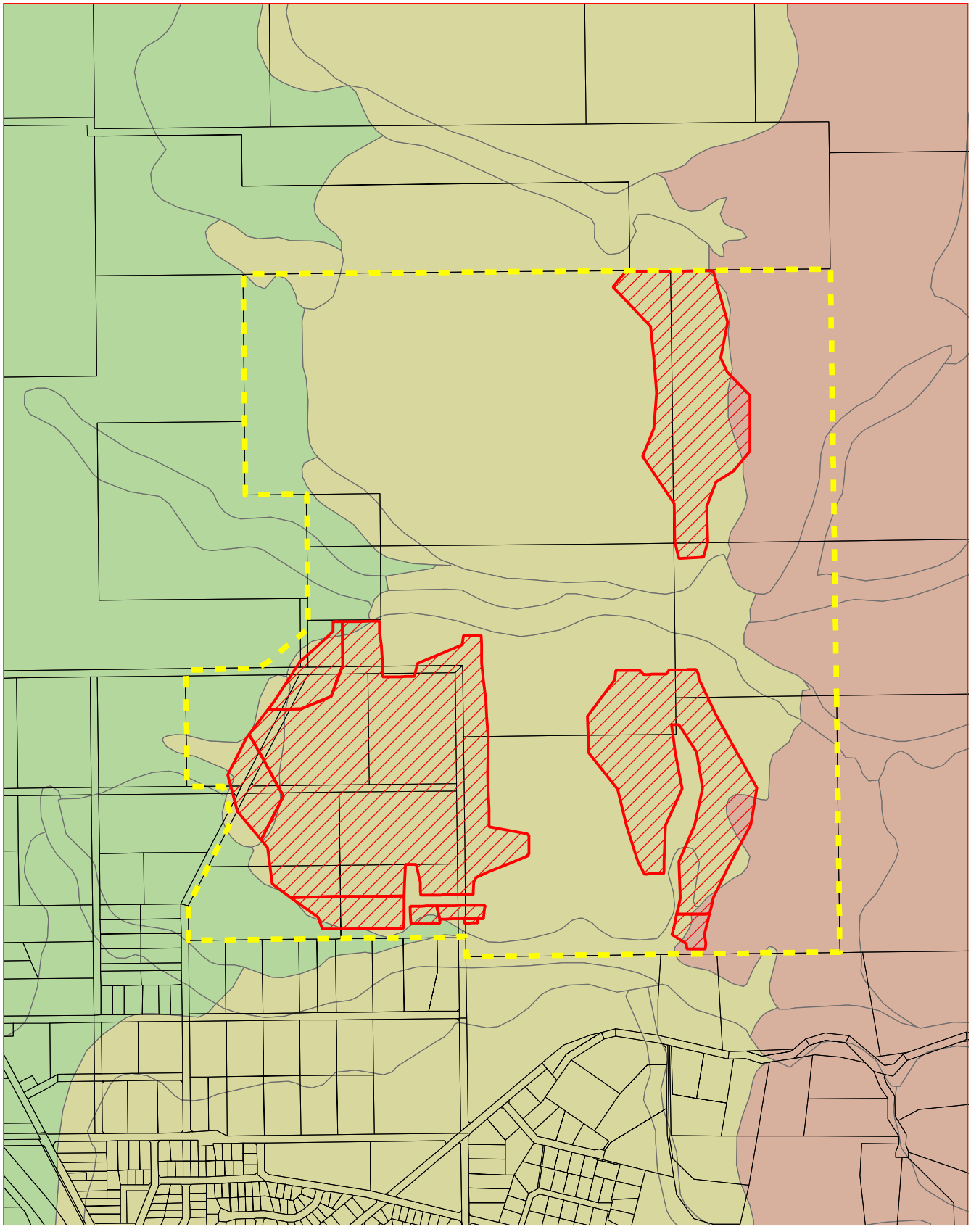
Iluka Resources Limited
WAROONA PROJECT - IMPACTS OF
MINING ON SHALLOW GROUNDWATER RESOURCES

TYPICAL SHALLOW GEOLOGICAL PROFILE REGIONAL CONTEXT

URS

Figure 9

Adapted from Geological Survey of Western Australia
1:50 000 Environmental Geology Series, Lake Clifton - Hamel Sheet



Legend

- Project area
- HM Reserves
- Forrestfield Soil Type
- Murray Soil Type
- Pinjarra Soil Type

N

0 250 500 750 Meters

ILUKA

ORIG:	L.Sadler
DRAWN:	D.G.S.
SCALE:	1:15,000
DATE:	17 Oct. 2005

WAROONA

SOILS IN THE WAROONA AREA

DWG No: 150057 ver.02

FIGURE: 10

4.5. Groundwater

The Project Area is located within the south-east portion of the Waroona Sub-area of the Murray Groundwater Area. The major aquifer zones that occur locally are limited to the Yoganup Formation and the deeper sedimentary deposits of the Perth Basin. The Archaean bedrock that forms the Yilgarn Shield does not form significant aquifers nor does it contain significant groundwater resources (Figure 9).

The aquifer systems underlying the Project Area consist of, in downwards order, the following formations:

- Superficial Aquifer, found within the Yoganup Formations (extending to 30 m depth);
- Leederville Aquifer (commencing from 10 – 30m to approximately 130 m); and
- Cattamarra Coal Measures (below 130 m depth).

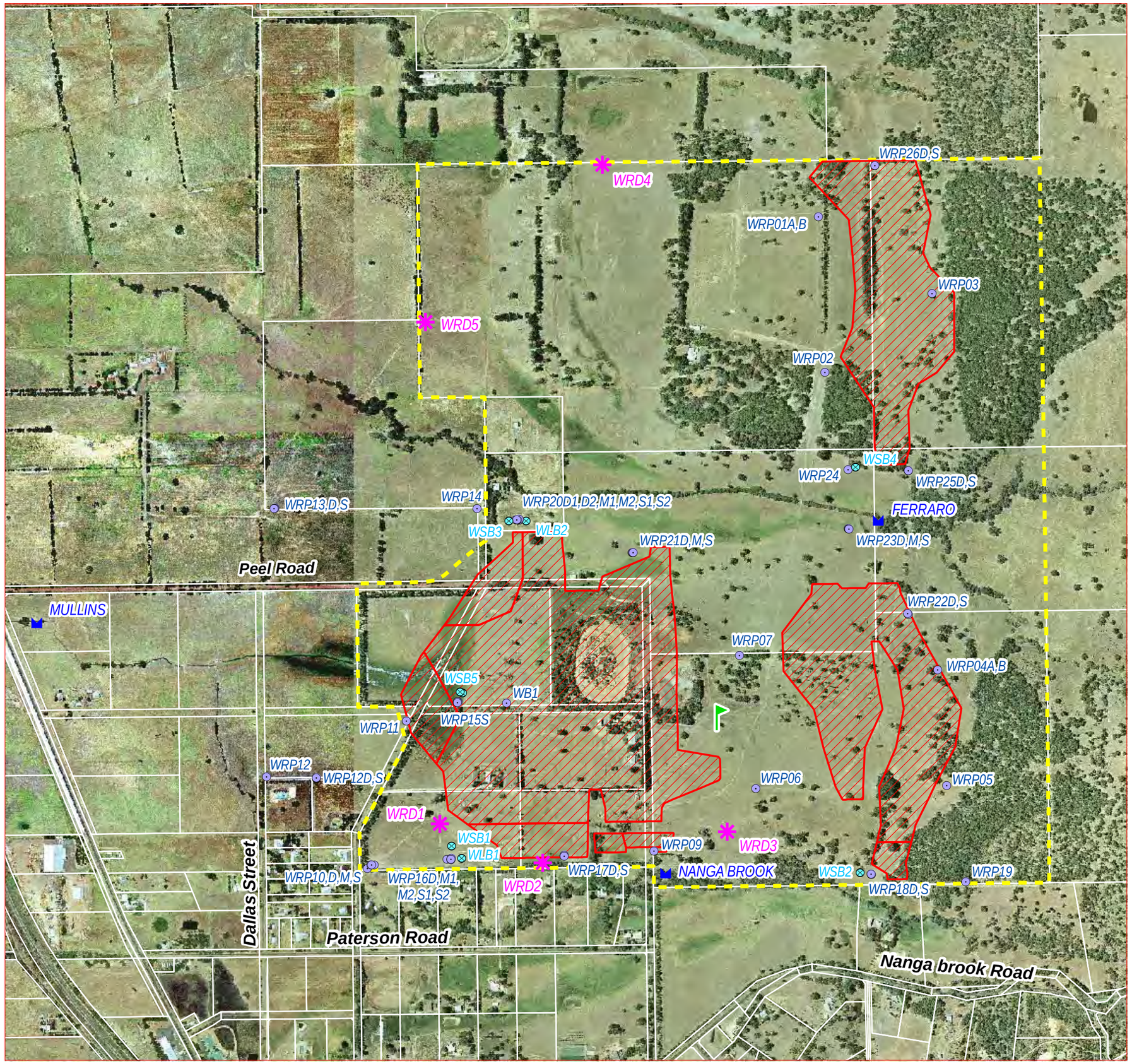
The Project Area occurs within one of the recharge zones for the Southern Perth Basin aquifer systems. Groundwater quality and quantity have been monitored by Iluka across the Project Area since 1992. Figure 11 shows the location of monitoring sites. The data provides an excellent baseline for the Project Area. Generally the groundwater quality within the Superficial Aquifer and shallow Leederville Aquifer is fresh to brackish, with measured salinity in the range 70 to 3,200 mg/L Total Dissolved Solids (TDS). Typically, the salinity increases with depth within the different aquifers. Hydrographs for bores in the Waroona Project Area are shown in Figure 12. These show the salinity and water levels for groups of bores across the Waroona Project Area.

4.5.1. Superficial Aquifer

The proportion of clay fines within the soil can be used to broadly indicate that saturated portions of the Yoganup Formation would generally form a low permeability aquifer. However the fines content decreases within the western areas of the Project Area. This higher permeability indicates the existence of preferred flow paths forming zones of high transmissivity. Within the Project Area the Superficial Aquifer is the most prevalent aquifer system (URS, 2002).

Where the Guildford Formation overlies the Yoganup Formation at the western margin of the Project Area, it is thought to form a confining layer (Figure 9). The confining layer, combined with clearing, has resulted in groundwater discharge occurring from the Yoganup Formation at the Mullins Sumpland.

Monitoring of groundwater within the Superficial Aquifer bores in the Project Area indicate that the water table is typically fresh, with bottom sections exhibiting fresh to brackish groundwater.



REVISIONS

Ver.	ORIG	DESIGN	DATE	COMMENTS
02	L.S.	D.G.S.	14.6.5	Project area added
03	L.S.	D.G.S.	17.10.05	Northern Pit Updated

Legend

- Project area
- HM Reserves
- Cadastre
- Bore
- Piezometer
- Weather Station
- Dust Monitoring Sites
- Surface Water Gauging Stations

Date of Photography: 2001

N

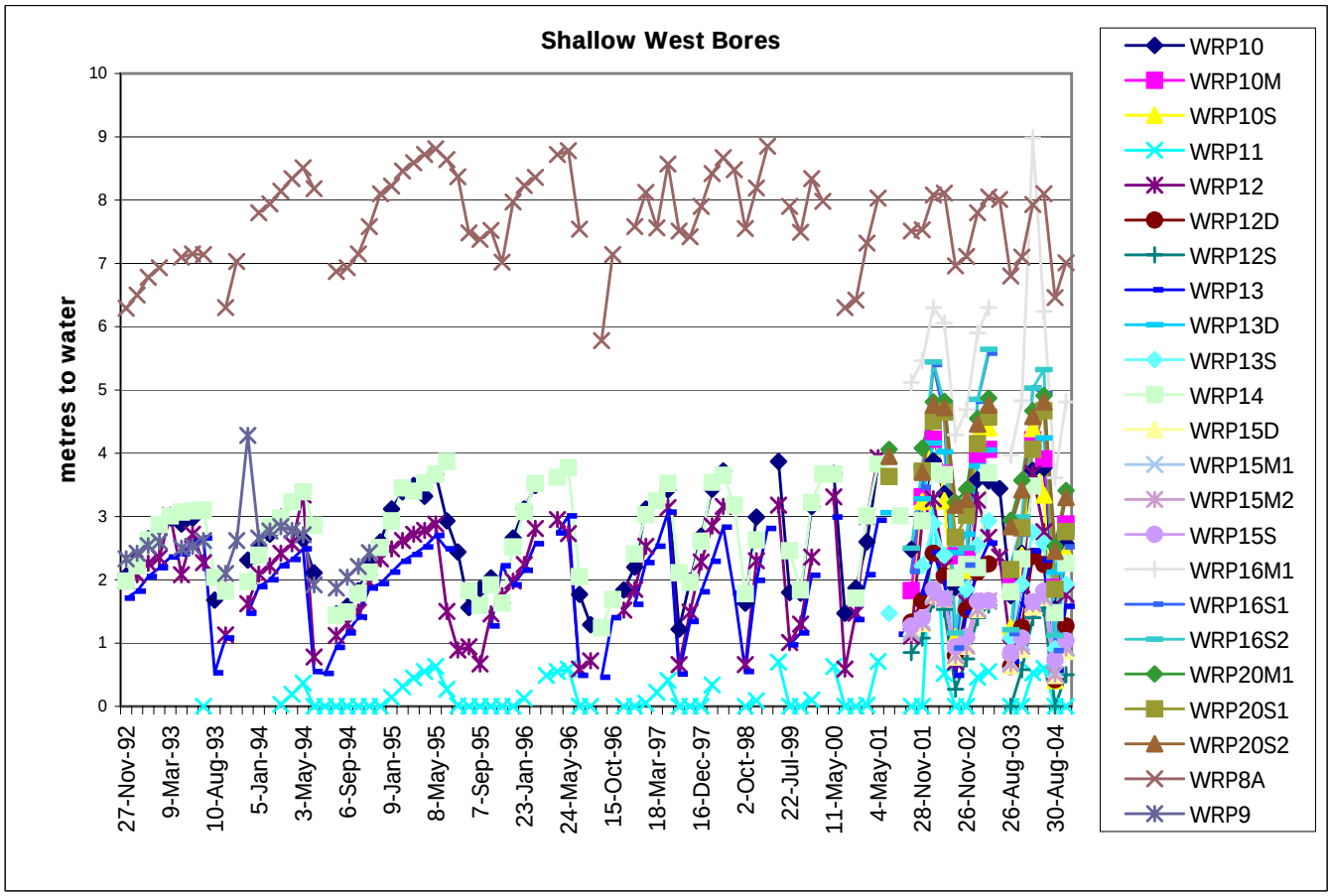
0 250 500 750 Meters

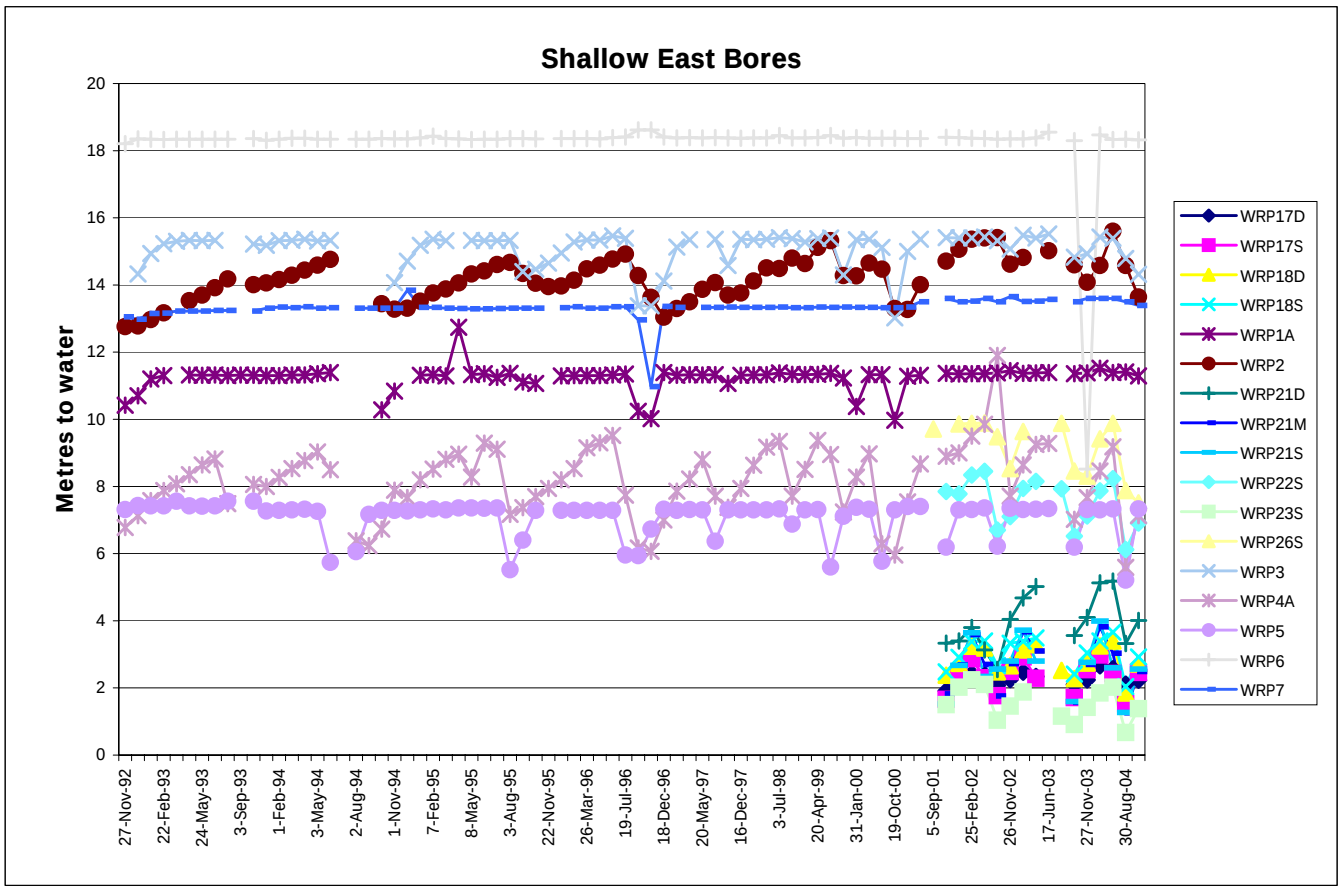
ILUKA

WAROONA

MONITORING SITES

ORIG:	L.Sadler		
DRAWN:	S.P.		
SCALE:	1:10,000		
DATE:	24 March 2005	DWG No: 150056 ver.03	FIGURE: 11

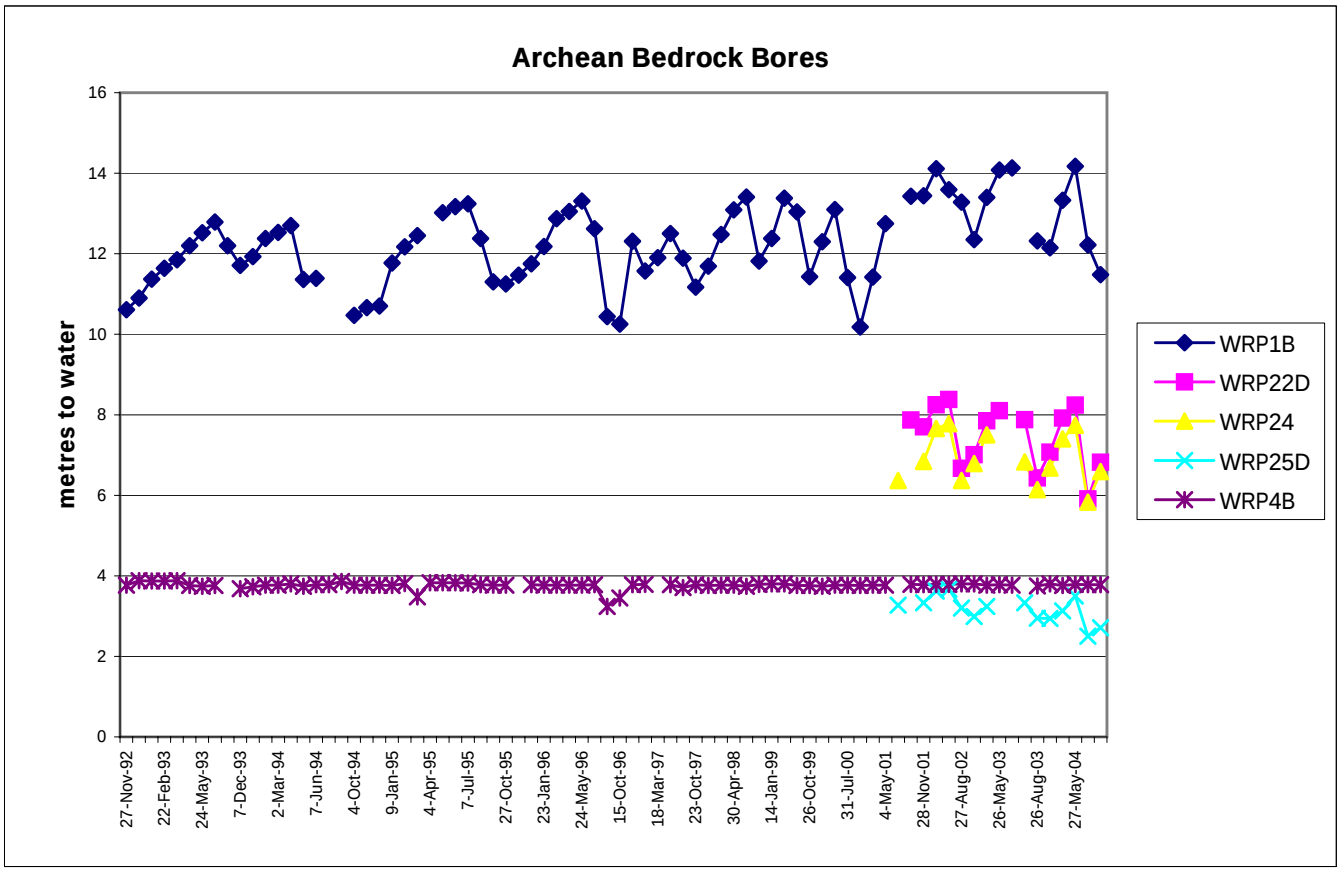


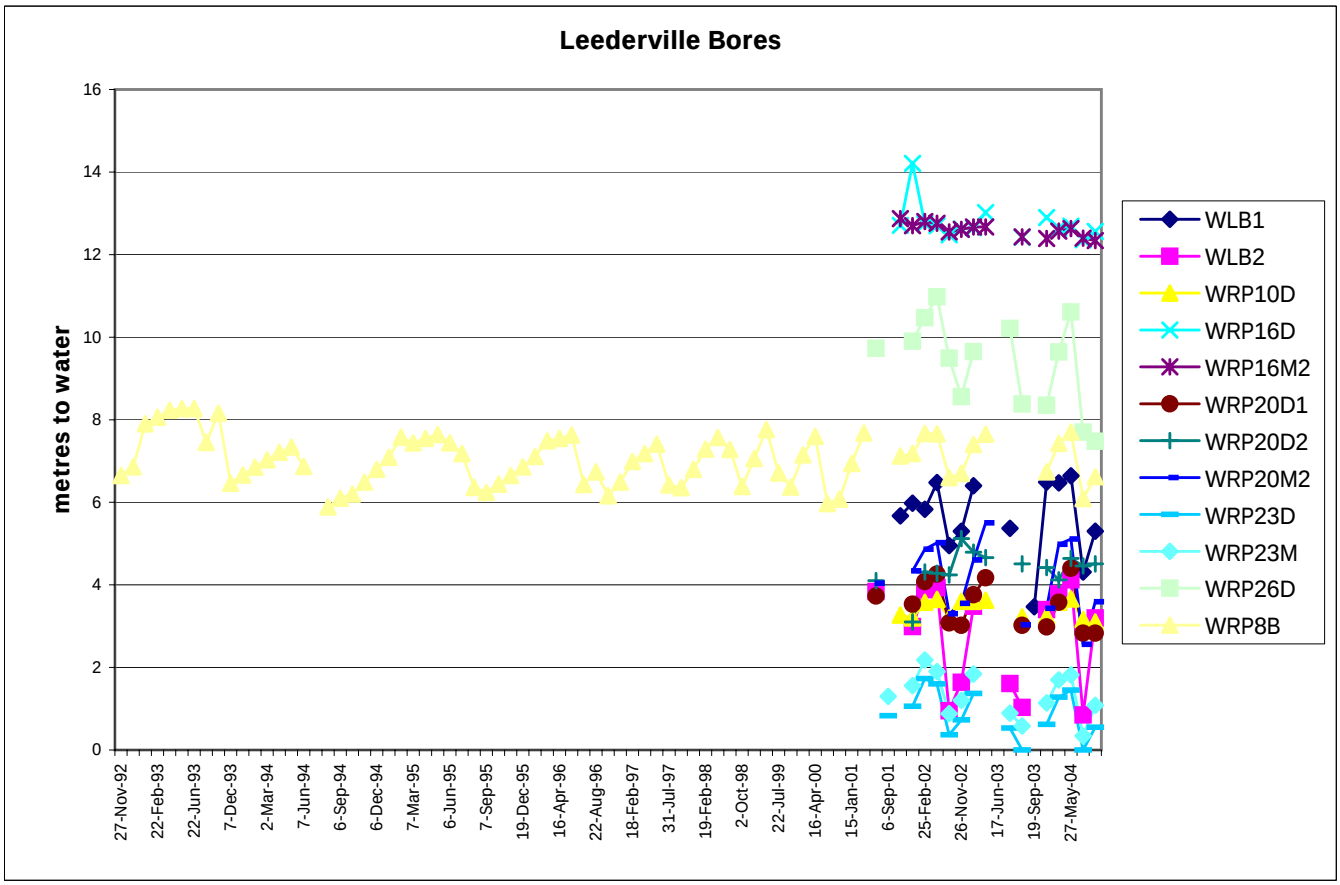


WAROONA PROJECT

Bore Hydrographs

Figure 12a





WAROONA PROJECT

Bore Hydrographs

Figure 12b

4.5.2. Leederville Aquifer

The inter-bedded sediments of the Leederville Formation have resulted in a multiple-layered, confined aquifer system of regional extent. The dominance of clayey sediments within the upper section of the Leederville Formation results in a low permeability and subsequently forms a low yielding aquifer. This occurs in areas close to the escarpment and the Darling Fault. The groundwater quality here is brackish, with salinity increasing with depth (URS, 2002).

4.5.3. Cattamarra Coal Measures

A multi-layered aquifer system of regional extent has formed within the Cattamarra Coal Measure. Regional data indicates the groundwater quality of the deep confined aquifers is brackish to saline, ranging from 3,000 to 10,000 mg/L TDS. Available data indicates that the aquifers found 7km south of Waroona are low yielding.

4.5.4. Local Groundwater Users

Historical demand for groundwater resources in the local area have been primarily met by abstraction from the superficial formations by landowners and from the Leederville Formation for domestic and stock purposes. Local landowners bores were identified through a bore census conducted as part of the groundwater studies.

4.6. Surface Hydrology

The Project Area lies within the Harvey River Basin catchment area. There are three streams that lie within or immediately adjacent to the Project Area originating within the hinterland of the Scarp and meandering west to north west across the Swan Coastal Plain before discharging into the Harvey River and ultimately Harvey Estuary and the Peel Inlet.

Within the Project Area Ferraro Brook traverses the Project Area between the proposed mining areas. Nanga Brook flows along the southern boundary of the Project Area. Wealand Brook is to the north of the Project Area. Mullins Sumpland lies to the west of the Project Area between Bradford Road and the South Western Highway and is an expression of the shallow groundwater table as outlined in section 4.5. The landowner reported the sumpland appearing after clearing over 80 years ago. The drain was then dug from the area to Nanga Brook. Ferraro and Wealand Brook join the Mayfield Drain and Nanga Brook joins the Drakesbrook Drain (Figure 13). Figure 14 and Figure 15 show photo sites of the surface water systems in the Project Area.

Surface water flows and quality within Ferraro and Nanga Brooks and west of the Mullins Sumpland have been monitored by Iluka since 1994 (Figure 16). Monitoring of Wealand Brook commenced in 2004. Runoff from rainfall is the major component of streamflow, particularly within the upper catchment areas. The brooks and drains are seasonal with some small permanent pools maintained by groundwater over summer. Water quality within the upper catchment areas is usually fresh, with salinity ranging up to 300 mg/L TDS.

The stream landscapes are considered extremely degraded due to historical clearing of catchment vegetation, drain construction and unrestricted stock access. Channels are characterised by extensive erosion with bank slumping, channel widening and bed down-cutting (Wetland Research and Management, 2005a).

The local surface waters are used for irrigation supply, environmental and recreational purposes. The Waroona and Harvey Irrigation Areas lie to the west and south west and are separated from the Project Area by the South Western Highway. Historically, the demand for irrigation water has averaged 60,000 ML/annum in the Harvey Irrigation Area and 16,000 ML/ annum in the Waroona Irrigation Area. Town water supply demand from surface water resources within the Harvey River Basin is currently about 2,000 ML/annum (URS, 2002). The increasing demand for water resources and activities such as clearing, damming and the movement of cattle have all contributed towards reducing the quality of water resources within the middle to lower catchment area.

A survey was conducted of the aquatic ecosystem at 12 sites along Ferraro Brook, Wealand Brook and Nanga Brook in October 2004 (Figure 17). Table 5 shows a description and environmental rating of the aquatic ecosystem sites surveyed. The ecosystems are considered of limited regional conservation value due to drain construction, disturbance of the riparian zone and loss of in-stream habitat. Aquatic biota study sites were characterised by moderate biological water quality. All watercourses were meso-eutrophic. At a number of sites, total nitrogen and total phosphorus levels exceeded the recommended maxima for the protection of aquatic ecosystems (Wetland Research and Management, 2005a). Macroinvertebrate communities at all sites were dominated by cosmopolitan species, typical of lowland rural regions. A total of 128 aquatic fauna taxa were identified across the 12 sites (Figure 17). Fauna was dominated by insects that feed on organic debris (78%). Well represented were the Diptera (two-winged fly), Coleoptera (aquatic beetles), Crustacea and Odonata (dragonflies and damselflies). Species diversity was low-moderate and typical of disturbed rural systems on the Swan Coastal Plain. There was no significant difference in taxa richness between the brook and drains. Koonacs and gilgies were also collected. Local landowners identified a number of small permanent pools that occur intermittently along Wealand Brook (sites WB2 and WB4), Ferraro Brook (upstream of FB3) and Upper Mayfield Drain (between sites UMD1 and UMD2). Though not confirmed it is likely that the pool at FB2 is also permanent (Figure 17). There was anecdotal evidence from landowners that the permanent pools provide habitat for the western long-necked tortoise. Two native fish (western minnows and pigmy perch) were present in low numbers. In their current condition, the drains and brooks do not provide suitable bedding or nursery habitat for native fishes.

Social water values of Nanga Brook, Ferraro Brook and Wealand Brook have been identified during specific studies (Wetland Research and Management, 2005b and URS, 2002) and in general consultation and discussion with neighbouring landowners. These are outlined under the description of each watercourse in the following sections.

Table 5: Description of aquatic fauna sites surveyed in October 2004

Table adapted from Wetland Research and Management, 2005a

Site Location	Bed Substrates	Site Description	Assessment Code	Environmental Rating
Wealand Brook				
Site WB1 Most upstream site on Wealand Bk; base of Scarp. Private property.	Gravels & clayey sand; overlain with organic silts 4-5 cm deep.	Sparse to open overstorey of *Eucalyptus* spp. Understorey predominantly pasture species; stock access/trampling (horses); channel heavily encroached by pasture grasses; *Lemna* spp. providing almost 100% channel cover in parts; waterlogged soils.	C1 (Erosion prone; understorey weeds only) B3 (Degraded; understorey weed dominated)	Poor - Moderate
Site WB2 Start of channelised section of Wealand Bk. Private property.	Sand overlain with silts.; sedimented to 50 cm (silt, anoxic mud).	Permanent pool; cattle access point. Overstorey of sparse paperbark *Melaleuca* sp. (moderately dense stand of paperbarks upstream), no native understorey other than clumps of sedge at edge of channel & encroaching pasture grasses. Point undercutting; down cut by ~1.5 m on south bank and ~0.5 m on north bank; tree roots scoured. Heavy trampling by cattle; 20-30% bare soils; 30-50% cover of algae and pond weed in-stream.	D1 (ditch or drain eroding; extensive erosion and saltation) C3 (Erosion and subsidence present)	Poor
Site WB3 Perched wetland on north side of Wealand Bk between SW Hwy & Railway. Reserve 31437. TEC community type 8.	Silt/mud/soft sediment; anoxic layer over clay; claypan.	Ephemeral wetland; dense emergent & submerged macrophytes, sedges & *Watsonia* spp.; lot of algae. Fringing open to mod-dense paperbarks to north-east. Bounded by drain levee to south and rail embankment to west. Standing water in wetland elevated above level in drain. Minor disturbance – tracks, rubbish dumping.	A3 (Slightly disturbed; local weed infestations)	Good
Site WB4 Wealand Bk, immediately west of Railway. Private property.	Clay and sand overlain with fine organic silts; anoxic muds; exposed coffe-rock; bedrock/ gravels near road culvert.	Mainly open pasture with a few scattered paperbarks. Trapezoidal channel with series of small pools; banks downcut to 2 m with major undercutting; 40-50% microphyte (*Potomageton*) & algal cover, some *Typha* stands; very turbid waters; *Oxalis* & other pasture weed choked channel; slow flow (max. < 5 cm/s). Channel fenced.	D2 (Freely eroding ditch; erosion/saltation out of control)	Very Poor
Ferraro Brook				
Site FB1 Most upstream site on Ferraro Brook; on Scarp. Mine lease, above pit areas. Iluka Property.	Granite/bedrock controlled; v. fine silt layer, 1% boulders, sand, gravel, rock.	Uphill; mod-steep slope; series of riffles & pools; narrow channel; open-mod dense *Melaleuca* & scattered euc's; channel incised & downcut to 1.5 m in places (ave. 0.5 m downcut); banks undercut and ± vertical; pasture spp. dominate understorey; max width 1.5 - 2 m (pools & meander bends); 10% filamentous algae; water clear.	B3 (Degraded; understorey weed dominated)	Poor - Moderate

Site Location	Bed Substrates	Site Description	Assessment Code	Environmental Rating
Site FB2 Ferraro Bk, base of Scarp. Mine area between North & south pits & above proposed dam site & d/s of gauging station. Iluka Property.	Gravels & sand.	Mod-dense paperbark woodland with scattered *E. rudis* over pasture grasses. Brook banks down-cut in places to 2+m; 15% filamentous algae, 5% bare soil. Cattle access.	C3 (Erosion and subsidence present)	Poor
Site FB3 Ferraro Bk on coastal plain east of SW Hwy. Private property.	Granite/bedrock & gravels; fine silt layer in pools.	Dairy farm; much of brook channelised & deeply (4 m) downcut; extensive bank slumping & undercutting; scouring. WRC constructed waterfalls in 2003. Overstorey of open *E. rudis* & paperbarks; understorey all pasture grasses. No macrophytes.	D3 (Weed infested drain; highly eroded)	Very Poor
Site FB4 Ferraro Bk, immediately west of Railway. Private property.	Sands & exposed coffee-rock	Drain. Open paperbarks over grass spp/pasture; replanted native veg. along northern bank over an area 4-5 m wide (trees <50cm tall). Channel overgrown - grass encroachment 20-30%. Banks down-cut 1.5 m on northern bank and 1 m on southern bank; major undercutting. Clear water.	D2 (Freely eroding ditch; erosion/saltation out of control)	Very Poor
***Site FB5** At confluence of Ferraro and Wealand brooks. Private properties.	Clayey sands & exposed coffee-rock; sedimented to 10 cm in places.	Drains. Scattered paperbarks over grass/pasture. A few clumps of sedge at waters edge; ~5% *Potomageton* sp. & *Lemna* sp. Trapezoidal channel with series of small, shallow pools. Channel overgrown - grass encroachment 20-30%. Banks down-cut to 1.5 m; major undercutting; some bank slumping. Clear water. Channel fenced. *Eleocharis* sp. (??*E. keigheryi*) in Wealand Brook ~60 m u/s of confluence & near fence across channel (x-sect. 15).	D2 (Freely eroding ditch; erosion/saltation out of control)	Very Poor
Upper Mayfield				
Site UMD1 Upper Mayfield Drain, Whettem Rd, ~1km d/s from confluence of Ferraro & Wealand brooks. Private property.	Clayey sands and silt over coffee-rock; sedimented to 10 cm in places.	Drain on dairy farm. No remnant vegetation; cleared, open pasture; replanted native veg. (1-2m high) adjacent to banks. Trapezoidal channel; banks down-cut 1.5 m & very steep; major undercutting; channel widening; 5% bare soils. Waters a little turbid; quite fast flowing. Some small shallow pools; groundwater springs downstream.	D2 (Freely eroding ditch; erosion/saltation out of control)	Very Poor
Site UMD2 Upper Mayfield Drain; most downstream site in study area; ~5Km west of SW Hwy, off Somers Rd. Private Property.	As for Site UMD1	As for Site UMD1	D2 (Freely eroding ditch; erosion/saltation out of control)	Very Poor
Nanga Brook				
Site NB1 Hill Street weir, main channel of Nanga Bk; within mine lease, adjacent to southern boundary. Iluka Property.	Sand/gravel with some overlying organic silts in pools; sedimented to 25 cm deep on inside of meanders.	Adjacent to old piggery; mod-dense overstorey of *Melaleuca* spp. and open *Eucalyptus rudis* over pasture grasses; down cut 2+m with major undercutting; tree roots scoured; 30% bare sand; no instream macrophytes; small gravel run by bed; upstream of weir; series of riffles and pools upstream of weir.	C1 (Erosion prone; understorey weeds only)	Poor

Nanga Brook

Nanga Brook is an ephemeral stream that flows from the Darling Scarp to the Swan Coastal Plain. Approximately 30% of its catchment upstream from Nanga Brook gauging station (Figure 11) has been cleared and the amount and quality of remaining native riparian vegetation has declined along its length. This is particularly the case downstream from the Project Area within the flatter terrain of the Swan Coastal Plain (URS, 2002). The lower section of the brook is highly modified west of the South Western Highway where its natural pathway is diverted into the Drakesbrook Drain before ultimately discharging into the Harvey River and subsequently the Harvey Estuary and Peel Inlet (Figure 13 and Figure 14).

Nanga Brook upstream of the Southwest highway is utilised primarily by local landowners as a water source for stock, irrigation and aesthetic purposes. The Brook has been dammed for farm/residential supply and ornamental purposes in several places. Anecdotal information from landowners suggests that water quantities have reduced as a result of an increased number of properties utilising water from Nanga Brook. Downstream of the confluence with Mullins Sumpland, Nanga Brook flows through two private properties before joining the Drakesbrook Drain. Two landowners are located along this stretch of the brook of which one landowner utilises the water for stock.

Iluka have two stream gauge points on Nanga Brook; Nanga Brook gauging station within the upper reaches of the catchment near the base of the Scarp, and Mullins gauging station located within the lower catchment area before Nanga Brook intersects with the South Western Highway (Figure 11). Mullins gauging station includes flows from the Mullins Sumpland. Average monthly flows in the gauging stations are shown in Figure 16. Significant water flows in Nanga Brook commence around May and continue through to October when the flow reduces to typically 5,000 m^3 or less during the summer months. Between 30–60% of flows recorded in Nanga Brook at Mullins gauging station are estimated to come from Mullins Sumpland with higher percentage contributions in summer months.

Harvey Estuary

Old Bunbury Road

MAYFIELD DRAIN

South West Highway

Williamson Road

WEALAND BK

FERRARO BK

NANGA BK

DRAKESBROOK DRAIN

DRAKESBROOK DRAIN

HARVEY RIVER

Coronation Road

Waroona

WAROONA DRAIN

Old Coast Road

Indian Ocean

Legend

Project area

N

0 2 4km

ILUKA

WAROONA

DRAINAGE SYSTEMS

ORIG: L Sadler		
DRAWN: D.G.S.		
SCALE: 1:80 000		
DATE: 14 June 2005	DWG No: 143379 ver.01	FIGURE: 13

Photo 1 - Oct 2004

Photo 2 - Oct 2004

Photo 3 - Sep 2004

Photo 4 - Nov 2004

Photo 5 - Aug 2004

Photo 6 - Oct 2004

Photo 7 - Oct 2004

Photo 8 - Oct 2004

Photo 9 - Dec 2004

Wealand Road
Wealand Brook
South Western Highway
Mayfield Road
McNeill Road
Peel Road
Ferraro Brook
Photo 8
Photo 7
Photo 6
Photo 3
Nanga Brook
Photo 5
Photo 4
Photo 1
Photo 2
Dallas Street
Paterson Road
Photo 9
Fawcett Road
Nanga brook Road
McDowell Street
Hill Street
Tatchel Street
Coronation Road

REVISIONS

Ver.	ORIG	DESIGN	DATE	COMMENTS
01	L.S.	D.G.S.	14.6.5	Project area added, tenements removed
02	L.S.	D.G.S.	17.10.05	Northern pit updated

Legend

- Photo Site
- Project area
- HM Reserves

Date of Aerial Photography: 2001

N

0 250 500 750 Meters

ILUKA

WAROONA

NANGA BROOK PHOTO SITES

ORIG:	L.Sadler		
DRAWN:	S.P.		
SCALE:	1:12,500		
DATE:	8 Feb 2005	DWG No: 148400 ver.02	FIGURE: 14

Photo 6 - Nov 2004

Photo 5 - Aug 2004

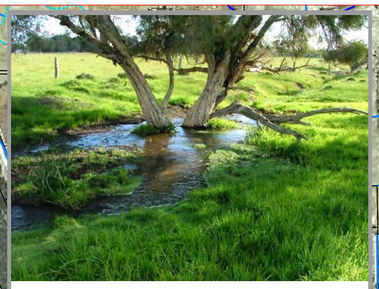


Photo 4 - Aug 2004

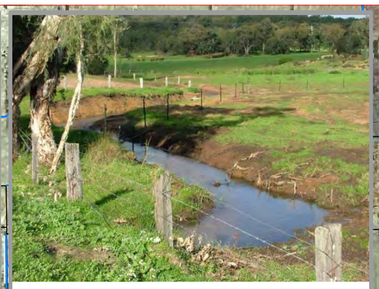


Photo 3 - Aug 2004

Photo 2 - Aug 2004

Photo 1 - Aug 2004

Photo 7 - Aug 2004

Photo 8 - Nov 2004

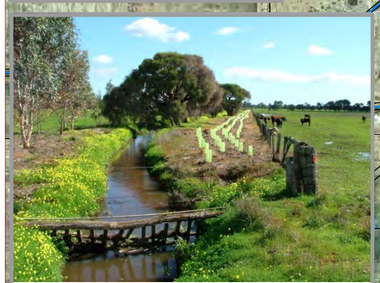


Photo 9 - Aug 2004

Photo 10 - Aug 2004

Photo 11 - Aug 2004

Photo 12 - Aug 2004

Photo 13 - Aug 2004

Photo 1
Photo 2
Photo 3
Photo 4
Photo 5
Photo 6
Photo 7
Photo 8
Photo 9
Photo 10
Photo 11
Photo 12
Photo 13

Wealand Road
Wealand Brook
Mayfield Road
South Western Highway
McNeill Road
Ferraro Brook
Peel Road
Nanga Brook
Nanga brook Road

REVISIONS

Ver.	ORIG	DESIGN	DATE	COMMENTS
01	L.S.	D.G.S.	14.6.5	Project area added
02	L.S.	D.G.S.	17.10.05	Northern pit updated

Legend

- Photo Site
- ILUKA Tenements
- HM Reserves
- Cadastre

Date of Aerial Photography: 2001

N

0 250 500 Meters

ILUKA

ORIG: L.Sadler
DRAWN: S.P.
SCALE: 1:12,500
DATE: 9 Feb 2005

WAROONA

FERRARO and WEALAND BROOK PHOTO SITES

DWG No: 148401 ver.02

FIGURE: 15

Ferraro Brook

Ferraro Brook is an ephemeral stream that originates within the Scarp, flowing north west once it reaches the lower topography of the Swan Coastal Plain. Like Nanga Brook, the lower reaches of Ferraro Brook are highly modified, with the natural pathway diverted into a system of drains, eventually becoming Mayfield Drain to the west of the South Western Highway and ultimately discharging into the lower reaches of the Harvey River and subsequently the Harvey Estuary and Peel Inlet (Figure 13 and Figure 15). Flows recorded in Ferraro Brook are less than those in Nanga Brook with minimal flows recorded between the months of December and April (Figure 16).

Ferraro Brook is not dammed at any point and landowners generally rely on groundwater bores, wells and soaks to provide water for stock over summer. Livestock have unrestricted access to Ferraro Brook east of the highway. West of the highway, electric fences have been installed to facilitate vegetation restoration along many drain reaches and cattle access is only permitted at points. The seasonal nature of Ferraro Brook means it is not relied upon for agricultural, livestock or domestic supply (Wetland Research and Management, 2005a). In winter, channel and sheet flooding bring too much water to downstream properties resulting in flooding. Local landowners commented that the brooks and drains typically run at bankfull each winter and drain reaches west of South West Highway may flood several times during a wet season. The majority of landowners contacted expressed more concern about groundwater drawdown than reduction in surface water flows (Wetland Research and Management, 2005a).

Ferraro Brook passes through remnant native vegetation containing TEC's between the railway and South West Highway (photo 8 in Figure 15). The brook is a drain by this stage and there are few riparian values. The surrounding vegetation is unlikely to be dependent on surface water flows in Ferraro Brook (Wetland Research and Management, 2005a).

An assessment of ecological water requirements (EWRs) was conducted along Ferraro, Wealand and Mayfield Drain (Wetland Research and Management, 2005b). Flows to meet EWRs were modelled using RAP (River Analysis Package) software incorporating the hydraulic model HEC-RAS (Hydrological Engineering Centre, United States Army Corps of Engineers, River Analysis System) (Wetland Research and Management, 2005b). The flow requirements to sustain ecological values in the system were assessed as:

- sufficient winter-spring flows to ensure any snags, rocks, macrophytes and some overhanging riparian vegetation remains inundated, ensuring habitat diversity is maintained;
- sufficient winter flows to maintain upstream-downstream linkages and therefore the transport of energy/carbon;
- an average depth of 5-10 cm is required over ripple zones to maintain winter-spring habitat for macroinvertebrates and provide for fish passage;
- predictable winter-spring flooding must be maintained to encourage breeding and recruitment of western minnows; and
- maintenance of natural seasonality (zero flows over summer and early autumn).

Flow Events Modelling (FEM) was then used to determine flow volume and frequency necessary to sustain these ecological water requirements. A summary of ecological flow

recommendations determined for Ferraro Brook and Upper Mayfield Drain are shown in Table 6.

Table 6: Ecological Flow Recommendations

Flow Component	Ecological attribute / Value	Season (duration)	Hydraulic metric	Ecological Flow Recommendation
Fish Passage Flow	Native fish diversity	Late Autumn - early Spring	Minimum depth over obstacles of 0.10 m; late May – November.	≥ 0.07 m^3/sec for duration of approx. 0.5 days in May, gradually increasing to 6 days in September, reducing again to 0.5 days in November.
Winter Low Flow	Invertebrates Native fish Vegetation Process	Winter - early Spring	Minimum stage height of 0.05 m & 100 % cover over gravel runs & riffles.	0.02 m^3/sec for duration of approx. 24 days/month during July, Aug. & Sept., with transition between summer & winter base flows during May/June & October/November.
Winter Medium Flow	Native fish Vegetation Process	Winter – early Spring	Flood lower benches	0.15 m^3/sec during winter with peak frequency of 2 days/month in July, Aug. & Sept., with peak duration of up to 7 days in July-Aug.
Active Channel Flow	Channel morphology	Winter	Active channel stage height on a 1:2 - 1:3 year frequency	0.45 m^3/sec for a duration of 1 day every 2 – 3 years.

Winter flows are now greater than would have occurred historically, however the seasonality of the flow regime has been maintained. Since the waterbodies are naturally seasonal, maintenance of summer surface flows in Ferraro Brook and Upper Mayfield Drain would not be required to maintain the existing riverine ecosystems. Any reduction in surface flows is likely to be compensated by overland paddock flows. Over summer, channel pools are likely to be maintained by groundwater. Retention of winter flows for maintenance of pool morphology is recommended, in order that pools continue to provide a summer dry-season refuge for macroinvertebrate species and to a lesser extent, long-necked tortoises (Wetland Research and Management, 2005b).

Wealand Brook

Wealand Brook is an ephemeral stream, similar to Ferraro Brook. Wealand Brook turns into an agricultural drain less than 1 km from its upstream reaches. Wealand Brook joins Ferraro Brook and becomes the Mayfield Drain west of the South West Highway at photo point 10 in Figure 15. There is unrestricted stock access to the upper reaches of the brook. Downstream the agricultural drains have largely been fenced off and tree-lined (photo 9 and photo 11 in Figure 15). Similar to Ferraro Brook, Wealand Brook is not relied on for water supplies and floods regularly. Wealand Brook also passes through the remnant native vegetation (photo 6 in Figure 15). Minimal riparian values were identified in this section of Wealand Brook and surrounding vegetation is unlikely to be dependent on surface flows in Wealand Brook (Wetland Research and Management, 2005a).

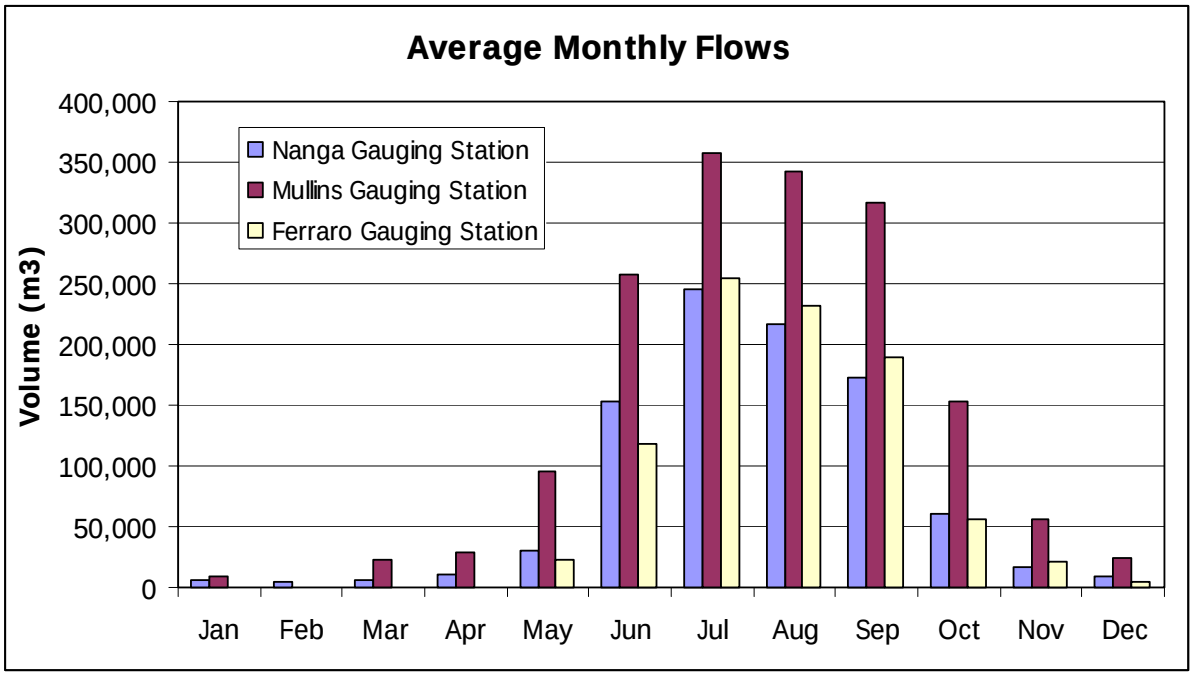


Figure 16: Average Monthly Flows in Ferraro Brook and Nanga Brook (when recorded during period 1995 to 2004)

4.7. Wetlands

Wetlands not only include lakes with open water but areas of seasonally, intermittently or permanently waterlogged soil. Approximately 25% of the Swan Coastal Plain between Moore River and Mandurah is classified as wetland (WRC, 2001). The classification system developed by the Semeniuk Research Group is employed for wetland classification on the Swan Coastal Plain (Hill et al, 1996). This system classifies wetlands based on landform and water permanence and includes dampland (seasonally waterlogged basin), sumpland (seasonally inundated basin), lake (permanent inundated basin), artificial basins (dam), floodplain (seasonally inundated flat) and palusplain (seasonally waterlogged flat).

Wetlands of international significance are listed under the Ramsar Convention which is an international treaty that covers the conservation of wetlands of international importance. Within Western Australia, twelve of these wetland systems are listed, none of which are located within or in close proximity to the Project Area.

Wetlands of national significance requiring protection are listed under the Directory of Important Wetlands and/or under the Australian Heritage Commissions Register of the National Estate. There are no listed wetlands within the Project Area or within a 4 km radius that are considered to be of national significance.

Wetlands of regional significance within the Swan Coastal Plain are protected under the Environmental Protection (Swan Coastal Plain Lakes) Policy (EPP) 1992. There are no EPP wetlands within the Project Area, however there are four gazetted EPP wetlands within a 4 km radius of the Project Area. Gazetted EPP Wetland 724 is approximately 3.5 km to the west whilst wetlands 740, 743 and 745 are clustered together over 4km to the south of the Project Area (Figure 17).

Three broad management categories are used to defined for wetlands (WRC, 2001). These include Resource Enhancement, Conservation and Multiple Use wetlands. Within the Project Area there are several areas classified as Multiple Use wetlands including Mullins Sumpland, and around and along Nanga Brook and Ferraro Brook (Figure 17). Multiple use wetlands are wetlands with few important ecological attributes and functions remaining (WRC, 2001). The management objective defined by WRC for these wetlands is "use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through landcare. Should be considered in strategic planning (e.g. drainage, town/land use planning)" (WRC, 2001). The areas classified as multiple use wetland within the Project Area are highly disturbed and have few wetland values or attributes other than hydrology (Wetland Research and Management, 2005a).

4.8. Vegetation and Flora

The Project Area and surrounding areas have been extensively cleared for agricultural purposes. Within the Project Area there remains only isolated paddock trees and small scattered clusters of native vegetation. Uncleared native vegetation, largely State Forest, exists to the east of the Project Area on the steep slopes and plateau of the Darling Scarp.

A spring vegetation assessment was undertaken by GHD in October 2003 of a study area comprising 600 ha, encompassing the proposed Project Area and the immediate surrounds (GHD, 2004). The survey was conducted in accordance with the methodology outlined in the EPA Position Statement Number Three on Terrestrial Biological Surveys (EPA, 2002a). An additional survey of the Project Area was conducted in August 2005 by Mattiske Consulting, focusing on three areas of native vegetation within the Project Area.

There are three broad historical vegetation complexes represented within the Project Area which predominantly reflect the topographical landscape units and their respective soil and moisture conditions. These vegetation complexes are the Darling Scarp Complex, the Forrestfield Complex (associated with Ridge Hill Formation) and the Guildford Complex (associated with the Pinjarra Plain) (Figure 18). Historically, approximately half of the Project Area would have been covered by vegetation from the Guilford Complex and Forrestfield Complex with small pockets of the Darling Scarp Complex along the eastern margins.

The condition and mosaic nature of the remaining vegetation made it difficult to directly associate it with the historical vegetation complexes. Remaining vegetation along the eastern boundary is representative of the mosaic that comprises the Darling Scarp Complex. Vegetation elements of the Guildford Complex exist on the flatter land of the Pinjarra Plain. Sandwiched between the Guildford and Darling Scarp Complexes, on the Ridge Hill Shelf, is the remaining vegetation from the Forrestfield Complex.

Williamson Road
UMD2
Mayfield Road
Whettem Road
724
FB5
WB3
WB4
FB4
Hall Road
Wealand Road
WB2
Wealand
Brook
WB1
FB3
Ferraro
Brook
FB2
FB1
Mayfield Road
South Western Highway
McNeill Road
Peel Road
Peel Road West
Drakesbrook
Drain
Nanga
Brook
Paterson Road
NB1
Nanga brook Road
McDowell Street
Brockman Road
Fawcett Road
Coronation Road
Somers Road
Waroona
Waroona
Drain
Weir Road
Buller Road
James Road
Riley Road
Burney Road
Roberts Road
740
McClure Road
743
745

Legend

- Aquatic study sites
- Project area
- EPP wetland with 50m buffer

Waters and Rivers - management areas

- Conservation
- No longer a wetland
- Not Assessed
- Resource Enhancement
- Multiple use

N

0 1000 2000 m

ILUKA

WAROONA

WETLAND AREAS

ORIG:	L Sadler		
DRAWN:	S.P.		
SCALE:	1: 40 000		
DATE:	20 June 2005	DWG No: 152501 ver.01	FIGURE: 17

F
Mel
WM
60m
80m
100m
120m

Legend

- Site Locations
- Survey Area
- Acacia oncinophylla ssp.oncinophylla

Assessed Remnants - Vegetation Complex

- F — Jarrah/Marri (Forrestfield)
- WM — Wandoo/Marri (Darling Scarp)
- MEL — Melaleuca, Eucalyptus rudis (Guildford)

N

0 200 400 600 Meters

Ver.	ORIG:	DESIGN	DATE	COMMENTS
02	L.S.	D.G.S.	17.6.5	Boundary colours changed
01	S.J.	S.P.	9.12.03	GENERAL REVISION

REVISIONS

ILUKA

ORIG :	S.JONES
DRAWN :	S.P.
SCALE :	1:10,000
DATE :	13 NOV 2003

WAROONA

VEGETATION COMPLEXES & REMNANT VEGETATION

DWG No : 124595 ver.01

FIGURE : 18

4.8.1. Vegetation

Two vegetation and flora studies were conducted at the site. The first was conducted by GHD in October 2003 with an additional follow up survey conducted by Mattiske Consulting in August 2005.

The initial survey assessed sixteen site locations were and classified into one of the three vegetation complexes described above (Figure 18). The condition of each site was rated according to the scale used for assessing Bush Forever sites (Government of Western Australia 2000). The scale is summarised in Table 7.

Table 7: Condition rating scale from Bush Forever (Government of Western Australia 2000 based on Keighery 1994)

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure covers repeated fire, aggressive weeds, dieback, logging, grazing.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure covers frequent fires, aggressive weeds at high density, partial clearing, dieback and grazing.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure includes frequent fires, presence of very aggressive weeds, partial clearing, dieback and grazing.
6	Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas often described as “parkland cleared” with the flora comprising weed or crop species with isolated native trees or shrubs.

Vegetation within the Forrestfield Complex was further separated into four different vegetation descriptions. The description of vegetation at the Project Area from the first survey is summarised below in Table 8.

Table 8: Description of vegetation areas identified within Study Site

Vegetation Complex (Heddle *et. al* 1980)	Vegetation Description	Site Locations	Bush Forever Scale Rating
Guildford Complex	*Eucalyptus marginata, Corymbia calophylla, Xanthorrhoea preissii* and *Xylomelum occidentale* scattered upslope within the paddocks and along fencelines. *Melaleuca rhaphiophylla, M. preissii, E. rudis, C. calophylla, Taxandria linearifolia* and *Kingia australis* were dominant species along creeklines. Some reeds (*Juncus pallidus*) and rushes (*Isolepis sp)* were found along Nanga Brook and Wealand Brook. The understorey of most creek and fenceline vegetation has been replaced by weeds and pasture species.	5,11,15	5 to 6
Forrestfield Complex	Dominated by *Eucalyptus marginata / Corymbia calophylla* woodland with a range of shrub and groundcover species. Understorey has been significantly grazed in most parts but there are some groundcover species (often tuberous) remaining.	1,2,7,10,12,13	Some sections of 2 and 13 rate 4, remainder 5 to 6.
	Woodland of *Eucalyptus marginata* and *Corymbia calophylla*, with scattered *Banksia grandis, Banksia attenuata* and *Xylomelum occidentale* with varying condition. Dense shrub layer is also present, with common species including *Hibbertia hypericoides, Bossiaea eriocarpa, Adenanathos meisneri, Dampiera linearis, Agrostocrinum scabrum* and *Pimelea imbricata.*	16	Western and northern sides are moderate to very good (3) with small areas in excellent condition (1-2). South and centre is in moderate condition (3-4). Eastern side is in poor condition (5).
	Eucalyptus marginata dominant on the sandy slope, with the occasional *Xylomelum occidentale*. Grazing is evidenced by the absence of a shrub layer, but the understorey is composed of a diverse mix of herbaceous species and monocotyledons. Common among these were *Xanthorrhoea gracilis, Desmocladus flexuosus, Sowerbaea laxiflora, Haemodorum sp*. and *Caladenia flava*. Scattered *Banksia grandis* and *B. attenuata* also present.	8,9	3

Vegetation Complex (Heddle *et. al* 1980)	Vegetation Description	Site Locations	Bush Forever Scale Rating
	Steep granitic gully in the eastern portion of this area is vegetated with an open forest of *Eucalyptus marginata, Corymbia calophylla* and scattered *Eucalyptus wandoo.* Creek and waterfall is 95 to 98% composed of pasture species with a small number of shrubs and herbaceaous species present. Creekline is infested with cotton bush.	4	Mostly 3, 5 along creek.
Darling Scarp	Vegetation mainly comprised of open forest of *Eucalyptus marginata* and *Corymbia calophylla,* with woodland of *Eucalyptus wandoo*. Lateritic hilltops and hillsides, and granitic slopes exhibited vegetation in a poor condition. Some shrubs and herbaceous species present however, grazing, pasture species and weeds have reduced the species diversity. Wealand Brook (site 6) is in slightly better condition and includes a variety of herbs and shrub species.	3,6,14	Mostly 4-5. Site 6 rates 3.

The second survey was aimed specifically at Sites 9 (Sandslope), 16 (Speedway) and Mullins sumpland located to the west of Site 16 (Mattiske Consulting 2005). Site 9 was considered the same vegetation unit as Site 8. Site 9 was selected for monitoring plots because it was considered to be slightly better condition.

A summary of the three sites is shown in Table 9. There is some variation in floristic data between the two surveys at Site 16. The Mattiske Consulting sampling took place two years afterwards slightly earlier in the season and was concentrated on the good quality vegetation in the south west corner of the speedway site.

Table 9: Vegetation description Sites 9, 16 and Mullins Sumpland

Location	Vegetation description	Bush Forever Scale Rating
Sandslope - Site 9	Sandslope (Site 9) is a Darling Scarp foothill surrounded by pastoral land. It featured sandy soils over laterite, which occasionally outcropped. The vegetation consisted of Open Forest of *Eucalyptus marginata* subsp. *marginata* with occasional *Corymbia calophylla*, *Banksia grandis*, *Banksia attenuata* and *Xylomelum occidentale* trees over a Low Shrubland/Sedgeland of *Xanthorrhoea* spp., *Tetraria octandra*, and a variety of native herbs.	The condition scale rating (Government of Western Australia 2000) of both quadrats was good (4) to very good (3).
Speedway – Site 16	Located in a small area of bushland on a gently-sloping sandy substrate to the south-west of an abandoned speedway track. The vegetation consisted of Open Forest of *Eucalyptus marginata* subsp. *marginata* with occasional *Corymbia calophylla* and *Banksia* spp. over a diverse range of understorey species dominated by	The condition scale rating (Government of Western Australia 2000) of both quadrats was very good (3).

Location	Vegetation description	Bush Forever Scale Rating
	Xanthorrhoea preissii.	
Mullins Sumpland	Mullins Sumpland was a degraded, seasonally-inundated basin measuring approximately 120m x 100m. The fringing vegetation consisted of a few small *Melaleuca preissiana* trees over a Sedgeland of *Lepidosperma effusum*, *Lepidosperma longitudinale* and **Isolepis prolifera*. It was surrounded by a pasture of kikuyu (**Pennisetum clandestinum*) and white clover (**Trifolium repens* var. *repens*). The preclusion of dampland native species by **Pennisetum clandestinum* and **Isolepis prolifera* means that the native understorey flora was largely limited to a few species of sedges occupying very boggy and/or seasonally-inundated ground.	-

The paucity of native flora means that the Mullins Sumpland vegetation does not warrant comparison with communities in a regional context.

Detailed comparisons have been made between the species recorded at the Sandslope - Site 9 and Speedway – Site 16 and the floras (*i.e.* 'typical' and 'common' species) listed for Community types 3b and 20b in Appendix 1 of Gibson *et al*. (1994). These two sites have been identified as having vegetation in very good condition on the Bush Forever Scale. Similarity co-efficients were also calculated from the floristic data recorded in both the GHD (2003) and Mattiske Consulting (2005) surveys.

Based on the two quadrats carried out at each site, Site 9 recorded 22 (58%) of the 38 typical and common community type 3b species and 25 (53%) of the 47 typical and common Community type 20b species. Site 16 recorded 22 (58%) of the 38 typical and common Community type 3b species and 23 (49%) of the 47 typical and common Community type 20b species. The similarity coefficients place both Site 9 and Site 16 somewhere between Community type 3b and Community 20b.

Gibson *et al*. (1994) found Community type 3b growing on alluvial soils near the Peel-Harvey estuary as well as on better-drained sites within the Pinjarra Plain unit on the eastern side of the Swan Coastal Plain. Community type 20b was found at the base of the Darling Scarp on Pinjarra Plain and Ridge Hill Shelf landforms between Byford and Yarloop (Gibson *et al*. 1994). A description of the 3b and 20b community types is given in Table 10.

Although the location of the two sites within the Forrestfield Complex would point to the sites corresponding to community type 20b, the dominance of *Eucalyptus marginata* and scarcity of *Banksia attenuata* at both sites and the greater proportion of typical and common Community type 3b species found at both sites means that Community type 3b –'*Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils' is a marginally better floristic match (Mattiske 2005). Discussions with CALM indicate that they consider Sites 8, 9 and 16 are representative of the Type 20b TEC.

If the native plant communities at Sites 8, 9 and 16 are considered in terms of the Gibson *et al*. (1994) community types, they correspond to vulnerable TEC types, either 3b of 20b. If Sites 8, 9 and 16 are considered as remnants of the Forrestfield Complex, they have particular regional significance because less than 17.5% of the original area of Forrestfield Complex vegetation remains. In either case the remnants which are less disturbed at Sites

8, 9 and 16 warrant consideration, so that the conservation values they represent can be retained or managed.

Three TECs occur approximately 2 km from the nearest pit (Figure 19). All co-occur within Parkland and Conservation Reserve 31437 that covers a total of about 36 hectares between South West Highway and the railway (English and Blyth, 2000 in Wetland Research and Management, 2005a). Community types present are 3a, 8 and 10a, as recognised by Gibson *et. al.,* 1994. A general description and category of each community type is presented in Table 10.

Table 10: Threatened Ecological Community Descriptions

Community Identity	General Description	Category of threat and criteria met under WA criteria	Category under Commonwealth *EPBC Act*
SCP 3a	*Corymbia calophylla* – *Kingia australis* woodlands on heavy soils, Swan Coastal Plain	CR B) ii) – Critically Endangered, current distribution is limited, there are very few occurrences each of which is small and/or isolated and extremely vulnerable to known threatening processes.	EN – Endangered, facing a very high risk of extinction in the wild in the near future.
SCP 8	Herb rich shrublands in clay pans	VU B) - vulnerable, can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.	Not listed
SCP 10a	Shrublands on dry clay flats	EN B) ii) – endangered, current distribution is limited, there are very few occurrences each of which is small and/or isolated and extremely vulnerable to known threatening processes.	Not listed
SCP 3b	*Corymbia calophylla* – *Eucalyptus marginata* woodlands on sandy clay soils of the eastern side of the Swan Coastal Plain	VN B) The ecological community can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.	Not listed
SCP 20b	Eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands	EN B) Current distribution is limited, and i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 10 years) ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes	Not listed

4.8.2. Flora

A search of Department of Conservation and Land Management (CALM) records for Declared Rare Flora (DRF) and Priority Flora (PF) within and surrounding the Project Area revealed that 19 PF species and four DRF species have the potential to occur within one kilometre of the Project Area. GHD reviewed this listing and identified eleven species that have the potential to occur within the Project Area based on similarity of habitat types and previous

collections. During the field survey one Priority 3 species, *Acacia oncinophylla subsp. oncinophylla*, was recorded in very low numbers (4 plants observed) at two locations (Site 3 & Site 14), in both cases on the Darling Scarp slopes near the eastern edges of the survey area (Figure 18). No other potential PF or DRF were observed and are considered unlikely to be found in the Project Area given the extent of clearing and grazing.

Priority Three Species are "taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey (GHD, 2004).

No Priority species or DRF were located in the second survey undertaken by Mattiske Consulting (2005). Two 10 m x 10 m quadrats were located at both Site 9 and 16. A total of 49 native and six introduced or exotic taxa were recorded in the two quadrats and surrounding bushland at Site 9. The mean native species richness was 32spp./100m^2. The woody shrub stratum seen in most south-western vegetation communities was almost entirely absent, which may reflect grazing pressure and/or burning regimes.

At Site 16, a total of 48 native and ten introduced or exotic taxa were recorded in the two quadrats and surrounding bushland. The mean native species richness was 27spp./100m^2. At Mullins Sumpland, sampling by quadrats was deemed inappropriate as the wetland included a range of plant communities along a moisture gradient.

4.8.3. Introduced Species and Weeds

A total of thirty three species of introduced and non-endemic species were identified within the study area. The diversity of weed species is high with twenty four genera represented.

The bushland at site 16 was being invaded from the east by *Adenanthos meisneri*, a native species that appears to have been planted around the speedway track. The areas bordering pasture to the south and west were infested by exotic grasses and herbs, especially kikuyu (**Pennisetum clandestinum*) and African lovegrass (**Eragrostis curvula*). To the north, the shrub layer was increasingly replaced by African lovegrass. At Site 9 there were very few weeds, even though the area was not fenced off from the surrounding pasture and there were signs of grazing (Mattiske Consulting 2005).

Amongst the weed species there were four declared weeds which are listed by the Department of Agriculture under the *Agriculture and Related Resources Protection Act* (1972) as being of particular significance. Weed species are usually listed because of their risk to agriculture.

The following Declared Species were present in the study area:

- Arum lily *Zantedeschia aethiopica* - this species is present along Nanga Creek, Ferraro Brook, a creekline north of the Project Area within Location 255 and in woodland on the foothills of Location 478.
- Cotton bush *Gomphocarpos fruiticosus* – this plant is mostly found in damp areas close to streamlines or where moisture runs off rocks (Location 255 & Lot 3).
- Blackberry *Rubrus ulmifolius* - occurs on Location 255 in small numbers along the creek.

- Apple of Sodom *Solanum linnaeanum* - observed on a sloping paddock in the foothills on Location 478.

The Commonwealth Government has produced a list of the top 20 Weeds of National Significance as part of the National Weed Strategy. These weeds are listed primarily due to the risk they pose to native ecosystems and their ability to spread rapidly. Two are present in the study area:

- Bridal creeper *Asparagus asparagoides* - found over shrubs on high ground at the eastern end of Location 255 and on Lot 3; and
- Blackberry *Rubus fruticose* (Location 255 and Lot 3).

4.9. Fauna

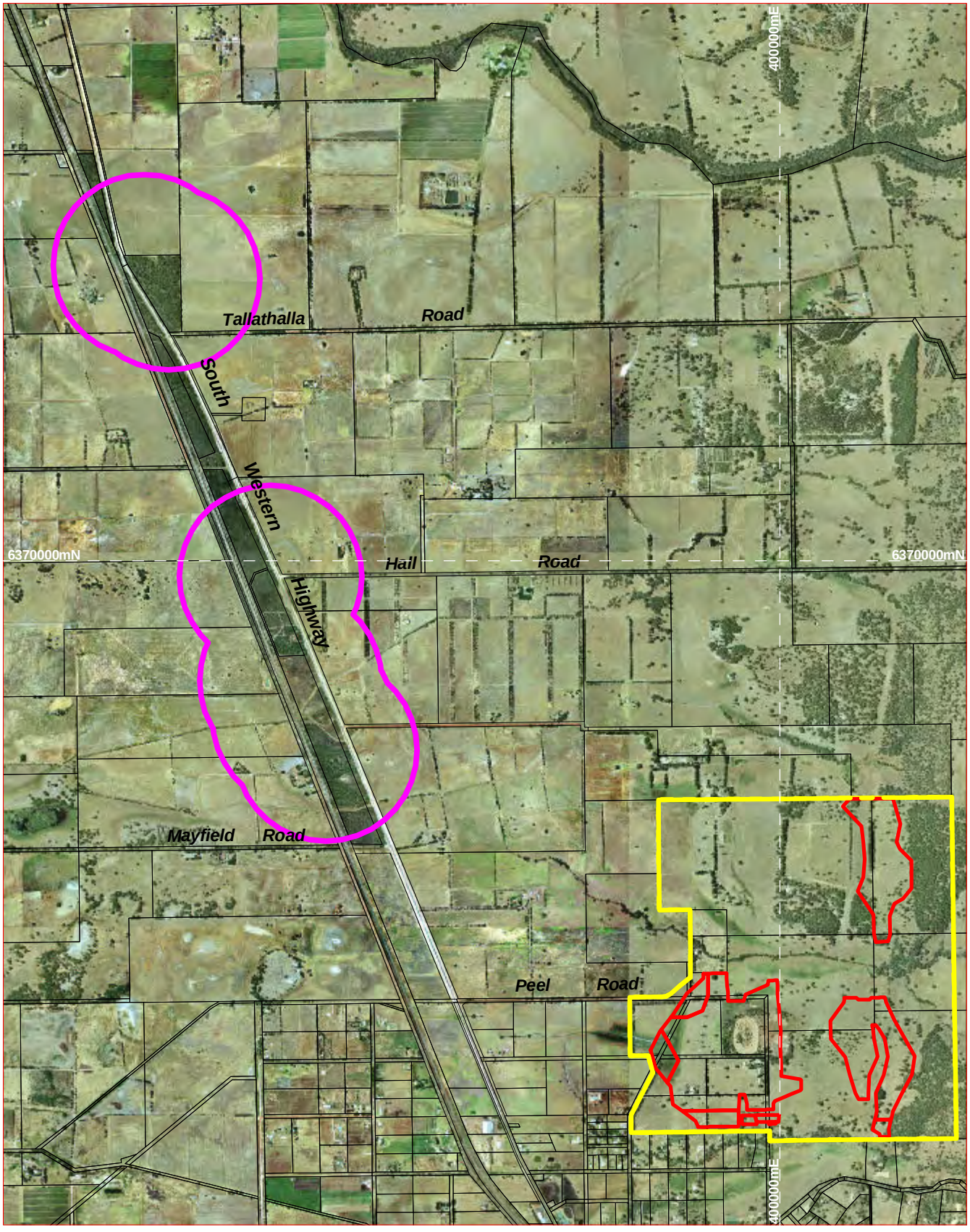
Western Australian Museum records and a review of published and unpublished data indicate that up to 84 bird species, up to 18 mammal species, up to 11 amphibian species, up to 6 fish species and up to 53 reptile species may potentially occur or have been observed in the general Waroona area (GHD 2004; Ninox 2005). Not all of these species are likely to occur regularly within the Project Area as their preferred habitats are either not present or are extremely degraded or fragmented.

A field survey was also conducted in conjunction with the first round vegetation survey, to search for fauna species, examine potential habitats present and assess their condition (GHD 2004). The survey was conducted in accordance with the EPA Position Statement Number Three on Terrestrial Biological Surveys (EPA 2002a). The survey was undertaken during mid spring, October 2003, after a winter of average rainfall. Windy conditions may have impacted on numbers of bird species sighted, but the lack of significant stands of understorey for cover across much of the study area is more likely to have reduced bird sightings. The survey was conducted in accordance with the EPA Position Statement Number Three on Terrestrial Biological Surveys (EPA 2002a).

A total of 43 bird species, 16 mammal species, two frog species and eight reptile species were identified during the survey. This included five introduced species (kookaburra, laughing turtle-dove, red fox, cat and rabbit), one gazetted threatened species (Baudin's Black Cockatoo) and one Priority 5 species (Quenda) (GHD 2004).

Following government consultation a subsequent literature review was conducted by Ninox Wildlife Consulting (Ninox Wildlife Consulting 2005). This first fauna survey was supplemented with an additional fauna survey was conducted in September 2005. The Ninox survey resulted in the recording of 38 species of bird, three species of native mammals, six frogs but no reptile species within the smaller survey area. Introduced species included one bird and three mammal species.

An inventory of the fauna species observed at the site and that may potentially occur at the site is given in the supporting document *Vertebrate Assessment Waroona Minerals Sands Project Area*.



Legend:

- Approximate location of threatened ecological communities; Source - CALM
- Project area
- HM Reserves

Date of photography: 2001

0 500 1000 Meters

MGA Coordinates, GDA94

N

ILUKA

ORIG :	L.Sadler
DRAWN :	D.G.S.
SCALE :	1:30 000
DATE :	17 Oct. 2005

WAROONA

LOCATION OF THREATENED ECOLOGICAL COMMUNITIES

DWG No : 140688 ver.03

FIGURE : 19

4.9.1. Birds

A total of 50 bird species were recorded between the GHD (2003) and Ninox Wildlife Consulting (2005) surveys. 29 species were common to both and 21 species were unique to either the GHD or Ninox survey.

The results of the literature review conducted by Ninox Wildlife Consulting showed that in addition to the 50 bird species recorded during both surveys, a further 74 species could be expected to occur as resident, nomadic, migratory or occasional visitor to the general area. Not all of these are likely to occur regularly within the Project Area as their preferred habitats are either not present or are extremely degraded. Additional species could occur as vagrants but these have not been listed. This latter group of birds could occur following specific climatic events, either in the south-west or inland, which encourage birds into or away from their normal distribution.

Many of the species listed have become extremely scarce on the Swan Coastal Plain and Darling Range foothills although they may be common elsewhere. These birds are either habitat specialists with a reduced distribution on the Swan Coastal Plain or are wide-ranging species with reduced populations on the Swan Coastal Plain; some may be locally extinct (Government of Western Australia 2000). The birds that fit into these categories include many birds of prey which are wide-ranging and being predators, would never have been particularly common. Other, small birds such as fairy-wrens and thornbills are less mobile than the larger birds and may only be surviving in remnants of native vegetation on the Swan Coastal Plain (Government of Western Australia 2000) although they are still common in parts of the adjacent Darling Range (cited in Ninox 2005).

The 50 species recorded in the Project Area are generally typical of farmland with fragmented remnants of degraded native vegetation. While the number of species of bird will increase with further field work, it is unlikely that these additions will be substantial (Ninox 2005).

4.9.2. Native Mammals

One native mammal, the Western Grey Kangaroo (*Macropus fuliginosus*) was recorded by GHD during the field survey in October 2003. The three additional species were noted by signs of their presence such as tracks, scats or diggings (Ninox 2005). The Ninox survey confirmed the presence of Grey Kangaroos which were observed in both remnant vegetation and pasture, and diggings of Quenda (*Isoodon obesulus fusciventer*) were also noted in Site 16. Fresh Common Brushtail Possum (*Trichosurus vulpecula*) scats were recorded in Sites 8, 9 and 16. The most scats were located at Site 8, then Site 9.

An additional 17 species could potentially occur in the Project Area, although this is unlikely given the fragmented and degraded condition of much of the remnant vegetation in the site. This number of species includes nine species of bat, a group that has not been systematically surveyed on the Swan Coastal Plain and about which little information is available on current status (Government of Western Australia 2000).

Relatively little survey work on ground-dwelling fauna, including native mammals, has been carried out on the southern Swan Coastal Plain. However, some unpublished data and a small number of published papers have been reviewed for this current assessment. Intensive, seasonal trapping in an almost pristine remnant of 75 hectares of Banksia

woodland near Keysbrook (West Kingia - part of Bush Forever site 77) resulted in only two native mammal species being captured: the Honey Possum (*Tarsipes rostratus*) and Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) (Ninox unpublished data). Grey Kangaroos were relatively common in the study area. Further north, in the much larger remnant bushland at Lowlands, near Serpentine (Bush Forever site 368 and 372), only two native mammal species were recorded during trapping: the Chuditch (*Dasyurus geoffroii*) and Common Brushtail Possum (*Trichosurus vulpecula*); and the Western Grey Kangaroo was observed (Ninox unpublished data).

In addition, field surveys of three locations on the southern Ridge Hill Shelf and Pinjarra Plain (Brickwood Reserve, Cardup Nature Reserve and Norman Road bushland) between Byford and Mundijong, resulted in the capture of only two species of small native mammal: the Mardo (*Antechinus flavipes*) and Western Pygmy Possum (*Cercartetus concinnus*); and the observation of only two additional species, the Grey Kangaroo and Southern Brown Bandicoot (Harvey *et al.* 1997).

4.9.3. Amphibians

Two species of frog were recorded in the Project Area by GHD (2003) and six species were recorded by Ninox in 2005. An additional five species could occur as they are able to persist in degraded creeks and wetlands (Ninox 2005).

Five species were recorded at both West Kingia and Lowlands although six species were recorded in total (Ninox unpublished data). Six species of frog were also recorded during the Harvey *et al*. (1997) survey of Brickwood Reserve, Cardup Nature Reserve and Norman Road bushland.

Most of the frogs known to occur in the general area rely on surface water to breed although many will be found in various habitats some distance away from water outside of their breeding season.

4.9.4. Reptiles

Five species of reptile were identified in the Project Area during the GHD October 2003 survey. An additional two species were seen but their identification was not confirmed (GHD 2004). No reptiles were recorded during the Ninox Wildlife Consulting survey although hand-foraging was undertaken. The cold and wet weather conditions probably contributed significantly to the lack of reptile observations and/or captures by hand-foraging.

Up to 48 additional species could occur in the general area although, as for native mammals, this is unlikely that many of these will occur in the Project Area given the fragmented and degraded condition of the remnant vegetation.

Only 16 species of reptile were recorded in the three areas sampled in the Harvey *et al*. (1997) study. Twenty-two species were recorded in West Kingia and eight species were recorded at Lowlands (Ninox unpublished data). However, some of the discrepancy between these two latter sites is most likely a result of the varying intensities of sampling rather than any inherent differences between the sites.

While an almost complete assemblage of reptiles can be found on recently isolated, small areas of undisturbed native vegetation in the Darling Range (cited in Ninox 2005) it is

unlikely that many are able to persist in highly disturbed and degraded remnant patches that have been isolated for a long period of time.

4.9.5. Introduced Species

Three introduced mammal species were recorded in October 2003 by GHD. This included two predators, the Red Fox (*Vulpes vulpes*) and feral Cat (*Felis catus*), and one herbivore, the European Rabbit (*Oryctolagus cuniculus*). Two introduced bird species were also observed: the Laughing Turtle-dove and Laughing Kookaburra.

In addition to these species, a further two introduced rodent species could be expected to occur: the Black Rat (*Rattus rattus*) and House Mouse (*Mus musculus*). Both of these rodents were recorded in all of the bushland sites sampled by Harvey *et al.* (1997). Two additional introduced bird species could also occur: the feral Pigeon or Rock Dove and the Spotted Turtle-dove.

While no introduced bird species were recorded in the bushland at either West Kingia or Lowlands, the Laughing Kookaburra and Laughing Turtle-dove were observed in the vicinity of the houses and outbuildings in both locations (personal observations). The House Mouse and Red Fox were also recorded in West Kingia and Lowlands (Ninox unpublished data).

It is unlikely that additional feral species to those described above will occur in the Waroona Mineral Sands Project Area. However, cattle have grazed most of the remnant patches of vegetation on the Project Area resulting in a highly modified environment.

4.9.6. Significant Species

A comparison of the species observed during the fauna survey and those potentially present at the site has been carried out using the lists contained in:

- the Environment Protection and Biodiversity Conservation Act 1999 (EPBC 1999);
- the Wildlife Conservation Act 1950 (WCA 1950);
- Department of Conservation and Land Management (CALM) Priority Fauna list; and
- those birds that have special conservation significance on the Swan Coastal Plain as listed in Table 15 of Bush Forever Volume 2 (Government of Western Australia 2000).

Significant species that were observed or maybe present in the Project Area are detailed below.

Commonwealth and State Legislation

One bird species, Baudin's Cockatoo, is listed as Vulnerable under the *EPBC Act (1999)* and listed under Schedule 1 (fauna that is rare or likely to become extinct) of the *WCA (1950)* was recorded by GHD during the October 2003 field survey (GHD 2004). A large flock of approximately 100 birds was observed within the Waroona Mineral Sands Project Area during the Ninox Wildlife Consulting assessment. These birds were observed feeding on particular Marri trees within the Project Area, which were tagged.

Carnaby's Cockatoo, which is listed as Endangered under the *EPBC (1999) Act* and Schedule 1 of the *WCA (1950)* could also occur in the Waroona Mineral Sands Project Area. Both of these black-cockatoo species have undergone a dramatic decline in recent years due to the loss of either food resources or as a result of their low reproductive rate (Johnstone and Storr 1998).

The Forest Red-tailed Black-cockatoo was also recorded during the Ninox Wildlife Consulting assessment. This is listed by CALM as a priority 3 species. This cockatoo is more commonly seen in the Jarrah forest of the Darling Range although it will be observed in remnant Jarrah or Marri vegetation on the Darling Scarp and foothills.

One bird listed on the China/Australia Migratory Bird Agreement (CAMBA): Glossy Ibis; one bird listed on the Japan/Australia Migratory Bird Agreement (JAMBA): Rainbow Bee-eater; and three birds listed on both: Fork-tailed Swift, Cattle Egret and Great Egret; could occasionally be present in the Project Area. These birds are not expected to be impacted by the Waroona project due to the large area that they potentially inhabit or the rareness of their visits to the Project Area.

The Peregrine Falcon which is listed as Other Specially Protected Fauna on the Western Australian *WCA (1950)* could occur in the Project Area.

The Chuditch (*Dasyurus geoffroii*) is listed as Vulnerable on both the *EPBC (1999)* and *WCA (1950)*. This marsupial has been frequently captured in the Darling Range (Ninox Wildlife Consulting 2002, 2003).

CALM Priority List

The Quenda was not seen but its presence was recognised by signs (scats, tracks or diggings) in October 2003 (GHD 2004). Three species that could occur are the Common Wambenger (*Phascogale tapoatafa*), the Western Brush Wallaby (*Macropus irma*) and the Water Rat (*Hydromys chrysogaster*). However, a search of the WA Museum database shows that there have been no recent specimens of any of these species.

Other Species

Forty-one of the 124 bird species identified as potentially using the site are either habitat specialists with a reduced distribution on the Swan Coastal Plain or are wide-ranging species with reduced populations on the Swan Coastal Plain (Government of Western Australia 2000). Eight reduced distribution species and three reduced populations were observed in the Project Area by GHD in October 2003. These were mainly small insectivores.

Most of these birds are common in the remainder of their geographic distribution but are reliant on the often fragmented and sometimes small remnant areas of native vegetation on the Swan Coastal Plain.

The depauperate state of small native mammal species on the Swan Coastal Plain, Ridge Hill Shelf and Darling Range foothills means that all native mammals remaining in these areas are of significance.

None of the frogs recorded or predicted to occur in the general area or within the Project Area are listed on any of the Government rare, threatened or vulnerable species lists.

Only one reptile that could potentially occur in the Project Area, the Carpet Python (*Morelia spilota imbricata*) is listed on any rare, threatened or vulnerable species list. This python is shown as Other Specially Protected Fauna on the *WCA (1950*). There are no recent records of this species in the general area of Waroona.

4.9.7. Fauna Habitats

Large mature trees containing hollows in the Project Area provide good habitat for bird species that utilise these resources. Likewise, possums, and other arboreal mammals also utilise such hollows. Few stands of healthy understorey vegetation remain in the study area (GHD 2004). Most of the remaining shrub vegetation is located in areas of granite and laterite outcrops, and it was in this area that most bird species were observed.

In the north-east portion of Site 8 a large number of trees have been historically ringbarked and burnt and these trees have developed substantial hollows. Several of these dead trees are located adjacent to live trees and this combination appears to provide excellent refuge and easy access for the Common Brushtail Possum. A large amount of fresh possum scats were noted on stumps and logs in the vicinity of these trees although it was not possible to determine how many possums potentially occur within this location. A similar situation was apparent in Site 9 although scats were less abundant in this remnant. Possum scats were uncommon in Site 16.

The lack of a woody shrub stratum means that only eight species of bird were recorded at Site 9 during the 2005 surveys. This was very similar to the heavily grazed Site 8 nearby which also lacked a mid-storey of shrubs and has a mainly pasture grass ground cover.

The thick vegetation, including the exotic grasses, located at Site 16 provides ideal cover for the Quenda *(Isoodon obeselus fusciventer)* and, during the GHD assessment; signs of their presence were numerous across the site. During the Ninox Wildlife Consulting survey, signs of the Quenda in this site were few although fresh tracks of both Red Fox and feral Cat were numerous. In the two years between the GHD and Ninox assessments, these two exotic predators may have had an impact on the Quenda within the speedway area.

Of the six species of frog recorded during the Ninox assessment, only three species were heard calling in Mullins Sumpland: the Quacking Frog (*Crinia georgiana*), Squelching Frog (*Crinia insignifera)* and Lea's Frog (*Geocrinia leai)*. The boggy surrounds of this sumpland have been trampled by cattle and polluted by their dung reducing its value as a wetland habitat (Ninox Wildlife Consulting 2005).

Many fauna species are likely to only be present as temporary inhabitants. Much of the site has been previously cleared for agricultural practices, and the fauna habitats remaining are severely degraded and isolated. None of the creeklines in the Project Area remain unaffected by land clearing and agricultural practices. The intermittent nature of remaining vegetation in the study area indicates poor vegetation linkage between habitats. Wealand Brook retains the most vegetation cover, but its minimal linkage to other habitats both up and downstream reduces its viability as a corridor for faunal movement, particularly ground dwelling fauna (GHD 2004).

4.10. Social Environment

The Shire of Waroona has a diverse range of industries including beef, sheep and dairy farming, tree farming, earthmoving, market gardens, engineering and mining (Shire of Waroona, 2003).

The land use of the Project Area is agriculture and vacant reserves (crown land). Specifically, the land in the Project Area is currently used for cattle and sheep farming. Numerous small rural landholdings surround the Project Area. The township of Waroona has approximately 2,300 residents.

4.11. Transport

The Waroona Project Area is located 2 km east of the Southwest Highway, a major south-west transport route that is heavily utilised for the transport of goods such as dairy, sheep, cattle and mineral sands. The route is also used by tourists as well as residents within the region. Vehicle movements measured by MRWA in two locations on Southwest Highway are shown in Table 11. The table shows that vehicle numbers are greater north of Waroona than south. There is less overall traffic on weekends, however, cars and caravans make up a higher percentage of weekend traffic. Heavy vehicle numbers decrease on weekends.

Table 11: Traffic Movements

Location	Waterous Road (4km south Waroona)				Paterson Rd (1km north of Waroona)			
Days	Mon – Fri		Sat - Sun		Mon – Fri		Sat - Sun	
Vehicle Type	Number	% of total	Number	% of total	Number	% of total	Number	% of total
Total Movements	4182	100%	3359	100%	5152	100%	4618	100%
Cars	3322	79%	2919	87%	4156	81%	3955	86%
Short towing (Caravans)	139	3%	215	6%	195	4%	335	7%
Pocket Road Trains	162	4%	42	1%	172	3%	63	1%
B Trains	79	2%	20	1%	90	2%	34	1%
Tri axial Trucks	101	2%	37	1%	144	3%	49	1%
Semis pulling bogies	46	1%	38	1%	35	1%	12	0%

4.12. Background Noise

Two background noise surveys were conducted in July 2004 and May 2005. In 2004, background noise was monitored at three residences over a 1 week period from 12 to 19 July 2004. In 2005, background noise was monitored at three residences over a 1 week period from 19 to 26 May 2005.

The environmental noise loggers were set to collect L_{A1}, L_{A10} and L_{A90} noise levels every 15 minutes, where:

- L_{A1} gives the noise level which is exceeded 1% of the time over a 15 minute period;

- L_{A10} gives the noise level which is exceeded 10% of the time over a 15 minute period; and
- L_{A90} gives the noise level which is exceeded 90% of the time over a 15 minute period.

The range of L_{A10} noise levels recorded during monitoring are shown in Table 12. The L_{A10} noise levels are the most relevant for comparison to EPA Noise Regulations and the noise emissions from the minesite due to their continuous nature.

Table 12: Background L_{A10} Noise levels

Location	Bradford St		Paterson Rd		Forrington Heights*	
Date	**July 2004**	**May 2005**	**July 2004**	**May 2005**	**July 2004**	**May 2005**
Day	39 – 68	40 - 64	35 – 58	37 - 80	28 – 59	33 - 53
Evening	37 – 51	36 - 63	30 – 51	33 - 59	24 – 43	30 - 51
Night	35 – 55	35 - 60	30 – 55	30 - 60	24 – 55	29 - 54

* note: different monitoring location at Forrington Heights in 2004 and 2005.

The results in Table 12 indicate a significant range in the L_A10 noise levels at each of the three locations throughout the day.

Although not assessable under the EPA regulations, the 90th percentile (or tenth highest) of the L_A90 measurements is considered a good indication of the typical background noise levels as this excludes isolated high noise events. Over the two surveys, L90 of L_A90 at Bradford Street range between 33 and 38 dB(A), at Paterson Road between 27 and 33 dB(A) and Forrington heights between 23 and 30 dB(A). This indicates that ambient noise levels at the residences are quite low.

4.13. Dust

Dust can be measured as total suspended particulates (TSP), particulate matter less than 10 microns in size (PM_{10}) or deposited matter. Deposited matter describes any particulate matter that falls out from suspension in the atmosphere. It is the least commonly used measurement in determining dust concentrations and there is no direct method of conversion between deposited matter and TSP or PM_{10}.

At Waroona, it was not possible to measure existing site dust levels using TSP or PM_{10}, due to the remoteness of the site from existing operations, and the lack of a reliable, long-term power supply or security across the site. As a result, deposition gauges were installed at five locations across the site in September 2004. The gauges were installed in accordance with Australian Standard AS/NZS 3580:10:1:2003, Methods for Sampling and analysis of ambient air. These gauges provide a guide to the existing conditions on site, and will be maintained for a time after the commencement of mining, in order to detect any change in dust fallout.

The sample bottles are changed and analysed monthly. Samples are analysed to determine the insoluble solids (IS), ash residue (AR), combustible matter (C), soluble matter (SM) and total solids (TS) content. The range in results from September 2004 to May 2005 is shown in Table 13.

Table 13: Range in content of deposition gauges at Waroona, September 2004 to May 2005

Sample component	Lower level recorded (g/m²/month)	Upper level recorded (g/m²/month)
Insoluble Solids (IS)	0.2	2.3
Ash Residue (AR)	0.1	1.7
Combustible (C)	0.1	1.0
Soluble Matter (SM)	0.9	4.6
Total Solids (TS)	0.1	2.8

4.14. Aboriginal Heritage

An archaeological and ethnographic survey of the Project Area and surrounds was conducted in 1997 (Carto-Cult, 1997). No new or previously recorded archaeological sites were identified. The survey did, however, result in the identification of three ethnographic sites. The three ethnographic sites identified were:

- Twin Springs – This site is located near the convergence of two creek lines and may have previously been a camping ground for Aboriginals or a previous corridor of movement for Aboriginal people.
- Triple Blackboy – This site is explained as being rare and significant to the Aboriginal people of the Southwest.
- Wuradjie Waterfall – This site is believed to be the abode of the Wuradjie spirit.

All three sites are outside of the Project Area. The sites are registered on the Department of Indigenous Affairs (DIA) site register.

4.15. European Heritage

A search was conducted of the Register of National Estate, National Trust and of the Heritage Council of Western Australia for heritage sites within the Project Area. No sites were identified as being located within the Project Area. A number of heritage sites listed in the Shire of Waroona Municipal Inventory were identified within the Waroona townsite but not within the Project Area.

5. COMMUNITY CONSULTATION

5.1. Iluka Community Relations Policy

Iluka's relationship with its employees, neighbours and the wider community is recognised as important to the long-term success of its operations.

The Company aims to be a valuable corporate citizen by:

- working closely with neighbours;
- supporting the community through sponsorship and resources;
- providing public information about environmental, community, and health and safety performances; and
- organizing external group visits to Iluka's operational sites.

Iluka's Community Relations Policy is a statement of the company's commitment to community relations and is shown below.

> *"Iluka Resources works with neighbours, employees, indigenous groups and other stakeholders to add value to the communities in the Company's operational areas.*
>
> *We establish partnerships on the following priorities*
>
> - *open and meaningful communication;*
> - *participation in community activities;*
> - *support for community initiatives;*
> - *timely provision of planning and operational information;*
> - *effective response to community concerns; and*
> - *respect for indigenous culture and aspirations."*

5.2. Waroona Consultation

The objective of the consultation program conducted during the preparation of this PER was to enable all individuals, groups and agencies that have an interest in the proposal to have input during the project design and environmental impact assessment process. This allows Iluka to address public interests both in this environmental review and following the implementation of the proposal.

In Western Australia the environmental approvals process is a public process, whereby the proponent is expected to consult with the public and government agencies to ensure that the most current information about local issues and concerns is used in the environmental and social impact assessment of the proposed project.

5.3. Consultation Program

The consultation program comprised the following phases:

- identification of stakeholders;

- dissemination of information and identification of stakeholder issues;
- collection of feedback from stakeholders;
- response to the stakeholder issues; and
- communication of the Proponent's response.

The Interim Industry Guide to Community Involvement (DoE, 2003) was used to review the community consultation program implemented by Iluka. Iluka's program was consistent with the requirements of the guide.

5.3.1. Identification of Stakeholders

Interested stakeholders in the Project have been identified as community members in the immediate surrounds of the project, people within the local shire, special interest groups and decision making authorities. The stakeholders identified are outlined in Table 14.

Table 14: Stakeholders Identified

Stakeholder Group	Specific Stakeholders
Landowners	Landowners and Residents along Wealand Road, Peel Road, Hall Road, South West Highway, Dallas St, Bradford St, McDowell St, Paterson Rd, Nanga Brook Rd and Forrington Heights (Figure 20)
	Shire of Waroona residents and business owners/operators
Community and Industry Groups	Conservation Council of WA
	Waroona Landcare "Crossing the Boundaries"
	Waroona Roadwise Committee
	Harvey River Restoration Trust
Government Agencies	Shire of Waroona
	Environmental Protection Authority (EPA)
	Department of Environment (DoE)
	Department of Industry & Resources (DoIR)
	Department of Conservation and Land Management (CALM)
	Main Roads Western Australia (MRWA)
	Department of Agriculture (DoA)
	Department of Indigenous Affairs (DIA)

5.3.2. Dissemination of Information & Identification of Issues

Liaison with stakeholders has been ongoing over the past 10 years as Iluka has conducted exploration activities and mining studies over the Project Area. A more detailed and comprehensive program of consultation has been undertaken since 2003, in preparation for Iluka's aim to proceed with the development of the Project in 2006.

Information has been disseminated to the identified stakeholders through the following mechanisms.

REVISIONS

Ver.	ORIG	DESIGN	DATE	COMMENTS
01	L.S.	D.G.S.	17.6.5.	Reformat to A3
02	L.S.	D.G.S.	17.10.05	Northern pit updated

Legend

- House
- Project area
- Iluka Properties
- HM Reserves
- Crown Reserve
- State Forest
- Unused road reserves

N

0 500 1000 m

MGA Coordinates, GDA94

ILUKA

WAROONA

SURROUNDING RESIDENCES

ORIG:	L.Sadler		
DRAWN:	D.G.S.		
SCALE:	1:15000		
DATE:	17 June 2005	DWG No: 151948 ver.02	FIGURE: 20

Community Updates

Community Updates (newsletters) have been issued in December 2001, March 2003, May 2004, October 2004 and September 2005 (Appendix 1).

Iluka Website

The Iluka website (www.iluka.com) contains information on Iluka and new projects. Information made available on this site about the Waroona Project includes the Scoping Study, Flora and Fauna Survey results, summaries of baseline groundwater and surface water environments and Community Updates.

Individual and Group Landowner Meetings

75 houses, not owned by Iluka, are located in Wealand Road, Peel Road, Hall Road, South West Highway, Dallas Street, Bradford Street, Paterson Road, Nanga Brook Road, McDowell St and Forrington Heights (Figure 20). Contact was made with 60 residents via either letter or telephone call in mid 2006. Individual visits were made to 51 interested landowners and residents in this area between June and August 2004. Landowners and residents were provided with an overview of the proposed mining operation and any questions or concerns were noted and responded to.

Interest was sought from residents in forming a Consultative Committee Meeting in mid 2004. This was initially requested through the Community Update and was followed up with a letter and/or phone call to residents as well as in discussions during individual meetings. There was little interest shown in forming a committee. In response to this, Iluka continued to provide information through the Community Updates and one on one discussion with residents.

A series of community briefings were held in December 2004. Of the 73 residents invited to the briefings 11 attended. Information provided at the briefing included:

- project overview;
- planned timing;
- site layout;
- mining method and schedule;
- environmental studies conducted;
- proposed management of environmental impacts;
- monitoring of environmental factors;
- transport options;
- community involvement; and
- post-mining land use.

A second round of community briefings were held in April 2005. This included two general community sessions and four landowner briefings. Advertisements were placed in the Harvey Reporter for two weeks advertising the Community Information Sessions (Appendix 2). Staff from Iluka were available for two three hour sessions (one during the day, one at night) to discuss any aspect of the Project. Three community members visited during the

period. Invitations were sent to 60 landowners for the briefings with 5 landowners attending. Information provided at the landowner briefings and community sessions included:

- update on project status;
- land valuation impacts;
- environmental and mining studies conducted;
- post-mining land use; and
- results of noise survey.

An Iluka office has been established in the Waroona business centre and is open one day a week. The purpose of the office is to make Iluka personnel regularly accessible to discuss aspects of the project with community members. Letters were sent to landowners and Iluka staff were available for three community information sessions at the offices on 12-13 October 2005. There were no attendees at these sessions. Further information will be provided through Community Updates, discussions with landowners and made available at the Waroona office.

Shire of Waroona

Discussions on the mining tenements with the Shire of Waroona commenced in 1993. Ongoing regular Shire briefings regarding a potential mining operation commenced in 2001. More recently, Iluka has made presentations to Council in April 2004 and November 2004. Iluka has part-funded, and been involved in, the Waroona North Structure Plan (Section 6.4.1) which aims to identify the future use of land in the northern section of the Waroona Shire.

Meetings with Organisations

Meetings were held with the Conservation Council of WA on 15 April 2004 and 5 July 2005.

A meeting was held with the local Landcare Officres in August 2004. These Landcare Officers also attended the landowner information session in December 2004. Information has been exchanged between Iluka and the Landcare group, including baseline data collected by Iluka. A presentation was given to the local LCDC groups in April 2005.

A presentation was made to the Wagerup Community Consultative Network in November 2004. This group has been formed by local residents in the town of Yarloop, specifically to look at the impacts of Alcoa's operations in the area. The group invited Iluka to present information about its Waroona project.

A presentation was made to the Waroona Roadwise Committee in May 2005 and was attended by representatives from the WA Police Service, Main Roads WA, Shire of Waroona, Waroona Districts High School, and Alcoa.

A meeting was held with representatives from the Peel Development Commission in May 2005. A presentation was given to the Waroona Business Council in May 2005. A presentation was given to the Lions Club of Waroona in August 2005.

EPA, DoE, DoIR, CALM, DIA, DoA, MRWA

A referral was submitted to the Environmental Protection Authority (EPA) on 6 January 2004. A scoping document was prepared by the proponent and submitted to the EPA in May 2004. A presentation to the EPA was made on 20 May 2004. The scoping document was approved on 23 June 2004.

A presentation was given to the DoA Waroona Branch staff in July 2004. A meeting and site visit was held with DoE representatives from the Kwinana-Peel licencing branch and EPA Services Unit in August 2004.

Discussions were held with CALM on the location and status of Threatened Ecological Communities, results of flora and fauna studies, groundwater impacts and rehabilitation. The results of the Aboriginal heritage survey were exchanged with the DIA. Discussions on transport options were held with MRWA. General presentation and discussion was conducted with the DoIR.

5.3.3. Responses to Issues Raised

Discussions with stakeholders have provided information on potential environmental issues of concern to the local and broader community. Table 15 summarises the issues raised and responses by Iluka during the consultation program. Government agencies reviewed a draft copy of the PER and issues incorporated into the document.

Table 15: Issues identified during consultation

Issues Raised	Response
Community Members	
Concern regarding noise from the mining activities	Noise modelling has been undertaken which shows that noise limits can be met under the majority of weather conditions. Equipment will be shut down when conditions indicate a potential for exceedence of the noise limits. Refer to section 9.2.
Will the mining operate for 24 hours a day and on weekends?	Following initial noise studies and community consultation, decision made that mining would be 12 hours a day only (excluding Sunday and public holidays) with processing activities occurring 24 hours. Refer to section 3.
Concern regarding what the site will look like and what residents will see from their homes	The site layout has been designed to minimise visual impact on adjacent landowners. Refer to sections 3 and 10.2.
Concern about lights from the site at night, shining towards houses	No mining activities occurring at night. Light from processing activities will be minimised. Refer to section 9.4.
Concern regarding the number of trucks and route through Waroona townsite.	Alternative routes have been considered, and deemed unsuitable as detailed in section 2.2.2. The South West Highway has been identified as the preferred route. The increase in truck movements is approximately 1% on current heavy vehicle movements. Refer to section 10.1.

Issues Raised	Response
Question about where the vehicle access to site will be and whether trucks will come down Paterson Rd	All access to the site will be from Peel Rd. No access will be from Bradford St or Paterson Rd. Refer to section 3.
Concern re dust generation from Peel Rd and mud trail from Peel Rd on to the highway	Peel Rd will be sealed from the highway intersection through to the HMC stockpiles. Trucks will not have mud on their tyres as they will not travel off the sealed surface. Refer to section 10.1.
Comments about the easterly winds in Waroona that are very strong at certain times of the year, and concern about how Iluka will manage the dust from the site	Iluka will minimise the generation of dust using a range of dust control measures. Refer to section 9.1.
Will local people be employed and will local businesses have the opportunity to supply services to the site?	Where positions are not filled by existing Iluka employees, there will be opportunities for appropriately skilled local people to apply for employment. Experience at other new operational sites shows that local people are employed by both Iluka and other contractors on site. Local businesses will have the opportunity to supply services to the site.
Will Iluka staff and their families move to Waroona?	Iluka cannot dictate where employees live, however, Iluka's policy for fatigue management encourages employees to minimise their travelling time to and from work. Experience in other areas shows that some employees do choose to relocate to the local area.
What resources will Iluka provide to help the community?	Iluka has a community support program, to assist organisations within the Company's operational areas. Support to date includes contributions to the Community Marketing Group, Tourist Information Centre, Heritage Trail Project, Cancer Fundraising Group, Waroona District High School and the Peel Economic Development Unit.
Concern regarding how much water is needed for the minesite and the impacts on local groundwater bores, flows to Nanga Brook and surface water.	Water will be from pit dewatering with additional water purchased from Harvey Water. Groundwater modelling has been conducted and no offsite impacts are identified. Refer to section 8.6. Reduction in surface water flows in Nanga Brook is estimated at less than 1% of annual flows. Refer to section 8.7.
Concern regarding the proximity of the mine and possible devaluation of properties	Landowners who demonstrate devaluation of their property due to Iluka's mining operations, may be entitled to compensation under the Mining Act provided certain criteria are satisfied. Where landowners fall within those criteria Iluka will meet its compensation obligations in accordance with the Mining Act. However, Iluka considers that post-mining development opportunities and the potential for future expansion of the Waroona townsite into this area are likely to provide a significant positive impact on nearby property values in the longer term. Iluka's experience in mining operations which are located in close proximity to existing residential areas, has not shown any devaluation of nearby properties.

Issues Raised	Response
Concern regarding presence of monazite and its disposal	Monazite material will not be returned to the Waroona site from Capel.
Interest in the rehabilitation plan for the area and post-mining land use	Iluka has financially assisted the Shire of Waroona to develop a Structure Plan for the 'Waroona North' area. This community & council-driven study will identify key future land uses for the area. Iluka will assist in the facilitation of future development by considering the identified future land use in the rehabilitation program. Refer to section 6.4.1.
Community and Interest Groups	
Rehabilitation and restoration works	Rehabilitation will be to similar landscape and agricultural land use. Refer to section 8.4. Restoration of Ferraro Brook and protection of native vegetation. Refer to section 8.5.
Groundwater impacts	Groundwater modelling has been conducted and no offsite impacts are identified. Refer to section 8.6.
Surface water flows	Reduction in surface water flows in Nanga Brook is estimated at less than 1% of annual flows. Flows originating from Mullins Sumpland will be reduced by up to 95%. Refer to section 8.7.
Local community support	Iluka has a community support program, to assist organisations within the Company's operational areas. Support to date includes contributions to the Community Marketing Group, Tourist Information Centre, Heritage Trail project, Cancer Fundraising Group, Waroona District High School and the Peel Economic Development Unit. Iluka will continue to work closely with the Shire of Waroona to identify key community projects requiring support.

5.3.4. Ongoing Consultation

The consultation program following the release of this environmental review will involve:

- displays within town including 3-D computer simulated mining operation;
- ongoing liaison with adjacent residents and landowners;
- ongoing liaison with government agencies;
- ongoing liaison with councillors and staff of local authorities;
- ongoing participation in the Waroona North Structure Plan Committee;
- dissemination of information through community newspapers and Iluka's Community Updates; and
- ongoing provision of information on Iluka's website.

Iluka will continue to liaise closely with local authorities and the local community during the construction of the Project and will implement a consultation program which includes regular meetings with landowners in close proximity to the mine, and consultation on specific issues as they arise.

6. ENVIRONMENTAL MANAGEMENT

6.1. Iluka's Environmental Management System

Iluka has an environment, health and safety management system (EHSMS) in place to provide effective EHS management and continuous improvement in performance at all its mineral sands operations. Iluka's EHSMS is designed to provide a framework for:

- developing and implementing a common approach to environmental, health and safety management across Iluka;
- integrating environment, health and safety management systems and processes into all business processes;
- effectively communicating company expectations to all employees, contractors and visitors;
- establishing clear environment, health and safety performance criteria against which all areas of the company can be monitored and audited;
- measuring environment, health and safety performance at all levels of the organisation;
- reporting environment, health and safety performance to stakeholders and interested parties; and
- ensuring continuous improvement in our environment, health and safety performance.

The EHSMS comprises:

- one corporate EHS policy;
- twelve EHSMS standards that describe the minimum requirement for all Iluka areas; and
- associated guidelines and tools to assist with the implementation and maintenance of the EHSMS (Figure 21).

6.2. Iluka's EHS Policy

Iluka's EHS Policy is a statement of the company's commitment to environmental protection. It is a general condition of employment that Iluka employees at all levels behave in accordance with the policy. Iluka's EHS Policy commits Iluka to:

- not compromise on safety;
- comply with all legislative requirements;
- work closely with our customers and maintain a product stewardship approach to our products to enable their ongoing use;
- identify, assess and manage environmental, health and safety hazards, risks and impacts of our operations;
- maintain an EHS management system to apply uniform standards to all operations and personnel;
- promote continuous improvement practices;
- minimise workplace exposure to hazards, ecosystem disturbance or degradation;
- re-establish disturbed areas as sustainable ecosystems and community assets;

- strive to use resources more efficiently by reducing, reusing and recycling waste products;
- encourage and support our employees to make positive lifestyle changes;
- understand and work to meet the expectations of the community; and
- provide appropriate training to employees and contractors to ensure environmental, health and safety issues and responsibilities are clearly understood.

6.3. Sustainable Development

The EPA Position Statement *Towards Sustainability* (EPA, 2002c) discusses the concepts of sustainability and outlines that sustainable development requires the integration of ecological thinking into all social and economic planning and actions. The EPA objective for sustainability is to ensure, as far as practicable, that the proposal meets or is consistent with the sustainability principles in the *National Strategy for Ecological Sustainable Development* (Commonwealth of Australia, 1992).

The National Strategy for Ecologically Sustainable Development outlines three objectives for the mining industry in addressing sustainable development. These are:

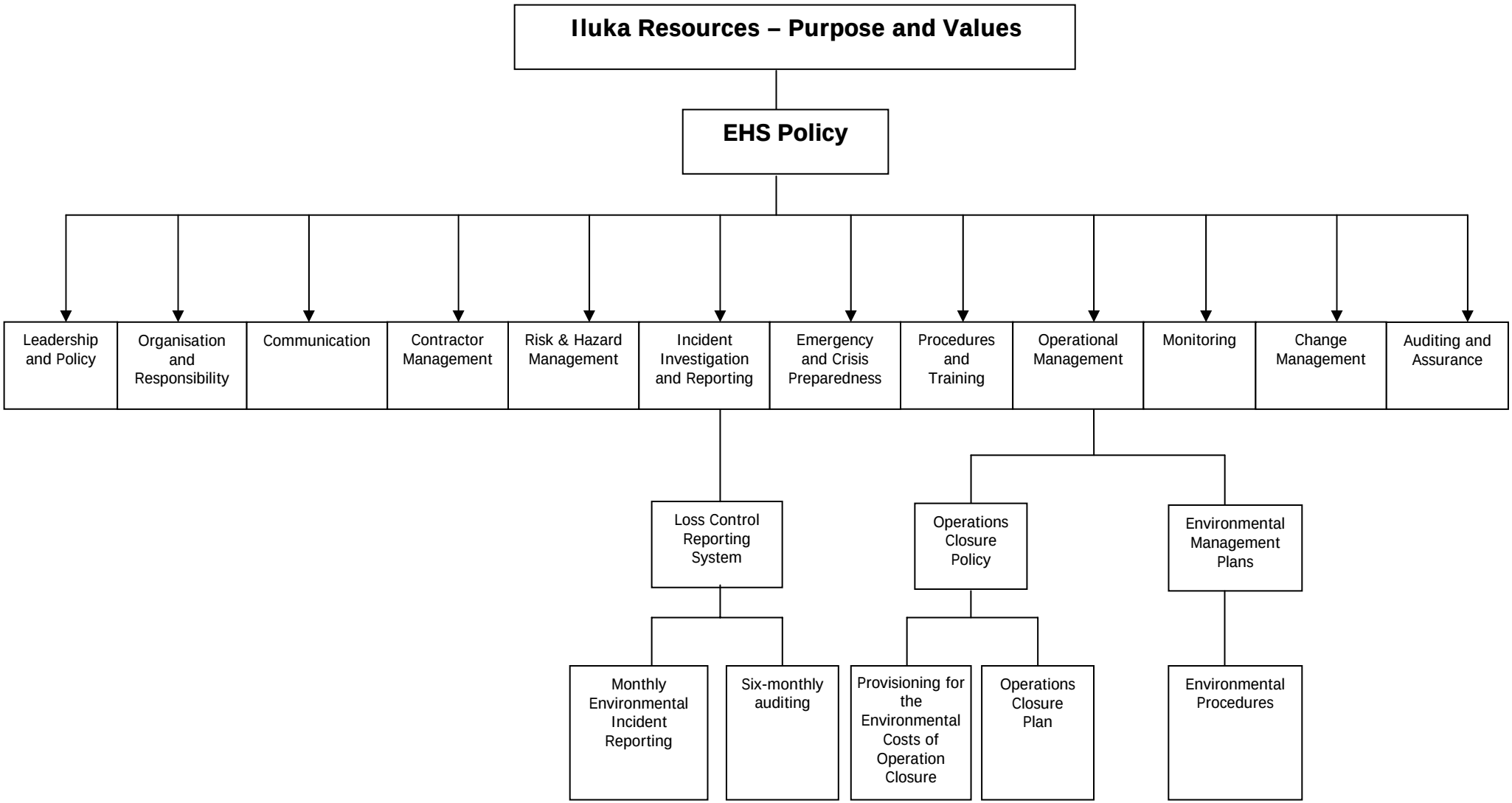
- to ensure minesites are rehabilitated to sound environmental and safety standards, and to a level at least consistent with the condition of surrounding land;
- to provide appropriate community returns for using mineral resources and achieve better environmental protection and management in the mining sector; and
- to improve community consultation and information, improve performance in occupational health and safety and achieve social equity objectives.

Concepts raised for the resource industry in the above guidelines have been integrated into the planning of the Waroona Project and the sustainable development strategies outlined below. In producing mineral products and supporting sustainable development at the Waroona Project a number of sustainable principles are considered and applied. These are detailed in Table 16.

Table 16: Implementation of Sustainability at Waroona

ILUKA SUSTAINABLE PRINCIPLES	WAROONA PROJECT IMPLEMENTATION
Integrate social and ecological considerations with economic evaluations of mine planning.	Mine planning has been conducted to include social and ecological considerations. This has resulting in the following outcomes: • concentrator located away from community; • mining during day-time only; • site perimeter bunding; • site access from Peel Rd; • no water dam on Ferraro Brook; and • placement of stockpiles and solar drying dams away from native vegetation.

ILUKA SUSTAINABLE PRINCIPLES	WAROONA PROJECT IMPLEMENTATION
Ensure that mining operations enhance existing biological diversity where possible.	Existing biological diversity will be enhanced through the restoration of 111 hectares including Ferraro Brook and several blocks of vegetation. This is detailed in Section 8.1.
Ensure that the mining areas are rehabilitated to sound environmental and safety standards, and to a level at least consistent with the condition of the surrounding land that enables the agreed post mining landuse.	The mining area will be rehabilitated to agricultural land-use with some infrastructure such as roads and powerlines remaining for potential future land zoning. This is detailed in Section 8.4.
Provide for effective involvement and prior informed consent of communities regarding all decisions and actions that affect them, and engage stakeholders and government in order to gain their views and take their interests into account.	A comprehensive community consultation program has been conducted during the feasibility studies. This is detailed in Section 5.
Provide support to communities through Iluka's Community Development Program.	A range of local programs have been supported during the feasibility studies as detailed in Section 5. Community support will continue during mine operations.
Ensure that current and future economic growth of WA and Australia will benefit from developments by Iluka and optimise economic return to local communities from mining.	Mining of the resource will provide economic benefit to Iluka, the State and local community. Local employment and services will be utilised where possible.
Efficiently manage resources and wastes.	Mining allows for the efficient management of the mineral sands resource. Wastes will be minimised and managed as outlined in Section 9.5 and 9.6.
Be accountable for all our actions by regularly reporting to the community, stakeholders and the government on performance.	An annual report will be prepared and submitted to government detailing performance against Ministerial Conditions and licence commitments. This will be made available to the community. Company environmental performance and management is also reported in the Iluka Annual Report.
Support sustainable development through commitment towards continual improvement in all aspects of environmental, health and safety programs.	The management plans and annual reporting process provide a regular review and improvement program.
Development and support of generic and site-specific research and development programs on technologies and techniques to improve the effectiveness and efficiency of environmental protection measures.	Iluka conducts and supports a range of research programs across the organisation. These including continuous noise monitoring trials, rehabilitation trials and process waste management research.



WAROONA PROJECT

EHS MANAGEMENT SYSTEM STRUCTURE

Figure 21

6.4. Iluka's Closure Plan Policy

In order to demonstrate its commitment to achieve environmentally and socially acceptable closure of all operations, Iluka has adopted an Operations Closure Policy that is supported by procedures for provisioning for the environmental costs of operation closure and the development of a closure plan. Iluka's closure procedures have been developed in accordance with the Australia and New Zealand Minerals and Energy Council (ANZMEC) Strategic Framework for Mine Closure (2000) which outlines a range of objectives and principles including stakeholder involvement, planning, financial provisioning, implementation, standards and relinquishment and the Minerals Council of Australia Mine Closure Policy (1999).

Iluka recognises two types of closure plan that relate to different phases in a project's development. Development of the conceptual closure plan commences in the planning phase for mine development and considers feasibility, design, construction and potential costs of closure. The closure plan is developed for implementation upon commencement of the mine development and specifically addresses closure requirements related to commissioning, operation, decommissioning and relinquishment. Both the conceptual closure plan and closure plan address the following aspects of mine closure:

- definition of the legal framework in which closure will be undertaken;
- definition of closure objectives regarding factors such as safety, landuse and socioeconomic considerations;
- stakeholder consultation;
- closure planning for rehabilitation and decommissioning;
- annual review and continual improvement; and
- identification of likely closure costs.

Iluka's target closure outcome is to create self-sustaining natural ecosystems and land uses that are acceptable to the community and other stakeholders.

6.4.1. Waroona North Structure Plan

In recognition of the future growth of the Waroona township, Iluka and the Shire of Waroona have initiated a planning study for the area north of the Waroona township that includes the mine area. The orebody represents a planning constraint on this area as development is inhibited until the orebody is mined. Housing development over the orebody would effectively sterilise it and prevent the State and other stakeholders from deriving benefit from it.

Completion of mining and rehabilitation will remove this significant land use constraint and provide an opportunity for the Shire to commence long term planning (Belton-Taylforth, 2005). Iluka has part-funded and participated as a landowner in the study. The study purpose is to guide land-use and development during mining and provide a longer term plan for the area post-mining. An Opportunities and Constraints Paper has been prepared (Belton-Taylforth, 2005) and the second phase of preparing land-use options for consideration has commenced.

Community input has been an integral part of the structure plan development. A committee consisting of shire and community members is overseeing the project. A community forum was held in February 2005 with participation from 18 community members. This forum developed the following vision for the Waroona North and Waroona areas.

> *"The sand mining operation in Waroona North area has long since ceased and the natural environment and beauty of the area has been restored and enhanced with vegetation, trees, woodlands and pristine waterways, providing an endurable environment for a diversity of native flora and fauna. An abundance of quality public park land and open space is the 'jewel in the crown' of the area, incorporating walking and cycleways, horse riding trails and diverse recreational and eco-tourism opportunities that draw locals and visitors alike. A diversity of compatible rural viticultural and horticultural industries add to a bustling local economy while providing employment opportunities, especially for young people. Small rural landholdings bring additional people to Waroona who value the land, sustainability and the unique lifestyle country living offers and a strong sense of community, pride and peaceful atmosphere prevails. The Waroona town centre remains as the central heart of the community, well connected to Waroona North with safe traffic and easy access to the Waroona townsite and within Waroona North."*

Iluka has taken into consideration the community vision and will rehabilitate the Project Area to compatible land-uses compatible and consistent with the Waroona North Structure Plan. As the structure plan develops Iluka will develop its closure plan accordingly.

6.5. Environmental Management Plan(s)

Appropriate management of key environmental issues for the Waroona Project will be detailed in Environmental Management Plans (EMPs) for the Project. These plans will define objectives, responsibilities and performance standards, and reference management and monitoring procedures for each environmental issue. Where appropriate, existing EMPs from the Southwest operations will be applied to the Waroona Project.

Iluka's Environmental Procedures provide the detailed, step-by-step actions to be undertaken to implement the procedures referenced in the Environmental Management Plan and to implement the standards set by the EHSMS.

6.6. Environmental Reporting

Statutory annual reports are submitted to government departments detailing compliance with conditions of approval and environmental performance.

Environmental performance at Iluka sites is monitored through a system including monthly reporting of incidents. Monthly internal environmental reports are generated.

The system of environmental incident reporting is maintained at all Iluka sites through the use of the Loss Control Reporting System. This system ensures timely notification of any incidents, internal investigation into causes and actions arising from environmental incidents or potential incidents to resolve them and reduce the risk of repetition.

7. IDENTIFICATION OF ENVIRONMENTAL FACTORS

A scoping document (Iluka 2004) was developed in consultation with the EPA to identify the environmental factors applicable to the Project. The factors were identified through preliminary investigations and consultation with key stakeholders. Several risk assessments have been conducted to evaluate the potential Project risks, including environmental risks. These assisted in reviewing environmental factors and ensuring appropriate controls are put in place to mitigate risks. The following factors have been identified as relevant to the Project. The numbers identify the section of this document in which they are discussed. Objectives, existing environment, potential impact, environmental management and predicted outcome relating to each factor are shown in Table 18.

Table 17: Environmental Factors Relevant to the Waroona Project

Biological Factors		**Physical Factors**		**Social Surrounds Factors**	
8.1	Vegetation and Flora	9.1	Dust	10.1	Transport
8.2	Fauna	9.2	Noise	10.2	Visual Amenity
8.3	Landform and Soils	9.3	Radiation	10.3	Aboriginal Heritage
8.4	Rehabilitation	9.4	Light	10.4	European Heritage
8.5	Biodiversity	9.5	Non-process Waste		
8.6	Groundwater Systems	9.6	Process Waste		
8.7	Surface Water Systems	9.7	Greenhouse Gases		

Table 18: Environmental Factor and Management Register

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
BIOPHYSICAL					
Vegetation and Flora	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	The majority of the vegetation areas are degraded, lacking any understorey due to historical clearing and grazing. Two areas of vegetation were identified as very good condition on the Bush Forever Scale. These areas have similarities to TEC type 3b. Within the Project Area one priority species was identified. Several previously recorded TEC's are located 2 km north west of the Project Area.	Mining operations will require 184 ha of disturbance of which 12.6 ha is remnant vegetation and 8.6 ha is planted native and non-native vegetation. Two areas of <0.5 ha and 1.5 ha containing vegetation in very good condition will be cleared. No clearing of identified Priority Species. No indirect impact through groundwater drawdown or surface water flows on the TEC's.	Native vegetation has been avoided where possible, including the modification of the northern mine pit to reduce clearing area. Clearing of native vegetation will be restricted to areas identified. Rehabilitation will include establishment of offsets for clearing, native vegetation corridors, restoration of existing degraded native vegetation and establishment of CALM conservation covenants. Specific measures to minimise impact include: • fencing Ferraro Brook and buffer area, Sites 8 and 9 with buffer areas and the remnant vegetation blocks; • undertake weed control within these areas; • infill plant these areas with native species, including riparian species around the brook and upland species in other areas • trial translocation of understorey flora from the Speedway site; and • placement of appropriate CALM Conservation Covenants over the identified blocks of remnant native vegetation.	Although there will be some loss of vegetation, implementation of proposed mitigation plan will improve the species diversity, condition and protection of vegetation sites, and result in net environmental benefit. The offsets package will replace the good condition vegetation at the site at a greater than 1:1 ratio. No impact on Priority Flora Species.
Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	There is little connectivity between the patches of vegetation within the Project Area. The area has low fauna value. Large areas of land adjacent to the site on the Darling Plateau are likely to provide more significant fauna habitats than those present in the Project Area. No fauna species rely exclusively on the native vegetation within the Project Area for habitat. The Quenda, *Isodon obesulus fasciventer*, a priority 5 species has been noted to be using Site 16 around the speedway. Flocks of Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), a threatened taxa, were observed flying over and feeding within the Project Area. A priority 3 species, Forest Red-tailed Black Cockatoo *(Calyptorhynchus banksii naso)* was also observed feeding within and flying over the Project Area.	Displacement of Quenda using habitat at Site 16 around speedway. Removal of some food resources for Baudin's and Forest Red-tailed Black-cockatoos and tree hollows used by various bird, mammal and reptile species.	Native vegetation has been avoided where possible. Clearing of native vegetation will be restricted to areas identified. The mitigation package includes several measures that will increase the protection of fauna habitat and enhance vegetation corridors between existing vegetation and the Darling Scarp. Specific measures to minimise the impact on fauna include: • preferentially retain trees identified with hollows on site; • inspect those trees within the clearing envelope with hollows for signs of bird nesting; • remove hollows from any suitable cleared trees and use within the rehabilitation and mitigation areas as fauna habitats; • protect Marri trees favoured by Baudin's Cockatoo as food sources from where practicable; • use seed from Marri trees favoured by Baudin's Cockatoo in the Vegetation Mitigation Plan. • prepare and implement a capture and relocation program for Quenda from the Speedway –Site 16 and the Common Brushtail Possum at Site 8.	Although there will be some loss of fauna habitat and food resources, implementation of proposed mitigation strategies will improve protection of fauna habitat and provision of vegetation corridors for native fauna species.

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Landform and Soils	To maintain the integrity, ecological functions and environmental values of the soil and landform.	The soils are associated with the Ridge Hill Shelf geology and subsequently consist of soils belonging to the Forrestfield Soil Associations. The Forrestfield Soil Associations consists primarily of sands and sandy gravels. A baseline investigation for Potential Acid Sulfate Soils (PASS) was conducted. No PASS were identified. Given the topographic, geomorphic, redoximorphic and hydrologic conditions occurring within the Project Area it is unlikely that any PASS will occur within the proposed Waroona minesite.	Disturbance to landforms will occur from the excavation of mining pits. Loss of nutrients and structure of soil horizon/profiles within mining area may occur.	Soil survey and classification of soils into Soil Material Management Units for handling during operations. Topsoils will be stripped and stockpiled for re-use. Mined overburden, clay and sand fines will be used to backfill mining voids to assist in recreating a soil profile similar in composition and structure to pre-mining profiles and landform. Pre-mining and post-mining agricultural productivity surveys will be conducted.	Environmental values, ecological function and integrity of soils are maintained.
Rehabilitation	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.	Refer above to vegetation, flora, fauna and soils and landforms.	Disturbance of some vegetation remnants on agricultural land.	Rehabilitation will restore agricultural systems and productivity. Restoration of degraded native vegetation not affected by mining will be conducted. The Waroona North Structure Plan will define potential post-mining landuse and zoning. Implementation of closure plan.	Reinstatement of landforms that are compatible with surrounding environment. Retainment of facilities that will assist post-mining landuse and zoning.
Biodiversity	To avoid adverse impacts on biological diversity, comprising the different plants and animals and the ecosystems they form at the levels of genetic diversity, species diversity and ecosystem diversity.	The majority of the Project Area has low biodiversity due to the historical grazing and agricultural use of the land. There is little connectivity between vegetation areas within and external to the Project Area.	Mining operations will require 184 ha of disturbance of which 12.6 ha is remnant vegetation and 8.6 ha is planted native and non-native vegetation. Less than 2 ha of this area is rated as in very good condition. This will have a local impact at a flora/fauna level with negligible impact on biodiversity.	Fencing and protection of 111 ha of vegetation. Infill planting of native species along Ferraro Brook and within other vegetation blocks. Trial translocation of vegetation from the Speedway site. Restoration of remnant vegetation will aim to increase the diversity of the vegetation communities. Restoration of Ferraro Brook will aim to increase species diversity and provide bank stability to reduce further erosion. Conservation covenants to protect remnant vegetation.	Restoration activities will extend the pre-mining vegetation cover and will create vegetation corridors assisting the biodiversity within the Project Area. Areas will be protected from clearing by conservation covenants.
Groundwater Systems (Quantity and Quantity)	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected. 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.	The major aquifer zones that occur locally are the superficial aquifer in the Yoganup Formation (<30m), the Leederville aquifer (10-30 – 130m) and the Cattamarra Coal Measures (>130m). Groundwater quality in the superficial aquifer and the shallow Leederville aquifer is fresh to brackish with salinity typically increasing with depth.	Pits will only extend below the water table in a few locations and dewatering volumes are anticipated to be minimal. Dewatering of the pits and abstraction from the superficial aquifer will result in drawdown of the water table. Impact is limited to the Project Area and is not anticipated to impact adjacent vegetation or water users. Potential for spillage of hazardous materials from mine operations results in contamination of groundwater.	Process water purchased from water supplier. Management plan for water resources that includes monitoring and reporting of groundwater levels, water abstraction rates and water usage. Hydrocarbons bunded according to relevant guidelines.	Beneficial uses of groundwater maintained. Groundwater quality will not be adversely affected by mine activities.

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Surface Water Systems (Quality and Quantity)	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected. 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.	The Project Area lies within the Harvey River Basement catchment area. Ferraro Brook traverses the Project Area. Nanga Brook and Wealand Brook are south and north of the Project Area respectively. Several small areas within the Project Area are classified as multiple use wetlands. Mullins Sumpland is an artificially induced expression of groundwater that drains to Nanga Brook. All the wetland areas are highly disturbed and have few wetland values or attributes other than hydrology. The stream landscapes are considered extremely degraded due to historic clearing of catchment vegetation, drain construction and unrestricted stock access.	Mullins Sumpland will be mined and surface water flows originating from this source will be reduced by approximately 95%. Baseflow contributions to Nanga Brook will reduce by less than 1% of annual flows. No impact on flows in Wealand Brook or Ferraro Brook. Excess water will be released in periods where dewatering exceeds site water requirements. Open area has the potential to result in uncontrolled runoff with high turbidity.	Provision of make-up water facilities to the surface water user of Mullins Sumpland if required. Any water discharges from mining operations will be licensed and regularly monitored. Control measures such as bunding, sumps and stormwater management systems implemented. Surface water monitoring program implemented including upstream and downstream of minesite.	Reduction in surface water flows from Mullins Sumpland. No impacts on flows in Nanga Brook, Wealand Brook or Ferraro Brook. Surface water quality will not be adversely affected by mine activities.
POLLUTION MANAGEMENT					
Dust	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.	Baseline dust monitoring has been conducted at Waroona since September 2004. Monthly total insoluble dust levels have ranged from 0.2 to 2.3 g/m^2/mth with an average of 0.81 g/m^2/mth. Particulate concentrations at the proposed mine locations are not available. However, background TSP and PM_{10} levels are available for nearby Wagerup as collected by Alcoa. These are considered to be representative of the area.	Potential dust generation on unsealed internal roads, stockpiles and open mine areas during dry, windy conditions. Modelling has been undertaken to predict dust resulting from mining and allow a dust management program to be developed. Modelled dust levels are shown to exceed both the TSP and PM_{10} limits at several residential locations. These exceedences are minimal and are partly a factor of using conservative assumptions. Analysis of the conditions that lead to the highest concentrations offsite indicate that concentrations to the west north west are due to strong easterly winds in summer and wind erosion. The higher concentrations to the south are due to operational activities associated with moving the overburden and ore.	Iluka will develop and implement a dust management plan involving standard practices to manage particulate emissions such that they do not cause environmental or human health problems. Dust control measures will include: • minimising clearing and open area; • not disturbing topsoil until required; • regular watering and grading of roads; • using biodegradable chemical suppressants; • growing of temporary crops to bind soil & lift wind from surface; • re-establishment of pasture as soon as possible after mining has been completed; • using sprinkler systems and oversize material where appropriate; • high wind warning system in summer to enable site to increase control mechanisms ahead of event; and • sealing roads if deemed necessary.	Dust will be managed and monitored during operations. With the proposed mitigation techniques in place, there will be no adverse impacts from dust on environmental values or the health, welfare and amenity of people and land uses.

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Noise	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	The environmental background noise levels were measured on two occasions with maximum daytime L_{A90} levels ranging between 45 - 55 dB(A) and minimum evening L_{A90} levels ranging between 21 - 34 dB(A).	Mining will occur in daytime hours only excluding Sundays. Processing will occur 24 hours a day. Noise modelling has shown that under the majority of weather conditions noise limits can be met.	Machinery numbers will be reduced under weather conditions likely to result in exceedance of noise limits. Prepare a noise management plan which includes: • hours of operation; • allowable noise levels of site machinery; • regular checking of noise levels of site machinery; • management of noise during construction; • management of noise during operations; and • monitoring and reporting of noise levels.	Compliance with statutory noise requirements.
Radiation	To ensure that radiological impacts to the public and the environment are kept as low as reasonably achievable and comply with acceptable standards.	The background radiation survey shows a range of 0.05 µGy/hour to 0.37 µGy/hour. This is consistent with typical natural radiation levels in the southwest region of WA.	Radioactive materials in the mineral monazite are concentrated from 0.1% in ore to 1-2% in HMC. HMC is able to be safely transported to Capel without specific safety requirements.	A pre-mining radiation survey has been undertaken. No monazite will be returned to Waroona. A post mining radiation survey will be conducted.	Post-mining radiation levels are the same or lower than pre-mining radiation levels. No impacts to the environment or public.
Light	To avoid or manage potential impacts from light overspill and to comply with acceptable standards.	Artificial light in the Project Area is restricted to vehicle movements on public roads, town lighting, residential lighting and farming activities.	24 hour processing will require lighting of mobile and fixed plant to enable a safe working environment.	Location of processing activities minimises the light overspill affecting adjacent residents. Focus lights internally to minimise light spill.	No significant adverse impacts from site lighting.
Non-process Waste	Ensure that wastes are managed and disposed of in a manner that does not result in long-term impacts on groundwater, surface water and the natural environment.	There is a large amount of scrap machinery and plant across the Project Area from farming operations.	Non-process waste generated by mining activities will create rubbish. There is the potential for reduced visual amenity and potential safety hazards created if not disposed property.	Avoid creation and reduce waste output. Implement re-use and recycling of waste. Ensure waste is disposed in a licenced landfill. Clean up existing debris.	No long term impacts on groundwater, surface water or the natural environment.
Process Waste	Ensure that waste streams from the process are returned to the mining pit in a manner consistent with closure objectives and end uses of the site.	NA	Sand and clay tailings are inert. Potential impacts from solar drying dams are related to risk of uncontrolled releases of clay fines.	Systems will be put in place to minimise the potential for spills. This includes regular checks and inspections, bunding of pipelines, maintenance of dam walls and provision of adequate freeboard for rainfall events.	No long term effects on groundwater, surface water or the natural environment.
Greenhouse Gases	To minimise emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions.	Iluka's Southwest operations have three concentrators and associated mining infrastructure. One of these will be relocated to Waroona.	Anticipated carbon dioxide emissions of 40 kt/annum mainly from electricity and diesel fuel consumption.	Energy efficiency techniques will be adopted to reduce unnecessary consumption.	There will be negligible increase in emissions from Iluka's activities.

Environmental Factor	Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
SOCIAL ENVIRONMENT					
Transport	To ensure that traffic activities resulting from the Project can be managed to an adequate level of public safety and have minimal impact on surrounding landowners.	The key transport route is the South West Highway. The Project Area is located less than 2 km from the highway off Peel Road. Peel Road is a gravel no-though road to the Speedway reserve.	HMC will be transported to Capel. 18 return journeys will be required on a daily basis. This is an increase of approximately 1% on existing heavy vehicle movements.	The Peel Road – South West Highway intersection will be upgraded to MRWA requirements. Peel Road will be bitumenised from the intersection to the minesite. This will mitigate dust from traffic and mud from vehicles wheels.	There will be minimal impact on current truck numbers and transport can be managed to an adequate level of public safety.
Visual Amenity	To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape to as low as reasonably practicable.	The Project Area is located in close proximity to residents. The landscape is undulating and some residents have extensive views that include the Project Area. Tree belts have been planted around the Project Area boundary near resident locations.	Some residents will be able to see components of the mining operation.	Visual impact has been mitigated through the mine planning process by locating infrastructure and stockpiles away from residential areas. Site perimeter bunding is proposed in key locations. Mining and rehabilitation of areas as soon as possible.	Visual impact has been reduced to as low as reasonably practical.
Aboriginal Heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	There are three ethnographic sites located within and immediately adjacent to the Project Area.	No ethnographic sites will be disturbed by the Project.	If during the course of development, artefact or skeletal material is uncovered, Iluka will report these discoveries under Section 15 of the *Aboriginal Heritage Act (1972-1980).*	No impact on known sites and process in place to ensure sites discovered during operations are reported.
European Heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	There are no heritage sites within the Project Area.	No heritage sites will be disturbed by the Project.	If during the course of development, heritage material is identified, the appropriate authorities will be notified prior to further disturbance.	No impact on known sites and process in place to ensure sites discovered during operations are reported.

8. BIOPHYSICAL ENVIRONMENT

8.1. Vegetation and Flora

8.1.1. Objective

The EPA objective is to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

8.1.2. Relevant Standards

The EPA has developed a Position Statement for the Environmental Protection of Native Vegetation in Western Australia, Clearing of Native Vegetation with particular reference to the agricultural region of Western Australia (EPA, 2000a). The Waroona Project is not within the agricultural area as defined in this position statement. However, the position statement also covers clearing in other areas of Western Australia. In assessing a proposal outside of the agricultural area, the EPA's consideration of biological diversity will include the following elements:

1. different development options have been considered and reasonable steps have been taken to avoid disturbing native vegetation;
2. no species or community of plants or animals is likely to become extinct as a consequence of the development and risks to threatened species are considered to be acceptable;
3. no association or community of indigenous plants or animals ceases to exist as a result of the Project;
4. vegetation removal does not compromise any vegetation type by taking it below the "threshold level" of 30% of the pre-clearing extent of vegetation;
5. where a proposal would result in a reduction below the 30% level it is expected that alternative mechanisms are developed to address the protection of biodiversity;
6. scarce or endangered habitats are comprehensively, adequately and securely represented within or in areas biologically comparable to the Project Area;
7. in a large Project Area, there is a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity is secure and protected; and
8. the on-site and off-site impacts are identified and the proponent demonstrates that these impacts can be managed.

In addition, the EPA has issued a guidance statement on the level of assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of the System 1 Region No. 10 (EPA, 2003). The guidance aims at ensuring that developments are compatible with the intent of the recommendations for and/or conservation values of these areas. The Waroona project is situated within the System 6 region.

The *Wildlife Conservation Act 1950* (WA) provides for the protection of all native flora, including declared rare and priority flora and the *Environmental Protection and Biodiversity Conservation Act 1999* provides for the protection of threatened flora and communities.

In June 2004, the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* came into operation. Under the regulations, areas subject to the formal environmental approvals process do not require a separate clearing permit. This PER document, if approved represents the approval for clearing associated with the project.

8.1.3. Issue Definition

The majority of the Project Area and surrounding areas have been extensively cleared for agricultural purposes. The implementation of the Waroona Project will result in the disturbance of 184 hectares of agricultural land and vegetation as broken down in Table 19. The area of vegetation disturbance has been calculated at 21.2 hectares from the vegetated envelopes shown in Figure 22. In addition to this, isolated trees occur in paddocks across the site. Of the 21.2 ha, 1.6 ha is planted pines and 7 ha is planted native and non-native trees in tree belts.

12.4 ha of the vegetation is in the Forrestfield Vegetation Complex and 0.2 ha in the Guildford Vegetation Complex. This vegetation is spread over the Project Area in isolated patches. Within the Forrestfield Vegetation Complex 2.9 ha of vegetation will be cleared from Site 16 adjacent to the speedway and 0.8 ha at Site 8 adjacent the northern pit. Of this, approximately 1.3 ha was considered to be in very good condition (Condition rating 3) (Mattiske Consulting 2005). 0.8 ha will be cleared from Site 13. The vegetation sites are described in Section 4.8.1 and shown on Figure 18. The remaining 7.9 ha of vegetation is from small clusters of isolated trees in paddocks generally less than 0.4 ha each. The Sandslope area at Site 9 will not be cleared.

0.2 ha of the Guildford Complex will be disturbed. This is vegetation along Ferraro Brook required for installing a crossing and drainage. No vegetation in the Darling Scarp Complex will be disturbed. Mullins Sumpland will be removed during the mining operation.

Table 19: Clearing Requirements

Area	Hectares
Mine Pits	74
Overburden and topsoil stockpiles	22
Infrastructure (concentrator, water dams, solar drying dams, workshops and roads)	88

No Declared Rare Flora or Priority Flora will be impacted from clearing (GHD 2004, Mattiske Consulting 2005). The Priority 3 species, *Acacia oncinophylla subsp. oncinophylla* was recorded at two locations which are outside the mining area and will not be cleared.

The Threatened Ecological Communities (TEC) identified from the CALM database are outside the Project Area are located 2 km north west of the closest mine pit. These TEC's lie within the road reserve of the South Western Highway and will not be directly impacted from mining activities. The extent of the predicted zone of groundwater drawdown arising from Iluka's dewatering of mine pits does not extend to the TEC's and hence groundwater drawdown from mining is not a risk to the TEC's. Ferraro Brook runs through the TEC's downstream of the Project. At this stage the brook has changed to a man made drain

(Figure 15). It is considered unlikely that the vegetation is reliant on surface flow from the drain. The seasonal nature of water in the drains means vegetation is more likely dependent on groundwater to sustain it over summer (Wetland Research and Management, 2005a).

8.1.4. Assessment and Management

A range of development options have been considered and reasonable steps taken to avoid native vegetation as required by element one of the EPA Position Statement. The location of supporting infrastructure and stockpiles has been developed to minimise impacts on native vegetation. The solar drying dams are preferentially located on backfilled mine areas to minimise the area of disturbance. The raw water dam will be located in the initial mine void rather than clearing vegetation along Ferraro Brook for a dam. The clearing footprint of the Northern mine pit has been revised following discussions with the EPA Service unit and CALM. Overall disturbance for the Project will be limited to the area shown in Figure 22.

No Priority Species or Declared Rare Flora will be impacted as a result of the Project. No species is likely to become extinct and there is no risk to threatened species. This meets the requirements of elements two and three of the EPA Position Statement.

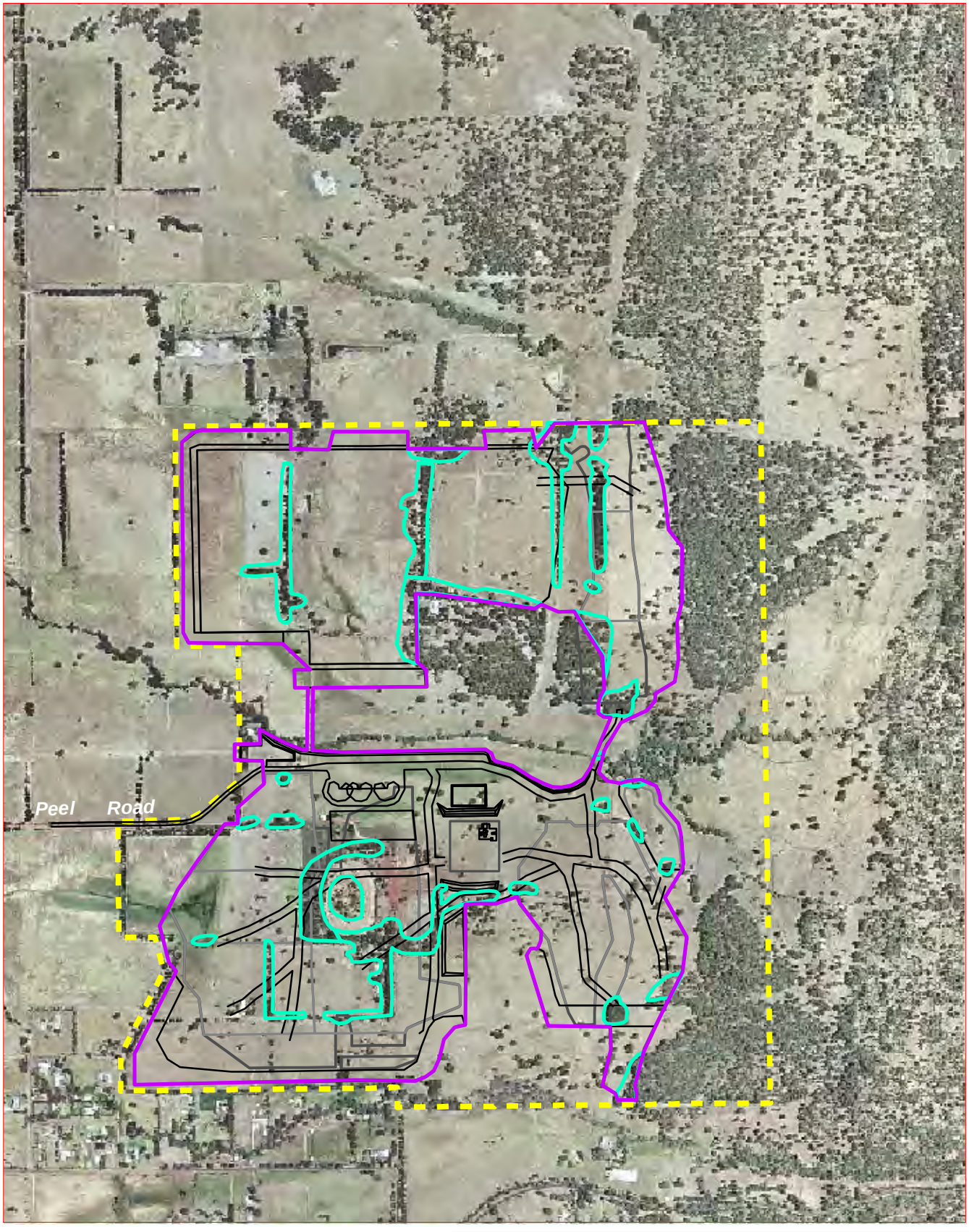
The majority of clearing will take place in vegetation that is part of the Forrestfield complex, a sequence of vegetation types featuring open *Corymbia calophylla-Eucalyptus marginata-E. wandoo* forest on the heavier soils and *E. marginata-C. calophylla-Allocasuarina fraseriana* forest on sandy soils, with *Eucalyptus rudis* and *Melaleuca rhaphiophylla* communities along streams. The Forrestfield complex is below the 30% threshold level as required by element four of the EPA position statement. Table 20 describes the area remaining extent of the Forrestfield complex that will be impacted by the proposal.

Table 20: Regional Extant and impact

Vegetation Complex	Current area (ha) [(a)]	% of original extent [(a)]	Area cleared as a result of proposal (ha)	% of existing extent	Area in Secure Tenure (ha) [(a)]
Forrestfield	3518	17.5	13.4	0.38	61

[(a)] From EPA 2003

As the Forrestfield complex is below 30% of the pre-settlement area this native vegetation has regional significance. The retention of at least 30% of the pre-settlement area of each ecological community is seen as a way of protecting Australia's biodiversity (Commonwealth of Australia 2001). In addition, the 0.5 ha of high condition vegetation at Site 16 and the area of 0.8 ha to be cleared at Site 8 contains flora that corresponds to the 20b TEC type.



Legend

- Project area
- Clearing Boundary
- Vegetated Areas

N

0 250 500 Meters

Date of Photography: 2002

ILUKA

WAROONA

CLEARING PLAN

ORIG:	L.Sadler		
DRAWN:	D.G.S.		
SCALE:	1:15,000		
DATE:	17 Oct. 2005	DWG No: 150065 ver.03	FIGURE: 22

Due to the regional significance of Sites 8 and 16 and the Forrestfield Complex alternative mechanisms must be developed to address the impact on conservation values and the protection of biodiversity as required by element five of the EPA Position Statement for the Environmental Protection of Native Vegetation. These mechanisms have been developed broadly in line with the EPA Preliminary Version 2 Position Statement 9 – Environmental Offsets.

Improvements for and protection of vegetation remaining in the Project Area is proposed. The following mitigation sequence has been utilised:

1. Avoid – The proposal has been designed as far as possible to be constructed on cleared agricultural land. The clearing footprint of the northern mine pit has been modified to avoid the clearing of the majority of the potential TEC area at Site 8 and the original proposed location of the water dam moved from Ferraro Brook.

2. Minimise – Where clearing is unavoidable, infrastructure will be concentrated within designated cleared areas, e.g. the two crossings across Ferraro Brook. Access by employees and the public to vegetation at the site will also be restricted.

3. Rectify –The disturbed area will be rehabilitated following mining. Trial translocation of understorey flora from the Speedway site to the Sandslope will be conducted.

4. Reduce – adverse impacts are rectified as soon as possible. The impact will be eliminated following mining.

5. Offset – The enhancement and re-establishment of native vegetation at the site is outlined in Table 21.

Table 21: Proposed offsets for vegetation clearing

Feature	Actions	Outcomes
Ferraro Brook and surrounds	Fence 50 m buffer area around Ferraro Brook to prevent stock access (total of 21.5 ha). Fence 5.5 ha of Guildford complex to the North of Ferraro Brook on Lot 265. Fence 1 ha of area between Site 9 and Ferraro Brook buffer area. Undertake weed control program in these areas. Infill plant the Brook with native riparian species. Infill plant areas either side of Ferraro brook with native upland species. Link Ferraro Brook to native vegetation blocks. Place CALM conservation covenant(s) on the Ferraro Brook area potentially for use as public open space.	Improve vegetation condition and diversity compared to pre-mining state in the brook and surrounds. Better vegetation linkages along Ferraro Brook and to native vegetation higher in the landscape and on Darling Scarp. Increased long term viability for values associated with the Brook. Increased protection for the vegetation in the brook area through protection by covenants.
Forrestfield and	Fence 14 ha Forrestfield block on Lot	Improve vegetation condition and

Feature	Actions	Outcomes
Darling complex vegetation blocks	478. Fence 45 ha Darling Scarp block on Lots 265 and 513 adjacent State Forest 14. Fence 17 ha Forrestfield block on Lot 513. Infill plant native species on all three blocks. Place CALM conservation covenants on these blocks allowing housing envelopes.	diversity compared to pre-mining state. Better linkages between scarp and upland vegetation and Ferraro Brook. Increase in 50% of current Forrestfield complex vegetation in secure tenure. Increase in the area of Darling complex vegetation in secure tenure. Protection for Priority 3 DRF located on Lot 478. Protection of Darling Scarp vegetation in good condition on Lot 478.
Sandslope – Site 8 and 9	Fence 4 ha of the Forrestfield vegetation/potential TEC at Site 9 on Lot 283. Fence 2.9 ha of the Forrestfield vegetation/potential TEC at Site 8 on Lot 283. Infill plant a 20 m vegetation buffer around both sites where possible using upland species. Fence and infill plant native vegetation to connect these areas to Ferraro Brook. Trial translocation of understorey flora from the Speedway site. Place CALM conservation covenants on these two areas that prevent development.	Improved protection and management of the two areas. Improved vegetation condition and diversity compared to pre-mining state, with protection from weed invasions through buffer areas. Increase in 8% of current Forrestfield complex vegetation in secure tenure. Protection of 6.9 ha of potential type 20b TEC offsetting the clearing of Site 16. Retention of flora associated with the Speedway site. Better linkages between the TECs and Ferraro Brook.
Mullins Sumpland	Reinstate soil profile at Mullins sumpland.	Replace wetland values of Mullins sumpland.

Figure 23 shows the location of the protected vegetation blocks. Iluka believes that the scale and location of the offsets described above will have a significant benefit for local and regional conservation outcomes. The 35.8 ha Forrestfield complex vegetation that will be fenced, infill planted and receive protection by the placement of conservation covenants will increase the representation of this complex within secure tenure by 58%. This area protected will include the regionally significant Sandslope (Site 8 and 9) area that CALM considers representative of the type 20b TEC , as well as two vegetation blocks north and south of Ferraro Brook. The clearing envelope of the northern pit has been modified to avoid the majority of this area.

The trial translocation of common understorey flora from the Speedway area will take place immediately adjacent the Sandslope area. This will incorporate the translocation of understorey flora through the removal of topsoil and live plants in-situ and using topsoil containing seed set from within the highest condition vegetation at Site 16.

Buffers will be placed around Sites 8 and 9 to reduce the potential for weed invasion. These will be 20 m buffers and will be revegetated with species representative of the TEC type 20b. At Sites 8 and 9 a 20m revegetated buffer will be included around the areas of vegetation with the best conditions. At Site 9 this buffer will be located on the northern and

western sides and at Site 8 to the north and east. Both sites will be linked to the Ferraro Brook area at the south. The presence of the Western Power 132 kV power line easement prevents buffering the eastern side of Site 9 and the western side of Site 8.

Fencing, infill planting and placement of conservation covenants will also be applied to 45 ha of Darling Scarp complex adjacent State Forest 14 and 3.5 ha of Guilford Complex adjacent Ferraro Brook. Fencing and infill planting of Ferraro Brook and widening of the vegetation corridor either side of the brook (28 ha area total) will have a major benefit in terms of both connectivity and viability for the values associated with the Brook. Riparian species will be planted within the Brook and transition to upland species away from the Brook. Replacing the wetland values represented by Mullins Sumpland will be incorporated into the closure plan for the mine.

CALM conservation covenants will be placed over areas shown in Figure 23. As an indication, the three Darling Scarp complex areas will allow development of building envelopes, with stocking or other clearing being restricted. The covenants placed over Sites 8 and 9 will prevent development, clearing or stocking within these areas. The Ferraro Brook area will be managed for uses including public open space and protected from clearing and stocking.

Based on past rehabilitation experience the re-establishment and enhancement of native vegetation will require expenditure of approximately $15,000 per ha. In addition, the post mining agricultural productivity of the overall property is reduced due to less stock grazing arable area.

The area of bushland at Site 16 is approximately 2.9 ha stretched around the northern, western and southern sides of the old speedway, which would be completely removed during mining. Of this area, less than 0.5 hectares in the south-west of the site is in very good condition. The shape of the remnant makes for a pronounced ‘edge effect’, with most places within ten metres or so of either pasture or the disturbed ground around the speedway. Site 16 is also isolated from other remnant vegetation.

In the event that mining did not take place the long term survival of the remnant would require ongoing weed management. No management of this area is currently carried out. Without weed management, the understorey of this isolated patch of bush can be expected to further deteriorate as large exotic herbs and grasses replace the less vigorous native shrubs, herbs and sedges.

By protecting the 6.9 ha area at Sites 8 and 9 that is part of the Forrestfield Vegetation complex and corresponds to the 20b community type, the impact of clearing 0.5 ha of very good quality vegetation at Site 16 will be completely offset. The protection of Sites 8 and 9 and the management works that will be undertaken mean that a greater than “like for like” offset is being proposed. Sites 8 and 9 will be linked to Ferraro Brook through the fencing and restoration of pasture land. A trial translocation of the understorey flora present at the Speedway site will also be included at Site 9. Monitoring of the vegetation health will be undertaken at the quadrat locations established during the second vegetation survey. Placement of CALM conservation covenants at these two sites will prevent further development, clearing and stocking.

The mitigation package will ensure that the conservation, integrity and biodiversity values remaining in the Project Area are secure and protected as required by elements six and seven of the EPA position statement for the Environmental Protection of Native Vegetation.

This demonstrates that the proposal meets the requirements of element eight of the EPA position paper for the Environmental Protection of Native Vegetation.

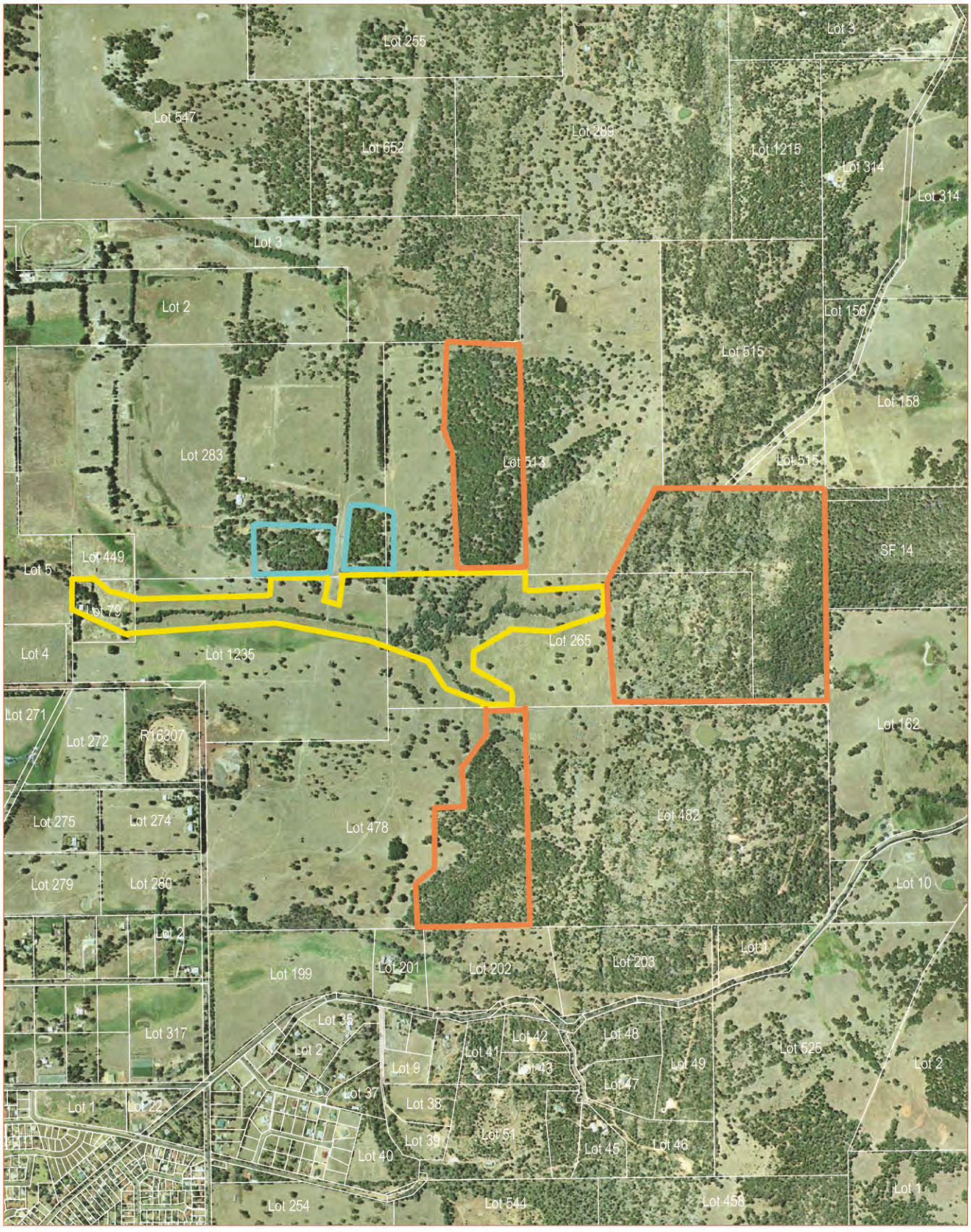
The EPA objective to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels will be met. The development of the mitigation package to offset the clearing of 8.6 ha of planted vegetation and 12.6 ha of remnant vegetation has utilised the mitigation sequence described in EPA Position 9 and results in a significant net environmental benefit. Enhancement and re-establishment of native vegetation will increase the abundance and diversity of flora compared to pre-mining levels and there will be improved vegetation linkages across the Project Area.

Proponent Commitments

Prepare a Vegetation Mitigation plan that addresses the following:

- fencing Ferraro Brook and buffer area, Sites 8 and 9 with buffer areas and the remnant vegetation blocks;
- undertake weed control within these areas;
- infill plant these areas with native species, including riparian species around the brook and upland species in other areas
- trial translocation of understorey flora from the Speedway site; and
- placement of appropriate CALM Conservation Covenants over the identified blocks of remnant native vegetation.

Implement the Vegetation Mitigation Plan.



Legend

- Ferraro Brook covenant area
- Sites 8 and 9 covenant area
- Darling Scarp covenant area

N

0 125 250 500 750 1,000 Meters

MGA Coordinates, GDA94

ILUKA

WAROONA

VEGETATION MITIGATION PLAN

ORIG:	L.Sadler		
DRAWN:	S.P.		
SCALE:	1:17 500		
DATE:	31 March 2005	DWG No: 150078 ver.03	FIGURE: 23

8.2. Fauna

8.2.1. Objective

The EPA objective is to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

8.2.2. Relevant Standards

The *Wildlife Conservation Act 1950 (WA)* provides for the protection of rare fauna and birds protected under an international agreement and other special fauna that are listed on specified schedules. Other species for which the status of abundance is unclear and there is some concern, are listed as Priority Fauna by CALM.

8.2.3. Issue Definition

The clearing of vegetation within the Project Area has the potential to disturb fauna in the short-term by removing fauna habitat and affecting the ability of fauna to move throughout the landscape. Iluka proposes to clear 21.2 hectares of native and non-native vegetation (Section 8.1). The vegetation is scattered with few links to other areas of native vegetation.

Underlying any discussion on the value of the remnant vegetation of the Project Area is the extent of clearing for agriculture in the site and the degraded nature of many of the remnant patches. Large areas of land adjacent to the site on the Darling Plateau are likely to provide more significant fauna habitats than those present in the Project Area although any remnant is of some value in a fragmented landscape.

The Quenda (*Isoodon obesulus fusciventer*), a priority 5 species, has been noted to be using vegetation around the old speedway site. Flocks of Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), a gazetted threatened species which is also listed as vulnerable under the EPBC act, were observed during the October 2003 and September 2005 field surveys. The Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*), a priority 3 species was also observed during both surveys.

8.2.4. Assessment and Management

Clearing of vegetation at the site will have some impact on the availability of habitat for fauna. This is particularly the case for large mature Eucalypt trees that may contain hollows of various sizes that will provide roosting, nesting and shelter for a large range of species. A number of birds including the Australian Ringneck, Elegant Parrot, Australian Kestrel and Tree Martin were using or investigating tree hollows in dead trees in paddocks within the Project Area. However, as a result of grazing there is little regrowth or recruitment and trees are also being damaged by cattle bark-stripping. While dead and hollow trees do provide habitat for fauna, a general decline in vegetation health will have a corresponding decline in the richness and biodiversity of resident fauna. This coupled with the lack of understorey shrubs and groundcover species across most of the Project Area reduces the habitat value present at the site (Ninox 2005).

Where possible, trees containing hollows will be retained in order to alleviate additional pressure on hollows within remnant vegetation. Those trees containing hollows within the clearing envelope will be inspected prior to clearing for evidence of bird breeding. Cleared trees with hollows will be placed in the rehabilitation area to act as fauna habitats.

Baudin's Black Cockatoo was observed in both fauna surveys. In the Ninox Wildlife Consulting survey, a flock of up to 100 birds was observed feeding on various Marri trees throughout the project area. Development of the Waroona Project will result in several of these trees being cleared. This will have some impact locally on the available food resources for Baudin's Cockatoo and other avian fauna, although birds will be making use of numerous other trees in the Project Area. Several other Marri trees favoured by the Baudin's will not be affected by the proposal and will be protected from clearing. Prior to any clearing taking place, seed from those trees favoured by cockatoos to be cleared will be collected and used in the rehabilitation committed to in the Vegetation Mitigation Plan, which will be protected through conservation covenants. This will aid in the recruitment of Marri trees in the longer term and mitigate the loss of food resources for Baudin's Cockatoo and other species.

Historically, Baudin's Cockatoo bred in the deep south west of Western Australia, north to Donnybrook (Johnstone & Storr 1998), which is approximately 80 km to the south of the Project Area. The major nucleus of the nesting areas is the Karri Forest in the far south west of the state. In recent years Baudin's have been observed breeding at Serpentine (40 km to the north of the project area) and Kojonup in the east (160 km to the south east) (T. Kirkby, pers. com., 4/10/05). These have been isolated pairs at the extremity of breeding range.

In the event that Baudin's Cockatoo was making use of nesting hollows in the Project area, it is likely that this is an isolated pair. Regional, the abundance of the Baudin's Cockatoo would not be impacted by the removal of small number of hollows at the extremity of its breeding range. The project will have no impact on the major concentration of breeding sites which is located over 80 km to the south.

The Forest Red-tailed Black-cockatoo, also observed within the project area, is more commonly seen in the Jarrah forest of the Darling Range although it will be observed in remnant Jarrah or Marri vegetation on the Darling Scarp and foothills. Clearing of vegetation within the project area will have minimal impact on the available food resources for this species and potentially nesting hollows. The impact of this clearing will be offset by the protection and rehabilitation of approximately 100 ha of remnant vegetation on the foothills and the scarp as part of the Vegetation Mitigation Plan.

Most of the remaining shrub vegetation clings to areas of granite and laterite outcrops near site 14 (Figure 18). This area was the most prolific in observing bird species during the first fauna survey (GHD 2004). It also provides good habitat for small mammals and reptiles that take advantage of the abundant shelter from crevices and food sources. This area will not be impacted by the Waroona project.

Of all the areas examined in the study area, the south-west corner on the outside of the old Waroona Speedway showed the healthiest vegetative cover, including healthy tree, shrub and ground cover layers in an area of approximately 0.5 ha. This vegetation has provided excellent cover for a suite of animal species. In the vicinity of this site, tracks of the Quenda (Southern Brown Bandicoot *Isoodon obeselus fusciventer)* were numerous during the 2003 survey, and diggings and shelter evident across the site. During the 2005 survey, signs of

the Quenda in this site were few although fresh tracks of both Red Fox and feral cat were numerous. In the two years between the GHD and Ninox assessments, these two exotic predators may have had an impact on the bandicoots within the speedway area.

The clearing of vegetation around the speedway will impact on any Quenda living in the area. The Quenda occurs widely in the Southwest of WA and despite declining greatly due to land clearing and fox predation, remains common. The clearing of the 2.9 ha area surrounding the speedway is unlikely to have an impact on the species generally (GHD, 2004). Similarly, other fauna present at the Speedway site do not rely exclusively on this area, so clearing will have minimal impact on populations.

Clearing of vegetation in the north-east section of Site 8 will impact on a number of dead trees containing hollows that appear to provide shelter for the Common Brushtail Possum. This species is common in the south west and the clearing of this area will not impact on the overall population of this species.

The intermittent nature of remnant vegetation patches in the study area indicates poor vegetation linkage between habitats. Few of the remaining vegetation sites examined in this study retain significant shrub and groundcovers, minimising the likelihood of providing linkage between sites. Much of the eastern Swan Coastal Plain has been cleared of vegetation over the last century for agricultural purposes, and few stands of remnant vegetation remain. In the study site, no linkages exist between the well forested western edge of the Darling Plateau and the flats of the Swan Coastal Plain. It is therefore not likely to expect much faunal movement, apart from bird species and the occasional large mammal, through the Project Area.

Generally, creeklines provide important linkages between upland and lowland habitats, but these too, have been impacted by land clearing practices, reducing their importance in providing corridors for faunal movement. Most of the ephemeral creeklines in the study site have been completely cleared in their lower reaches, and their usefulness as vegetation linkages is minimal.

The important habitat of the Speedway is poorly linked with other remnant vegetation in the Project Area, and has become an important refuge for ground dwelling fauna. The lack of continuous linkage, particularly with the healthier forested areas of the Darling Plateau indicates that the relative isolation means the Speedway site is more vulnerable to impact.

Due to the isolated nature of vegetation at the speedway, any Quenda living in the vegetation will not have the opportunity to move to other vegetation during clearing. It is proposed that prior to clearing a trapping and relocation program will be implemented in consultation with CALM. Relocation will be to areas on site that will not be impacted by clearing, as these may be within the animals' territory and may not, therefore, result in conflict with existing populations.

A trapping and relocation program will also be conducted for any Common Brushtail Possums present within hollows at Site 8. This area is within the clearing envelope for the northern mining pit. Captured animals will be relocated to nearby remnant vegetation, such as Site 9. Trees containing hollows that are cleared will be relocated and placed on the ground within the uncleared portion of Site 8. These trees are likely to become an important refuge for ground-dwelling fauna.

In total, the study site considered here has a low specific value associated with fauna because it is typical of habitat that has been severely disjointed by previous land clearing practices. Impacts on fauna as a result of the Waroona project will be limited to the short-term habitat loss associated with unavoidable habitat removal. The mitigation package detailed in Section 8.1 incorporates significant fencing, infill planting and conservation covenants that will improve vegetation linkages and vegetation condition in Ferraro Brook and other vegetated areas, protecting existing vegetation and ultimately providing new habitat for fauna. Older, larger trees that contain hollows outside of required clearing envelopes will be retained as a priority. The EPA objective to maintain the abundance, diversity, geographic distribution and productivity of fauna will be met.

Proponent Commitments

To minimise the impact on fauna at the site Iluka will:

- preferentially retain trees identified with hollows on site;
- inspect those trees within the clearing envelope with hollows for signs of bird nesting;
- place any cleared trees with hollows within the rehabilitation and mitigation areas for use as fauna habitats;
- protect Marri trees favoured by Baudin's Cockatoo as food sources from where practicable;
- use seed from Marri trees favoured by Baudin's Cockatoo in the Vegetation Mitigation Plan; and
- prepare and implement a capture and relocation program for Quenda from the Speedway –Site 16 and the Common Brushtail Possum at Site 8.

Refer to also to the Commitments under Section 8.1.

8.3. Landform and Soils

8.3.1. Objective

The EPA objective is to maintain the integrity, ecological functions and environmental values of the soil and landform.

8.3.2. Relevant Standards

As there are no regulatory standards for general soil and landforms, the standard is to be assessed against the objective. Iluka has well established protocol in delineating and handling soils that will be followed for the Waroona project.

The DoE has released a General Guidance on Managing Acid Sulfate Soils (DoE, 2003b) to direct those involved in areas where acid sulfate soils are present to sources of information, and provides a framework for decision-making associated with ground-disturbing activities in ASS risk areas. This guideline is aimed at minimising the risk to the environment resulting from the potential exposure of any PASS, to be achieved by implementing appropriate detection and management strategies.

8.3.3. Issue Definition

Disturbance to the landform will result from pit excavations, topsoil and overburden stockpiles. Topsoils and subsoils have certain physical properties and attributes that are essential to plant growth. The soils need to be handled in a manner which ensures these properties are retained for rehabilitation.

Disturbance of the soils may result in the exposure of acid sulfate soils. ASS may impact soil, water, biota and air. In turn, ASS also impacts upon recreation, tourism, human health and visual amenity (DoE, 2003b). Projects in PASS risk areas involving excavation, lowering of the water table or lateral displacement of previously saturated sediments, may result in soil, groundwater and/or surface water acidity and the release of metals and precipitates (DoE, 2003).

8.3.4. Assessment and Management

A detailed survey of the soils has been conducted. This divides the soil types into SMMU (Soil Material Management Units). Each SMMU will be stockpiled separately to preserve its physical properties and attributes. Stockpiling of the soil components will enable them to be appropriately blended with sand and clay tail fractions removed during the separation process.

Topsoil and subsoils will be removed and stockpiled for rehabilitation. Stripping of topsoil occurs immediately prior to pit development to minimize open area. Topsoil stockpiles will be up to 5 metres in height and where required will be seeded with a cover crop to stabilize and to avoid airborne dust and material loss. Stripping will be conducted during dry, calm conditions to minimize the possibility of erosion, increased turbidity and excessive dust generation.

The mining pits will be backfilled following mining aiming to replicate pre-mining physical properties as closely as possible so that the water storage capacity, infiltration and transmissivity characteristics are maintained. Overburden will be directly returned to the mining void where possible. Following overburden replacement and sand and clay tails incorporation, sub-soils are replaced. The material is landscaped and blended throughout the process.

The landscape will be rehabilitated to reflect the pre-mining contours and revegetated to promote stability and mitigate the likelihood of erosion. There will be no void remaining following landscaping. Detailed surveys are conducted to ensure appropriate drainage controls are incorporated.

A preliminary assessment of the PASS has been conducted. This has shown that the PASS occurrence across the Project Area is low. Discussions with the EPASU indicated the need for additional testing work to meet the sampling density requirements recommended by DoE. Iluka will develop and carry out an additional sampling program for PASS prior to construction. The Soil Management Plan will be updated based on these results to manage any risk from PASS/ASS.

The above management strategies ensure that soils will be handled in a manner which maintains the integrity, ecological functions and environmental values of the soil.

Proponent Commitments

Iluka will undertake additional testing for PASS within the Project Area prior to construction and modify the Soil Management Plan based on the results.

Refer to Commitments under Section 8.4.

8.4. Rehabilitation and Closure

8.4.1. Objective

The EPA objective is 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.

8.4.2. Relevant Standards

The Australia and New Zealand Minerals and Energy Council (ANZMEC) standard Strategic Framework for Mine Closure (2000) outlines a range of objectives and principles relevant to rehabilitation, including planning, financial provisioning, implementation and standards.

8.4.3. Issue Definition

Mining results in the disruption of the land profile. Rehabilitation is required to restore the landscape and enable post-mining land uses. Rehabilitation must be of a standard which complies with meets the EPA and Iluka's objective of achieving a stable and functioning landform which is consistent with the surrounding landscape and is acceptable to the community and other stakeholders.

8.4.4. Assessment and Management

Iluka has significant experience in rehabilitating former mining areas to productive agricultural land in the Southwest of WA. Standard operating practices have been developed based on rehabilitation experience. These will be applied at Waroona.

Rehabilitation at Waroona will return the land profile consistent with the surrounding topography and recreate the agricultural productivity to pre-mining values. Rehabilitation will involve replacement of soils and landforms as described in Section 8.3 followed by seeding and fertilising the re-created landscape. Seeding and fertilising is conducted using agricultural machinery. In line with the Waroona North Structure Plan, roads and road reserves may be installed in accordance with the land-use zoning and with the approval of the Shire of Waroona. A fencing plan will be developed and fences installed dividing the mined area into agricultural paddocks. This will include fencing of remnant vegetation as outlined in Section 8.1. Infill planting will be conducted of the fenced remnant vegetation and Ferraro Brook using local provenance native seed. Two Brook crossings and stock watering points will be incorporated at selected locations along Ferraro Brook.

The Waroona North Structure Plan being prepared by the Shire of Waroona will define the proposed landuses and zoning for the area post-mining (Section 6.4.1). Iluka will continue to work with the Shire to develop the Waroona North Structure Plan and will integrate measures to achieve the proposed landuses and zoning into the Mine Closure Plan. The

structure plan is only expected to make minor changes to the closure plan. Examples include placement of fences, retention of powerlines and water pipelines and placement of laneways in potential future road reserves.

Following completion of mining all infrastructure and buildings will be decommissioned and removed from the site. All concrete fittings and pads will be removed. Some powerlines may be left in place with the approval of the Shire of Waroona.

The Closure plan will address the above management strategies. The plan will be developed and submitted for approval 2 years prior to the cessation of mining. This will reflect ongoing rehabilitation and mining activities. The closure plan will ensure that the EPA objective of a stable and functioning landform consistent with the surrounding landscape and other environmental values is met.

Proponent Commitments

Prepare the Closure Plan, prior to the cessation of mining, which addresses:

- post-mining land-use;
- soil management;
- post-mining landforms;
- fencing plans;
- infill planting with native species;
- brook crossings and stock watering points; and
- decommissioning of mining infrastructure.

Implement the Closure Plan.

8.5. Biodiversity

8.5.1. Objective

The EPA objective is to avoid adverse impacts on biological diversity, comprising the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.

8.5.2. Relevant Standards

The EPA's Position Statement Number 3, *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA, 2002a) discusses the principles which the EPA will use when assessing proposals which may impact on biodiversity values. The Position Statement outlines the EPA's principles for environmental impact assessment of biodiversity. The Principles include:

- the definition of Biological Diversity and the Principles defined in the National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia, 1996) are adopted;

- proponents are expected to demonstrate that all reasonable measures have been undertaken to avoid impacts on biodiversity, or that the impact will not result in unacceptable loss;
- information gathered must meet State, National and International Agreements, Legislation and Policy in regard to biodiversity conservation;
- the quality of information and scope of field surveys must meet standards, requirements and protocols determined by the EPA;
- the Interim Biogeographic Regionalisation of Australia (IBRA) is used for EIA decision-making in relation to biodiversity conservation;
- terrestrial biological surveys are expected to provide sufficient information to address both biodiversity conservation and ecological function values;
- terrestrial biological surveys are expected to be made publicly available and will contribute to the bank of data available for the particular region, aiding the understanding and assessment of biodiversity; and
- the precautionary principle will be adopted in the absence of information that could provide assurance that biodiversity will be protected.

The National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia, 1996) describes biological diversity as the variety of life forms: the different plants, animals and microorganisms, the genes they contain, and the ecosystems they form. Biological diversity is usually considered at three levels: genetic diversity, species diversity and ecosystem diversity. The *Environmental Protection and Biodiversity Conservation Act (1999)* was implemented under the National Strategy to assist the consideration of biodiversity impacts on a National level.

8.5.3. Issue Definition

The EPA regards biodiversity as a key environmental factor and has an objective to ensure that biological diversity is protected. The EPA expects the Proponent to demonstrate in their proposal that all reasonable measures have been undertaken to avoid impacts on biodiversity. Where some impacts on biodiversity cannot be avoided, it is for the proponent to demonstrate that the impact will not result in unacceptable loss.

The clearing of native vegetation and the removal of fauna habitat may lead to the loss of biodiversity within a region which has already been extensively cleared for agriculture. The assessment of these impacts as individual factors is addressed in Section 8.1 Vegetation and Flora and Section 8.2 Fauna. The vegetation and fauna surveys did not identify any environmental matters within the Project Area that trigger the *Environmental Protection and Biodiversity Conservation Act (1999)* (GHD 2004).

8.5.4. Assessment and Management

Within the Project Area there remains only isolated paddock trees and small clusters of native vegetation (GHD 2004). Most of the vegetation structure is altered and has obvious signs of disturbance, the most significant of which are the presence of weeds and grazing by stock. Flora and fauna surveys have been conducted to meet the requirements of EPA Position Statement Number Three. The survey reports has been reviewed by CALM and made publicly available through the PER process and on the Iluka website.

A key objective in the National Strategy for the Conservation of Australia's Biological Diversity is to "repair and rehabilitate areas to restore their biological diversity". The vision of the Waroona community for the Waroona North Structure Plan (Section 6.4.1) included areas of native vegetation. There are several vegetated areas within the Project Area that are in reasonable condition and can be preserved through fencing from stock to reduce grazing pressure and encourage the recruitment of understorey species.

Several areas on Iluka property, within and adjacent to the Project Area, have been identified to be fenced and protected from further clearing through the placement of appropriate conservation covenants. Two blocks located within the Forrestfield Complex of 14 ha and 17 ha and a third block of 45 ha within the Darling Scarp Complex will be protected. Two smaller blocks, one within the Guilford Complex adjacent Ferraro Brook and the other corresponding to the TEC 20b and 3b community type, Sites 8 and 9, will also be protected. These are shown in Figure 23. These areas have been selected as they are a suitable size, condition and value for protection and will enable the creation of links with Ferraro Brook and State Forest.

Ferraro Brook is degraded and has no understorey vegetation present (Section 4.6). It is proposed to fence off Ferraro Brook through the length of the Project Area over a width of 100 m, with a total area of 21 ha. The aim of the restoration will be to improve species diversity and stabilise eroding banks. The area will be infill planted with native riparian and upland species and a weed control program will be implemented to rehabilitate the brook to have greater conservation value. Ferraro Brook is within the Guildford Complex.

Ferraro Brook will be used to form vegetation corridors between the protected vegetation blocks and Ferraro Brook as depicted in Figure 23.

The rehabilitation program will enhance and protect existing native vegetation and provide linkages between vegetation remnants.

Another key objective in the National Strategy for the Conservation of Australia's Biological Diversity is to "achieve the conservation of biological diversity through the adoption of ecologically sustainable agricultural and pastoral management practices". The cleared land disturbed by the mining operations will be rehabilitated to agricultural land as outlined in Section 8.3.

Measures have been undertaken to avoid adverse impacts on biodiversity through the avoidance of areas containing native species as outlined in Section 8.1. Impacts are restricted to individual plants and animals. Impacts to biodiversity are negligible. The restoration and protection of remaining vegetation and creation of native vegetation corridors linking isolated remnants will improve the biodiversity of the Project Area following mining.

Proponent Commitments

Refer to commitments made under Section 8.1 and 8.4.

8.6. Groundwater Systems (Quality and Quantity)

8.6.1. Objective

The EPA objective for groundwater is to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance are protected.

The EPA objective for water quality 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.

8.6.2. Relevant Standards

The use of groundwater is controlled under the *Rights in Water and Irrigation Act 1914*, administered by the Water and Rivers Commission. The Act requires the regulation of water systems in certain localities, limits water extraction rates and requires monitoring and reporting.

A pollution prevention licence will be issued for the operation of the site under Part V of the *Environmental Protection Act 1986*. This is likely to include conditions on groundwater monitoring and management.

The *Australian and New Zealand Water Quality Guidelines* (2000), while not a regulation, provides trigger levels for assessing water quality and developing appropriate water management strategies.

The EPA's Position Statement No. 4 Environmental Protection of Wetlands, identifies activities with the potential to degrade wetlands and the EPA's principles for the protection of wetlands.

8.6.3. Issue Definition

During construction predicted water supply demands are in the order of 250 ML/annum. Once operational it is anticipated that Iluka's processing operations will require 2,300 ML/annum. This water will be sourced from pit dewatering and a private water supplier.

Parts of the mineral reserves to be mined are beneath the watertable of the superficial aquifer. The north and south pits are mainly dry with the most water encountered in the western section of the main pit. Therefore, as mining progresses, groundwater will ingress into the pit voids requiring dewatering to enable dry mining to occur. This water will be pumped to the raw water dam for use within the concentrator plant. It is estimated that up to 300 ML of groundwater would be abstracted annually.

Potential impacts resulting from groundwater drawdown are impacts on neighbouring bores, impacts on vegetation and impact on surface water bodies. Impacts on surface water bodies from groundwater drawdown are covered in Section 8.7.

Studies have been conducted on the impact of mining on the shallow groundwater resources (URS 2000, URS 2002) to characterise the pre-mining hydrology, simulate the mine dewatering schedule and model the groundwater contours during and after mining. Groundwater modelling was completed using TARGET-3DU, a 3D finite difference groundwater flow code (URS, 2002). Modelling indicates that the abstraction of groundwater over the lifespan of the mining operations will result in a cone of depression underneath the mining pits.

The modelling shows that groundwater abstraction of less than 1.1 ML/day is required for the majority of the mining area. The remaining mine area will have minimal (less than 0.02 ML/day) or no dewatering requirements. It is expected that the cone of depression will be

confined to Iluka owned properties. There is no impact from drawdown predicted on neighbouring properties. Modelling and past experience indicates that water levels will recover post mining without the need for intervention. Anticipated residual drawdown two years following the completion of mining is shown in Figure 28.

Key aspects of the predicted drawdown include:

- mining occurs close to the water table in block 5 (Figure 24) and small-scale groundwater abstraction and localised drawdown of the water table is expected;
- as mining progresses to mining block 9 (Figure 25), drawdown propagates beyond the western boundary of the mining area;
- as mining is progressed to block 13 (Figure 26) drawdown propagates beyond the northwest and northern boundaries of the mine area. Drawdowns of up to 1 m extend beneath Ferraro Brook. Mining of Mullins Sumpland will result in substantial reduction in flows from the sumpland to Nanga Brook; and
- as mining is progressed to block 16 (Figure 27) drawdown occurs within the mined areas (URS, 2002).

Potential impacts to groundwater quality due to mining activities within the Project Area are likely to be related to the migration of pollutants on the surface into the groundwater system through infiltration. They key potential source of pollutant is hydrocarbons. There is also a low potential for acidification of shallow groundwater through changes in groundwater levels due to dewatering.

8.6.4. Assessment and Management

Except for vegetation located within the mine pits, drawdown contours are only present beneath a section of Ferraro Brook, isolated trees in paddocks and planted tree belts. As such, there is limited potential for impact on native vegetation from dewatering. The 1 m maximum drawdown contour extends beneath vegetation along Ferraro Brook for approximately 200 m. Drawdown in this area is associated with mining of the western side of the main pit and is not anticipated to be sustained for more than six months. Depth to water in this area ranges seasonally between 3 to 5 m from surface. It is not anticipated that a short-term drawdown of 1 m will impact vegetation along Ferraro Brook given the depth to water and seasonal variations. The vegetation along the brook is in poor condition with no understorey present.

Vegetation health in this section of the brook will be monitored through regular photo surveys. Improvements to the stream are proposed as outlined in Section 8.3. As a contingency, any vegetation loss through water stress will be replaced as part of the site restoration.

Except for vegetation located within the mine pits, drawdown contours are only present beneath isolated trees in paddocks and planted tree belts. As, such there is limited potential for impact on native vegetation from the dewatering.

Regular photo surveys will also be conducted at permanent points in other vegetated areas adjacent to pits to measure vegetation health will be conducted in vegetated adjacent mine pits health. Transects were left in place at site 9 and will be used to assess flora and vegetation condition.

Groundwater abstraction through dewatering will be minimized to the level required to enable safe dry mining to occur. Abstraction volumes will be measured on a regular basis, compared to the model and reported according to licence requirements. Piezometers surrounding the minesite will continue to be monitored on a regular basis and reported annually. The monitoring program is detailed in the Water Resources Management Plan, and includes monthly water level measurements in the piezometer network and testing of water quality, including pH.

To manage its water supply, the minesite will operate a recirculating water system, which maximises the potential for recycling. Water will be returned to the raw water dam from various sources including:

- groundwater collection from pit sump pumps;
- decanting from tailings and fines dams and drainage from stockpiles; and
- collection of stormwater and surface waters within the site.

The modelling shows no anticipated impact on surrounding landowner's groundwater supplies. However as a contingency Iluka will maintain adequate water supplies to nearby residents, should any adverse changes due to mining be detected. Baseline information on adjacent landowner water usage has been obtained from the landowners. An ongoing dialogue will be maintained with landowners throughout the operation to enable issues to be addressed if they occur.

Potential impacts to groundwater quality are likely to be restricted to the migration of pollutants on the surface into the groundwater system through infiltration. Process water from mineral sands mining process contains no hazardous chemicals. A biodegradable flocculant is added to the thickener to help clay settle out during the solar drying dam process. Hydrocarbons are utilised on site in mobile and stationary equipment. All hydrocarbon storage facilities are bunded according to the Water Quality Protection Guideline No. 10 Above Ground Chemical and Fuel Storage (WRC, 2000a) reducing the risk of hydrocarbon spills entering groundwater systems.

Although considered a remote possibility due to the location of the site in the landscape and the low potential for PASS, any sudden changes in the water levels may give rise to conditions that result in the acidification of shallow groundwater. Monthly monitoring of the groundwater levels in the piezometer network and the quarterly water quality monitoring (including pH and Fe) will be carried out and an analysis of trends included in the Annual Environmental Review.

A management plan will be developed that documents the management initiatives outlined above. Implementation of the plan will ensure that quantity and quality of groundwater is managed so that existing and potential environmental values, including ecosystem maintenance are protected.

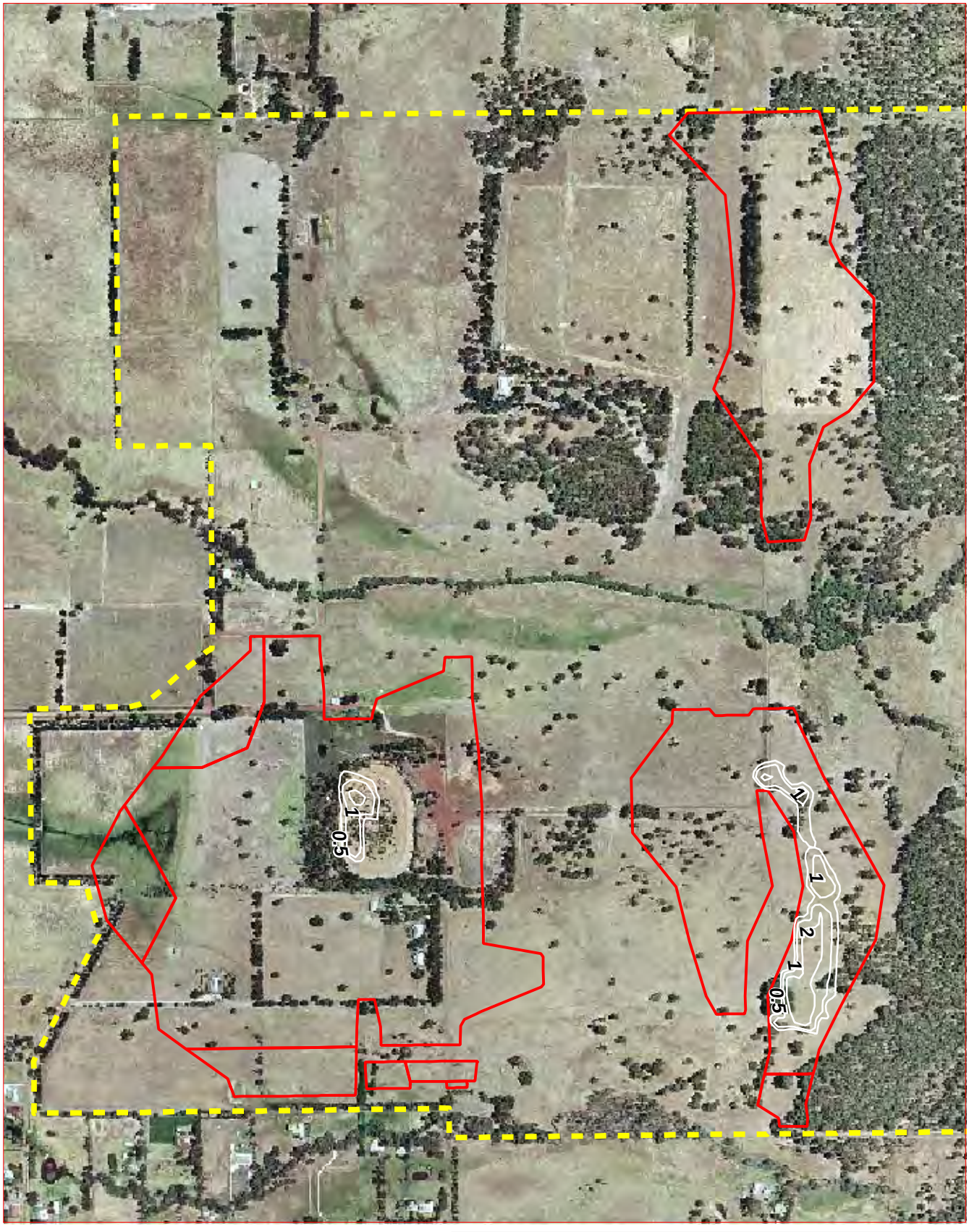
Proponent Commitments

Prepare a management plan for the protection of water resources that includes:

- monitoring and reporting of groundwater levels and vegetation impacts (through photo surveys) in area of drawdown;
- monitoring and reporting of stream flows and potential impacts of reduced flows in Nanga and Ferraro Brook;

- monitoring and reporting of aquatic biota in Nanga and Ferraro Brooks;
- measurement and reporting of water abstraction and usage;
- monitoring of water quality and water levels within the piezometer network;
- spills and hydrocarbon management; and
- contingency actions for affected water supplies.

Implement the Water Resources management plan.



Legend:

- Project area
- Predicted drawdown contours (m)
- HM Reserves

N

0 250 500 m

Date of photography: 2002

ILUKA

ORIG:	L.Sadler
DRAWN:	D.G.S.
SCALE:	1:10 000
DATE:	17 Oct. 2005

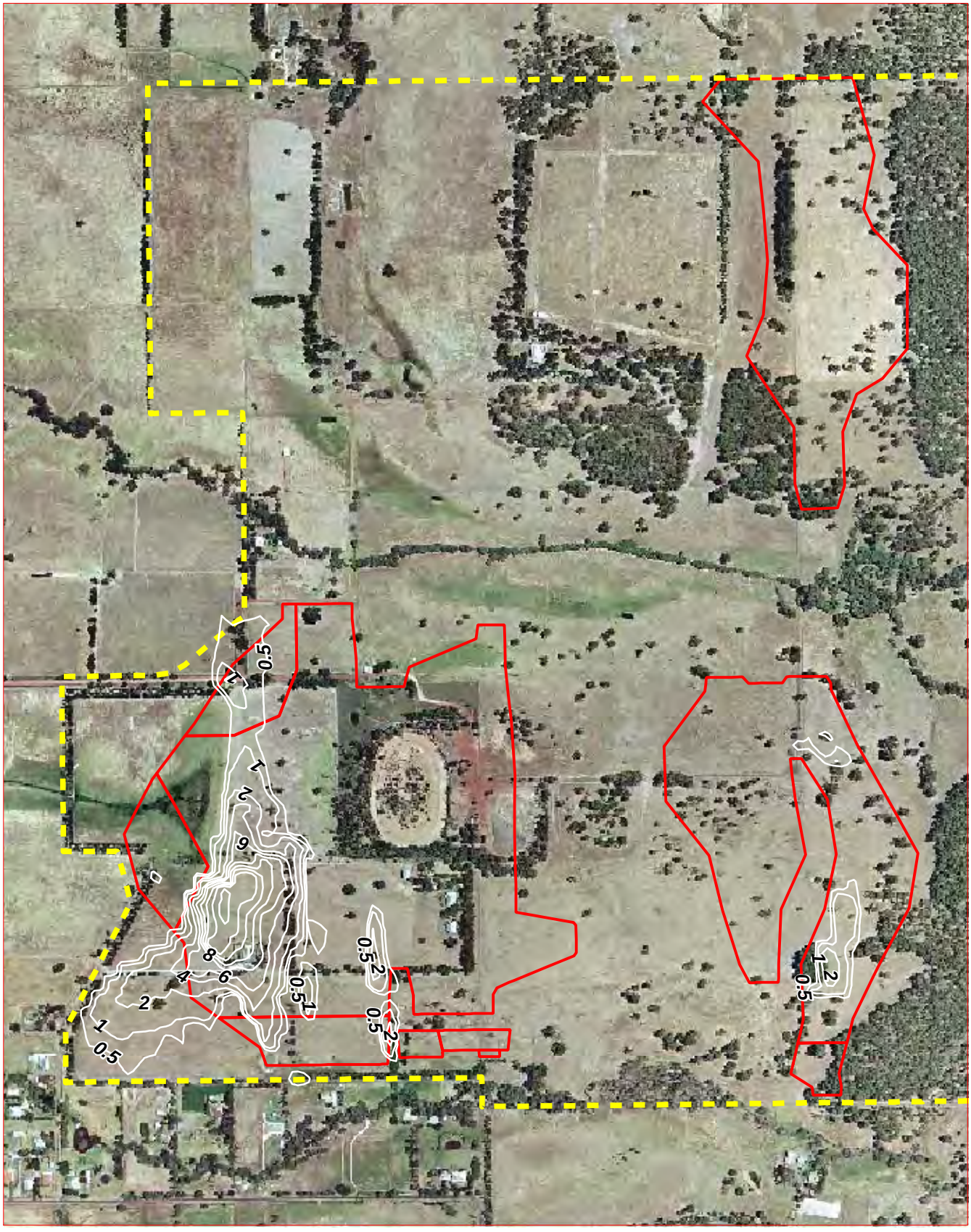
WAROONA

PREDICTED WATER TABLE DRAWDOWN

at the end of mining block 5

DWG No: 144204 ver.02

FIGURE: 24



Legend:

- Project area
- Predicted drawdown contours (m)
- HM Reserves

N

0 250 500 m

Date of photography: 2002

ILUKA

ORIG: L.Sadler

DRAWN: D.G.S.

SCALE: 1:10 000

DATE: 17 Oct. 2005

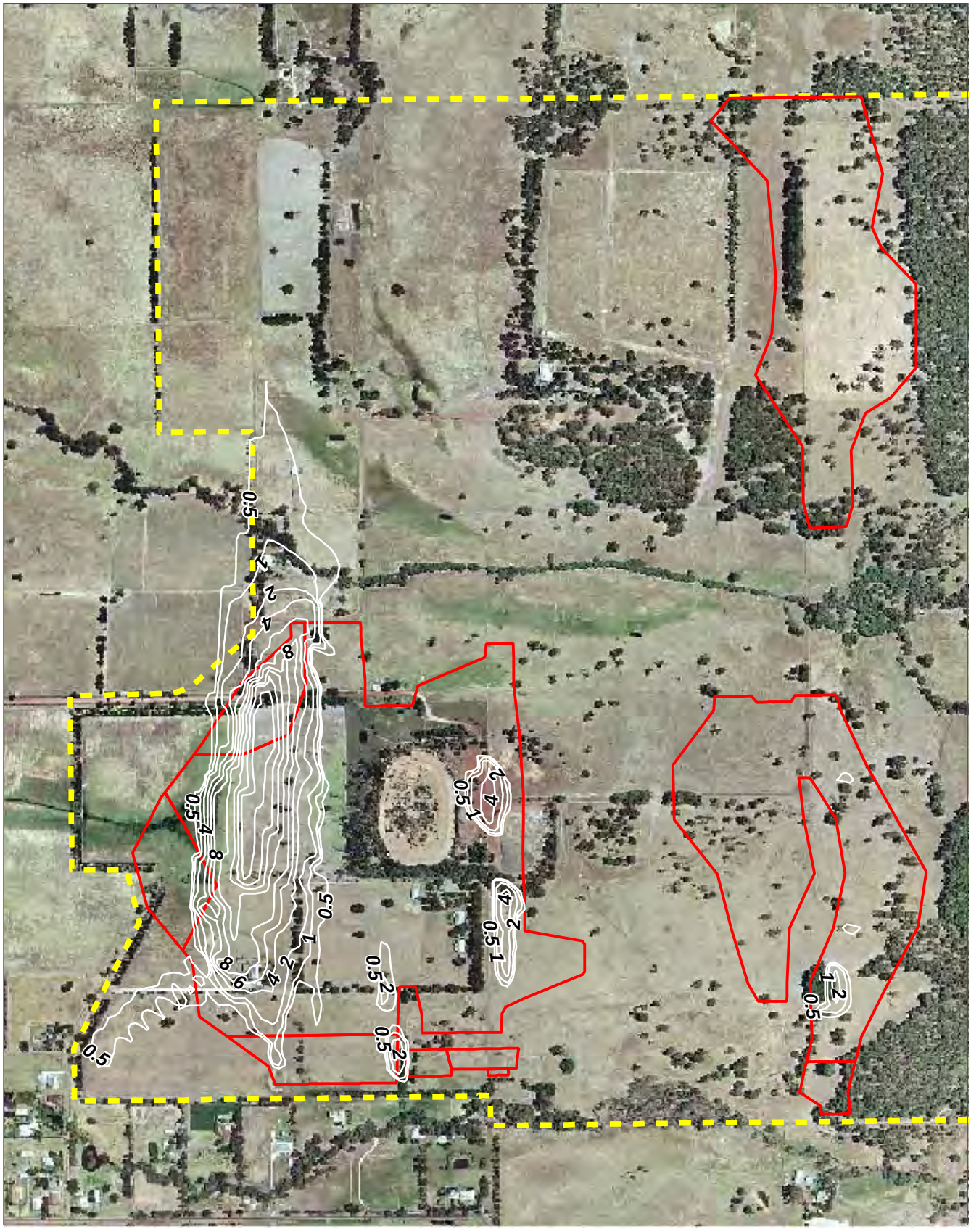
DWG No: 144205 ver.02

FIGURE: 25

WAROONA

PREDICTED WATER TABLE DRAWDOWN

at the end of mining block 9



Legend:

- Project area
- Predicted drawdown contours (m)
- HM Reserves

N

0 250 500 m

Date of photography: 2002

ILUKA

ORIG:	L.Sadler
DRAWN:	D.G.S.
SCALE:	1:10 000
DATE:	17 Oct. 2005

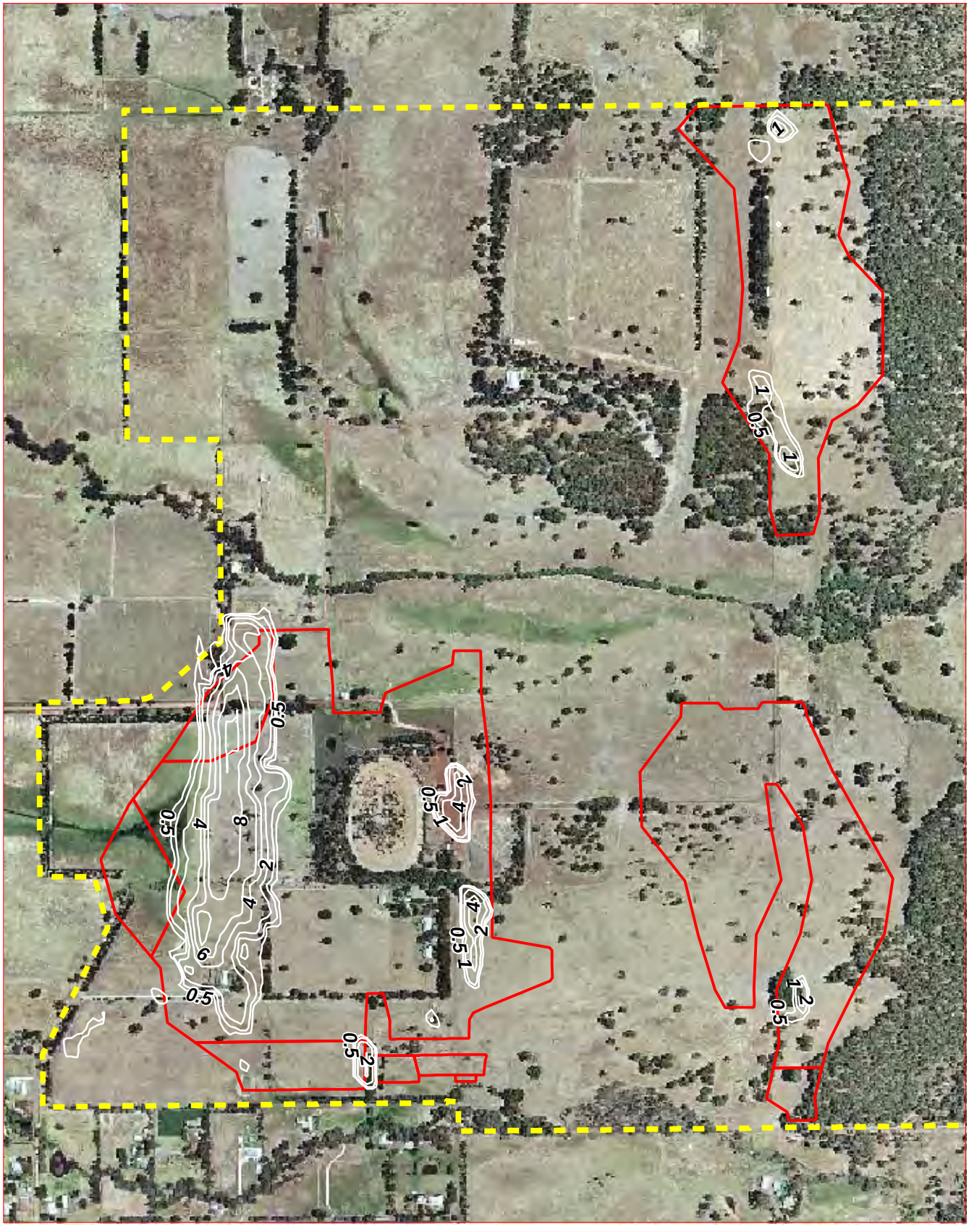
WAROONA

PREDICTED WATER TABLE DRAWDOWN

at the end of mining block 13

DWG No: 144206 ver.02

FIGURE: 26



Legend:

- Project area
- Predicted drawdown contours (m)
- HM Reserves

N

0 250 500 m

Date of photography: 2002

ILUKA

ORIG:	S.Mason
DRAWN:	D.G.S.
SCALE:	1:10 000
DATE:	17 Oct. 2005

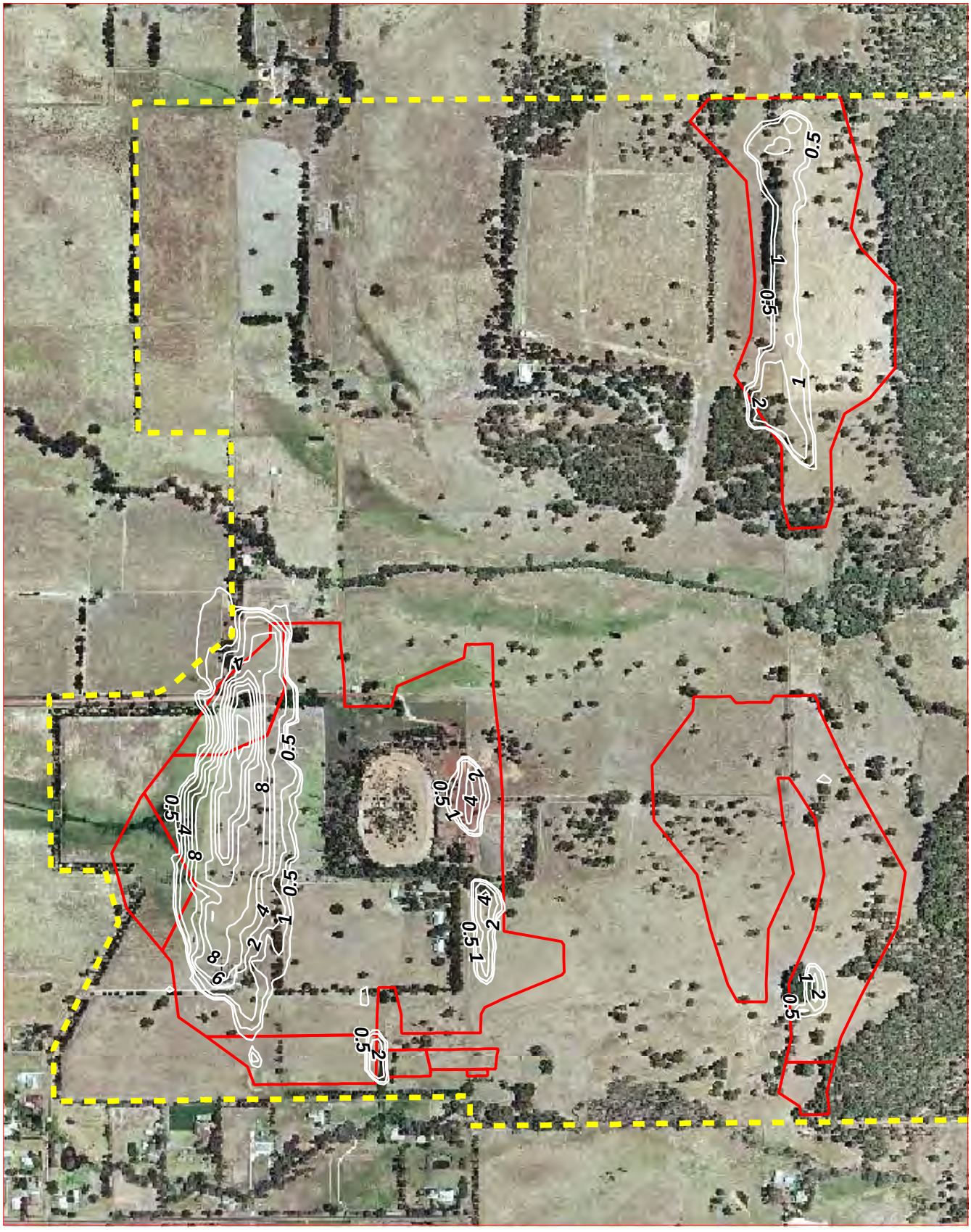
DWG No: 144208 ver.02

FIGURE: 28

WAROONA

PREDICTED WATER TABLE DRAWDOWN

2 years after the end of mining



Legend:

- Project area
- Predicted drawdown contours (m)
- HM Reserves

N

0 250 500 m

Date of photography: 2002

ILUKA

ORIG:	L.Sadler
DRAWN:	D.G.S.
SCALE:	1:10 000
DATE:	17 Oct. 2005

WAROONA

PREDICTED WATER TABLE DRAWDOWN

at the end of mining block 16

DWG No: 144207 ver.02

FIGURE: 27

8.7. Surface Water Systems (Quality and Quantity)

8.7.1. Objective

The EPA objective for surface water quantity is to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

The EPA objective for surface water quality is to ensure that emissions do not adversely affect environmental values of the surface water and groundwater resources or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

8.7.2. Relevant Standards

Protection of the environmental values of surface waters on the Swan Coastal Plain are addressed in the *Environmental Protection (Swan Coastal Plan Lakes) Policy* (1992). Principles for the protection of wetlands is addressed in the *Position Statement No. 4 Environmental Protection of Wetlands (2004).*

The EPA *Draft Guidance No 26: Management of Surface Run-off from Industrial and Commercial Sites* (1999) addresses the assessment of surface water quality and management of surface water run-off to ensure that receiving water bodies are protected from contamination.

A pollution prevention licence will be issued for the operation of the site under Part V of the *Environmental Protection Act 1986*. This is likely to include conditions on surface water, drainage and waste management.

The *Australian and New Zealand Water Quality Guidelines* (2000), while not a regulation, provide trigger levels for assessing water quality and developing appropriate water management strategies.

The DoE/DoIR Water Quality Protection Guidelines are a set of guidelines designed to protect water resources. The Water Quality Protection Guidelines No 11.: Mining and Mineral Processing: Mine Dewatering (WRC, 2000b) details general release criteria from minesites (Table 22).

Table 22: Receiving Water Quality Criteria (Source: WRC, 2000b)

Indicator	Allowable change from seasonal background of receiving waterbody caused by discharge water
pH	No more than +- 0.5 units
Total dissolved solids (TDS)	No more than +- 10%
Dissolved oxygen (DO)	No more than 10 % decrease
Suspended solids/turbidity	No more than 10 % increase
Floatable matter	No visible floating oil, foam, grease, scum, litter or other objectionable matter
Settleable matter	No adverse effect on visual, recreational and ecological values
Odours and colours	No discernible variation
Temperature	No more than +- 2˚C
Toxicants	No more than 10 % increase
Radionuclides	No more than 10 % increase
Nutrients	No excessive nuisance algal growth

8.7.3. Issue Definition

Mining will interrupt overland surface water flows across the Project Area. Runoff and erosion from disturbed areas has the potential to increase turbidity and suspended solids in surface water flows. Potential contamination types include hydrocarbons and flocculants.

At some stages during mining, groundwater dewatering and stormwater flows may exceed site water requirements and to maintain the safety of the site, discharge of excess water will be required. This will be released from the raw water dam to Ferraro Brook.

Groundwater dewatering will have some impact on groundwater contributions (baseflows) to the streams. The Mullins Sumpland will be mined removing groundwater seepage as a source of surface water from this area during mining.

The existing groundwater flow model of the Waroona Deposit (URS, 2002) has been modified to focus on the potential impact of pit dewatering on the baseflow contributions to Nanga Brook (URS, 2005). This involved the conversion of the TARGET_3DU model to MODFLOW_SURFACT which allows the simulation of watercourses in the groundwater modelling and estimation of surface water flows in the watercourses.

The sensitivity of Nanga Brook and the nature of the MODFLOW_SURFACT model mean a number of conservative assumptions have been incorporated into the modelling. These include:

- averaging of the net annual recharge which will retard the response of groundwater levels to seasonal rainfall;
- lack of seasonal infiltration of rainfall that temporarily enters the groundwater before entering surface water courses. This is estimated to be up to 6-15% of flow at Hill Street and Mullins weirs; and

- not including a water content of backfill material of up to 30%. This will significantly influence the rate of recovery of groundwater tables in and around the pits.

The conservative assumptions included in the modelling mean that the results carry with them a high level of conservatism.

The ecological and social values supported by Nanga and Ferraro Brooks are described in Section 4.6. The potential impacts described above may affect these values.

8.7.4. Assessment and Management

Overland surface water flow across the site is not considered significant in maintaining regional water flows. Runoff and erosion from disturbed areas has the potential to increase turbidity and suspended solids in watercourses. Fine particles could travel some distance in surface water flows, whereas heavier particles are likely to settle close to the source of the erosion. Monitoring shows that background levels of sediment in stream flow are already high and variable as a result of land use change, mainly related to agriculture, and degradation of streamlines. To minimise stormwater runoff and sediment turbidity from the Project Area, drainage bunds will be installed around the perimeter of each pit to direct run-off around and away from the minesite and into natural watercourses. After mining is complete the general landform and drainage will be reinstated.

Potential contaminants include hydrocarbons and flocculants. Potential contamination sources include the concentrator area, mine workshop, vehicle washdown bay, fuel bays and refuelling areas. Runoff from the concentrator and mine workshop will be directed to the raw water dam and utilised in the process. When machinery is operated or serviced on site, there is a risk of fuel, oil or grease leakage into waterways, in storm-water run-off, or through rainwater hosted infiltration into the groundwater. Equipment servicing areas where hydrocarbon spillage risk is highest will be bunded in accordance with the site licence conditions. The refuelling area, washdown bay and workshop areas will be designed to minimise stormwater runoff into the facilities and water from these areas will be directed to the raw water dam. Appropriate freeboard will be set and maintained on the raw water dam for normal operating conditions.

Excess water is only anticipated when large amounts of water collect in the pit from dewatering and stormwater collection. At a water purchasing site this is only likely to occur in periods of extreme rainfall. When onsite water exceeds storage capacity the excess water will be released to Ferraro Brook via a settling sump at the western end of the Iluka property. Discharge water will be required to be of a quality and quantity that will not adversely affect the beneficial use of the receiving waterbody, not cause or contribute to soil erosion and not have a detrimental effect on flora and fauna downstream of the discharge point. Water levels in the raw water dam will be managed through control of water inflows with controlled discharge only permitted when water is of appropriate release criteria. Water release will be monitored for water quality and quantity on a regular basis in accordance with the site pollution prevention licence. Site specific water quality criteria for discharge will be developed in consultation with the DoE.

Groundwater dewatering will have some impact on groundwater contributions (baseflows) to the streams. In Nanga Brook, baseflows contribute an average of 35% of streamflow. A reduction in these baseflows is estimated to contribute to a reduction in annual streamflows of less than 1% (URS, 2005). During autumn and summer baseflows make up the majority

of flows in the brook and the reductions may be noticeable. However, Nanga Brook rarely flows continuously in summer due to losses to groundwater and interception of surface flow by dams. Any water present is usually in small pools. It is therefore unlikely that the small reduction in streamflow will impact ecological or social water uses. Baseflows are anticipated to return following completion of mining.

The Mullins Sumpland will be mined as part of the main pit. Flows from the sumpland contribute approximately 30 – 50% of flows at the confluence with Nanga Brook. Water flows from Mullins Sumpland to Nanga Brook will be substantially reduced by approximately 96% (URS, 2005). Nanga Brook changes to a drain west of the highway and flows through two properties before joining Drakesbrook Drain. It is estimated that Nanga Brook provides up to 20% of flows at the confluence with Drakesbrook Drain. Discussions have been held with two downstream landowners who may be affected by the changes in flows. One landowner relies on the water from Mullins Sumpland and Nanga Brook for stock watering. Alternative water arrangements will be made with the landowner if required. Liaison with the resident will be ongoing throughout the life of the mine. No reduction in surface water flows in Wealand Brook or Ferraro Brook are anticipated.

Due to the assumptions associated with the modelling, the predicted drawdown in groundwater and reduction in baseflow impacts modelled by URS (2005) are considered to represent the least likely and highest potential impact of dewatering. In practice, any drawdown and reduction in the stream flow in Nanga Brook (and to a lesser extent Mullins Sumpland) would be mitigated through seasonal infiltration of rainfall entering the watercourses and increased recharge due to increased groundwater storage caused by pit dewatering activities.

A surface water monitoring program including quarterly water quality and monthly quantity measurements upstream and downstream of the mining operations is already in place and will be continued throughout mine life. Monitoring of aquatic biota will be conducted after one year of operation and subsequently as recommended following the initial survey.

The risk of the impacts on surface water flows from the operation of the mine is considered low. The management strategies outlined above will ensure that the ecological and social values supported by surface water are protected. Surface water discharges will meet statutory requirements and there will be no adverse environmental impacts.

Proponent Commitments

Refer to commitments made under Section 8.6.

9. POLLUTION MANAGEMENT

9.1. Dust

9.1.1. Objective

The EPA objective 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.

9.1.2. Relevant Standards

The DoE will regulate dust emissions for the Waroona Project and are likely to set a licence limit for total suspended particulates (TSP) allowed at the site boundary when an environmental licence is issued for the site.

The only legislated dust criteria for Western Australia (WA) are those promulgated for the Kwinana Environmental Protection Policy (EPP) area, as listed in Table 23. These specify standards and limits for Total Suspended Particulate matter (TSP) concentrations within residential areas, an intermediate buffer zone area and industrial areas. In the past the Department of Environment (DoE) has used the residential TSP standards and limits as objectives for new industrial developments.

Table 23: Total Suspended Particulate Standards and Limits for the Kwinana Policy Area (after EPA, 1999)

Species	Area [2]	Averaging Period	Standard[1] ($\mu g/m^3$)	Limit[1] ($\mu g/m^3$)
Particles	A,B,C	15-minute	-	1000
	A	24-hour	150	260
	B	24-hour	90	260
	C	24-hour	90	150

Notes:

1) All values expressed at 0^oC and 101.3 kPa.
2) Area A: the area of land on which heavy industry is located
   Area B: the area surrounding industry designated as buffer zone, plus other outlying land zoned for industrial use
   Area C: land beyond areas A and B used predominantly for rural and residential purposes.

In addition, the DoE uses a value of 1000 $\mu g/m^3$ for a 15-minute average limit not to be exceeded for very short term dust events.

The EPA Guidance Statement on prevention of air quality impacts from land development sites (EPA, 2000b) outlines the measures for controlling dust and smoke on new development sites.

The National Environmental Protection Measure (NEPM) for air quality lists a standard for particulates with an aerodynamic diameter less than 10 µm (PM_{10}) of 50 $\mu g/m^3$ averaged over 24 hours. It is recommended that this level not be exceeded more than 5 days per year.

An ambient air quality goal for $PM_{2.5}$ of 24 µg/m^3 for a 24-hour averaging period and 8µg/m^3 for an annual average, was introduced into the NEPM during May 2003. This is an advisory reporting standard with a goal to gather sufficient data nationally to facilitate a review of the advisory reporting standard as part of the review of this measure scheduled to commence in 2005 (NEPC, 2003).

There is no regulatory standard relating to dust deposition, however the NSW EPA has a guideline for acceptable increases in dust emissions as measured using depositional gauges. The current draft NSW assessment criteria (NSW EPA, 2004) set a maximum annual dust deposition rate of 4 g/m^2/month and a maximum allowable increase in the deposition rate of 2 g/m^2/mth, whilst still remaining below the limit.

9.1.3. Issue Definition

The operations of the Waroona Project will generate dust through the removal of topsoil, excavation and stockpile of overburden material and ore and vehicular movement. Dust generated from the Project Area has the potential to affect environmental values and the health, welfare and amenity of people and land uses.

Baseline dust monitoring has been conducted at Waroona since September 2004. Monthly total insoluble dust levels have ranged from 0.2 to 2.3 g/m^2/mth with an average of 0.87 g/m^2/mth (Refer section 4.13). Dust levels are below the annual average insoluble deposition rate of 4 g/m^2/mth (NSW EPA, 2004). Monthly total solid deposition has ranged from 0.9 to 4.6 g/m^2/mth with an average of 2 g/m^2/mth.

Particulate concentrations at the proposed mine locations are not available. However, background TSP and PM_{10} levels are available for nearby Wagerup as collected by Alcoa. These are presented in Table 24 from Air Assessments (2005a) and are considered to be representative of the area. These background levels were estimated by taking the lowest of the monitored values for each day at nine monitoring sites around the Alcoa residue area.

The results in Table 24 indicate that background TSP at Wagerup are low, below the Kwinana EPP standard and limit. For PM_{10} there was one day with PM_{10} values just above the NEPM standard in the 12 month period, but this is well below the goal of no more than five exceedances per year. This event was considered due to smoke from a bush fire. As a comparison to the Wagerup PM_{10} concentrations, the PM_{10} concentrations from the Bluewaters site (5 km NE of Collie) are also presented from SKM (2005). This shows similar, though slightly higher concentrations than at Wagerup.

Table 24: Background Particulate Concentrations at Wagerup

Statistic	***Wagerup Background TSP***	***Wagerup Background PM_{10}***	***Collie (Bluewaters) PM_{10}***
Years	*4 years (2000/01 - 2003/04)*	*1 year (2004)*	*3 years (2001-2003)*
Maximum	*59 - 86 (64)*	*50.6*	*73*
# of Exceedances of NEPM standard	*NA*	*1*	*0.66 (ave 3 years)*
90^{th} Percentile	*23-31 (26.5)*	*21.8*	*23.6*
70^{th} Percentile	*16-19 (17.8)*	*15.4*	*16.0*
Average	*13.8 - 17.4 (15.3)*	*12.1*	*14.1*

Notes:
Wagerup background TSP concentrations are provided as the range of concentrations and the average (in brackets) of the 4 years of data. The Collie (Bluewaters) maximum is the maximum of the 3 years of data, whilst the other statistics are averages.

9.1.4. Assessment and Management

In order to ascertain the impact of fugitive sources due to wind erosion and operations at nearby sensitive receptors, the dispersion modelling system Calmet/Calpuff was used. Calpuff (the Californian Puff model) is the US regulatory model for long range dispersion and for areas with complex terrain. A full description of the assumptions and set up of the dust modelling is provided in Air Assessments (2005b).

Modelling of dust emissions from the minesite incorporates:

- upper atmosphere wind and temperature profiles and cloud cover from Perth Airport;
- land use and roughness data for the Waroona area;
- meteorological data from the Iluka Waroona weather station for the year 2000/2001;
- mine planning data for the period when operations are closest to the town of Waroona (July 2007- June 2008);
- differing operational activities that will give rise to dust emissions, such as movement of topsoil, ore, grading of roads, bulldozer operation and light vehicle movements;
- emission rates for particulates of various pieces of equipment based on NPI (National Pollutant Inventory) or USEPA (United States Environmental Protection Agency) emissions equations; and
- background levels of TSP and PM_{10} and particle size distributions.

Table 25 shows the results of the PM_{10} and TSP modelling at 14 sensitive premises in the vicinity of the Project Area, with and without background particulate levels.

Background 24-hour values of PM_{10} and TSP have been incorporated by using the 90th percentile background concentrations of 21.8 and 26.5 µg/m^3 as determined at Wagerup. The 90th percentile background concentration is considered a conservative measure. The predicted annual average concentration of TSP includes a background concentration of 15.3 µg/m^3.

The results in Table 25 indicate that PM_{10} concentrations at residences 7 to 11 may potentially breach the NEPM PM_{10} standard of 50 µg/m^3. Maximum 24-hour TSP concentrations at residences 8 to 10 may potentially breach the Kwinana EPP residential standard.

Table 25: Predicted concentrations at sensitive receptors (µg/m^3)

Source	Criteria	Receptor No.														Max
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Mine Contribution alone																
PM_{10}																
Max 24-hour	NA	14	24	18	12	18	26	30	42	55	70	34	7	4	4	72
5th 24-hour	NA	10	12	9	9	12	19	20	30	47	48	19	5	3	3	48
TSP																
Max 24-hour	NA	35	58	40	27	40	50	52	90	110	110	49	10	7	6	110
5th 24-hour	NA	20	30	20	19	29	33	34	51	90	93	28	8	5	4	93
Annual	NA	4.5	4.9	3.2	2.5	4.9	6.5	6.5	8.5	14	16	4.2	0.9	0.9	0.7	16
With Inclusion of Background Concentrations																
PM_{10}																
Max 24-hour	50	36	46	40	34	40	48	52	64	77	92	56	29	26	26	92
5th 24-hour	50	32	34	31	31	34	41	42	52	69	70	41	27	25	25	70
TSP																
Max 24-hour	90	62	85	67	54	67	77	79	117	137	137	76	37	34	33	137
5th 24-hour	90	47	57	47	46	56	60	61	78	117	120	55	35	32	31	120
Annual	NA	20	20	19	18	20	22	22	24	29	31	20	16	16	16	31

Figure 29 and Figure 30 show the maximum 24-hour ambient concentrations for PM_{10} and TSP that result from the operation of the mine alone. Analysis of the conditions that lead to the highest concentrations offsite indicate that concentrations to the west north west are due to strong easterly winds in summer and wind erosion. The higher concentrations to the south are due to operational activities associated with moving the overburden and ore.

Figure 29: Predicted Maximum 24-hour PM_{10} Concentrations (µg/m^3)

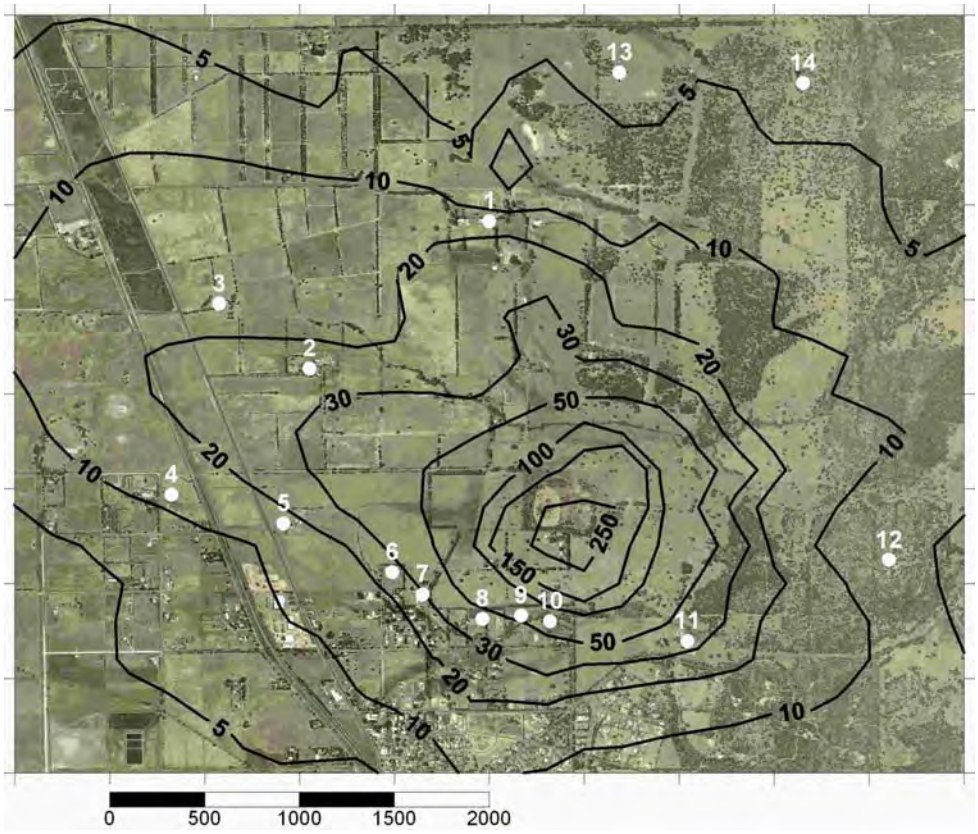
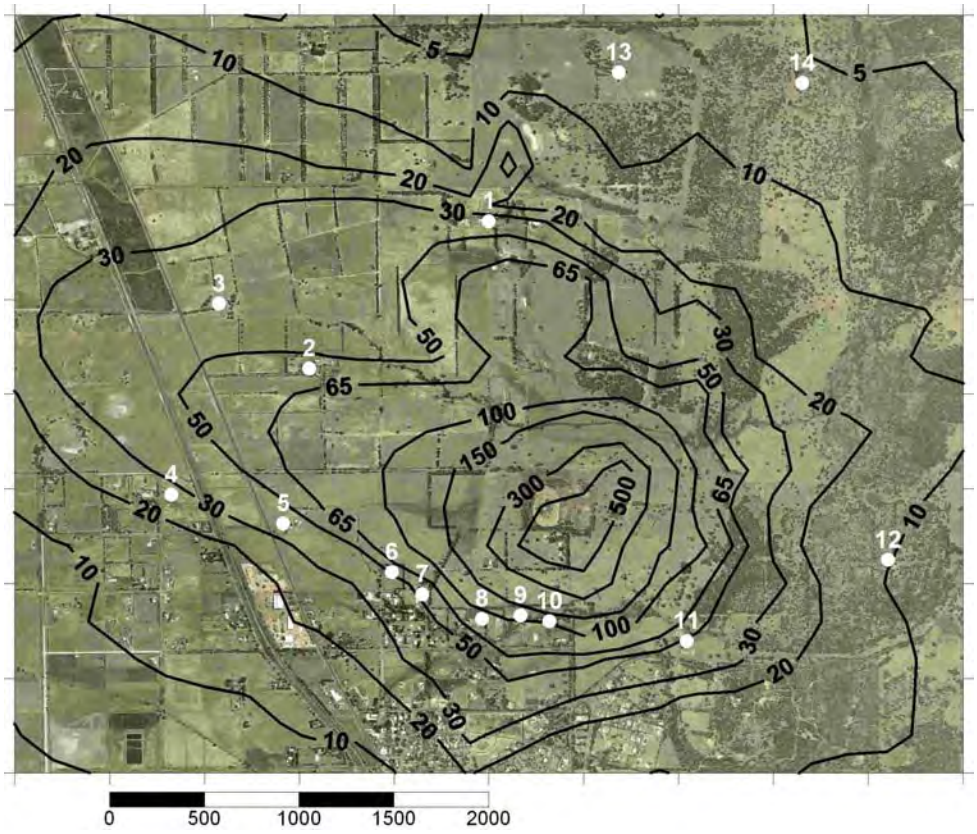


Figure 30: Predicted Maximum 24-hour TSP Concentrations (µg/m^3)



It should be noted that the modelling is indicative only and incorporates the limitations and assumptions that underlie the various particulate emissions rates. The model also incorporates conservative assumptions regarding the location of mining and the existing ambient dust levels. As such the results of the modelling highlight the need for a comprehensive dust management plan including feedback mechanisms including monitoring to ensure dust impacts are minimised.

Iluka will develop and implement a dust management plan involving standard practices to manage particulate emissions such that they do not cause environmental or human health problems. Dust control measures will include:

- minimising clearing and open area;
- not disturbing topsoil until required;
- regular watering and grading of roads;
- using biodegradable chemical suppressants;
- growing of temporary crops to bind soil & lift wind from surface;
- re-establishment of pasture as soon as possible after mining has been completed;
- using sprinkler systems and oversize material where appropriate;
- high wind warning system in summer to enable site to increase control mechanisms ahead of event; and
- sealing roads if deemed necessary.

The baseline dust sites will provide information on pre-mining dust levels and enable comparison once mining commences. In addition, Iluka will establish monitoring sites for operations in accordance with DoE licence requirements, which will be detailed in the dust management plan.

To ensure continuous improvement is achieved, regular reviews of monitoring will be conducted and investigations of high results conducted and corrective actions will be implemented. Regular communications will be held with adjacent landowners and a complaints management system, including investigation, action and feedback, implemented.

Dust will be managed and monitored during operations. With the above mitigation techniques in place, there will be no adverse impacts from dust on environmental values or the health, welfare and amenity of people and land uses.

Proponent Commitments

Prepare a dust management plan that includes:

- minimising open area;
- dust management measures;
- monitoring and reporting of dust levels;
- review and continuous improvement program; and
- community complaints system.

Implement the dust management plan.

9.2. Noise

9.2.1. Objective

The EPA objective is to protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.

9.2.2. Relevant Standards

Noise limits are defined in the *Environmental Protection (Noise) Regulations (1997)*. The Environmental Protection Agency (EPA) addresses the assessment of environmental noise, including identification of potentially significant noise emissions and demonstration of compliance, in Draft Guidance No.8: Guidance for Environmental Noise (1998).

The Guidance includes assessment of operational noise, involving determination of ambient noise, predicted noise levels, adjustments to predicted noise levels, comparison with noise criteria, noise reduction measures, consideration of other activities associated with the operation, blasting and monitoring and construction noise assessment, involving on-site operations, construction traffic, and blasting.

Noise limits defined in the regulations are shown in Table 26.

Table 26: Noise Limits for Surrounding Noise Sensitive Premises

Time	Noise Limit L_{A10} dB(A) at Premises
0700 – 1900 hours Monday to Saturday	45
0900 – 1900 hours Sundays and Public Holidays	40
1900 – 2200 hours Monday to Saturday	40
2200 – 0700 hours Monday to Saturday and to 0900 hours Sundays and Public Holidays	35

Under Regulation 13 (Construction Sites) of the *Environmental Protection (Noise) Regulations 1997*, Regulation 7 (Prescribed Standard for Noise Emission) does not apply to noise emitted from a construction site as a result of construction work carried out between 7 am and 7 pm on any day excepting Sundays and public holidays, provided that:

- construction work is carried out in accordance with control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- the equipment used is the quietest reasonably available; and
- a noise management plan in respect of the construction site is prepared, approved by the CEO and adhered to during construction.

9.2.3. Issue Definition

There is potential for residents in the vicinity of the Project Area to be affected by noise as a result of project operations. The mining activities will operate on a day shift roster only. Day shift is defined as 0700-1900 hours Monday to Saturday. Processing activities (screenplant, concentrator and one front end loader) will be undertaken on a continuous

basis 24 hours a day, seven days a week. Main noise sources vary depending on operation areas and wind direction.

Ambient noise levels were recorded at three locations surrounding the proposed mining operation. Measurements were carried out in July 2004 and May 2005 (refer section 4.12). Table 12 shows the range in L_{A10} from monitoring at three locations in the vicinity of the proposed minesite. These levels and the L90 of L_A90 that the ambient noise levels are quite low increasing the potential for noise from mine operations to be audible at residences.

9.2.4. Assessment and Management

There are numerous residences surrounding the Project Area, with the majority on the south side of the Project (Figure 20). An acoustic model has been applied to predict sound pressure levels (SPL) at surrounding residences. The characteristics of the proposed equipment and their respective locations have been incorporated into the model, together with the topography of the surrounding area, to predict the environmental noise impact of the development. The eight cardinal wind directions have been modelled combined with the meteorological conditions likely to generate the highest noise levels including temperature, humidity, inversion and wind speed.

The concentrator and screen plant are modelled operating from their proposed location. The concentrator and screen plant is cut in to the side of the hill to minimise noise, but no other screening or bunding of the equipment was modelled. The mobile machinery is modelled operating under eight mining locations. Topsoil stripping, overburden stripping and ore mining activities are modelled. Ancillary equipment including a grader, dozer and watercart are also modelled as operating on the haulroads. Noise bunds have been included to provide an effective noise mitigation measure. All machinery is modelled with noise attenuation fitted. It will be a requirement of the earthmoving contract to ensure all mining equipment is fitted with noise attenuation.

The SPL at the surrounding residences under the eight wind directions is predicted for each of the eight day time mining locations. Night time noise of the concentrator and screenplant is also modelled under the eight wind directions. The worst-case wind direction and highest noise level at a receiving residence is shown in Table 27. This shows that during the day time the noise limit of 45 dB(A) can be met under worst case conditions for locations 3, 4 and 8. Noise levels for locations 1, 2, 5, 6 and 7 range from 1 to 5 dB(A) over the noise limit. Other wind conditions may also give rise to exceedances of the noise limit, but to a lesser extent. Noise monitoring will detect the occasions when noise is likely to exceed the noise limit. During these periods, items of machinery operating will be reduced in order to meet the noise regulations at the sensitive locations.

Night time noise is worst in a south-easterly wind direction with maximum noise levels of 42 dB(A). Further attenuation of the concentrator and screen plant will be undertaken and stockpiles utilised as noise bunds around the processing area in order to meet the night time noise regulation level.

Table 27: Noise Modelling Results

Mining Location	Worst Case Wind Direction	% occurrence of wind direction*	Highest noise level (L_{A10} dB(A)) at receiving residences
1	Easterly	7.88	48
2	North-easterly	3.48	48
3	North-easterly	3.48	43
4	Southerly	6.62	45
5	Northerly	3.95	50
6	Easterly	7.88	46
7	Westerly	3.05	47
8	South-easterly	10.08	44
Night time	South-easterly	10.08	42

*Annual wind direction July 2000-June 2001. Refer to Figure 8.

Under a worst case scenario with no noise attenuation control measures on mobile machinery in place, the highest noise levels would increase by 7 dB(A).

All equipment, fixed and mobile, will be tested on commencement of operations. Noise will be monitored during the construction and initial mining phases with results used to refine the noise model. The noise model will be incorporated into the noise management plan and used to identify the appropriate operations under different weather conditions.

Weather conditions will be continuously monitored at the plant site. Noise will be monitored at several residential locations surrounding the Project Area and detailed in the noise management plan. The noise monitoring equipment will be linked by telemetry to the concentrator control room. This allows the operator to change the machinery operation when the noise regulations are likely to be exceeded.

Construction work will be conducted in accordance with Regulation 13 (Construction Sites) of the *Environmental Protection (Noise) Regulations 1997*. The initial mine pit development during construction when noise bunds are being developed is unlikely to comply with the noise regulations. During these periods, residents will be notified of operations and minimal machinery will be operating. Construction mining activities will take place during day time only. Some activities may be conducted at the plant site during night time.

Discussions have been held with the surrounding residents regarding noise levels during operations. They will be advised of the sequence of mining and hence when mining will be conducted close to their residence. Ongoing liaison with residents will continue during operations. A complaint procedure exists that will be followed in the event of a resident noise concern. If noise management measures cannot limit noise to below resident expectations, alternative arrangements such as noise attenuation of residential properties will be discussed with each resident.

A noise management plan will be developed to enable monitoring and management during construction and mining operations and will incorporate the initiatives outlined above. The noise modelling conducted to date shows that limits can be reached with the modification of

machinery and limiting machinery hours. The modelling conducted provides worst-case indications of noise levels and gives a base from where to reduce noise levels through mitigation and management. The implementation of the Noise Management Plan will ensure Iluka complies with all legislative requirements relating to noise.

Proponent Commitments

Prepare a noise management plan which includes:

- hours of operation;
- allowable noise levels of site machinery;
- regular checking of noise levels of site machinery;
- management of noise during construction;
- management of noise during operations;
- monitoring and reporting of noise levels;
- review and continuous improvement program; and
- community complaints system

Implement the noise management plan.

9.3. Radiation

9.3.1. Objective

The EPA objective is to ensure that radiological impacts to the public and the environment are kept as low as reasonably achievable and comply with acceptable standards.

9.3.2. Relevant Standards

The Mines Safety and Inspection Regulations (DoIR, 1995 - Section 16) requires that any mine involved with the mining of radioactive materials that may result in employees receiving radiation doses in excess of 0.001 Sv/year have a Radiation Management Plan. A guideline has been developed by DoIR that provides details on the development of a suitable detailed plan for the control and monitoring of radiation exposure and the management of radioactive wastes, as required under regulation 16.7 of the Mines Safety and Inspection Regulations.

The Radiation Management Plan must consider measures that can be taken to minimise exposure of employees and the general public to radiation by addressing use of appropriate facilities and equipment, monitoring programs, dosage assessments, reporting, training and inductions, and waste disposal.

Monazite is a naturally occurring mineral often found in association with the target minerals rutile, ilmenite and zircon. It is classified as a “Class 7” material and a Low Specific Activity (LSA) radioactive substance under the Dangerous Goods Regulations.

9.3.3. Issue Definition

The HMC from the Waroona Project contains the mineral monazite. Monazite contains the naturally occurring radioactive elements thorium and uranium, which are associated with all heavy minerals mined by Iluka. The concentration of thorium and uranium in the heavy mineral concentrate produced is variable but typically in the order of 800 ppm thorium and 100 ppm uranium and is significantly dependent on the concentration of the mineral

monazite. The mineral monazite typically contains around 60,000 ppm thorium and 2,500 ppm uranium.

This mineral is the main source of possible radiation exposure at Iluka Operations. Monazite is the rare earth phosphate [Ce, La, Nd, Th (PO_4)]. Monazite content in mineral sand deposits is typically confined to the orebody at concentrations of about 0.1%. It increases through the concentration process to approximately 1-2% in the HMC.

9.3.4. Assessment and Management

A pre-mining radiation survey has been conducted as outlined in Section 4.4.2. The handling, storage and transport of ore and HMC is able to be conducted safely without specific management requirements. No monazite will be returned from Capel to Waroona.

A post-mining radiation survey will be conducted to ensure levels are similar to pre-mining levels. There will be no radiation impact on the public and the environment.

9.4. Light

9.4.1. Objective

The EPA objective is to avoid or manage potential impacts from light overspill and comply with acceptable standards.

9.4.2. Relevant Standards

Australian Standard AS 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting outlines a range of management measures that can be utilised to assist in reducing the amount of diffusion and spill lighting created from proposals.

9.4.3. Issue Definition

Processing operations at Waroona will be undertaken on a 24 hour basis. Night lighting is required to ensure that the safety and security of operations is not compromised. However, lighting of night operations can also have negative external effects on nearby residents and traffic.

Potential impacts arising from illumination at night can arise from obtrusive light spill, by general luminance diffusion, reflection from existing surfaces or through atmospheric scattering. These effects may impact directly on neighbouring dwellings, can potentially create safety hazards on adjacent roads due to glare reducing the visibility of objects, interfere with night time navigation signalling and reduce the overall environmental night amenity.

9.4.4. Assessment and Management

In order to minimise lighting impacts, Iluka will:

- provide uniform illuminance over the target area without compromising visual conditions for workers;
- direct light sources at targeted work areas, preferably in a downwards direction;

- adopt a low vertical aiming angle of the light;
- preferentially use narrower light beams over wider, diffuse beams;
- fit louvres, baffles or shields to floodlights if required without reducing the lighting performance;
- position floodlights so that the brightest view of the lights is not directed towards eye-height on neighbouring properties;
- preferentially select floodlights that produce asymmetric beams;
- utilise shielding provided by trees, earth embankments or physical features between the illuminated mine area and neighbouring dwellings;
- locate lighting as close as possible to the target area of illumination;
- preferentially select bulbs with smaller flux output; and
- conduct regular maintenance to maintain optimum performance.

There will be no lighting required in the pits during night time. The location of the concentrator should avoid the majority of light impacts on landowners. Implementation of the above mitigation strategies will minimise the amount of light emitted from the concentrator.

9.5. Non-process Solid Waste

9.5.1. Objective

There is no EPA objective specifically for waste. Iluka's objective is to ensure that wastes are managed and disposed of in a manner that does not result in long-term impacts on groundwater, surface water and the natural environment.

9.5.2. Relevant Standards

The DoE has published guidelines including Guidelines for Acceptance of Solid Waste to Landfill (2002), Waste Management Bill 2000, Rural Landfill Management (2000), and the Western Australian Waste Reduction and Recycling Policy (1997) that address the appropriate disposal and management of solid wastes and recommendations for waste minimisation.

9.5.3. Issue Definition

Mining operations at Waroona will generate a suite of solid wastes including domestic waste, recyclables (for example paper, steel, waste oil, tyres, batteries) and septic waste that may result in environmental contamination if not appropriately managed. No chemical waste will be generated in association with the mining operations.

9.5.4. Assessment and Management

Iluka encourages the use of alternatives to landfill with the priorities for waste management being:

1. Waste avoidance/reduction
2. Reuse/recycle

3. Waste treatment
4. Waste disposal

Domestic and workshop refuse will be collected in bins for disposal at a licensed landfill. Recyclables will be collected separately before removal from site. The handling, use, storage, and disposal of hydrocarbons will be managed to ensure that their use results in minimal environmental impact.

Wastes will be managed in a manner that does not result in long-term impacts on groundwater, surface water and the natural environment.

9.6. Process Waste

9.6.1. Objective

There is no EPA objective specifically for process waste. Iluka's objective is to ensure waste streams from the process are returned to the mining pit in a manner consistent with closure objectives and end uses of the site.

9.6.2. Relevant Standards

The DoIR has two guidelines for tailings management. Guidelines on the Safe Design and Operating Standards for Tailings Storage (1999) is designed to assist in the design, construction, management and decommissioning of tailings storage facilities so as to achieve efficient, cost effective, safe and environmentally acceptable outcomes. Guidelines on the Development of an Operating Manual for Tailings Storage (1998) is designed to ensure consistency of approach in developing Operating Manuals and an administrative framework which meets the requirements of regulations affecting the mining industry.

The WRC (now DoE) Water Quality Protection Guidelines No. 2 Tailings Facilities (2000) provides guidance in managing the impact of tailings containment facilities on the quality of the region's water resources.

9.6.3. Issue Definition

Clay tails are removed from the ore prior to the wet concentrator processing. The fines are pumped to a thickener and the underflow is pumped to shallow solar drying dams. The clay is allowed to dry prior to being returned to the mining pit.

Sand tails are produced by wet concentration and are pumped to the mining void. The sand and water streams separate easily allowing the sand to dry readily. The water component is returned to the raw water dam with the dewatering water.

9.6.4. Assessment and Management

The solar drying dams have been located to minimise impacts on native vegetation and to minimise visual impacts. The dams are used as many times as possible.

The potential impacts associated with the drying of clay fines in solar drying dams are related to uncontrolled release of clay fines. The risk events that could lead to this are

overtopping of the dams, embankment failure or pipe leaks. The potential for spills will be reduced through:

- setting environmental design criteria for dam construction;
- programming regular checks and inspections;
- ensuring bunding of pipelines;
- conducting maintenance of dam walls; and
- maintaining provision of adequate freeboard for rainfall events.

An operating strategy will be developed and implemented in accordance with DoIR requirements (DoIR 1998). Implementation of the operating strategy will ensure that the potential of spills from solar drying dams is minimised.

The dried clay will be returned to the mining void with the sand tails and overburden. This will be landscaped to blend with the surrounding landforms and covered with sub-soils and topsoils. Some clay may be retained and blended with the topsoils to improve agricultural productivity. Soils will be handled and managed as outlined in Section 8.3.

Waste streams from the process will be managed and returned to the mining void in a manner that minimises the potential for spills to the environment and maximises the post mining land use.

9.7. Greenhouse Gas

9.7.1. Objective

To minimise emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions.

9.7.2. Relevant Standards

State and Commonwealth legislation relevant to the emission of greenhouse gases from the Waroona Project includes:

- the National Greenhouse Strategy for providing a framework for meeting international commitments;
- the Greenhouse Challenge as a voluntary program between government and industry to abate greenhouse emissions;
- the Western Australian Greenhouse Strategy; and
- EPA Guidance Statement No 12 – Minimising Greenhouse Gases.

9.7.3. Issue Definition

The implementation of the Waroona Project would result in the emission of carbon dioxide, directly or indirectly, as a result of the following activities:

- consumption of electricity;
- mobile mining plant and equipment and the transportation of HMC to Capel; and
- clearing of vegetation.

Total consumption of diesel by the project in mining and transportation of the HMC will be approximately 3 300 kL/year and total imported electricity for the processing plant 30 000 MWh/year.

Mining will involve the clearing of 21.2 ha of degraded native and non-native vegetation currently located on agricultural land and 163 ha of pasture. All of this area will be rehabilitated to agricultural land following completion of mining.

Greenhouse gas emissions were calculated for the project based on the information in the Australian Greenhouse Office (AGO) Factors and Methods Workbook (2004) (Strategen 2005). The emissions factors for the consumption of diesel by mobile plant and equipment and through the use of electricity from the grid are shown in Table 28.

Table 28: Greenhouse emission factors

Energy Source	Emissions Factor
Imported electricity [(a)]	1.053 t CO_2-e/MWh [(c)]
Diesel [(b)]	2.5 t CO_2-e/kL [(c)]

[(a)] Include the full fuel cycle for the generation of electricity and transmission and distribution to the user.

[(b)] Diesel emissions only include direct emissions from the combustion of fuel.

[(c)] Emissions are expressed in tonnes of CO_2-equivalent (CO_2-e) which includes CO_2 as well as the global warming effect of the relatively small quantities of CH_4 and N_2O emitted.

Based on the expected electricity use and fuel use at the mine, the estimated emissions from the mining, concentrating and transportation operations are shown in Table 29 (Strategen 2005).

Table 29: Estimated annual emissions

Emissions Source	Estimated emissions (t CO_2-e)
On-site concentrator	31 590
Mobile equipment/transport	8 800
Total Annual emissions	40 390

Clearing of the degraded native vegetation will result in some emissions of greenhouse gases. Millable wood will be removed from site prior to mining and the remaining vegetation will be mulched for use on-site and within the local community. Underground woody biomass removed during mining operations will also be mulched where possible.

9.7.4. Assessment and Management

The proposal will be a minor source of greenhouse gases and will not add to emissions from current operations at Yoganup Extended. Total annual emissions from the operation of the minesite and transportation of HMC are estimated at approximately 40 390 tonnes CO_2-e (Strategen 2005). The majority of the emissions from the Waroona minesite are due to the consumption of electricity by the HMC concentrator. This concentrator is currently in operation at Iluka's Yoganup Extended mine and will be relocated to Waroona. There is not expected to be any change in emissions from this relocation and therefore there will be no net increase in emissions. Mining activities at Yoganup Extended will cease. Similar amounts of mining equipment currently operate at Yoganup Extended. HMC transport

requirements will increase due to increase distance from Capel resulting in a slight increase in overall emissions.

Removal of the degraded native vegetation will result in some greenhouse emissions in the first year of operation of the mine. The emissions resulting from clearing are not expected to be significant, with the emissions partially offset by the uptake of soil carbon following rehabilitation (Strategen 2005).

In order to manage the emissions of greenhouse gases from the Waroona mine, Iluka will ensure that all machinery is used in the most efficient manner possible. Iluka will also undertake employee training in energy efficient practices. The company will also estimate emissions and implement practices in line with the EPA Guidance Statement No. 12 - Guidance Statement for Minimising Greenhouse Gas Emissions (EPA 2002b).

There will not be a significant increase in greenhouse emissions from Iluka operations resulting from the operation of the Waroona mine. The major source of greenhouse emissions is an existing concentrator that will be relocated to Waroona from another mine, with no change in emissions. The small increase in annual emissions will be due to fuel consumption by increased transport distance. There will also be some clearing of degraded native vegetation that will result in emissions.

10. SOCIAL ENVIRONMENT

10.1. Transport

10.1.1. Objective

There is no EPA objective for transport. Iluka's objective is to ensure that traffic activities resulting from the Project can be managed to an adequate level of public safety and have minimal impact on surrounding landowners and the town centre.

10.1.2. Relevant Standards

As there are no regulatory standards, the factor is to be assessed against the objective.

10.1.3. Issue Definition

The HMC will be transported using B-double or similar trucks from the Waroona Project to Capel. The transport route will be south through Waroona along Southwest Highway through Bunbury to Capel. The selected transport route is shown in Figure 5. Truck cartage hours will be 24 hours a day, 7 days per week. 18 return journeys (36 truck movements) will be required on a daily basis. In addition to HMC transport, minor deliveries will be made and personnel in light vehicles will travel to the site. All access to and from the site will be from Peel Road only.

Additional traffic has the potential to increase dust, noise and safety issues.

10.1.4. Assessment and Management

The additional truck transport on the Southwest highway will result in a small increase in existing truck numbers. The impact of the additional 36 truck movements per day is shown in Table 30. Increases range from 0.63% to 1.02% of existing heavy vehicle movements. Numbers as a percentage of overall vehicles are slightly higher on Saturday and Sunday when truck numbers generally decrease. Liaison with MRWA has identified that the selected route is capable of the increased truck numbers.

The Peel Road – Southwest Highway intersection will be upgraded to ensure safe entry and exit, in consultation with MRWA. Peel Road will be bitumised from the intersection to the plant site. This will mitigate dust from traffic and mud from vehicle wheels on the highway. The loading of HMC into a truck and truck noise on Peel Road has been included in the noise modelling (Section 9.2). The model shows minimal noise impacts from HMC loading and transport.

There will be minimal impact on current traffic numbers and transport can be managed to an adequate level of public safety. Iluka has attended meetings with the local roadwise committee and will work with the police and schools to ensure public safety is maintained.

Table 30: Traffic Movements with Iluka HMC Haulage

	Total vehicle movements/ day	Total heavy vehicles/day	Heavy vehicles as % of total movements	Variance from current situation
South West Hwy at corner Waterous Rd (4km South of Waroona PO)				
Monday – Friday				
Current situation	4182	388	9.28%	
With Iluka hauling	4218	424	10.05%	0.77%
Saturday & Sunday				
Current situation	3359	137	4.08%	
With Iluka hauling	3395	173	5.10%	1.02%
South West Hwy at corner of Paterson Rd (1 km North of Waroona PO)				
Monday – Friday				
Current situation	5152	441	8.56%	
With Iluka hauling	5188	477	9.19%	0.63%
Saturday & Sunday				
Current situation	4618	158	3.42%	
With Iluka hauling	4654	194	4.17%	0.75%

10.2. Visual Amenity

10.2.1. Objective

The EPA objective is to ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape to as low as reasonably practicable.

10.2.2. Relevant Standards

As there are no regulatory standards, the standard is to be assessed against the objective.

10.2.3. Issue Definition

The Project Area is located in close proximity to the Waroona township, South west highway and Darling Scarp. Many landowners on the Scarp have views of the Waroona township and across to Mandurah. Several landowners have views of the Project Area and will be able to see parts of the operation as part of their view. The Project entrance will be near the entrance to Waroona town from Perth.

10.2.4. Assessment and Management

To reduce visual amenity of the Project on nearby landowners tree belts have been planted along Bradford St, behind Paterson St, Hill St and Nanga Brook Rd. These tree belts are over 10 years old and have matured to provide an excellent buffer from mining operations.

In addition to the tree belts, stockpiles will be installed around the perimeter of the operation. These will be grassed to provide an effective visual, noise and safety bund (refer to photo in Appendix 1).

In order to minimise visual impacts for landowners with views from the scarp, the offices, concentrator and workshops have been located on a topographic low adjacent to Ferraro Brook. This will be outside the majority of landowner views. The area of disturbance will be kept to a minimum. The southern section of the south pit will be mined and rehabilitated within one year and a stockpile established across the mined area. This ensures impacts on adjacent landowners in this area are within the smallest possible timeframe.

The site access road and concentrator area will be bituminised. This will ensure trucks and vehicles turning onto Southwest Highway do not leave a mud trail or generate dust.

A visual flyover of the Waroona operation was developed and utilised in consultation with landowners.

The Project Area will be rehabilitated to agricultural land following mining. Mining will occur for four years, with rehabilitation taking approximately three years. The majority of earthworks are completed during the first year of rehabilitation with agricultural type activities (seeding, fencing, drainage control) being conducted in subsequent years.

The visual impact on surrounding landowners is only a part of their overall outlook and will be a temporary impact. The consideration of visual amenity in the Project design and measures outlined above have reduced visual impact to as low as reasonably practicable.

10.3. Aboriginal Heritage

10.3.1. Objective

The EPA objective is to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

10.3.2. Relevant Standards

The *Aboriginal Heritage Act* 1972 provides for the recording and protection of areas and artefacts used by the original inhabitants of Australia.

The EPA also consider aspects of Aboriginal heritage and have developed a Draft Guidance Statement for the Assessment of Aboriginal heritage with the objective of ensuring that the changes to the biological and physical environment resulting from the proposed development do not adversely affect matters of heritage significance to Aboriginal people. The proponent is required to provide sufficient information must be provided for the EPA to consider if Aboriginal heritage is a relevant environmental factor in relation to the proposal. If it is determined to be a relevant factor, sufficient information to report to the Minister on the implementation of the proposal in relation to resulting changes which may impact on attributes of heritage significance to Aboriginal people. It is suggested in the Guidance Statement that the following actions be taken:

- consultation with the Aboriginal Affairs Department and desktop review of site records in accordance with the Aboriginal Heritage Act 1972;

- undertake an Aboriginal heritage survey including consultation with appropriate Aboriginal people and/or an archaeological survey;
- informing the relevant Aboriginal people of the proposal, including potential impacts;
- consultation with relevant Aboriginal people to highlight their concerns regarding the proposal; and
- demonstrating that these concerns have been adequately considered in impact management strategies.

10.3.3. Issue Definition

A baseline archaeological and anthropological/ethnographic survey was conducted over the Project Area (Carto-Cult, 1997). During a field survey in July 1997 no archaeological sites were recorded in the Project Area. Three sites of ethnographic significance were identified by the Aboriginal people who participated in the survey (Westralian Sands, 1997). Discussions were held with the DIA in 2004 who regarded the 1997 survey as sufficient for the current proposal.

None of the ethnographic sites will be impacted upon by mining.

10.3.4. Assessment and Management

If during the course of the development of the mine, artefact or skeletal material is uncovered Iluka will report these discoveries under Section 15 of the *Aboriginal Heritage Act* (1972-80) to the appropriate department.

The implementation of the Waroona Project will not adversely affect historical and cultural associations and will comply with relevant heritage legislation.

10.4. European Heritage

10.4.1. Objective

The EPA objective is to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

10.4.2. Relevant Standards

The factor is to be assessed against the objective.

10.4.3. Issue Definition

A search of the Register of National Estate and heritage database held by the Heritage Council of Western Australia indicated that no heritage sites are listed for the Project Area.

10.4.4. Assessment and Management

If any heritage sites are identified during ground disturbing activities, the Australian Heritage Commission, the Heritage Council of WA, the National trust of Australia and the Shire of Waroona will be consulted prior to further disturbance. This will ensure sites are evaluated and appropriate management actions are developed.

11. CONCLUSION

The impact assessment shows that the Waroona Project can be conducted without causing significant environmental impacts. Mining has been considered utilising sustainable development principles of ecological, social and planning options. Minor, local impacts have been identified and management controls applied in project design and to be implemented during project operation. Ongoing community consultation and support is proposed over the life of the Project. Environmental management commitments made in this PER are shown in Table 31.

Noise modelling indicates the site can operate within noise limits under meteorological conditions likely to generate highest noise levels. Dust will be monitored and managed during operations to ensure emissions are within licence limits. Rehabilitation and restoration programs will improve on current ecological values within the Project Area. The implementation of the Waroona Project will result in a net environmental benefit in the catchment.

Mining of the resource removes a planning constraint and allows for the future development of the Waroona township. Consideration of future zoning in closure planning will enable assets to be left for the community. The State and local community will benefit from the generation of employment, local expenditure and royalties resulting from the Project.

Table 31: Environmental Management Commitments

Number	Topic	Objective	Action	Timing	Advice
1	Vegetation and Flora	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Prepare a Vegetation Mitigation plan that addresses the following: • fencing Ferraro Brook and buffer area, Sites 8 and 9 with buffer areas and the remnant vegetation blocks; • undertake weed control within these areas; • infill plant these areas with native species, including riparian species around the brook and upland species in other areas • trial translocation of understorey flora from the Speedway site; and • placement of appropriate CALM Conservation Covenants over the identified blocks of remnant native vegetation. Implement the Vegetation Mitigation Plan.	Before Construction	CALM, DoE
2	Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	To minimise the impact on fauna at the site Iluka will: • preferentially retain trees identified with hollows on site; • inspect those trees within the clearing envelope with hollows for signs of bird nesting; • remove hollows from any suitable cleared trees and use within the rehabilitation and mitigation areas as fauna habitats; • protect Marri trees favoured by Baudin's Cockatoo as food sources from where practicable; • use seed from Marri trees favoured by Baudin's Cockatoo in the Vegetation Mitigation Plan; and • prepare and implement a capture and relocation program for Quenda from the Speedway –Site 16 and the Common Brushtail Possum at Site 8.	Before Clearing	CALM
3	Landform and Soils	To maintain the integrity, ecological functions and environmental values of the soil and landform.	Iluka will undertake additional testing for PASS within the Project Area prior to construction and modify the Soil Management Plan based on the results.	Before construction	DoE
4	Rehabilitation and Closure	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.	Prepare the Closure Plan, prior to the cessation of mining, which addresses: • post-mining land-use; • soil management; • post-mining landforms; • fencing plans; • infill planting with native species; • brook crossings and stock watering points; and • decommissioning of mining infrastructure. Implement the Closure Plan.	Before cessation of mining	Shire of Waroona DoE DoIR
5	Groundwater and Surface Water	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected. 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.	Prepare a management plan for the protection of water resources that includes: • monitoring and reporting of groundwater levels and vegetation impacts (through photo surveys) in area of drawdown; • monitoring and reporting of stream flows and potential impacts of reduced flows in Nanga and Ferraro Brook; • monitoring and reporting of aquatic biota in Nanga and Ferraro Brooks; • measurement and reporting of water abstraction and usage; • monitoring of water quality and water levels within the piezometer network; • spills and hydrocarbon management; and • contingency actions for affected water supplies. Implement the Water Resources Management Plan.	Before Construction	DoE

Number	Topic	Objective	Action	Timing	Advice
6	Dust	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.	Prepare a dust management plan that includes: • minimising open area; • dust control measures; • monitoring and reporting of dust levels; • review and continuous improvement program; and • community complaints system. Implement the dust management plan.	Before Construction	DoE
7	Noise	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	Prepare a noise management plan which includes: • hours of operation; • allowable noise levels of site machinery; • regular checking of noise levels of site machinery; • management of noise during construction; • management of noise during operations; • monitoring and reporting of noise levels; • review and continuous improvement program; and • community complaints system Implement the noise management plan.	Before Construction	DoE

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13. GLOSSARY

Bassendean Dune System	Oldest, most eastern coastal dune system.
DoA	Department of Agriculture.
CALM	Department of Conservation and Land Management.
Cone of depression	Term used to describe the drawdown effect on the groundwater table in the vicinity of groundwater abstraction.
CO2-e	Carbon dioxide equivalent, a measure of the global warming effect of the emission of carbon dioxide and the relatively small quantities of CH_4 and N_2O emitted during fossil fuel combustion.
Colluvial	Rock detritus and soil accumulated at the foot of a slope
Cretaceous	Interval of Geological time between about 140 Million years ago and 65 Million years ago.
DEH	Commonwealth Department of the Environment and Heritage
DIA	Department of Indigenous Affairs
DoE	Department of Environment (comprising the former Department of Environmental Protection and Water & Rivers Commission).
DoIR	Department of Industry and Resources.
Drawdown	A decline in the watertable due to abstraction.
EPA	Environmental Protection Authority
Ecosystem	A dynamic complex of plant, animals and micro-organism communities and their non-living environment interacting as a functional unit.
Genetic diversity	A measure of the number of genes in a population and their expression as different phenotypes.
GL	Gigalitres (1 GL = 1 000 000 000 litres)
Groundwater	Underground water contained within a saturated zone or rock ie an aquifer.
GWL	Groundwater Licence
ha	Hectares
Hydrocarbon	An organic molecule containing hydrogen and carbon; the major components of petroleum.
HM	Heavy Mineral
HMC	Heavy Mineral Concentrate
Jurassic	Interval of Geological time between about 210 Million years ago and 140 Million years ago.
kL	Kilolitre (1 kL = 1000 litres)
Laterite	Broadly used to describe the cemented layer of aluminium and iron oxides found at the surface of strongly weathered relict soils.

m	Metres
mm	Millimetres
ML	Megalitres (1 ML = 1 000 000 litres)
MW	Mega Watts
MRWA	Main Roads Western Australia
Perched water table	A water table which occurs above an impermeable zone, which is underlain by unsaturated materials
Permian	Formation includes two mainly siltstone members – the Otorowiri Member and the Carnac Member.
pH	A measure of the alkanity or acidity of a substance. A pH of 7 is regarded as neither acid or alkaine. 0 is extremely acidic and 14 is similarly extremely alkaline.
Piezometer	A small diameter cased bore used for water level measurements.
Radionuclide	A nuclide that is radioactive.
Rehabilitation	Re-establishing pre-mining environmental values in areas disturbed by Iluka operations.
Redoxomorphic	Soils that alternate between reducing/oxidising conditions due to changes in the wetting/drying cycle
Restoration	Enhancing the environmental values of areas that are not disturbed by Iluka's operations.
SMMU	Soil Material Management Units.
Soil horizon	Horizontals zones that make up a particular mature soil. Each horizon has a distinct texture and composition that vary with different types of soils.
Soil profile	Cross sectional view of the horizons in a soil.
t	Tonnes.
tph	Tonnes per hour.
Transect	A line used to survey the distribution of organisms across an area
Turbidity	The cloudy conditions caused by suspended solids in liquids.
Water table	The top of the saturated soil in an unconfined aquifer.

APPENDIX 1

Community Updates

WAROONA EXPLORATION UPDATE 2001

Who is ILUKA Resources Limited?

In December 1998, Westralian Sands Limited merged with RGC Minerals Sands Limited (Renison Goldfields Corporation) to form one of the world's largest companies involved in the Titanium minerals industry.

Shareholders voted in May 1999, to change the name of the combined company to ILUKA Resources Limited. The new company is ranked second as a producer of titanium feedstock for paints, coatings and colouring agents - and first in the world production of zircon for ceramics and refractory linings.

There are more than 2500 people working for the company in eight production centres in three continents, with over 1000 of those employees currently working in the Western Australian operations.

ILUKA RESOURCES LIMITED

Previous Work

ILUKA Resources Limited commenced preliminary exploration work in the Waroona area in February 1986 and a Mining Lease was granted in 1996.

The first major exploration program by the Company commenced in 1991 and was completed in June 1992. More recently ILUKA has undertaken an extensive drilling program over the last 2 years with further drilling currently taking place.

In 1997 the Company undertook a consultation program to talk to those residents that occupy properties in the vicinity of the mining lease area. Information flyers were also distributed to residents at this time. ILUKA is committed to keeping the community informed of any significant progress and will continue to provide the community with regular updates.

Recently representatives from ILUKA met with the Waroona Shire Council to discuss the current status of the project. It was agreed with Shire Councillors that ILUKA will conduct another briefing within the second half of this year.

Forthcoming Program

AIM

The aim of the program is two fold.

1. To further assess the results from our drilling program to determine if the resource is economical to mine and conduct the relevant pre-feasibility studies.

2. To conduct hydrogeological studies of the area, in conjunction with external environmental consultants from URS. This will initially involve conducting a bore census.

Program

The bore census will involve talking to landowners that live in the vicinity of the mining lease area to discuss their water usage and undertake some simple measurements of their bores. This will start to provide ILUKA with valuable data as to the quantity of water being extracted from certain aquifers which will assist in determining whether a mining operation will impact local groundwater and surface water users.

The Waroona bore census will be undertaken by ILUKA Community Relations Officer, Sharon McDonald, and a hydrogeologist from URS, in the coming months. Landowners will be contacted by phone to arrange a time that is suitable for them to discuss their individual water usage. It is in each landowner's best interest to participate in the census to ensure their ground and surface water requirements are considered prior to further mine feasibility studies.

For any enquiries regarding the bore census please do not hesitate to call the Community Relations department on 97 803 200 during office hours.

Questions and Answers

Why should we participate in the bore census?

ILUKA is undertaking a comprehensive study to determine if local bores will be affected by the mining operations. The results from each bore that is assessed will be made available to the respective landowner for their records.

Should mining actually go ahead, it is in each landowner's best interest to have a baseline record of their bore's water quality and condition.

What tests will be performed on my bores?

If you are contacted to have your bore assessed, the tests may involve a depth measurement to the resting water level and a conductivity test using a digital conductivity probe in a small sample of the water taken from the bore.
The conductivity test is simply a measurement of the amount of dissolved salts in the water.

How long will the discussion be?

We will ask for approximately 30 minutes of your time to discuss your ground and surface water usage, at a time that is most suitable to you.

What is the drilling that has recently occurred?

21 piezometers and 7 test production bore sites have recently been installed that will be monitored regularly to assess seasonal groundwater fluctuations and provide ongoing water quality data to ILUKA before, during and after mining.

What is a pre-feasibility study?

A pre-feasibility study is a study of the economic viability of the proposed mine that takes into account factors such as transport costs, quality of the resource, infrastructure availability such as power and water, together with an investigation of the relevant environmental and social factors.

ILUKA RESOURCES LIMITED

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Waroona•Wagerup

Community Update

Iluka Resources Limited

Update March 2003

WAROONA

The mining of the Waroona Deposit is currently part of Iluka's 10 Year Plan with mining estimated to commence in the middle of 2005. The operations are expected to run for 51 months, with an additional 3-4 years of ongoing rehabilitation work required post-mining. Pre-production work is expected to commence in the second quarter of 2004.

These dates may vary according to Iluka's requirements.

Consultation with some adjoining landholders and the Shire is currently underway. A meeting was held with the Shire in December 2002.

Studies for the proposed Waroona Deposit are currently underway, these include:

- A Feasibility Study is still underway. This includes development of a mine plan and determination of all requirements to get the operation underway.
- A site visit by hydrologists has been undertaken to determine stream gauge requirements for baseline monitoring. These are likely to be put in early this year to give us at least two years monitoring prior to mine start-up.

Further studies will include noise, flora and fauna, heritage and cultural studies. Information regarding the studies will be advised in future updates.

Wagerup

Representatives from Iluka held a Community Information session at the Waroona Shire Council offices on Tuesday, 12th November, to inform the community about the proposed Wagerup mining operation.

Twelve community members attended the session and were given a presentation by Russell Harvie, Community Relations Manager and Kylie McAuliffe, Community Relations Officer about the proposed Wagerup deposit.

Approval to mine has not yet been obtained for the proposed mining operation at Wagerup. Proposed dates for the commencement of operations are as follows:

Pre-production: April 2003 (approx 2 – 3 months)

Production: Jan 2004 (approx 3 years of mining)

Rehabilitation: approx 2-3 years after mining is completed

Please note that dates may vary according to approval and Iluka's business requirements.

The main issues raised at the meeting were water and access to the South Western Highway.

Iluka anticipates that access to the highway will be via the existing route previously used by Cable Sands. Discussions with Main Roads Western Australia are currently underway.

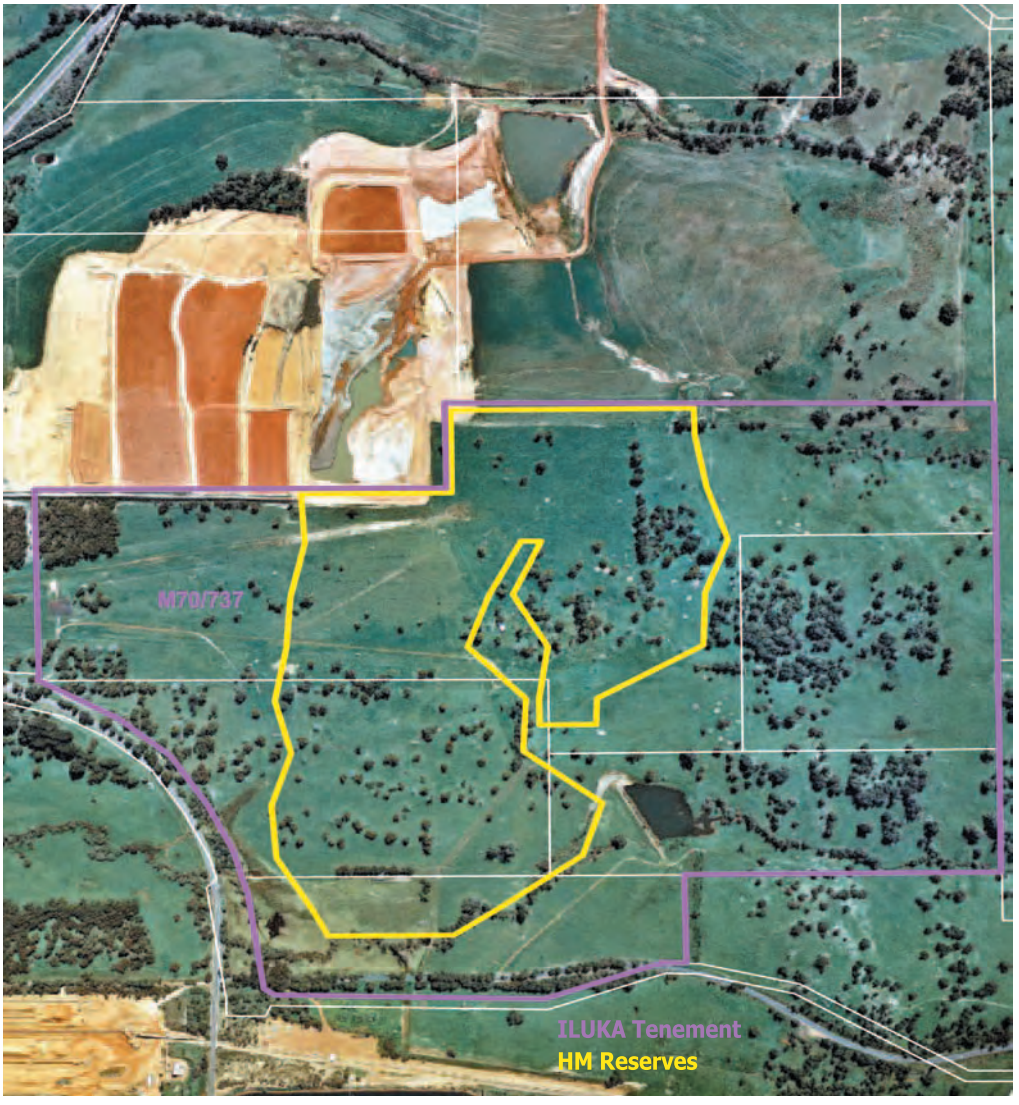
Iluka proposes to purchase the majority of process water from Harvey Water. An advertisement for Application for Groundwater Licence was applied for dewatering purposes and for the use of test production bores.

As part of the shallow groundwater investigations, several test production bores were installed immediately adjacent to the planned mine pit perimeter. These test bores were test pumped to enable a detailed understanding of the local hydrogeology and expected impacts of mining upon other groundwater users. However, these bores are not planned to be used during mining as dewatering will be achieved by use of in-pit sump pumps.

The groundwater studies conducted by environmental consultants URS concluded that dewatering of the proposed mine "Would have no significant adverse impacts on other groundwater users in the area".

The test production bores were included on the advertised Groundwater Licence Application in the likelihood that they must be used to provide small groundwater supplies (less than 50,000 kL/year) during the mine rehabilitation stage.

The Works Approval is about to be issued and the Notice of Intent was submitted in December 2002.



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For further information regarding the Wagerup project please contact: Kylie McAuliffe, Community Relations Officer (08) 9780 3310.

Flora

A desk top study on Flora was conducted by Iluka Resources Rehabilitation Department personnel utilising the CALM rare flora database, herbarium records, published references and expert knowledge. Following this a field ground survey was conducted on the area to be disturbed.

This concluded that there was no Declared Rare Flora in the proposed mining area.

Iluka will maintain as much of the remnant vegetation directly outside of the mining path and proposed solar drying dam locations, in particular the remnant vegetation along the northern boundary of the block running along the western edge of the airstrip.

The natural waterway, Yalup Brook and surrounding environment will be isolated from the mining operation by fencing.

Before clearing, all harvestable timber will be recovered and stockpiled for the landowner. The remainder will be used as firewood or mulched where quantities are significant.

Fauna

No formal fauna study has been carried out. The area is predominantly Alcoa farmland, however, observations during ground studies of the vegetation revealed no rare vertebrate species and that most faunal species would make only incidental use of the area.

Minimising clearing and establishment of further vegetation belts will ensure that any fauna in the area would not be threatened by the proposed project.

Aboriginal Sites

The Heritage and Culture Division of the WA Department of Indigenous Affairs was contacted regarding the potential for Aboriginal heritage sites in the proposed project area. Due to the level of agricultural, industrial and mining development that has occurred in the project area it is not expected that any Aboriginal sites of significance will exist on the mining lease. Iluka will notify the WA Department of Indigenous Affairs and the Department of Mineral and Petroleum Resources in the event of any Aboriginal site being uncovered during the operation as required under the Act.

Consultation

Consultation with nearby landholders has been undertaken. Further consultation will be undertaken with the community once details on the project have been finalised.

Noise

Contractors were commissioned by Iluka in September 2001 to carry out an environmental noise assessment for the proposed mine at Wagerup. A computer noise model was constructed based upon operational conditions for the proposed mine.

As with other Iluka sites in the South West, overburden removal operations at Wagerup are planned to be carried out on dayshift only. A range of successful noise reduction methods in use at other Iluka sites will also be employed at Wagerup. These will include:

- Noise attenuation of fixed plant and machinery by way of suppression barriers, and where practical, the isolation or redesign of vibrating equipment.
- Muffling of exhausts on earthmoving equipment.
- Strategic placement of earth bunds or similar structures around the mining operations and fixed plant such as pumps.
- Restricting equipment movements and number, wherever practical.
- Confining mining equipment, including scraper, hopper and screen to the pit and therefore below ground level.
- Restricting certain activities during adverse weather conditions.
- Permitting only essential mining activities at night and on Sundays.
- Use of lower noise emission equipment such as smaller scrapers where possible.
- Substitution of flashing lights for reversing beepers on mobile mining equipment working at night, depending on approval from the Department of Industry and Resources.
- Use of electrical pumps in place of diesels whenever possible.
- Leaving trees and tree belts to mask noise.
- Scheduling of mining activities to reduce impact on surrounding residences.

As part of Iluka's ongoing environmental monitoring program, noise surveys will be conducted as required to ensure compliance with the relevant regulations.

Post Mining Land Use

Iluka's policy is to return the land back to its pre-mining agricultural land use and general topography.

Heritage

There are no items of European heritage value on the site, such as those listed by the Heritage Council of WA and the Australian Heritage Commission.

Sponsorships

Iluka works with local groups to add value to the communities in the company's operational areas. At Iluka we are currently reviewing our sponsorship guidelines. New guidelines for applying for sponsorships will be advertised in local papers in 2003.

Waroona Celebrity Cricket Match

Iluka has been a major sponsor of the Waroona celebrity cricket match for the past 5 years and was disappointed that the match was cancelled for 2002 due to public liability insurance costs. We look forward to be able to support this event in future years if it is to continue.

If you would like to be placed on the database to receive future updates please contact Kylie McAuliffe, Community Relations Officer on (08) 9780 3310 or 0427 569 557

ILUKA RESOURCES LIMITED
ABN 34008 675 018

Waroona • Wagerup

Community Update

Iluka Resources Limited

Update May 2004

ON SITE WORKS

Surveying and drilling work is being undertaken on the Waroona project site during May this year. A drill rig mounted on a 4WD vehicle is used to drill holes to a depth of approximately 25m. A few other light vehicles will be in attendance during this time.
For further information, please contact Mark Csar from Iluka's exploration department on 0408 803 299.

FLORA & FAUNA SURVEY

In October 2003, Iluka undertook a flora and fauna survey over the project area and on some private land surrounding the project area. Thank you to the landholders who allowed us access to their property to undertake the survey. The survey is to assist Iluka in identifying the vegetation types and the location of any rare or priority flora and fauna. Results of the survey have been finalised and a summary is available by contacting Liz Kerr on 9360 4396.

ILUKA

For further information regarding the Waroona project please contact Liz Kerr, WA Community Relations and Land Access Specialist on (08) 9360 4396 or Mob 0409 112097

Waroona

Iluka is continuing planning for mineral sands mining of the Waroona deposit, located to the north of Patterson Road (see map below).

Various studies are undertaken as part of this process and as required by the Environmental Protection Authority (EPA).

In January this year, Iluka submitted an Environmental Referral to the EPA for this project. The level of assessment determined by the EPA for this project is known as a Public Environmental Review (PER). This level of assessment was advertised in The West Australian on 23rd February 2004.

Comprehensive assessment of all environmental aspects of the project is underway and will be complete by August this year. Iluka proposes to submit the PER documentation to the EPA in September. The EPA will then release the document for a four-week public review period. Any submissions received during this time will be responded to by Iluka.

Following this review, the EPA undertakes a final assessment of the project and reports to the Minister for the Environment.

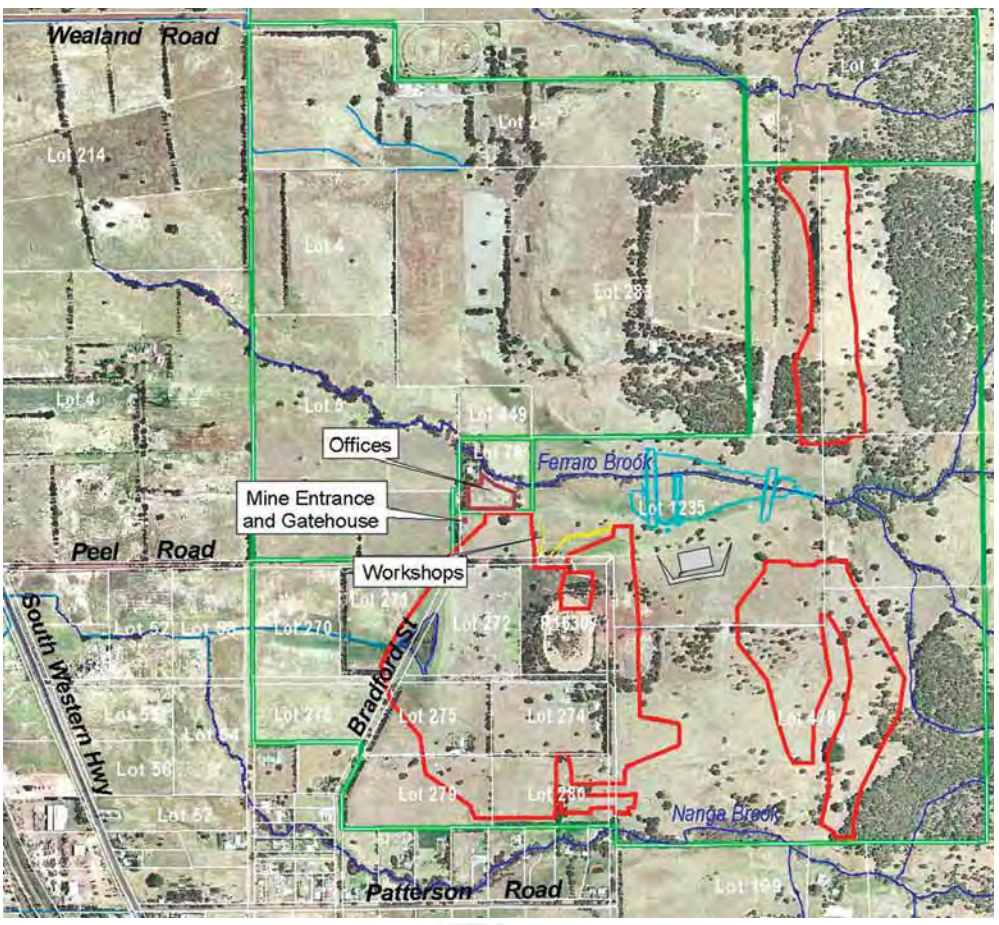
The Minister consults with other government agencies and decides whether or not the project should proceed.

Environmental factors to be considered in the Waroona PER include:

- Groundwater
- Surfacewater
- Flora and Vegetation
- Fauna
- Noise
- Dust
- Aboriginal heritage
- European heritage
- Visual impacts
- Soils
- Greenhouse gases
- Rehabilitation

Many of these factors have already been studied. An outcome of all studies will form part of the PER, and will be available for public comment later in the year.

It is anticipated that the preparation of the site will commence in the fourth quarter of 2005, subject to all environmental and works approvals being received.



SHIRE VISITS JOSHUA BROOK SUBDIVISION

Late last year, Shire Councillors, together with Kevin O'Connor (Shire CEO) & Matthew Turner (Manager of Planning and Development Services) attended a site visit hosted by Iluka, to the Joshua Brook subdivision in Boyanup.

The Shire Council were treated to a picnic lunch near the lake and then enjoyed a tour of the subdivision. The Joshua Brook subdivision in Boyanup is an example of rehabilitation of a former mine site, which was undertaken by Iluka. The Boyanup deposit was mined from 1986 to 1997 and rehabilitation was completed in 2002.

The first release of blocks has been sold and the second release is due soon. The subdivision includes nature walks, park benches and bird hides which make it a relaxed environment to live in. Iluka envisaged the visit would give council an insight into what is possible post-mining and will assist them with future planning for the Waroona townsite.

ILUKA HELPING TO BRIGHTEN WAROONA'S TOWN CENTRE

Brightening and rejuvenating sites around the town has been a recent focus of the Waroona Community Marketing Group. Local artist, Vicki Anderson, has been working hard on designing and painting the water tanks on the eastern side of the football ground. The murals depict images of local community events and facilities as well as a sunset landscape.

With assistance from Iluka, the project has become a reality. Waroona Community Marketing Coordinator, Audrey Smith, says that, "the people of Waroona have been very enthusiastic about working together and contributing to projects that brighten the town and life of the community. This project is a great example of community artwork that reflects the community spirit of Waroona."

Iluka is pleased to be involved with this project and keen to become an active member of the local community.

Wagerup

Mining of the Wagerup deposit has been delayed until the first quarter of 2005. Commencement of this project was originally scheduled for earlier this year. Due to the discovery of further mineral in some of the company's existing mine sites, and variations in the world market, Iluka currently has less need for the grade of mineral which is present at Wagerup, and hence mining has been delayed for 12 months.

It is anticipated that preparation of the Wagerup mine site will commence later this year, with full production in mid-2005.

FUTURE BUSINESS ENTREPRENEURS FOR WAROONA DISTRICT

Waroona District High School has been busy obtaining community support for a Business Enterprise Training Centre for their students to gain necessary skills in the business world. The school managed to obtain an old mining hut, completely refurbished, to set up the centre. The building has a classroom, an entrance foyer and an office.

Late last year, Iluka Resources Limited assisted the Waroona District High School with the Business Enterprise Training Centre by providing office desks, a large pin up board, two white boards and a front reception desk. Liz Kerr, Community Relations Officer, said that Iluka was happy to assist the school with the donation for the centre which will assist the young people in the community to obtain important skills for their future.

Grace Brothers removals delivered the office furniture from Capel to Waroona on a back load free of charge for the school.

The school is working on establishing a simulated office situation so that students doing work experience with businesses in the community will bring the required skills to the situation. Within the centre the students learn to master a conventional curriculum by planning and establishing a small business, producing a product or a service, managing a profit or loss situation and paying a dividend at the end of the year.

GETTING THE TILLS RINGING IN YOUR COMMUNITY

Guest speaker Peter Keynon attracted a significant number of people to the Breakfast Series concept in Waroona late last year and it wasn't just for the cooked breakfast.

Peter is renowned for motivating and assisting small communities to enhance their reputation and his presentation on "Getting the Till Ringing in Your Community" was no exception.

Peter has travelled extensively over the world and throughout Australia and spoke of many successful businesses, sometimes in the smallest communities in the remotest places.

Iluka Resources and the Shire of Waroona were joint sponsors of the breakfast and were pleased to be able to bring Peter to the Waroona community. The Breakfast Series are an initiative of the Peel Economic Development Unit (PEDU) and are designed to stimulate business interests and economic development in the Peel region.

ILUKA

Wagerup . Waroona

Community Update

Iluka Resources Limited

Update October 2004

WAGERUP SOIL STOCKPILING

During the next two months, Iluka's earthmoving contractor will be removing and stockpiling top soil and sub soil from the initial mining area. Immediately after being stripped, the exposed soil will be seeded and hydromulched to eliminate the generation of dust over the windy summer months. Topsoil bund walls will be created in various areas around the perimeter of the site, as pictured.

An example of a topsoil bund wall

In April 2005, the concentrator will be relocated by truck from another Iluka mine site near Capel, to the Wagerup site. Mining of this area and production of Heavy Mineral Concentrate will then commence in 2005.

One of Iluka's concentrators being reassembled following relocation

Wagerup preparatory work commenced

Preparatory work for Iluka's mineral sands mining operation at Wagerup has commenced. The site is due to start production in the second quarter of 2005.

New fences have been installed around the site to delineate access routes and mining areas. Broadwater Fencing contractors, Peter Silverwood and Ben Hill, have been on site over the last month installing the fences.

Timber from the site is being harvested, and where it is unsuitable for alternative uses, will be mulched and re-used on the site for dust suppression and in our rehabilitation program.

What dust control mechanisms will be in place at Wagerup?

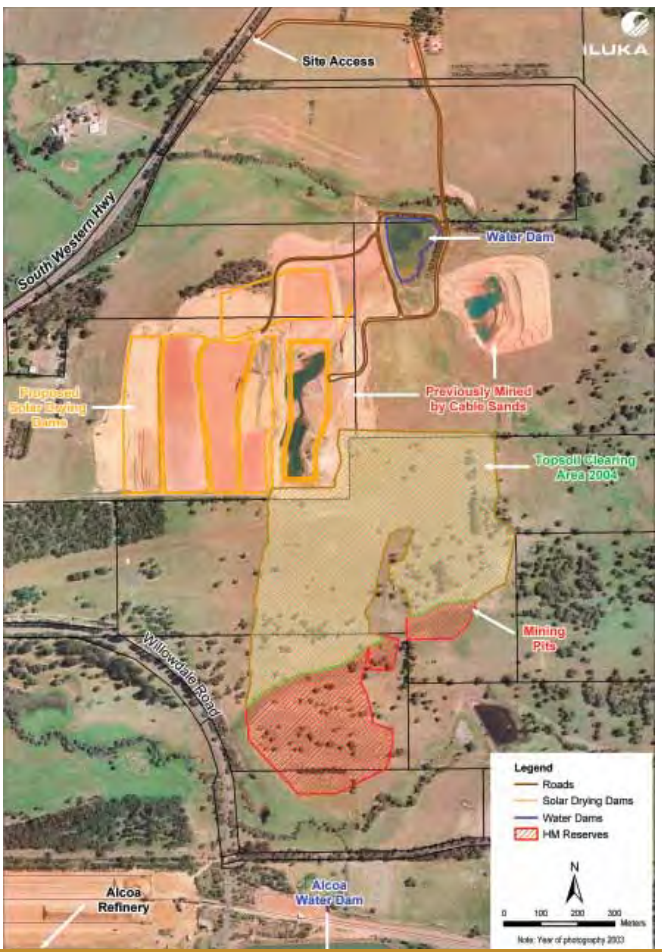
While earthmoving on the site, there is the potential for dust to be generated. Iluka intends to control dust using a combination of the following techniques:

- Undertake activities like topsoil removal during the winter & spring to take advantage of the soil moisture,
- Minimise the amount of area open at any one time,
- Seed grasses or cover crops over any exposed areas and soil stockpiles,

Project Manager, Mark Gell

- Use water trucks to distribute water and/or a clay layer on top of exposed areas to keep the material moist,
- Spray hydro mulch (shredded newspaper) over disturbed areas, and
- Spread mulch or hay over disturbed areas

Mark Gell is Iluka's project manager for the company's operations at Wagerup. Mark can be contacted at any time on 0417 938 987 if you would like more information or have any concerns about the current activities on the site.



Fencing contractors Peter Silverwood and Ben Hill

WAGERUP SITE ACCESS AND INTERSECTION UPGRADE

All access to and from Iluka's mining operations at Wagerup will be from the South West Highway as seen in this map. The intersection will be upgraded during the next six months to improve its safety and to minimise impact on highway traffic. Local road safety issues will be considered in detail and incorporated into the design.

ILUKA

Waroona Project
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SHARING LOCAL KNOWLEDGE WITH LANDCARE

Iluka's Senior Environmental Advisor, Lisa Sadler, and Community Relations Advisor, Liz Kerr, recently met with local Waroona Landcare and Rivercare officers, Kim Wilson and Jesse Steele. The meeting was held to discuss local projects, baseline studies and research, and opportunities for both organisations to continue to share information about the local environment and restoration works. It is anticipated that all organisations can all work together on local landcare projects over the next few years, and as part of Iluka's rehabilitation program.

SHIRE LAND USE STRATEGY FOR WAROONA NORTH

Planning for the future use of the land between McDowell Street and the northern shire boundary is a key focus for the Shire of Waroona in 2004/05. Iluka has recently contributed $10,000 towards the development of a land use strategy for the area. The Council has formed a local community steering committee to guide the development of this strategy. Further information is available by contacting the Manager of Planning and Development Services, Matthew Turner, at the Shire of Waroona on 9733 7804.

LOCAL WATER STUDY

In preparation for Iluka to submit an application to the government for mining approval, an extensive array of environmental studies is undertaken. As part of this work, an assessment is being undertaken of the Ferraro, Wealand and Nanga Brooks, by University of WA Researcher, Sue Creagh.

The study includes determining the existing condition of the vegetation, water quality and aquatic life in the watercourses. Sue has held discussions with landowners downstream of the proposed mining area to get an understanding of the history of the brooks. It is also important to identify landowners along the brooks who use surface water for irrigation, stock or other purposes.

The collation of this information allows Iluka to determine if there will be any impacts on the watercourses and how significant this impact is to vegetation, aquatic life and human water users. This information will be made available at landholder briefings and will be detailed in the Public Environmental Review.

UWA Researcher, Sue Creagh, assessing local brooks

A great night out at the Dancing Daffodils Ball

ILUKA IS HELPING YOUR COMMUNITY TO HELP OTHERS

The Dancing Daffodils Ball in Waroona was once again a resounding success. Iluka is delighted to have been able to assist with this important fundraising event. Congratulations to the organising committee and well done to everyone who came along and supported the Cancer Foundation.

WAROONA HERITAGE TRAIL

In June 2004, Iluka agreed to sponsor a heritage trail bollard, located in the town centre. The Heritage Trail identifies key historical sites and buildings within the town, and will be a permanent reminder of Waroona's early days.

KEEPING IN CONTACT WITH THE COMMUNITY

Iluka representatives have met individually with many landholders in Waroona over the past four months, to provide information about the proposed mineral sands mining project. It is planned to continue to provide information to all interested people and receive feedback from the community via regular landholder briefings. Such briefings will be held in Waroona on a quarterly basis, and all landholders in the vicinity of the proposed mining area will be notified and invited to attend. The next landholder briefings will be held in late November. For further information, please contact Liz Kerr on 9360 4396.

WANT TO FIND OUT MORE?

Information relating to the proposed mineral sands mining project at Waroona is now included on Iluka's website. Please visit **www.iluka.com** and follow the links from our Global Operations page to Waroona. This page will be updated as new information and data comes to hand.

For further information regarding the Waroona project please contact Liz Kerr, WA Community Relations and Land Access Specialist on (08) 9360 4396 or 0409 112 097

ILUKA

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Iluka Resources Limited

ILUKA'S MINERAL SANDS MINING

Every day people throughout the world use products created with mineral sands.

Examples of these products include toothpaste, sunscreen, aeroplanes, paint and ceramics.

Mineral sands is the term given to a group of minerals often found and mined together. The most valuable minerals include rutile, zircon and ilmenite.

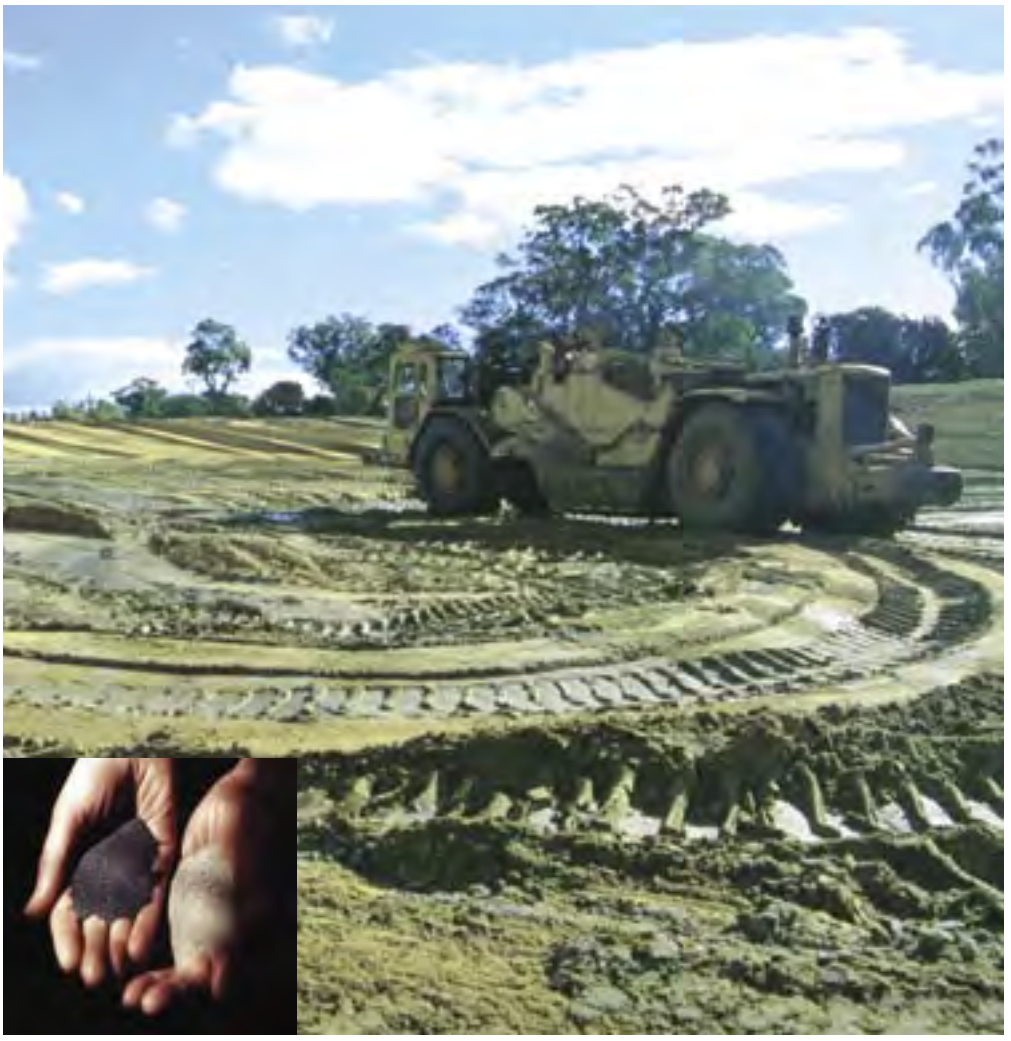
Iluka Resources Limited is a leader in the global production, processing and sales of titanium minerals.

Mining methods can vary between sites. Dry mining operations use scrapers or excavators and trucks to collect ore which is then transported to concentrator plants.

The ore is pumped to the concentrator and washed through spirals that use gravity to separate the heavy mineral sands from the lighter quartz and clay.

The heavy mineral concentrate (mainly ilmenite, rutile and zircon) is transported to Iluka's processing plants in Geraldton or Capel and further separated by using powerful magnets and electrostatic charges.

Some of the ilmenite is processed further to synthetic rutile by roasting, aeration and acid leach treatment to remove impurities. Rutile and synthetic rutile is sent to companies around the world for further processing into titanium dioxide.



ILUKA SWINGS INTO THE LOCAL SCHOOL

Waroona students are set to benefit from a recent contribution of $5,000 by Iluka, for the purchase of swings and improvements to the school playground.

The Waroona P&C have been working on the Early Years Playground for some time, and together with other partners in the community, Iluka is pleased to be able to contribute to this important project.

Community Relations Manager, Liz Storr, said that "Iluka is committed to forming partnerships with community groups in areas where we operate. The company is keen to support projects which will have a lasting benefit for local people."

Iluka's contribution will also assist in the next phase of the project which includes paths, walls, landscaping and an outdoor classroom.

Mark Charlesworth (School Principal), Liz Storr (Iluka) & Mark Winter (P&C) with students on the new playground equipment

WHERE ARE MINERAL SANDS FOUND?

Deposits of mineral sands can be found along ancient coastlines where heavier minerals have been concentrated by wave and wind action.

Iluka's geologists select sites for exploration by researching an area's geology, topography, soil types and geological history. Issues like current land use and access to the land are also important.

Areas are drilled with a widely spaced grid to identify any presence and concentration of minerals. If the results are promising, samples are taken from a more closely spaced grid.

Most areas mined by Iluka have been cleared for agriculture, but land may also be lightly cleared sand dunes, heathland or bush.

WHAT WORK IS ILUKA DOING IN THE WAROONA AREA?

Iluka has recently commenced mining at Wagerup, just north of Willowdale Road. This mine site will be operational for approximately three years.

Iluka is planning the development of a mineral sands mine just north of the Waroona town site. Subject to government approvals, this mine will commence in mid-2006 and operate for about four years. Further information is available from Iluka's Waroona Office – open Thursdays - or by phoning 08 9360 4700.

WHAT ARE MINERAL SANDS USED FOR?

Most of Iluka's titanium minerals products are used to manufacture titanium dioxide pigment which is used in protective coatings such as house and car paints, sunscreens, cosmetics, plastics, paper and textiles.

Rutile and synthetic rutile are used to make titanium metal, which is essential to the aerospace industry because of its lightness, strength and durability.

Titanium metal can be used in desalination plants and corrosive chemical industries, because of its inertness and resistance to rusting. It is also one of the few materials that can be used in the human body as hip replacements and pacemakers.

Titanium metal is also used in sports equipment and jewellery.

Rutile and leucoxene are used as flux material in welding electrodes for shipbuilding and civil engineering.

The largest use of zircon is the ceramics industry, where it gives whiteness and durability to tiles, sanitary-wares and tableware.

Zircon compounds have a very low toxicity and are often used in foodstuffs, pharmaceuticals and medicines.

ENVIRONMENTAL STUDIES

A range of environmental studies have been conducted over the past 18 months in order to assess environmental aspects of the proposed Waroona project. These have been collated into a document, referred to as a Public Environmental Review (PER). This document has been finalised and with authorisation from the Environmental Protection Authority (EPA) will be released for public comment in October 2005. Submissions will be taken by the EPA over a 4 week period. Iluka must then respond to the submissions and the EPA undertakes an assessment and reports to the Minister for the Environment. The Minister consults with other government agencies and decided whether or not the project should proceed.

RESTORATION AND REHABILITATION

As part of the Waroona mine site rehabilitation most of the land will initially be returned to agricultural use. During surveys of the vegetation, several areas of degraded vegetation were identified that will be fenced off and protected. These areas are currently grazed by cattle.

Ferraro Brook is currently degraded with minimal understorey and eroded banks. This brook will be fenced along both sides and infill planted with native species. The brook will be linked to the vegetation blocks and state forest through vegetation corridors.

The enhancement of the degraded vegetation blocks and Ferraro Brook will improve the vegetation condition and protection in the area. Inclusion of vegetation was a key aspect identified by participants in the Waroona North Structure Plan.

WATER FOR THE MINE SITE

Iluka's mineral sands mines in WA are operated using dry mining techniques. Any water that flows into the mining pits needs to be pumped out. This is termed dewatering. The water is stored in dams on the mine site and re-used in the mining process.

Water is used to form a slurried ore, so it can be pumped from the screen plant to the concentrator. Water is also used in the concentrator to assist in the gravity separation process.

The wet ore travels through a series of spirals, separating the heavy mineral from the lighter sand and clay.

Heavy mineral is stockpiled and later transported from the site. The clay and sand is put back into the mine pits.

Iluka anticipates that 2300ML of water per year will be used on the Waroona site. Up to 300 ML will be from the dewatering of the pits and the remainder will be purchased from the local irrigation network.

Harvey Water has an annual industrial allocation of water. This is water that is earmarked for industrial purposes only, and is not used for agriculture. Iluka will purchase approximately 2000 ML per year.

An offtake from the irrigation network will be installed at the intersection of McNeill Road and the Peel Road reserve. Culverts will be installed to enable the pipeline to go under the railway line and South West Highway. The pipe will then follow the Peel Road route to reach the mine site.

A similar water pipe to this one at Wagerup, is planned for Waroona.

SHARING INFORMATION ABOUT LAND CARE

Harvey & Coolup LCDC members met together at the Waroona Community Centre in April to hear more about Iluka's mineral sands mining proposal for Waroona, and in particular discussed the environmental aspects of the project.

Iluka's Senior Environmental Advisor, Lisa Sadler, spoke about the management and stockpiling of different soil types, groundwater and surface water monitoring, local flora and fauna surveys, site rehabilitation, and the environmental approvals process.

LCDC members were interested to hear about Iluka's plans for Ferraro Brook, which include fencing and revegetation of areas which have been heavily degraded due to cattle grazing over a long period of time. Ms Sadler explained that, "we are keen to involve the local landcare groups in identifying local species that will be appropriate for planting along the brook, and also to share information on current restoration techniques."

GROUNDWATER AND MINING

In some areas, mining at Waroona will extend to below the water table. Iluka needs a dry pit to be able to mine. To do this, groundwater will have to be pumped from the pits. Rainfall and runoff will also be collected in the pits and sent to the site's clean water dam. Only enough water to maintain a dry pit floor is pumped out. Groundwater levels will be reduced near the mining pit where pumping takes place.

Iluka has done studies to look at the potential impact of this pumping on local groundwater levels and surface flows in Nanga Brook (also known locally as the A4 drain). Modelling of the groundwater pumping shows that there will not be any impact on bores in neighbouring properties. Following the completion of mining, the groundwater will recover to natural levels.

Iluka has many monitoring bores surrounding the proposed mining area. Water levels in these bores will be monitored during mining and compared to the modelling. Regular feedback will be provided to adjacent landowners. In the unlikely event that there are impacts on a landowner's bore, caused by the mining activity, Iluka will discuss alternative water supplies with the landowner.

Groundwater pumping will have a very small impact on the groundwater inflow in to Nanga Brook. The reduction in the groundwater flow into Nanga Brook will be less than 1% of the annual flow. Flows will return to normal after the completion of mining.

The sumpland, located to the west of the old speedway, will be mined as part of the main pit. This sumpland contributes about half of the flow where it meets Nanga Brook. Mining will significantly decrease the flow from the sumpland.

TRANSPORTING MINERAL TO NORTH CAPEL

During the four years of mining at Waroona, there will be approximately one million tonnes of Heavy Mineral Concentrate (HMC) extracted. This HMC will be taken by truck to Iluka's processing plant at North Capel, using the South West Highway, which is a route designated by Main Roads WA for such vehicles.

This will require approximately 24 truck movements per day. At times, there may be 3 trucks each making 6 trips per 24 hour period (36 movements).

To minimise the impact on the town centre, Iluka will haul over a 24 hour period, on any day of the week. This would mean that the trucks are travelling less frequently through the town – approximately 1 hour between each truck. Over peak holiday periods and on public holidays, all efforts will be made to minimise trucking activity.

There are already around 5,000 vehicle movements per day on the South West Highway through Waroona, according to Main Roads WA. Of these, nearly 500 are trucks. Iluka's contribution of heavy vehicles to the current highway traffic over the four years of mining is estimated at increase of no more than 0.5%.

Iluka's haulage contractor in Western Australia is Giacci. The trucks used will be pocket road trains: a 6x4 prime mover pulling a tri axle lead trailer with a six axle dog trailer. The dog trailer or second trailer is on a triaxle dolly.

Iluka understands that local people are concerned about the number of trucks going through the town centre, and so has considered alternative routes including Old Bunbury Rd and Somerset Rd but these routes are not suitable because of the road surface, road width, other road users (cattle, tractors etc) and the presence of school bus routes and stops.

Iluka will continue to ensure that the truck drivers carrying our HMC obey all local road rules, with a particular emphasis on the town centre and safety for pedestrians.

At a recent presentation to the Waroona RoadWise committee, Iluka representatives committed to coordinating an education program at the local schools. This program will ensure that students have a good understanding of how trucks stop and safety when crossing the highway and riding their bikes.

This program will be conducted in conjunction with Giacci, local police, local schools and the RoadWise committee. Other transport carriers and industries in the area will be encouraged to participate.

WOULD YOU LIKE TO BE ADDED TO OUR MAILING LIST?

For more information about Iluka's mineral sands mining operations and proposals, or to be added to our mailing list, please contact

Liz Storr
Community Relations Manager WA
Ph 9360 4700
Em liz.storr@iluka.com

CONTROLLING MINE SITE DUST

Iluka has already started monitoring the background dust in the area of the proposed mine site, so we can understand the local conditions. We use dust deposition gauges, which stay permanently in the paddocks. Each month, the bottles that collect the dust are changed, and the dust collected is analysed.

A dust model has been prepared to help Iluka determine what dust control will be required for the mine. The model shows that dust levels are highest to the north west of the mine due to the strong south easterly winds.

The results show that under dry, windy conditions, without any dust controls in place, the dust from the mine would be more than is allowed in a 24 hour period. This highlights the need for dust controls and monitoring to be in place during mining. Iluka will install dust monitors to allow dust levels to be monitored. Dust control measures will be implemented including:

- minimising clearing and open area;
- not disturbing topsoil until required;
- regularly watering and grading roads;
- using wet clay, sprinkler systems, hydro-mulch, and heavy/rocky sand to wet or cover the exposed surfaces areas;
- growing of temporary crops; and
- re-establishment of pasture as soon as possible.

The Department of Environment will regulate dust emissions for the Waroona Mine Site and are likely to set a licence limit allowed at the site boundary when an environmental licence is issued for the site.

Further detail on the results of the dust modelling is available on the fact sheet on the Iluka website.

MINIMISING NOISE FROM THE MINE SITE

Input from nearby residents and modelling of anticipated noise levels from the mine site has been used to determine the best ways to operate the mine, monitor mining activities and manage the noise output.

Noise limits are set by the government under the Environmental Protection (Noise) Regulations. The mining earthmoving machines will operate during the day only (7am to 7pm), 6 days per week (no Sunday or public holiday operations).

The ore will be stockpiled near the concentrator during the dayshift mining operations. A front end loader will load the stockpiled ore into the screenplant. The screenplant separates out oversized material that cannot be further processed and then pumps slurry (ore and water mix) to the concentrator. The front end loader, screenplant and concentrator will operate 24 hours a day, 7 days a week.

Noise levels are modelled using the local weather conditions, noise outputs from selected machinery, mining locations and the topography.

The modelling shows that under most weather conditions, Iluka will be able to meet the noise limits as required by regulation. In some weather conditions, however, the amount of machinery operating may need to be reduced.

Further detail about this noise modelling is available on the fact sheet on the Iluka website.

ILUKA
www.iluka.com

LOCAL OFFICE FOR ILUKA

Waroona residents will now be able to access information about Iluka's activities in the area with the opening of a local office.

Located opposite the Waroona Pharmacy, and next door to Waroona Community Marketing, the Iluka office is in a central area where people can drop in and find out more about Iluka's mining proposal for Waroona and current mine site at Wagerup.

Maps, brochures, mineral samples and company reports are all available from this office, which is open each Thursday from 9am to 4pm and at other times by appointment.

The local phone number is 9733 3618 (Thursdays only) or contact Iluka's head office on 9360 4700.

APPENDIX 2

Harvey Reporter Advertisement

COMMUNITY INFORMATION SESSION

INFORMATION

ILUKA RESOURCES is currently developing a proposal to establish a mineral sands mine just north of the town of Waroona.

Iluka Resources is proposing to establish a mineral sands mine just north of the town of Waroona, east of SW Highway and north of Paterson Road.

Subject to government approval, mining will start in mid-2006 for about four years. Rehabilitation of the site will follow.

Local weather conditions and neighbouring houses are important considerations for Iluka when planning the various stages, methods and locations of the mining program.

Detailed studies are currently being done to look at a range of factors associated with mining in this area.

Iluka has been discussing this proposal with local people, the Shire of Waroona, state government departments and local community groups.

Iluka representatives regularly visit Waroona and are available to give you more information about the proposed mine site.

If you are interested in finding out more about Iluka's proposal, please visit us at the **Waroona Community Health and Resource Centre** during the following times:

Tuesday 19th April
5:00pm – 8:00pm

Wednesday 20th April
10:00am – 1:00pm

Further information is available by phoning Iluka on 9360 4700 or visiting our website www.iluka.com

ILUKA