ILUKA

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ILUKA RESOURCES LIMITED

TECHNICAL REPORT

JACINTH-AMBROSIA PROJECT

Mining and Rehabilitation Compliance Report 2012

Nick Travers
Sam Doudle

Date: 31st March 2013

ILUKA

Report sign-off:

ISSUED:

NAME: Nick Travers **DATE:** 31/03/13

POSITION: Senior Environmental Advisor **SIGNATURE:**

NAME: Samantha Doudle **DATE:** 31/03/13

POSITION: Rehabilitation Specialist **SIGNATURE:**

REVIEWED / APPROVED:

NAME: Shane Tilka **DATE:** 31/03/13

POSITION: Operations and Facilities Manager **SIGNATURE:**

MARCR 2012 – Revision Status

Revision	Date	Revision Comments
1.0	29/03/13	Review Version
2.0	31/03/13	Final Version

MARCR 2012 – Supporting Documents

Title	Revision #	Revision Date
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1. INTRODUCTION

1.1 Background

Construction activities on the Mining Leases (ML), Miscellaneous Purpose Leases (MPL) and Extractive Mineral Licences (EML) at Jacinth Ambrosia commenced in August 2008 and were completed in September 2009. Mining activities commenced in September 2009 with the pre-stripping of vegetation, topsoil and overburden and the commissioning of the Wet Concentrator Plant (WCP), Tails Storage Facility (TSF), Heavy Mineral Concentrate (HMC) storage area and Mining Unit Plant (MUP). Processing of ore commenced in November 2009. Steady state production has occurred for the whole of 2011. A plan of the Jacinth Ambrosia mine site and infrastructure is presented in Appendix 13.1, Figure 31 and Figure 32.

1.2 Purpose

The purpose of this Mining and Rehabilitation Compliance Report (MARCR) is to meet reporting conditions associated with the granting of mineral tenements and authorisation of activities on these tenements under the *Mining Act 1971*, as identified below.

Specifically, this MARCR addresses compliance with Mining and Rehabilitation Program (MARP) commitments for mining operational activities on the mining leases, miscellaneous purposes licenses and extractive mineral leases:

- ADP 2009/04 - Jacinth-Ambrosia Mining and Rehabilitation Program (MARP) for ML 6315, EML 6316, MPL 110, MPL 111.
- ADP 2008/021 - MARP for Extractive Mineral Leases EML 6325 – 6326, EML 6330 – 6334.

The reporting period is 1st January 2012 to 31st December 2012.

1.3 Report Summary

Iluka implemented and maintained Environmental Management Systems throughout 2012 and supported a wide ranging research program and several community programs to deliver on MARP commitments. Section 2 summarises 2011 mining activity and Section 4 describes the Environmental Management System supporting mining activity to minimise the impacts of operations on environmental, social and heritage aspects. Iluka inducted all personnel and contractors to ensure their environmental obligations for operating at the Jacinth Ambrosia mine site were understood.

Personnel reported **187** environmental incidents relating to flora, fauna, pests, soils, waste, air, quality and compliance. Improved accuracy in reporting and more detailed analysis of incident types and causality was undertaken in the preparation of this report allowing for improved response to and management of environmental issues and impacts. As in previous years fauna-related incidents accounted for the majority of incidents in the reporting period.

Section 5 examines the performance of implemented systems against the outcomes and commitments of the MARP, ADP 2009/04, and ADEP 2008/021. Iluka is compliant with 12/20 ML and MPL MARP outcomes. Four (4) ML/MPL outcomes are yet to be determined including pest plants and animals (x2 outcomes), surface water quality (x2 outcomes) and groundwater (x2 outcomes) and socio-economic (x1 outcome). A comprehensive review and update of the Jacinth MARP (PEPR) in 2013 including re-assessment of outcomes notably pest species and surface water is expected to resolve several of these issues.

As in previous years no discernible trends appear at JA with respect to the abundance or condition of flora, fauna and pest species – monitoring and data collection continues and meaningful analysis will be possible once sufficient data is available. Weed diversity and abundance continue to be addressed through the site weed management program. Prioritised management targets for these are presented in this report.

As in 2011, management activities in 2012 were dominated by the groundwater mounding issue and focussed on the implementation of the groundwater interception and recovery scheme at the off-path TSF. The scheme was commissioned in November 2012 and early data suggests a positive influence and localised drawdown of the mound aquifer. A detailed assessment of system performance, and measures to expand the groundwater interception system, will be communicated in the 2013 MARCR.

The response in mid-2012 to depressed global economic markets required a change in the mining path to pursue low-grade ore, and corresponding requirement to expand on-site HMC storage to allow long-term stockpiling of mineral in response to significantly reduced zircon demand. DMITRE granted approval for an extension of the HMC storage area at JA, but this did not represent an amendment to the MARP.

Seasonal high-wind conditions in late 2012, coinciding with mining clearance to access low grade ore and increased mineral storage, presented issues with wind erosion and dust generation on site. Several key projects are subsequently programmed for 2013 to significantly improve dust management capability on site.

Iluka participated in several community events in 2012 (JA site visits, public festivals) and reached over 450 children through the ‘Talk in Schools’ initiative.

1.4 Exclusions

Compliance reporting for the following documents is excluded from this report and will be reported separately:

- Jacinth-Ambrosia Project Ooldea Road North and Ooldea By-Pass - Rehabilitation Plan, July 2008
- Jacinth-Ambrosia Project Ooldea Road North and Ooldea By-Pass – Environmental Management (Construction) Plan, Appendix A Dust Management Sub-Plan, July 2008, and
- Pre-construction feasibility activities carried out on Exploration Leases.

2. DESCRIPTION OF MINING ACTIVITIES

Name of the mine	Jacinth-Ambrosia
Tenement numbers	ML 6315 EML 6316, 6325, 6326, 6330, 6331, 6332, 6333, 6334, MPL 110, 111
Name of the mine owner and operator	Iluka Resources
Person accepting responsibility for the report	Shane Tilka
Dates of the reporting period for the report	1st January to 31st December 2012

* *ML - Mining Lease, EML - Extractive Mineral Lease, MPL - Miscellaneous Purposes Licence*

2.1 Mining Activities 2012

Mining activities over 2012 consisted of:

- Processing of 9,137kt of ore through the mining unit plant (MUP).
- 8,762.1kt of tailings were placed into the off-path tailings storage facility (TSF) and the first in-pit cell.
- 375kt of heavy mineral concentrate (HMC) was produced, with 210kt transported by truck to the Port of Thevenard and shipped to the processing plant at Narngulu, WA.

Table 1: 2012 Mining Summary – Ore, overburden and heavy mineral concentrate

Material	Tenement	Quantity
Ore (t)	ML 6315	9,137.0
Overburden (BCM)	ML 6315	905.8
HMC (t)	ML 6315	374.9
ModCod Tailing (t)	ML 6315	8,762.1

3. ORE RESERVES AND MINE LIFE

Iluka undertook further edge definition drilling and re-optimised the Jacinth-Ambrosia ore body with updated sales prices during 2012.

At current rates of mining Jacinth has a remaining life of 8.85 years.

Measured, indicated and inferred mineral resources are summarised in Table 2.

Table 2: JA Ore Reserves

EUCLA BASIN MINERAL RESOURCE BREAKDOWN BY DISTRICT, DEPOSIT AND JORC CATEGORY AT 31 DECEMBER 2011

Summary of Mineral Resources (1,2) for Eucla Basin				2011	2011		HM Assemblage(3)		
District	Deposit	Mineral Resource Category	Material Tonnes (Millions)	InSitu HMTonnes (Millions)	HM Grade (%)	Clay Grade (%)	Ilmenite Grade (%)	Zircon Grade (%)	Rutile Grade (%)
East Eucla	Ambrosia	Measured	96.8	2.59	2.7	15	25	50	5
		Indicated	18.6	0.28	1.5	14	21	48	5
		Inferred	27.2	0.39	1.4	13	19	50	5
	Atacama	Inferred	93.0	7.63	8.2	8	69	13	2
	Jacinth	Measured	98.5	4.73	4.8	11	31	49	4
		Indicated	3.8	0.14	3.6	11	20	56	4
		Inferred	1.7	0.06	3.7	6	20	57	4
	Sonoran+	Inferred	30.3	2.21	7.3	8	67	17	2
	Tripitaka	Indicated	58.4	1.05	1.8	15	10	64	5
	Typhoon	Inferred	24.3	1.46	6.0	10	64	13	1
East Eucla	**Measured Total**		**195.3**	**7.32**	**3.7**	**13**	**28**	**49**	**4**
East Eucla	**Indicated Total**		**80.8**	**1.47**	**1.8**	**15**	**13**	**60**	**5**
East Eucla	**Inferred Total**		**176.5**	**11.75**	**6.7**	**9**	**66**	**15**	**2**
East Eucla	**Total**		**452.6**	**20.54**	**4.5**	**12**	**49**	**30**	**3**

Notes:

(1) Mineral Resources are inclusive of Ore Reserves.

(2) Rounding may generate differences in last decimal place.

(3) Mineral assemblage is reported as a percentage of InSitu HM content.

4. REHABILITATION AND ENVIRONMENTAL MANAGEMENT ACTIVITIES

4.1 Iluka Environmental Management Systems

Jacinth Ambrosia implemented and maintained systems for managing and measuring aspects of the environment through 2012. Iluka's EHS Management System (EHSMS) policy outlines twelve corporate standards (Table 3) and their associated procedures, guidelines, forms and training that describe the minimum requirements for all Iluka operations

The Iluka EHSMS and associated programs align with Iluka corporate standards and contribute to monitoring environmental impacts and managing compliance with stated MARP outcomes.

Table 3: Iluka Corporate Standards and Environmental Management System

	Corporate Standards	Policy & Systems
1.	Leadership and Policy	- EHS policy
2.	Organisation and Accountability	- Designated JA environmental personnel
3.	Communication	- Inductions - Intranet
4.	Contractor Management	- Contractor approval process - Inductions
5.	Risk and Hazard Management	- Take two - Job Safety & Environment Assessments
6.	Incident Investigation and Reporting	- Safety & Environment Observations
7.	Emergency and Crisis Preparedness	- Emergency Response Plan
8.	Procedures and Training	- Procedures for key areas - Inductions - Weekly toolbox meeting
9.	Operational Management	- Management plans exist for key areas
10.	Environmental Management	- Environmental Management System in place
11.	Monitoring	- Monitoring of environmental aspects & impacts
12.	Auditing and Assurance	- Internal & external audits - Inspections

4.2 Incident Reporting

Iluka personnel and contractors reported **187** environmental incidents (actual environmental impact) and hazards (potential environmental impact) via the Iluka Lost Control Card (LCC) reporting system in 2012 (Figure 1).

A review of the incidents that occurred in each category is provided in Section 5.0 of this report, as listed in Table 4.

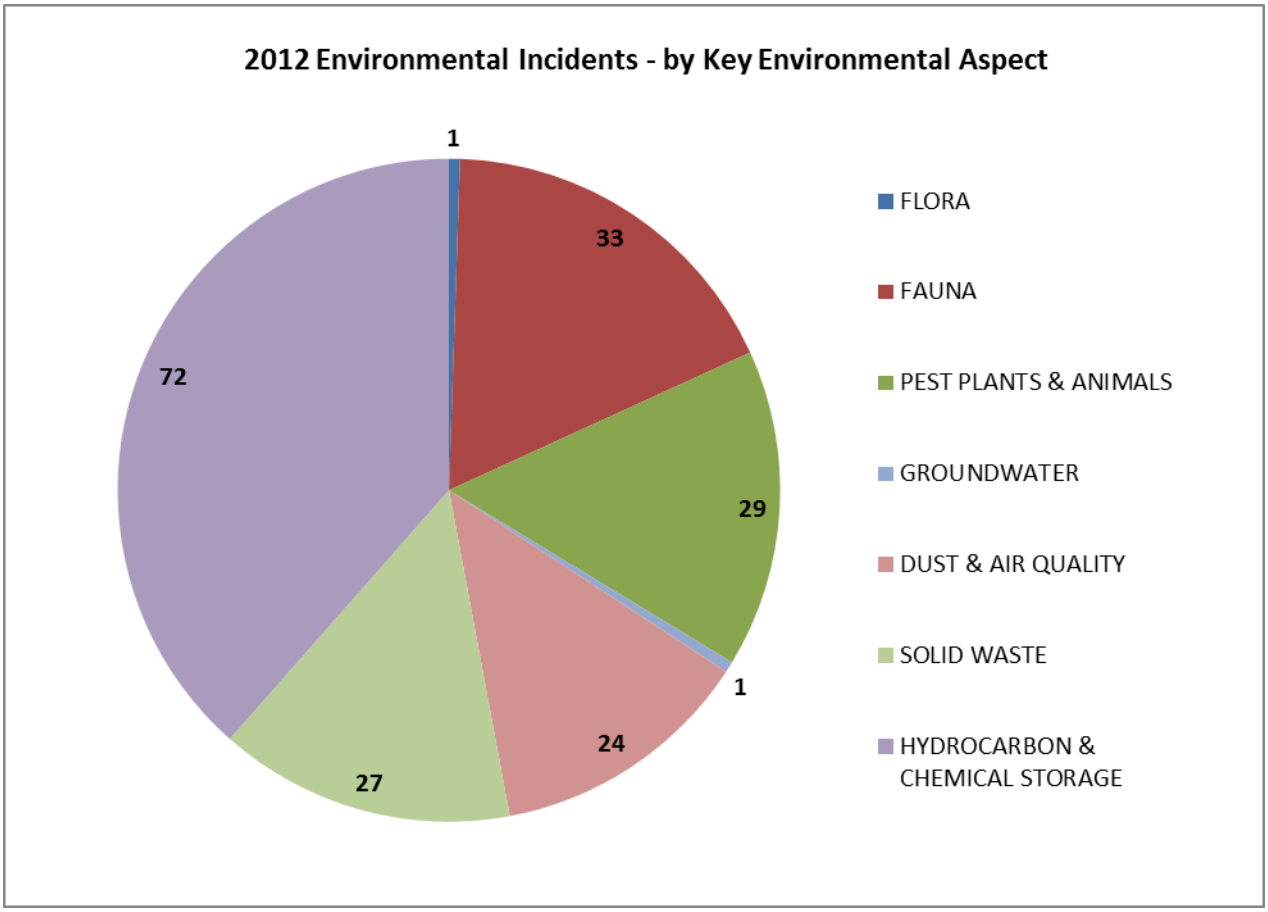


Figure 1 – Environmental incidents reported via LCC, by key environmental aspect

The number of incidents reported in 2012 equals that of 2011, however the following is noted:

- 2011 statistics incorrectly included non-mining related fauna incidents (e.g. public road kill), representing an over-reporting of incidents in the 2011 MARCR;
- 2011 statistics included incidents not relevant to MARP outcomes/criteria (e.g. sightings of non-significant native fauna, asset faults and process improvement suggestions). These were misrepresented as 'incidents' under the LCC system and represented an over-reporting of incidents in the 2011 MARCR;

- 2012 saw an increased awareness on reporting of environmental incidents particularly those concerning soil, dust/air-quality and solid waste.

In summary, actual MARP-related environmental incidents were higher in 2012 than in 2011, a consequence of improved environmental reporting rather than a decline in environmental performance.

Table 4: Summary of environmental incidents (by aspect) and applicable MARCR section

CATEGORY / ENVIRONMENTAL ASPECT	Incidents	MARCR Section
FLORA	1	Section 5.1
FAUNA	33	Section 5.2
PEST PLANTS & ANIMALS	29	Section 5.3
INDIGENOUS / NON-INDIGENOUS HERITAGE	0	Section 5.4
SOIL	0	Section 5.5
SURFACE WATER QUALITY	0	Section 5.6
GROUNDWATER	1	Section 5.7
DUST & AIR QUALITY	24	Section 5.8
SOLID WASTE	27	Section 5.9
HYDROCARBON & CHEMICAL STORAGE	72	Section 5.10
TOTAL ENVIRONMENTAL INCIDENTS	187	

4.3 Rehabilitation Summary

This section presents a summary of 2011 rehabilitation activities and proposed works for 2012. Data is reported by Domain and Sub Domain, as per JA MARP Closure Plan.

- **Domain 1**: Ooldea Rd (not reported through MARCR, figures displayed in this report for record only).
- **Domain 2**: MPL111 Airfield & Village
- **Domain 3**: MPL110 Borefield & Access Rd
- **Domain 4**: ML6315 Mine Site

The disturbed and rehabilitated areas for the MARCR reporting area (Domains 2, 3 & 4) are summarised in Table 5, the locations of which are displayed in Figure 33.

In 2012, a total area of 64.4 ha was cleared and stripped of soil in accordance with the Jacinth Ambrosia Vegetation Removal and Soil Management Procedure, PRC 5061.

Summary 2008 – 2012, Domains 2, 3, 4

Total area disturbed: 621.8 ha. Total area rehabilitated: 10.9 ha.

Table 5: Operations summary table

Domain	2008-2011		2012		2013	
	Previous Reporting Periods		Current Reporting Period		Proposed Next 12 Months	
	Disturbed (ha)	Rehab (ha)	Disturbed (ha)	Rehab (ha)	Disturbed (ha)	Rehab (ha)
Domain 1: Ooldea Rd						
A Borrow Pits	*93.6*	*59.22*	*0*	*0*	*0*	*0*
B Water Points	*2.8*	*0.2*	*0*	*0*	*0*	*2.6*
C Ooldea Rd (actual rd area 155.7 ha)	*0.7*	*0*	*0*	*0*	*0*	*0*
SUBTOTAL	*97.1*	*59.42*	*0*	*0*	*0*	*2.6*
NB: Domain 1, Ooldea Rd data is not reported on within the PEPR. Data displayed here for record only.						
Domain 2: MPL 111 Airfield & Village						
A Airfield	40.1	0	0	0	0	0
B & C Village	10.5	1.7	0	0	0	0
SUBTOTAL	50.6	1.7	0	0	0	0
Domain 3: MPL110 Borefield & Access Rd						
E Tank Farm 1	3.0	0	0	0	0	0
C Turkey's Nests, Bores	10.9	3.8	1.1	0	0	0
F EML's, Borrow Pits	14.2	5.4	0	0	0	0
A, B, D Infrastructure	105.1	0	0	0	0	0
SUBTOTAL	133.2	9.2	1.1	0	0	0
Domain 4: ML6315 Mine Site						
A Jacinth Pit	127.0	0	29.0	0	0	7.5
D Soil Stockpiles	92.2	0	23.7	0	0	0
C Tailings Storage Facility (inc. stockpiles)	108.7	0	0	0	0	0
E, F, G, H Infrastructure	46.4	0	10.2	0	0	0
SUBTOTAL	374.3	0	62.9	0	0	0
Total Area (exc. Domain 1)	**557.9**	**10.9**	**63.9**	**0**	**0**	**7.5**

NB: small areas will vary between domains over the years as the sub domains change, i.e. from in- fill drilling to become pit or haul road to become pit.

4.4 Rehabilitation Progress 2012, Plans 2013

Rehabilitation in 2012 was scheduled to commence for approximately 10 ha of Jacinth Pit Tailing Cell 1. Approximately 7.5 ha were completed to top of overburden, prepared for subsoil and topsoil in 2013. During 2012 J-A received 91.8 mm of annual rainfall, with only 13.6 mm from July to December **(Figure 2**). The extremely low rainfall saw no plant germination in the last half of the year and death of most seedlings that had germinated on the summer rains earlier in February. The huge populations of short lived perennial spear grass that were sustained on above average rainfall since 2009 have now largely died off throughout the Reserve and in the rehabilitated areas. Weed control activities were minimised as a result of the drought.

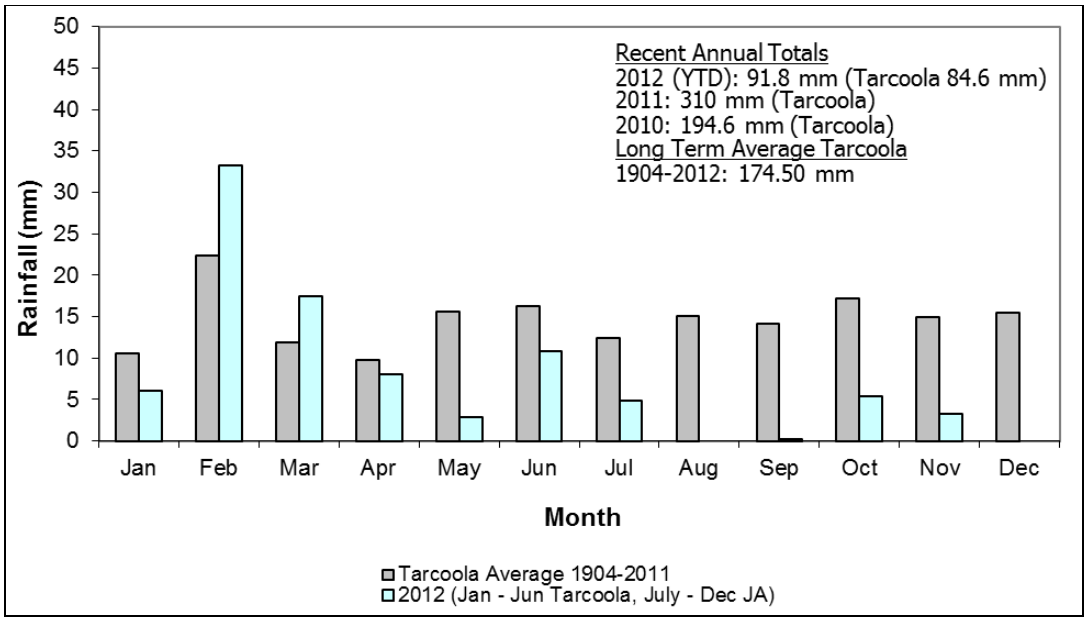


Figure 2 – Average rainfall, Tarcoola 1904-2012 and 2012 annual rainfall Tarcoola and J-A

DOMAIN 2B, Canberra Camp (1.4 ha)

2012 Progress: No germination of natives or weeds, however all remaining plants seeded prolifically. No weed control required. LFA: 2011, 2012, next scheduled 2015, 2020. Photo-point: Figure 3.
2013 Plans: Septic & pipe still to be removed. Weed control if necessary.

DOMAIN 2B, Contractor Camp (1.51 ha)

2012 Progress: No germination of natives or weeds. No weed control required. LFA: not scheduled on this small area. Photo-point: Figure 4.
2013 Plans: Weed control if necessary.

DOMAIN 3E, Tank Farm 1 (3.02 ha)

2012 Progress: No germination of natives or weeds. No weed control required. LFA: 2011, 2012, next scheduled 2015, 2020. Photo-point Figure 5.
2013 Plans: Weed control if necessary.

DOMAIN 3F, Borrow Pit, EML 6325 (2.36 ha)

2012 Progress: No germination of natives or weeds. No weed control required. LFA not scheduled on this area. Photo-point Figure 6
2013 Plans: Weed control if necessary.

DOMAIN 3C, Borefield Turkeys Nests (3.76 ha)

2012 Progress: No germination of natives or weeds. No weed control required. LFA: scheduled for 2012, postponed due to total lack of germination, next scheduled 2013, 2014, 2017, and 2022. Photo-point Figure 7.

2013 Plans: Weed control if necessary. Monitor LFA transects.

DOMAIN 4A, Jacinth Pit, Cell 1 A (10 ha)

2012 Progress: Approximately 11 ha of tailings were reshaped, followed by the application of 0.5 m of capillary break , 3.2 m of red loam and 2.3 m of brown loam, as per the MARP commitments for a Mallee/Myall woodland unit. Studies during 2012 showed that the Mallee/Myall woodland unit does not contain as much sand dune material as required in the MARP soil profile prescriptions for rehabilitation – 2.4 m deep (pg. 22 MARP Rehab Plan, Table 4.1). The same studies also showed that Mallee and other sand related species do not require 2.4 m of sand dune material to germinate and grow. The study findings were applied to the Cell 1 A rehabilitation area and the depth and extent of dune sand was reduced in line with natural occurrence. The brown loam was then raised by a further 2.3 m to meet the MARP total profile depths and within this a 3.5 ha x 1 m deep dune feature was embedded (Figure 8). The study findings and subsequent change to Cell 1 A rehabilitation design were discussed with DMITRE, DENR and EPA representatives during the October 24 site visit. The wider J-A Rehabilitation plan will be updated with this new information during the 2013 MARP review and PEPR update.

Designs and budget were submitted to apply subsoil and topsoil to Cell 1 A and begin overburden return on Cell 1 B, the western 10 ha of Cell 1 in 2013/2014. Overburden to Cell 1 B is pending tails filling with sand stacking.

2013 Plans: Apply subsoil and topsoil to Cell 1 A. Reshape sand stacked tailings on 10 ha of Cell 1B, apply capillary break, red loam, brown loam and dune sand. Subsoil and topsoil in Cell 1 B are to be applied prior to winter 2014.

C20NW 2009

CN20NW 2012

Figure 3 – Canberra Camp photo-point, pre (left) and post (right) rehabilitation

Lucas Camp 2010

Lucas Camp 2012

Figure 4 – Lucas Camp photo-point, pre (left) and post (right) rehabilitation

AR65W 20090303

AR65W 20130224

Figure 5 – Tank Farm 1 photo-point, pre (left) and post (right) rehabilitation

Cal NW 20090414

Cal NW 20130224

Figure 6 – Calcrete Borrow Pit photo-point, pre (left) and post (right) rehabilitation

TN03 20100926

TN03 20130225

Figure 7 – Borefield Turkey's Nests photo-point, pre (left) and post (right) rehabilitation

Pit05W 20090427

Jacinth pit - prior to disturbance

Cell1SW 20110318

Jacinth pit – pre-tailing

Pit09SW 20110318

Jacinth pit – post-tailing

Pit09WW 20120210

Jacinth pit – reshaping drained tailings.

Pit09SW 20120705

Jacinth pit – top of red loam surface

Pit09SW 20121229

Jacinth pit – top of brown loam, dune LHS.

Figure 8 – Jacinth Pit photo-point; Cell 1 A rehabilitation area.

4.5 Seed Collection Program

The JA Native Seed Store now houses a collection of 65 species from 20 families (Table 6). Due to the 2012 drought conditions native seed was scarce in the undisturbed areas of the mine lease where collections have traditionally been made. Some collection was possible from roadsides, vegetation strips between camp buildings (received more run off) and regenerating areas such as soil stockpiles. A few Pearl Bluebush (*Maireana sedifolia*) set viable seed for the first time since J-A commenced in 2009. A small collection of this seed is now secured.

As in all previous years, seed was collected with support from casual indigenous employees from Ceduna and surrounding communities. The Seed Store was comprehensively catalogued and the 2012 collection was cleaned and stored by Keli Payne (Figure 9). Keli is an Eyre Peninsula local who worked at J-A as a casual between University of Adelaide semesters during 2012 whilst completing her First Class Honours Degree.

Figure 9 – Keli Payne updating the Jacinth Ambrosia Native Seed Store.

Table 6: JA seed collection program, species collected

Family	Genus	Species	2009	2010	2011	2012
Aizoacea	*Tetragonia*	*eremaea*	*	-	-	-
Amaranthaceae	*Ptilotus*	*obovatus*	*	-	*	*
	Ptilotus	*exaltus*	-	-	*	-
Asclepiadaceae	*Marsdenia*	*australis*	-	-	*	-
Casuarinaceae	*Casuarina*	*pauper*	-	-	-	*
Chenopodiaceae	*Atriplex*	*vesicaria*	*	*	*	*
	Chenopodium	*curvispicatum*	-	-	*	*
	Enchyaleana	*tomentosa*	-	*	-	*
	Eriochiton	*sclerolaenoides*	*	*	*	*
	Maireana	*erioclada*	*	*	*	*
	Maireana	*integra*	*	*	*	-
	Maireana	*pentatropis*	*	*	-	*
	Maireana	*radiata*	-	*	*	*
	Maireana	*sedifolia*	-	-	-	*
	Maireana	*trichoptera*	*	*	*	-
	Maireana	*turbinata*	*	*	*	*
	Rhagodia	*parabolica*	*	-	-	*
	Rhagodia	*spinescens*	*	-	-	*
	Salsola	*tragus*	*	-	-	*
	Sarcocornia	*species*	*	-	*	*
	Scleroleana	*obliquicuspis*	-	*	-	-
	Scleroleana	*patenticuspis*	*	*	*	*
Compositae	*Brachyscome*	*ciliaris var. ciliaris*	*	-	-	-
	Cephalipterum	*drummondii*	*	*	-	-
	Cratystylis	*conocephala*	*	-	-	*
	Pycnosorus	*pleiocephala*	*	-	-	-
	Rhodanthe	*floribunda*	*	-	-	-
	Vittadinnia	*cervicularis*	*	*	-	*
Cruciferae	*Lepidium*	*phlebopetalum*	*	-	-	-
	Arabidella	*glaucescens?*	-	*	-	-
Frankeniaceae	*Frankenia*	*species*	*	*	*	-
Goodeniaceae	*Goodenia*	*pinnatifida*	*	-	-	-
Gramineae	*Austrodanthonia*	*caespitosa*	*	*	*	*
	Austrostipa	*platychaeta*	*	*	*	-
	Austrostipa	*eremophila*	*	*	*	-

Family	Genus	Species	2009	2010	2011	2012
	Austrostipa	*nitida*	*	*	*	-
	Eragrostis	*falcata*	*	-	-	-
Leguminoseae	*Acacia*	*ligulata*	-	-	*	-
	Acacia	*oswaldii*	-	-	*	-
	Acacia	*papyrocarpa*	*	*	*	*
	Glycine	*sp*	-	-	-	*
	Senna	*artemisioides ssp. coriacea*	*	-	*	-
	Senna	*artemisioides ssp. petiolaris*	-	-	*	*
	Senna	*cardiosperma ssp. gawlerensis*	*	-	-	-
Malvaceae	*Radyera*	*farragei*	*	-	-	-
Myoporaceae	*Eremophila*	*latrobei ssp. glabra*	*	-	-	-
	Eremophila	*alternifolia*	-	-	*	-
	Myoporum	*platycarpum*	-	-	*	-
Myrtaceae	*Eucalyptus*	*oleosa ssp ampliata*	*	-	-	-
	Eucalyptus	*gracilis*	-	-	-	*
	Melaleuca	*interioris*	-	-	-	*
Santalaceae	*Santalum*	*acuminatum*	*	-	-	-
	Santalum	*spicatum*	*	-	-	-
Sapindaceae	*Alectryon*	*oleifolius*	-	-	-	*
	Dodonaea	*viscosa ssp. angustissima*	*	-	*	-
	Duboisia	*hopwoodii*	-	-	-	*
Zygophyllaceae	*Zygophyllum*	*apiculatum*	-	-	*	-
	Zygophyllum	*aurantiacum ssp aurantiacum*	*	*	*	*
	Zygophyllum	*eremaeum*	*	*	*	-
	Zygophyllum	*ovatum*	*	*	*	-

4.6 Rehabilitation Research and Monitoring Programs

These programs have been developed to address the priority issues identified from the JA rehabilitation research planning exercise conducted in 2009 and include issues that have been identified as operations have progressed. Projects are grouped into categories with a major aim and each project is described using title, type of work, collaborators and progress (Figure 10).

Progress from all projects will be updated in the 2012/2013 J-A Research and Monitoring Summary (JARMS), scheduled for March 2013. Detailed progress reports are currently available for selected projects where stated.

The research highlight for 2012 was the successful University of Adelaide and Iluka bid for an Australian Research Council Linkage Project, detailed in relevant sections below.

4.6.1 Salinity Migration

AIMS: to understand the potential extent and impact of saline water upward migration and lateral and downward seepage from mining tails.

- **Potential for salt migration from tailings (consultancy)**

  SRK Consulting, Douglas Partners, Iluka Resources

  Progress: Phase 1 complete and reported in JARMS 2011. Modelling suggests capillary break not required. Field verification activities scheduled for 2012 were postponed due to impending change of tailing method to sand stacking and 30% higher fine ModCod. The two new tailings streams will be assessed using the same modelling approach after samples of tailings stream become available 2013. Field verification treatments are included in the field trial below.

- **Water and salt movement in ModCod (JA field experiment)**

  Iluka Resources, University of Adelaide

  Progress: Trial tailings base established in 2012 adjacent to Cell 1 A rehabilitation area. Treatments scheduled to be applied and monitoring instrumentation installed in March 2013.

- **Potential effect of saline water seepage on deep rooted vegetation (JA field monitoring)**

  Iluka Resources

  Progress: Transects established March 2011 and monitored extensively over 2012 and reported in JARMS 2011. Most of the Cell 1 transects were consumed in the mine path during 2012 hence no further monitoring possible. TSF transects for Myall trees continue to be monitored once per year.

4.6.2 Soil Management

AIMS: to regularly assess the quantity and quality of soil material available for rehabilitation and thereby maximise its contribution to the creation of sustainable landscapes.

- **Soil tracking and condition monitoring (JA survey)**

  Iluka Resources

  Progress: GIS database of in-situ and stockpile locations and soil type, annual condition monitoring, reported in JARMS 2011. Monitoring continues.

- **Comparison of in-situ and disturbed soil characteristics and how these will impact rehabilitation outcomes (JA field experiments and surveys)**

  ARC Grant, University of Adelaide, Iluka Resources

  Progress: Incorporated into ARC grant, field work to begin in 2013.

- **Rehabilitation soil resource balance (Annual JA planning activity)**

  Iluka Resources, JA Mine Engineers & Survey, Perth Closure Planning Group

  Progress: Initial modelling included in MARP rehab plan, first review scheduled in April 2011, postponed until early 2013 due to mine schedule changes. Any changes or new information will be included as part of the 2013 MARP update into a PEPR document.

- **Stabilisation of process water dam wall (JA field experiment)**

  Iluka Resources

  Progress: Experiment implemented April 2011 to assess steep slope water erosion control methods, progress reported in JARMS 2011. No additional vegetation growth or water erosion on any treatment due to 2012 drought.

- **Categorising sand dune soils and vegetation to improve rehabilitation outcomes for this landscape type (JA field surveys).**

  Iluka Resources

  Progress: Four dunes exist in Jacinth pit. One study is finished and the other three are all partially complete. Interim report available.

- **Categorising Jacinth and Ambrosia catchments and designing surface water management structures (Consultancy).**

  Iluka Resources and Consultants

  Progress: Delayed until early 2013. Background material available upon request, 'Jacinth Ambrosia Catchment Mining Rehabilitation Planning', S Doudle, R Eckert (Iluka).

4.6.3 Landscape Design

AIMS: to investigate key components of in-situ landscape arrangements from landscape to micro-topography level, to create sustainable rehabilitation landforms.

- **Landscape Function Analysis (JA site surveys)**

  Iluka Resources

  Progress: Surveys conducted 2010 and 2011 on analogue and rehabilitation areas and to assess Chenopod and Mallee landscape arrangements, reported in JARMS 2011. Lack of vegetative growth due to drought prevented new LFA transects from being monitored in 2012.

4.6.4 Vegetation Water Use

AIMS: to investigate the water requirements and survival strategies of key JA vegetation types and match these requirements to rehabilitated soil profiles in order to create sustainable vegetation associations.

- **Root mapping of JA vegetation (JA field survey)**
- **What is the minimum soil profile depth and characteristics to sustain Western Myall and their associated plant communities? (JA field experiments and surveys)**

  ARC Grant, University of Adelaide, Iluka Resources

  Progress: Field mapping of tree root types, depths, locations and soil types began in 2010 and continued through 2011, progress reported in JARMS 2011. Progress available upon request: “Root distribution and salinity and soil water dynamics in a chenopod shrubland: implication for restoration ecology. Summary report, January – September 2012”.

4.6.5 Vegetation Salt Tolerance

AIMS: to investigate the actual tolerance to soil salinity of JA vegetation species at various life stages.

- **Effect of saline tailings on Myall (J-A field experiment)**

  ARC Grant, University of Adelaide, Iluka Resources

  Progress: Blue drum trial established progress report in JARMS 2011. Measurements continued in 2012.

- **Seed germination of five arid plant species under salinity and water stress (PhD – 1 chapter)**

  Botanic Gardens of Adelaide, University of Adelaide, Iluka Resources.

  Progress: PhD published, available upon request, ‘Soil seed banks and vegetation dynamics in Western Myall Open Woodland’, Dr Emma Steggles.

- **Tolerance of JA vegetation to salinity, germination & seedling stage (BG glasshouse experiment)**

Botanic Gardens of Adelaide, Iluka Resources

Progress: 3 year project, established in Feb 2011, progress report in JARMS 2011. Progress reports available upon request, 'Restoration Technology Project', Dr Jenny Guerin. Project finishes June 2013, final report and fact sheets due Sept 2013. New project in planning.

- **Tolerance of JA vegetation to salinity, germination & seedling stage (Honours Degree. Field survey)**

  University of Adelaide

  Progress: Honours thesis complete (1st Class). Report available upon request, 'Salinity effects on germination and seedling growth of key species in a chenopod shrubland', Keli Payne.

  Iluka Resources

  Progress: Alternative research area prepared at process plant in June 2011, seeding postponed until resources available.

- **Tolerance of JA vegetation to salinity, mature stage (JA field surveys)**

  Iluka Resources

  Progress: Opportunistic soil and vegetation health measurements on areas affected by saline water spillage. Progress reported in several reports in JARMS 2011, various. Data continued to be collected during 2012.

- **Tolerance to saline 'slime' coating for dust control (JA field experiment)**

  Iluka Resources

  Progress: 2010 trial report in JARMS 2011. New trial proposed, no progress in 2012.

- **Does saline water runoff affect vegetation along Ooldea Road? (field survey)**

  Iluka Resources

  Progress: Finished. 2010 report in JARMS 2011.

4.6.6 Biological Soil Crust (BSC)

AIMS: to determine the extent and function of BSC at JA and their potential for use as an initial rehabilitation resource.

- **Biological soil crusts at the Jacinth-Ambrosia Mine: can they be used to improve ecosystem rehabilitation outcomes? (Honours)**

  University of Queensland, Iluka Resources

  Progress: Honours Thesis complete, reported in JARMS 2011.

- **Influence of biological soil crust and seedling emergence and seed germination (PhD – 1 chapter)**

  Botanic Gardens of Adelaide, University of Adelaide, Iluka Resources.

Progress: PhD published, available upon request, 'Soil seed banks and vegetation dynamics in Western Myall Open Woodland', Dr Emma Steggles.

- **BSC re-establishment from topsoil scalping (JA mini field trial)**

  Iluka Resources, University of Queensland

  Progress: No progress in 2012, rescheduled to a treatment in Cell 1 trial for 2013.

- **BSC re-establishment from cyanobacteria culture (JA glasshouse experiments)**

  University of Queensland, Iluka Resources

  Progress: Project finished. Final report available upon request, 'Jacinth-Ambrosia - Characterisation and Growth of Cyanobacteria from Intact and Disturbed Biocrusts', Dr Wendy Williams.

- **BSC longevity in soil stockpiles (JA field survey, UQ lab experiments)**

  University of Queensland, Iluka Resources

  Progress: Project finished. Final report available upon request, 'Activity of cyanobacteria in topsoil stockpiles of varying ages at the Jacinth Ambrosia mine site', Dr Melanie Schneemilch. Post doc with UQ pending.

- **Influence of BSC on plant germination (UQ lab experiments, proposal)**

  University of Queensland, Iluka Resources

  Progress: Experiment unsuccessful, further work postponed until Post Doc secured. Interim report available upon request, 'Determination of the influence of Biological Soil Crusts (BSC's) on seedling emergence in plant species native to the Jacinth-Ambrosia mine region' Dr Melanie Schneemilch. Post doc with UQ pending.

4.6.7 Seed Ecology and Soil Seed Banks

AIM: to investigate and catalogue plant seed ecology of J-A species.

AIM: to investigate the behaviour of native seeds in both in-situ and soil stockpile situations to guide rehabilitation topsoil replacement and direct seeding strategies and rehabilitation outcome monitoring.

- **Species phenology, seed embryo types, overcoming seed dormancy (Post Doc, JA field and BG lab experiments).**

  Botanic Gardens of Adelaide, University of Adelaide, Iluka Resources.

  Progress: Post Doc completed, report available upon request, 'Investigating seed ecology dynamics of plant species native to the Jacinth/Ambrosia mineral sands deposit', Dr Leanne Pound.

- **Investigating soil seed banks in *Acacia papyrocarpa* woodland. Physiological seed dormancy of three species of *Enneapogon* (PhD, JA field and BG lab experiments))**

  Botanic Gardens of Adelaide, University of Adelaide, Iluka Resources.

  Progress: PhD published, available upon request, 'Soil seed banks and vegetation dynamics in Western Myall Open Woodland', Dr Emma Steggles.

- **Viability testing, germination screening, longevity assessments, seed and seedling images (BG lab experiments)**

  Botanic Gardens of Adelaide, Iluka Resources.

  Progress: 3 year project, established in Feb 2011, progress report in JARMS 2011. Progress reports available upon request, 'Restoration Technology Project', Dr Jenny Guerin. Project finishes June 2013, final report and fact sheets due Sept 2013. New project in planning.

- **Regeneration on soil stockpiles (JA field monitoring).**

  Iluka Resources

  Progress: Annual data collection & analysis continuing, reported in JARMS 2011.

4.6.8 Vegetation Characteristics – Other

AIMS: to provide a responsive research program to address issues of importance to future JA rehabilitation outcomes.

- ***Atriplex vesicaria* dieback on Nullarbor Plain (JA field investigation)**

  Iluka Resources

  Progress: borer activity identified & insect samples collected, initial helicopter survey conducted. DENR & UA offers of assistance to investigate in 2011. Mini report in JARMS 2011. No progress in 2012.

- **Effect of dust smothering on *Maireana sedifolia* (JA field monitoring)**

  Iluka Resources

  Progress: Progress report in JARMS 2011. Monitoring continues.

- **Growing bullock bush from root shoots (JA field investigation)**

  Iluka Resources

  Progress: Mini report postponed.

- **Tolerance of native vegetation to relocation (JA field investigation)**

  Iluka Resources

  Progress: Mini report postponed.

- **Aging JA Myall communities (JA field survey)**

  ARC Grant, University of Adelaide, Iluka Resources

  Progress: 1st set of vertical tree samples collected and sent to U of A for analysis. No progress in 2012.

Keli Payne (UofA), Dr Jenny Guerin (BG), Sam Doudle (Iluka), Dr Emma Steggles (UofA), research update in Adelaide.

Dr Jenny Guerin (BG), Sam Doudle (Iluka) assessing seed for the 2012 Botanic Garden Restoration Technology Project.

Dr Emma Steggles (UofA), Dr Melanie Schneemilch (UQ), Angela Chilton (UNSW) and Con Miller (Iluka) collecting soil samples at JA for the UQ BSC project.

Shane Doudle (Iluka) using an air spade to expose roots for mapping at J-A, ARC Linkage project.

Shane and Sam Doudle (Iluka) sampling soil pits for the dune study.

Sap flow meters and deep root species identification, ARC grant.

Figure 10 – Selection of photos from the 2012 J-A research and monitoring programs

5. COMPLIANCE WITH OUTCOMES

This section reports on compliance against the lease conditions and the environmental and socio-economic outcomes prescribed in the Mining and Rehabilitation Plan (MARP). Each section describes the measurement criteria and provides a summary of the data supporting the compliance statement.

Selected raw data is supplied in the Appendices, and where not supplied can be made available upon request.

5.1 Flora

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
All clearance of native vegetation is authorised under appropriate legislation.	Demonstrate that actual clearance boundaries are within authorised clearance boundaries (output from GIS).	Annual Biological Survey – Monitor changes in abundance, composition or condition against control sites or background data to identify changes outside approved clearance boundaries. Visual observation (during clearing activities) to ensure clearance boundaries are maintained. Visual observation (as required – e.g. in event of a spill) to ensure clearance boundaries are maintained.	Compliant
No uncontrolled fires caused by mining operations.	Demonstrate that actual clearance boundaries are within authorised clearance boundaries (output from GIS).	Annual Biological Survey – as above. Visual observation (as required – e.g. in event of a fire) to ensure clearance boundaries are maintained.	Compliant

5.1.1 Measurement of compliance

1) ***Clearance within authorised boundaries***: Iluka reconcile survey clearance data with an aerial photograph and calculate the difference between clearances permitted through the Vegetation Clearance Procedure and actual clearance as a measure of compliance to procedures.

2) ***Uncontrolled fires***: Iluka use the Loss Control Card reporting system to record incidents of uncontrolled fire.

3) ***Incident Reporting***: Iluka personnel report flora related incident through the Loss Control Card reporting system.

4) ***Flora Monitoring***: Iluka via contractor Ecological and Biodiversity Services (EBS Ecology) conduct annual flora surveys to determine the effects of operations on flora for three community types (Mallee, Chenopod and Myall).

5.1.2 Summary of key measurements

5.1.2.1 Clearance within authorised boundaries 2012

There were zero breaches of the Iluka Vegetation Clearance Procedure in 2012. Authorised clearance permits totaled 72.07 Ha, with actual clearance of 63.90 Ha (Table 7). The bulk of vegetation clearance in 2012 was associated with the change in mining path and pursuit of low grade ore in response to market conditions.

The objectives of the clearance procedure ensured that in 2012:

- Vegetation clearances occurred within authorised clearance boundaries;
- All vegetation clearance was authorised internally through the Vegetation Clearance permit system;
- Vegetation clearance records were maintained.

The total clearance at Jacinth for the four (4) year period to 2012 is 665.62 Ha, approximately 44 Ha less than the clearance endorsed through the Jacinth Vegetation Clearance Permit System.

All vegetation clearance for 2012 occurred in Domain 4 within authorised clearance boundaries.

Table 7: Vegetation Clearance (Permitted vs. Actual), 2008 - 2012

	Area Cleared (ha)		
	2008 - 2011	**2012**	**TOTAL**
Vegetation Clearance Permits (Ha)	593.55	72.07	**665.62**
Actual Disturbance (Ha)	557.90	63.90	**621.80**
Difference, Permitted vs. Actual (Ha)	**(35.65)**	**(8.17)**	**(43.82)**

5.1.2.2 Uncontrolled fires

Iluka report no uncontrolled fires resulting from mining operations for 2012.

Several wildfires occurred beyond the boundary of the mining lease in late 2012, reported to DEWNR and the Country Fire Service (CFS) in accordance with agreed communication procedures. These fires were not linked to mining operations.

5.1.2.3 Incident Reporting – Flora

Iluka personnel reported one (1) flora related incident for the reporting period (Appendix 13.2, Table 18) associated with vehicle damage to a sandalwood tree at the Jacinth village. Protection for this sandalwood tree has been upgraded to prevent reoccurrence.

5.1.2.4 Flora Surveys 2012

Iluka contracted EBS to conduct an annual flora monitoring program at Jacinth since 2009, with the aim of establishing an accurate understanding of the impacts of mine operation on native vegetation. Data from control sites (> 5km from the impact zone surrounding the mine) and impact sites will be used to determine trends in flora diversity and abundance. The program also aims to assist future rehabilitation work by developing an understanding of typical vegetation community structures and compositions and how these respond over a range of seasonal conditions. The survey team employs methods outlined in the *Guide to the Native Vegetation Survey Using the Biological Survey of South Australia* (EBS 2013).

As discussed in MARCR 2009, long-term monitoring requires multiple datasets (usually 3–5 years) to detect environmental change. As in previous years, the 2012 flora survey cannot be used to draw definitive conclusions about potential indirect impacts of mining activities on vegetation at Jacinth as distinguished from environmental factors such as seasonal variation and rainfall patterns. Several datasets are required for meaningful assessment and analysis of possible trends and impacts. EBS Ecology indicated in their 2010 report that statistically valid models are likely unavailable until at least post-2013 (EBS 2013).

The 2012 field survey was conducted from 13th – 23rd November (report available upon request). Highlights of the survey included:

- Rainfall diminished in the period from the start of April 2012 through until the current survey period, with only 18.4 mm of rain being recorded in this time. This is the likely cause of the desiccation of shallow rooted annual species and the continued growth of semi-woody biennial and perennial species observed during the 2012 survey. Competition from long-lived perennial species reduced the ability of herbaceous annual species to persist throughout this period;
- Overall, the health of perennial vegetation was considered to be in good condition. Most species had finished flowering at the time of the survey. Natural dust cover on vegetation was evident throughout the wider area and there was a general sense of the need for a good rain to wash the dust off vegetation and freshen the soil profile. This is highlighted by the low rainfall totals in the lead up to the survey and was not expected to cause long term negative health impacts.
- **Species Richness**: Species richness totals for Chenopod, Myall and Mallee sites (both Impact and Control sites) have reduced from 2011, however the trends for Control and Impact sites were very similar. This trend suggests a response to decreased rainfall in 2012 compared to the more favourable seasons in 2010/2011.

Overall trends for species richness have, however, remained consistent over the four year survey period;

- **Abundance**: Abundance of perennial species has dropped from 2009 but not significantly. This may be due to a lack of recruitment from species such as *Atriplex vesicaria* (Bladder Saltbush) or the loss of the shorter lived perennial species such as *Sclerolaena diacantha* (Grey Copperburr) following a growth flush;
- **Community structure and composition**: The drier conditions have presented a community composition that is representative of the base long term vegetation structure for the area;
- **Threatened species**: no species of conservation significance were recorded during the 2012 survey;
- **Alien Species**: no alien species were recorded in the 2012 survey

5.2 Fauna

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
There are no net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.	Fauna diversity and abundance trends to be consistent with impact zone expectations (as per the *Fauna Management Plan*). Fauna recovery during habitat re-establishment post closure to be consistent with baseline data and control site trends (as per the *Fauna Management Plan*)	Annual Biological Survey – Monitor fauna distribution (numbers and species) in lease and surrounding areas per the *Fauna Management Plan*. For each identified impact zone: Habitat assemblage, fauna species likely to occur, feral animals, linkages between fauna and vegetation communities. Visual observation – Significant fauna sightings on site and occurrence of injured or dead fauna.	Compliant
All sick and injured fauna must be managed as per the requirements of the Prevention of Cruelty to Animals (Animal Welfare) Act 1985.	Records indicating compliance with the requirements of the Prevention of Cruelty to Animals (Animal Welfare) Act and Regulations Demonstrated that fauna management procedures are consistent with the Act	Visual observation – Significant fauna sightings on site and occurrence of injured or dead fauna.	Compliant

5.2.1 Measurement of compliance

1) ***Fauna Diversity and Abundance:*** Iluka conducted the annual biological fauna survey in November 2012 to determine the effects of mining operations on fauna. Trends in fauna diversity, abundance and recovery cannot be determined based on current data.

2) ***Fauna Management and Welfare***: In accordance with the Jacinth MARP *Fauna Management Plan* and Procedure Iluka maintained records of all fauna fatalities, injuries, relocations, rescues and interactions using the LCC system to demonstrate compliance with the *Prevention of Cruelty to Animals (Animal Welfare) Act*.

   Further, Iluka recorded all observations of significant fauna in the JA Fauna Sightings Register.

5.2.2 Summary of key measurements

5.2.2.1 Fauna Diversity, Abundance and Recovery – EBS Fauna Surveys

Iluka have contracted EBS Ecology since 2009 to conduct annual fauna monitoring surveys at JA. This monitoring aims to assess the potential impact of mine construction and operation on local fauna populations, and to generate a dataset to assist the generation of mine closure criteria. Data from control sites (> 5km from the impact

zone surrounding the mine) and impact sites will be used to determine trends in the abundance of the species present, and classify which species can be considered permanent residents, and which species can be considered transients. An additional aim of the program is to document typical fauna community structures, including species diversity, community composition, and habitat requirements of fauna, to assist rehabilitation work programs.

As discussed in previous reports, Iluka view this outcome as one aimed at fauna recovery following cessation of mining activities. Further data is required to allow for robust statistical analysis; therefore existing data and results alluding to the effects of mining impacts on fauna populations are also likely to be heavily confounded by season and general trap-capture variations. Consequently, data analysis and interpretation of results cannot be specifically related back to mining operations. As this dataset grows data variations will decrease, allowing for improved detection of natural trends in trap-captures and seasonal climatic variation and ability to distinguish between mining and non-mining related impacts. Meaningful and statistically valid modelling will not be possible until at least post-2013 (EBS Ecology, 2013).

The 2012 field survey was conducted from 13th – 23rd November targeting mammals, reptiles, birds and invertebrates. The survey followed standardised techniques at eight established trapping, bat and bird sites, four additional bird survey sites, four additional bat sites and four spotlighting sites. A copy of the EBS report is available on request.

Due to the preliminary nature of this work only species diversity summaries are presented as highlights from the 2012 survey:

- At the time of the survey all sites were considered to be in relatively poor condition, which can be relatively confidently attributed to low rainfall leading up to the survey. Rainfall in the 12 months prior to the survey (1st November 2011 – 1st November 2012) was significantly lower than observed before the 2011 survey (125mm and 279mm, respectively);
- **Terrestrial Mammals**: Seven native and three exotic terrestrial mammal species representing nine families were recorded during the November 2012 survey, either through captures or direct observations;
- **Bats**: Five bat species were recorded with certainty due to distinguishable calls on the Anabat;
- **Reptiles**: Thirty-four reptile species representing nine families were caught or observed during the November 2012 monitoring survey, predominantly skinks and gecko species. No reptile species of national or state conservation significance were recorded;
- **Birds**: Forty-seven native bird species representing 23 families, and no exotic species, were recorded during the November 2012 survey through survey observations, spotlight observations and opportune observations. Honeyeaters and Field Wrens showed the most diversity. Four species not previously recorded during the monitoring program were observed during the spring survey - Grey Currawong (*Strepera versicolor),* Australian Barn Owl (*Tyto delicatula*), Great Cormorant (*Phalacrocorax carbo*) and the Brown-headed Honeyeater *(Melithreptus brevirostris).* One species of conservation significance was recorded

during the current survey, the nationally vulnerable and State rare Slender-billed Thornbill (*Acanthiza iredalei iredalei*). One migratory species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the Rainbow Bee-eater (*Merops ornatus*) was observed.

- **Invertebrates**: Over 2,150 invertebrate specimens collected during the November 2012 survey were identified to an appropriate level. This number is slightly higher than the 1,200+ specimens collected during the November/December 2011 survey.

5.2.2.2 Animal Welfare

In accordance with the Jacinth MARP Fauna Management Plan and *Prevention of Cruelty to Animals (Animal Welfare) Act*, Iluka maintained a record of all fauna fatalities, injuries, relocations, rescues and interactions during the reporting period using the Iluka sing the LCC system.

Incidents involving sick/injured/at-risk fauna during the reporting period that invoked fauna welfare procedures included:

- Rescue and release of dingos and birds from trapped in process water areas (several events);
- Dingo hit by mining haul truck and suffering extensive injuries – dingo euthanized in accordance with the JA Fauna Management Procedure and *Animal Welfare Act* by means of a quick blow to the head to immediately render the animal insensible to continued pain and distress. Notification sent to DEWNR.
- Iluka Contractor feeding dingo – non-compliance with *Parks & Wildlife Act*. Contractor dismissed from site; Site Notice distributed and signs installed concerning prohibitions on feeding dingos (Figure 11).

A summary of relevant LCC incident records is provided in (Appendix 13.2, Table 19). Full copies of incident reports can be made available on request.

A review of fauna euthanasia options (e.g. firearms, lethal injection, other) will be undertaken as part of the MARP review in 2013. This review will seek to ensure processes for animal euthanasia meet animal welfare best practice.

Figure 11 – Dingo 'no feeding' prohibition signs

5.2.2.3 Significant Fauna Observations

Two opportunistic sightings of significant fauna occurred in the reporting period, both involving the Australian Bustard (*Ardeotis australis).* Both observations involved healthy individuals in proximity to the mining area.

EBS Ecology recorded two observations of significant fauna during the November 2012 flora survey – the nationally vulnerable and State rare Slender-billed Thornbill (*Acanthiza iredalei iredalei*) and one migratory species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the Rainbow Bee-eater (*Merops ornatus*).

5.2.2.4 Incident Reporting

Iluka personnel and contractors reported **33** native-fauna incidents linked to mining operations in 2012 (Figure 12). These incidents covered interactions within the mine area, village, borefield, Ooldea Rd and other areas within the boundaries of the Iluka ML, MPL and EML's.

The number of fauna incidents is significantly less than the 101 incidents reported in 2011:

- 2011 statistics incorrectly included non-mining related fauna incidents (e.g. public road kill);
- 2011 was a significant year for Iluka with respect to mineral sand sales. Road kill trends in 2011 reflected increased mineral haulage during this period;
- Conversely, mineral haulage ceased during the latter half of 2012 following a downturn in the mineral sands market, with a matching decrease in road kill;

- Observations of *non*-significant fauna – misrepresented as fauna 'incidents' under the LCC system – and not involving fauna harm, are omitted from the statistics presented within this report.

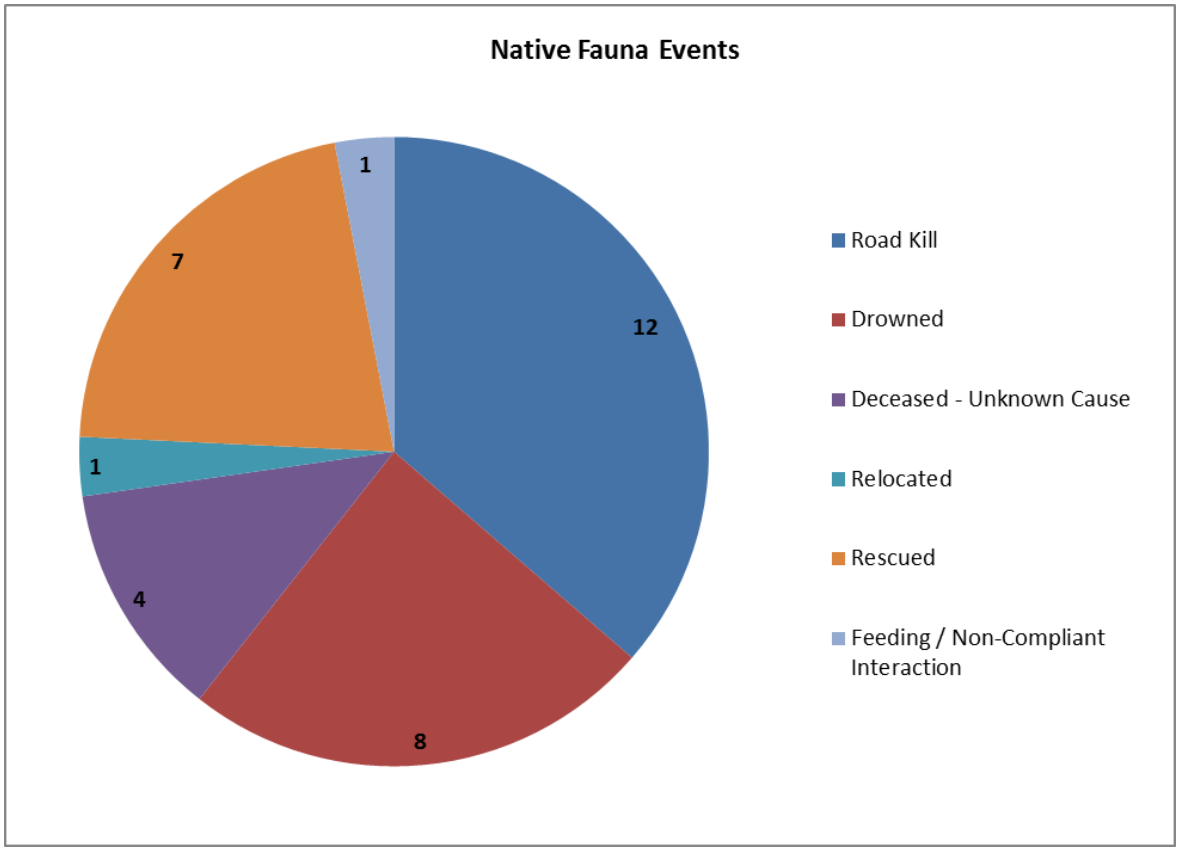


Figure 12 – Fauna incidents by type, as reported via Lost Control Cards in 2012

With respect to 2012 fauna incidents:

- As in previous years, road kill represented the greatest impact to fauna and mostly involving wombats.
- Drowning events declined in 2012, down 38% from 2011. This is attributed to fencing upgrades and other activities completed in 2012:
    - Addition of chicken wire to existing cyclone fencing around process water dams;
    - Installation of gate self-closing mechanisms to mitigate issues with fauna access to water bodies through gates left open;
    - Ongoing repairs to electric fencing;
    - Installation of additional fauna escape matting;
    - Implementation of a daily borefield and bore-line inspection including checks of Turkey Nests;

- Daily inspection of village and mine-site wastewater treatment plants (tanks and ponds) and fencing.
- Ongoing inspection of mine-site water dams and fencing (every two days).
- Ad-hoc inspections linked with other operational activities.

- Improved incident performance with fauna drownings was offset in part by the number of fauna rescues from water bodies, almost all involving dingos. Dingos gained access through fencing yet to be upgraded and opportunistic entry (e.g. fence damage, electric fence faults, gates left open).
- Fauna fatalities with unknown cause declined in 2012 compared to 2011. As in previous years birds accounted for the majority of these incidents, and generally discovered in proximity to process water areas. Consumption of saline water is considered the likely cause however this cannot be substantiated.

  A review of bird control measures (e.g. bird diverters, bird netting) was completed in 2012 and an audio deterrent system is proposed for trial at the Jacinth process water dam. Netting systems were deemed impractical given the size of the process water bodies in question.

Figure 13 – Chicken wire upgrade to existing process water pond cyclone fencing

5.3 Pest Plants & Animals

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
No introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the lease area and adjacent areas caused by mining operations.	Weed species and abundance at closure to be consistent with baseline data and/or control sites. Comparison of results against baseline data and/or control site(s) and implementation of weed management activities (as identified in the *Weed Management Plan*)	Opportunistic visual observations: - Disturbed areas - Annual Biological Surveys (native flora) Recording of pest plant species identification and locations, presence and composition of vegetation and weed infestations	To be determined
	Pest animal species abundance at closure to be consistent with baseline data and/or control sites.	Opportunistic visual observations: - Disturbed areas - Annual Biological Surveys (native fauna) Recording of pest animal sightings on site. Habitat, fauna species likely to occur, fauna species identified, feral animals, linkages between fauna and vegetation communities.	To be determined

5.3.1 Measurement of compliance

1) ***Weed Species and Abundance:*** The Iluka Weed Management Program places a large effort on weed reporting, mapping and weed control in and adjacent to the mining lease. Records are maintained using GIS.

   Iluka, via contractor Ecological and Biodiversity Services (EBS Ecology), report on opportunistic weed observations during annual flora surveys. The surveys provide a comparison of mining and non-mining related impacts on native and introduced species distribution and abundance and linkages with the main vegetation associations (Mallee, Chenopod and Myall).

   Iluka personnel also record weed issues using the LCC reporting system. This includes incursion of new weed species and non-conformances with vehicle hygiene and wash-down procedures.

2) ***Pest Species and Abundance:*** Pest animal observations are maintained in the Fauna Sightings register. Pest animal interactions (e.g. fatalities, sickness/injury, relocations, captures) are recorded using the LCC reporting system. General information on trends in pest species abundance and distribution is obtained from government sources as required.

Iluka, via contractor Ecological and Biodiversity Services (EBS Ecology), report on opportunistic observations of pest animals during annual fauna surveys. These surveys provide a comparison of mining and non-mining related impacts on native and introduced species distribution and abundance and linkages with the main vegetation associations on site (Mallee, Chenopod and Myall).

5.3.2 Species and Abundance – Weeds

The Iluka Weed Mapping Management Program has been described in detail in all previous MARCR reports. A summary of the 2012 program is outlined here, with more detail available in Section 13.3 of this report.

5.3.2.1 Ability to meet MARP commitment

The J-A Weed Management Plan was discussed with DEWNR representatives on site during 2012 and with DMITRE during the 2011 MARCR review. Feedback from both parties encouraged a continuation of the J-A weed management effort; however the MARP weed management outcomes and criteria require reconsideration. This is scheduled to occur during the 2013 J-A MARP to PEPR update.

5.3.2.2 2012 JA Weed Diversity and Distribution x Domain

The J-A weed mapping and management program is prioritised on two levels;

- **Location**: the landscape types most prone to weed invasion are the highest priority areas, the three highest of which are rehabilitation areas, soil stockpiles and areas with frequent offsite vehicle movement (Appendix 13.3, Figure 36). All weed species will be managed in these high priority areas, regardless of weed species priority.
- **Weed Species**; the weeds of highest management priority are Buffel Grass, Ruby Dock, Horehound, Onion Weed and Iceplant. These weeds will be managed across all high and medium priority landscape types. They will also be managed on low priority landscape types if they occur in an area that has the potential to influence mining operations, e.g. transport corridor.

Weed Distribution

Within the MARCR reporting area (Domains 2, 3 and 4) 621.8 ha of land have been disturbed by mining related activities. An updated analysis for the JA Weed Management Plan indicates 436.24 ha are considered to have potential to host weeds if a seed source became available. In 2012 weed management was required on 11.64 ha, as compared to 24.74 ha in 2011. The reduced area managed is largely as a result of the drought conditions over the latter half of the year.

Weed Diversity

Weed diversity recorded decreased from 15 species in 2011 to seven in 2012 and none of these were new recordings. Two Buffel Grass plants were found and managed, one at the camp and the other adjacent the Haul Road near the turn off to Oak Valley.

Table 8: J-A weed management 2012 summary, Domains 2, 3 and 4

Zone	Priority	Description	Weed Potential Area 2012 (ha)	Area managed 2012 (ha)	% of potential area requiring 2012 mgmt
A Rehab Areas	A 1	Early (1-5 years...depending on seasonal conditions)	10.15	0	0%
	A 2	Mid (5-10 years) (after plant & BSC re-establishment		n/a	n/a
	A 3	Late (10+ years) (leading to closure)		n/a	n/a
B Soil Stockpiles	B 1	Topsoil stockpiles	12.06	0	0%
	B 2	Vegetation stockpiles	3.35	0	0%
	B 3	Subsoil stockpiles	12.33	0	0%
	B 4	Overburden stockpiles	36.08	3.90	11%
	B 5	Disturbed areas between stockpiles	62.65	0.00	0%
C Areas with frequent offsite vehicle movement	C 1	HMC Pad	0.80	0.01	2%
	C 2	Car Parks @ Process Plant & Camp	19.69	1.55	8%
	C 3	Laydowns	2.73	0.13	5%
	C 4	Monitoring areas – bores, dust traps, etc	25.43	0.00	0%
D Other areas where weeds occur in disturbed areas	D 1	Advance cleared areas	55.09	3.75	7%
	D 2	Haul roads & tracks adjacent and within pit	18.69	0.22	1%
	D 3	Creeks in the mine path	4.14	1.85	45%
	D 4	Creeks upstream of creeks removed in mine path	12.31	0.00	0%
	D 5	Creeks downstream adjacent currently disturbance	11.32	nc	n/a
	D 6	Creeks downstream of mine path and disturbance	18.96	nc	n/a
E Roadside and haul roads	E 1	Exploration tracks in mine path	9.74	nc	n/a
	E 2	Exploration tracks near current or future disturbance	nm	nc	n/a
	E 3	Haul Rd - Tank Farm 1 to Camp Turn off	30.99	0.00	0%
	E 4	Haul Rd - Camp to Process Plant	18.75	0.20	1%
	E 5	Borefield Road	61.66	0.03	0%
	E 6	Ooldea Rd Nth	9.32	nc	n/a
	E 7	Ooldea Rd South	nm	nc	n/a
	E 8	Exploration tracks elsewhere	nm	nc	n/a
F Other areas where weeds occur in undisturbed areas	F 1	Lake Ifould	nm	nc	n/a
	F 2	Dune	nm	nc	n/a
	F 3	Wombat/Rabbit Holes/Depressions	nm	nc	n/a
		TOTALS	**436.24**	**11.64**	**3%**

Mgmt Priority	Weed Target	# Visits Target
High	Zero	At least 3 (early, mid & late)
Medium	Minimise	2 only (early & mid)
Low	Reduce seed set	1 only, mid-season

nm = not measured, nc = not checked, n/a = not applicable

Table 9: Weed diversity summary 2012, Domains 2, 3, 4

MARCR Reporting Area Summary: Mine Lease, Camp, Access Rd, Borefield Rd		**Yr Registered**					
Common Name	***Scientific Name***	2012	2011	2010	2009	2008	2005-06
Wards Weed	*Carrichtera annua*	X	X	X	X	X	X
Turnip	*Brassica tournefortii*	X	X	X	X	X	X
Oats - domestic[1]	*Avena sativa*			X			
Canola	*Brassica napus*						
London Rocket	*Sisymbrium sp*		x	X	X		
Milk Thistle	*Sonchus oleraceus*	X	X	X	X		
Barley Grass	*Hordeum sp*		x	X	X		
Wild Oats	*Avena sp*		x	X	X		
Iceplant	*Mesembryanthemum crystallinum*		x	x			
Ruby Dock	*Acetosa vesicaria*		x	X			
False Sowthistle	*Reichardia sp*	X	X	X	X		
Horehound	*Marrubium vulgare*						
Fleabane	*Conyza sp*	x	x	X	X		
Cape Weed	*Arcotheca calendula*	x	x	x			
Buffel Grass	*Cenchrus ciliaris*	x		x			
Saffron Thistle	*Carthamus lanatus*			x	X	X	
Blackberry Nightshade	*Solanum nigrum*			x			
Wild Lettuce	*Lactuca serriola*			x			
Rye Grass	*Lolium sp*		x	x			
Wild Radish	*Raphanus raphanistrum*			x			
Onion Weed	*Asphodelus fistulosus*						
Couch	*Cynodon dactylon*			x			
Fat Hen	*Chenopodium sp*		x	x			
Medic	*Medicago sp*		x	x			
Lincoln Weed	*Diplotaxis tenuifolia*						
Iceplant Angled	*Mesembryanthemum aitonis*		x				
Wheat	*Triticum sp*						
Paddy Melon	*Citrullus sp*				X		
Sea Rocket	*Cakile maritima*						
Common Heron's Bill	*Erodium cicutarium*					X	X
Native Tobacco	*Nicotania megalosifium*					X	

Number of separate areas where weed species managed (this is a reflection of abundance, not an actual measure and does not apply to pre 2009 surveys): **X** = 20+ locations, X = 5-20 locations, x = <5 locations

5.3.2.3 EBS Ecology Survey

No weed species were recorded through formal survey or opportunistic sightings during the EBS Ecology 2012 flora survey.

5.3.2.4 Incident Reporting – Weeds

The Iluka Lost Control Card (LCC) system is used to record the discovery of new weed species within the boundaries of the Jacinth-Ambrosia operation. All weeds reported through LCC are also managed and recorded in the weed mapping program described in Appendix 13.3.

No incursions of new weed species were recorded in 2012.

5.3.3 Species and Abundance – Pest Animals

5.3.3.1 Sightings and Interactions

A total of **22** pest animal events were reported in 2012, **14** of which were opportunistic observations (Figure 14) predominantly feral cats and camels.

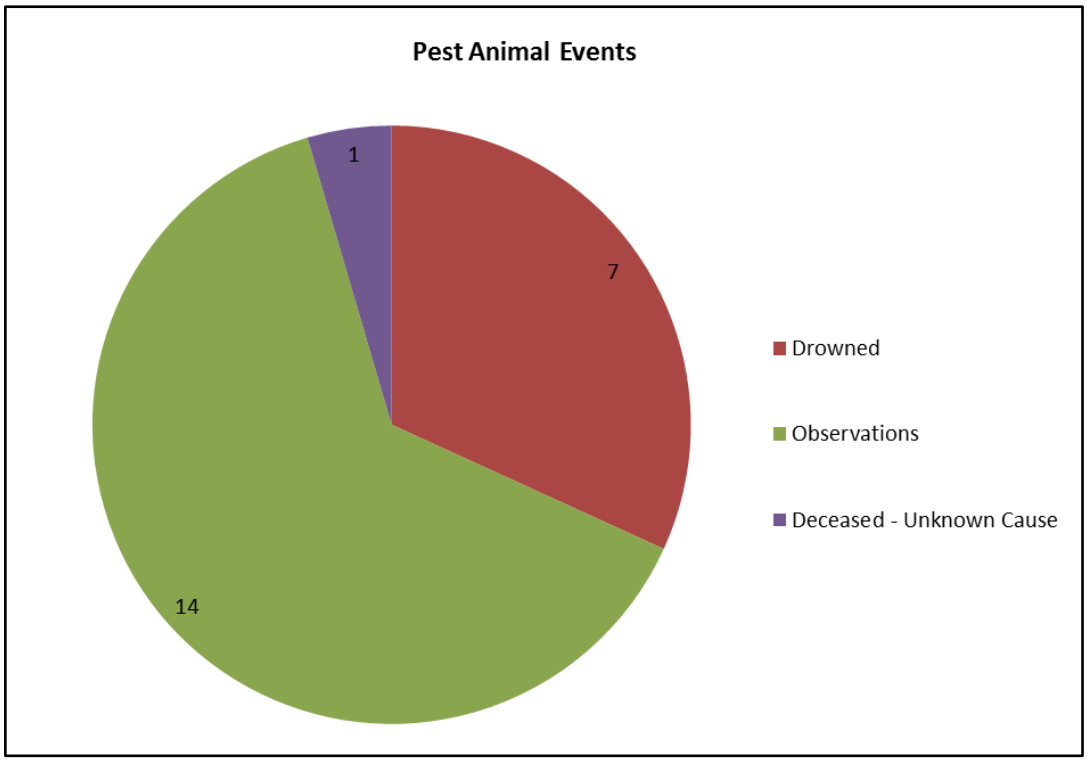


Figure 14 – Pest animal events during the 2012 reporting period

Foxes and rabbits accounted for all pest animal drownings with fox access, like dingos, achieved via opportunistic entry through damaged or de-electrified fencing.

5.3.3.2 EBS Ecology Survey

EBS conducted a fauna survey at Jacinth in November 2012, which included an assessment of pest animals. Exotic species recorded during the 2012 survey were the house mouse (captures), and observations of camels and one rabbit (Table 10).

EBS noted a significant decrease in house mouse abundance since 2011 (1098 captures in 2011, 22 captures in 2012), with rabbit activity also lower than the previous year.

Based on available survey data, exotic fauna do not appear to have increased in abundance since 2008 when the fauna monitoring program commenced.

Table 10: Pest animal species observed or detected at Jacinth 2006 – 2011

Pest Species	2006 SKM	2008 EBS	2009 EBS	2010 EBS	2011 EBS	2012 EBS
Fox	x					
Camel	x	x	x			x
Cat	x		x	x		
Rabbit	x	x	x	x	x	x
Mouse	x	x	x	x	x	x

5.3.3.3 Pest management activities

Routine mouse baiting continued throughout 2012, although mouse numbers were significantly lower than was observed in 2011.

Cat traps were used on several occasions in response to cat sightings, with no successful captures. Footprints were observed around cat traps but no captures were made. The majority of cat sightings occurred in early 2012 on the tail end of favourable environmental conditions, and declined to zero sightings later in the year. Trapping efforts will continue as required.

Rabbit baiting with 1080-poisoned oats was completed in June 2012 taking advantage of lower natural feedstock. No data is available to measure the success of this program, however rabbit observations dropped significantly in subsequent months. Rabbit activity was observed towards the end of 2012 and baiting will occur in 2013 accordingly.

Camels were observed on several occasions during the latter half of 2012 along the Ooldea Haul Rd, Jacinth Borefield and mine site. Footprints and scat was observed regularly around the Jacinth village and mine site in October/November.

5.4 Indigenous Heritage & Non-Indigenous Heritage

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
No disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained	GIS figure/map demonstrating that no work/activity has been undertaken in areas for which heritage clearance has not been gained. Demonstration of compliance with regulatory requirements (through internal incident reporting procedures and requirements.	Visual identification of artefacts or sites of significance	Compliant

5.4.1 Measurement of compliance

1) ***Compliance with regulatory requirements:*** Sites of indigenous heritage significance are located in and around the Jacinth-Ambrosia site. Representatives of the Far West Coast Native Title Claimants surveyed and cleared all areas for Aboriginal artefacts and sites of significance and relocated several artefacts in 2009 prior to commencement of mining.

2) ***Mapping:*** Iluka measures compliance against Heritage & Non-Indigenous Heritage outcomes through program implementation, GIS mapping and incident reporting.

5.4.2 Summary of Key Measurements

Iluka reported no disturbance to heritage sites for the reporting period.

As noted in Section 5.1.2.1, all vegetation clearances occurred within approved clearance boundaries (Domain 4) as surveyed and cleared by the Far West Native Title group in 2009 prior to the commencement of mining operations.

Iluka maintained the site Vegetation and Heritage Clearance Procedure to ensure that heritage sites are not disturbed.

Iluka maintained a register of clearance permits, survey records and approvals to demonstrate compliance with this outcome.

5.5 Soil

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
Migration or infiltration of any spillage or leakage to the surrounding environment is prevented (in conformance with relevant Environment and Protection Authority guidelines). All clearance of native vegetation is authorised under appropriate legislation.	Demonstrate that facilities are designed in accordance with EPA Guidelines (via a post construction audit). Demonstrate that actual clearance boundaries are within authorised clearance boundaries (output from GIS).	Visual inspection / audit of relevant facilities	Compliant

5.5.1 Measurement of compliance

1) ***New facilities:*** Post-construction audit of new facilities to ensure compliance with EPA Guidelines

2) ***Clearance within authorised boundaries:*** Construction or installation of facilities occurs within lease boundaries and subject to Vegetation Clearance Permit where required.

5.5.2 Summary of key measurements

One refrigerated container was installed behind the village kitchen for cold food storage – no EPA guidelines apply to this facility. No other facilities were constructed or installed during the reporting period.

As above, the installation of a refrigerated container behind the village kitchen required minor vegetation clearance. A Vegetation Clearance Permit (Appendix 13.1, Figure 34) was issued in accordance with the Vegetation Clearance Procedure.

NOTE:

Statistics and discussion on spill events are now correctly reported under 'Hydrocarbon & Chemical Storage' (Section 5.10) in line with the outcomes and assessment criteria for that outcome.

5.6 Surface Water Quality

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
The post mining ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved.	Pre-mining flow regimes are re-established post mining.	Surveys (pre-mining and post mining). Design of site surface water diversions to be surveyed to ensure design capacity and integrity is maintained. Survey to include: - Stream profile and hydraulic function - Ecological function	To be determined
Ecosystems are not damaged by release of contaminated water off lease	Water turbidity and EC measurements along creek lines up and downstream of lease boundary, demonstrate no release of contaminated water from operations.	Water quality – opportunistic sampling during or following rainfall events. Turbidity or equivalent (upstream and downstream of the mine site).	To be determined

5.6.1 Measurement of compliance

1) ***Pre-mining flow regimes:*** Creek lines and catchments, surveyed prior to commencement of mining operations, are mapped within GIS. Flow regimes will be re-established post-mining as part of mine rehabilitation and closure planning.

   Two small catchment zones (north and south) feed the creek running west from Jacinth and out through the plains toward Lake Ifould. The mine pit currently terminates the creeks. The creeks do not hold or trap water for any length of time because the catchment is very small, the sandy creek bed is porous and the water flows readily out onto the plain.

2) ***Water quality:*** Personnel are required to sample creek flows during/after rainfall at points upstream and downstream of the lease boundary.

5.6.2 Summary of key measurements

Pre-mining flow regimes: The mine is currently active and no reporting on the re-establishment of pre-mining flow regimes is possible at this time. Studies have commenced to provide accurate assessments of pre-disturbance hydrologic and hydraulic characteristics. This information will be used to provide rehabilitation designs for waterway re-establishment and will be included in future updates of the rehabilitation plan (interim report available upon request).

Water quality: No opportunistic surface water sampling was undertaken in 2012. Given the operational and environmental constraints to achieving this commitment, Iluka

proposes to review surface water risks and outcomes in consultation with DMITRE for inclusion in the next iteration of the MARP / PEPR.

No surface-water related incidents were reported in 2012.

Several measures are used to proactively manage risks associated with uncontrolled discharges – these include:

- Daily Production/Planning Meetings – planning of daily operational, maintenance and other work activities. Earthworks activities are addressed – e.g. construction, maintenance and lifting of bunds (refer example meeting record, Appendix 13.5). Daily planning is linked to the Jacinth mine planning process which captures rehabilitation and environmental requirements;
- Reporting of bund/launder quality and integrity (hazards) via the LCC system.

A detailed review of surface water studies, impacts and management commitments will be undertaken as part of the Jacinth MARP review in 2013.

5.7 Groundwater

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
The extraction and use of groundwater does not adversely affect environmental processes that are reliant on that groundwater system.	Ground water levels/ drawdown as measured are the same or better as predicted.	Borefield: - Flow meters, monthly extraction volumes - Standing water levels (depth) measured quarterly - Groundwater quality, bi-annually	To be determined
Groundwater systems outside of the extent of the mine workings are not altered by the disposal of process water in the pit.	Groundwater levels in areas adjacent to and surrounding the mine site do not exceed standing water levels determined to result in adverse impacts* **Standing water levels to be determined in consultation with regulatory agencies and based on surrounding groundwater environmental and vegetation associations*	Mining Lease: - Standing water levels (depth) measured monthly - Groundwater quality, bi-annually	To be determined

5.7.1 Measurement of compliance

1) ***Borefield Drawdown:*** Borefield drawdown monitoring is undertaken using real-time abstraction data and monthly dip-meter readings of standing water level (SWL). A hydrogeological review of the aquifer drawdown model is undertaken annually as prescribed in the *Jacinth Groundwater Management Plan*.

2) ***Groundwater Levels*:** Iluka conduct bi-annual groundwater quality chemical sampling and analyses (EC, metals, hydrocarbons and radionuclides) of borefield and mine-site groundwater bores. Mine site water levels are monitoring fortnightly (high risk wells) and monthly (low risk wells) in accordance with defined site-specific trigger levels (SSTL).

5.7.2 Summary of key measurements

5.7.2.1 Borefield Groundwater Drawdown

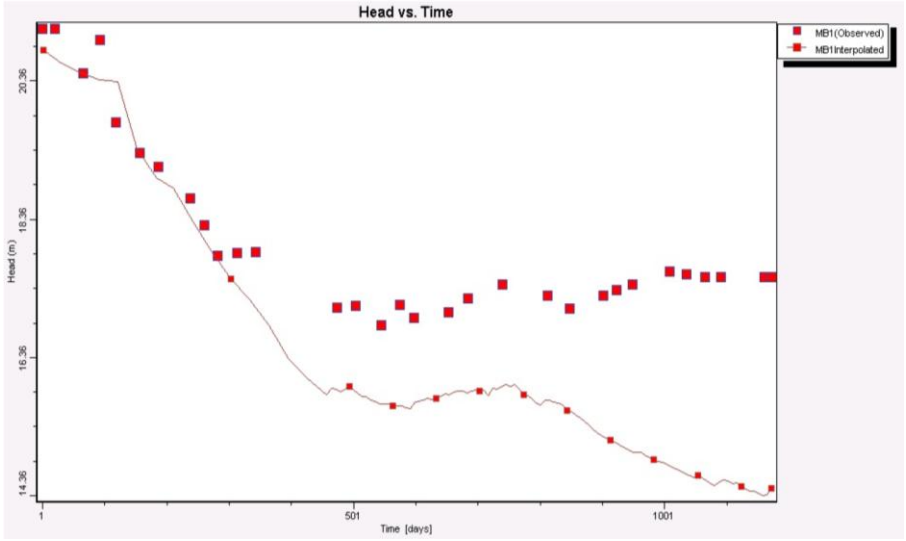
Sinclair Knight Merz (SKM, 2011) developed a groundwater flow model of the Jacinth borefield palaeochannel-hosted aquifer in April 2011. The model was developed using Visual MODFLOW (SWS, 2013) and calibrated using abstraction and groundwater level data for the period between 1 August 2009 and 1 November 2010.

In February 2013 the revised model was extended to include abstraction data from 1 November 2010 to 31 January 2013. Model predictions were compared to measured groundwater responses to determine the validity of the current model.

Key findings:

- Predicted groundwater drawdown per the SKM model was over-predicted to the north of the borefield (Figure 15), and under-predicted to the south (Figure 16). This divergence suggests that groundwater flow is partially restricted to the south of the borefield and subsequently compensated by groundwater flows from the north;
- The over-prediction of drawdown observation wells to the north of the borefield field (MB01, MB02, and MB03) is attributed to increased groundwater flows from this area. This hypothesis is supported by regional maps of the area which suggest the Jacinth borefield may be truncated by a secondary palaeochannel. Regarding this:
    - Should the borefield occur near the confluence of two in-filled palaeochannels, orientated north-south and northeast-southwest respectively, the area to the north of the confluence may represent a significantly wider aquifer than is currently represented in the current SKM model;
    - Similarly, should these two palaeochannels represent tributaries of a single palaeovalley to the south of the confluence, the aquifer extent may be over-represented;
- Overall, and despite the observed divergence in drawdown north and south of the borefield, the current SKM model and predictions and implications on the sustainability of abstraction remain valid.

Further review of the model will be undertaken to better represent aquifer orientation and number and to refine the model predictions.

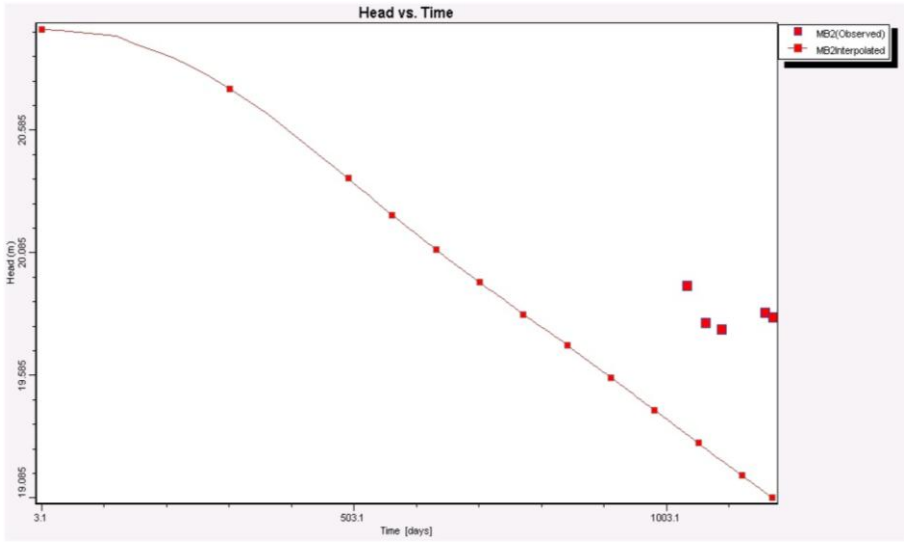


MB01 –

Predicted vs. Actual (Observed) *

Observed levels are higher than predicted (over-prediction of drawdown)

** Predicted indicated by line; actual indicated by unconnected points*



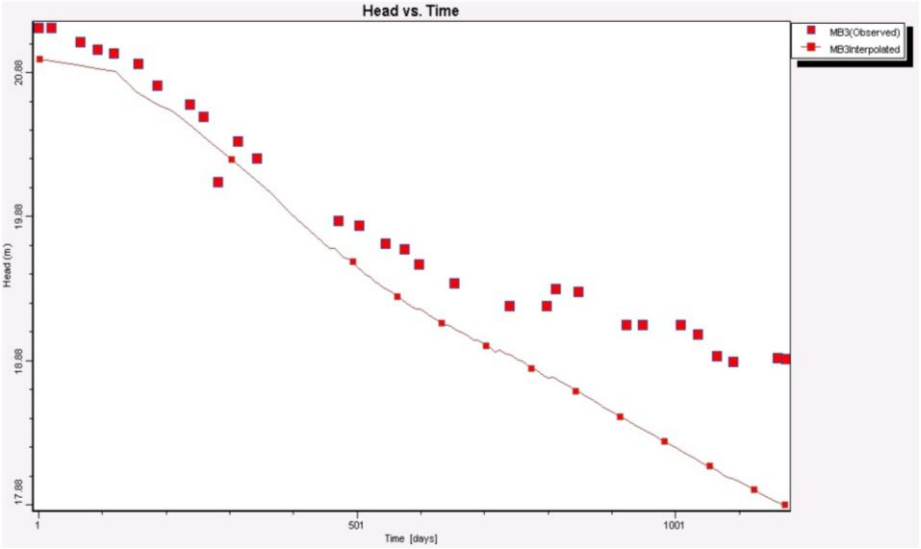
MB02 –

Predicted vs. Actual (Observed) *

Observed levels are higher than predicted (over-prediction of drawdown)

(NOTE: MB02 installed early 2012 hence limited dataset)

** Predicted indicated by line; actual indicated by unconnected points*



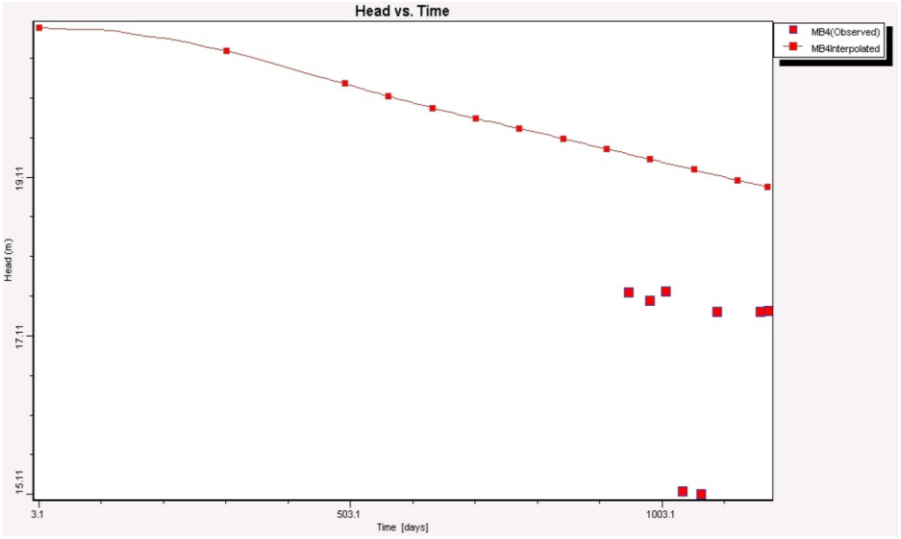
MB03 –

Predicted vs. Actual (Observed) *

Observed levels are higher than predicted (over-prediction of drawdown)

** Predicted indicated by line; actual indicated by unconnected points*

Figure 15 – Drawdown (actual vs. predicted) in monitoring wells north of borefield



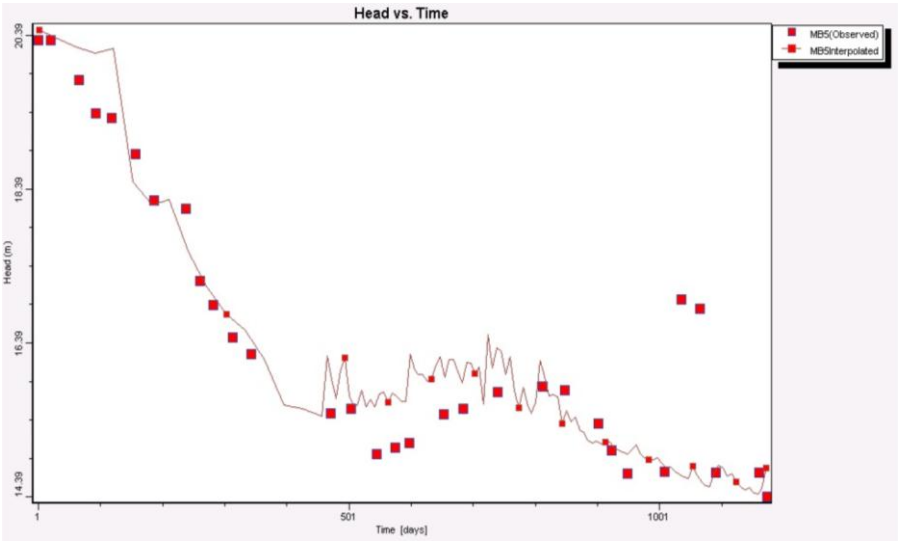
MB04 –

Predicted vs. Actual (Observed) *

Observed levels are lower than predicted (under-prediction of drawdown)

(NOTE: MB04 installed early 2012 hence limited dataset)

** Predicted indicated by line; actual indicated by unconnected points*

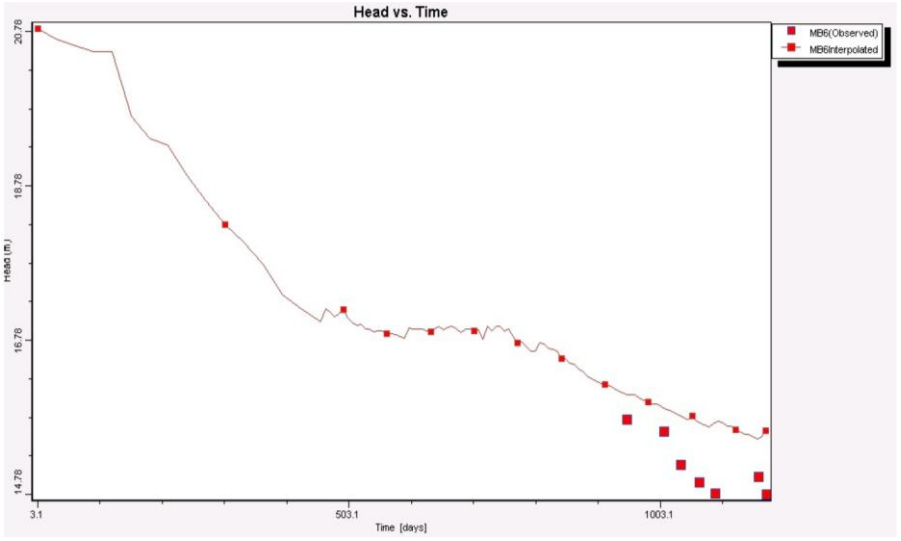


MB05 –

Predicted vs. Actual (Observed) *

Observed levels are lower than predicted (under-prediction of drawdown)

** Predicted indicated by line; actual indicated by unconnected points*



MB06 –

Predicted vs. Actual (Observed) *

Observed levels are higher than predicted (over-prediction of drawdown)

(NOTE: MB04 installed early 2012 hence limited dataset)

** Predicted indicated by line; actual indicated by unconnected points*

Figure 16 – Drawdown (actual vs. predicted) in monitoring wells south of borefield

5.7.2.2 Groundwater Mounding – Update

5.7.2.2.1 TSF Interception Scheme

Installation of the groundwater interception scheme for the Jacinth off-path TSF ('TSF Interception Scheme') was completed in December 2012. In response to observed groundwater rise north-west of the off-path TSF, additional dewatering wells will be installed (subject to favourable yields) to augment the existing interception scheme.

Table 11: Summary – JA groundwater mounding response program

Phase	Outcomes	Status
1	▪ Expand the existing monitoring well network to better understand the scope and extent of the issue ▪ Trial the installation of 8" production (dewatering) bores as a means of reducing groundwater mounding at Cell 1	**Complete** (Sept 2011)
2	▪ Further expand the existing monitoring well network at the mine site and Jacinth borefield ▪ Based on data obtained during Phase 1, install a network of groundwater production (dewatering) bores at the off-path TSF, and additional production bores at Cell 1 ▪ Production bore locations to coincide with locations with high potential extraction yields and/or proximity to surface. ▪ Establish draft operating parameters (trigger levels) as a risk-based approach to the management of groundwater.	**Complete** (May 2012)
3	▪ Install a dedicated dewatering (decant) system for the ongoing control and recovery of groundwater around the off-path TSF	**Complete** (Nov 2012)
4	▪ Installation of additional dewatering wells on the west / north-western corner of the off-path TSF and expansion of the existing interception scheme (subject to test-pumping and viability for extraction given unfavourable geology in this area)	**Pending** (July 2013)

The scheme is comprised of seventeen dewatering bores arranged into four ring mains (Figure 17) decanting reclaimed groundwater into the Jacinth process water dam. Well pumps are powered by ten diesel generators providing constant 24/7 dewatering capability.

At time of reporting the system provides a yield of ~80L/sec (~7340 KL/day) with reclaimed groundwater discharged to the Jacinth process water dam (Figure 19). The system (generators, pumps and pipelines) are subject to 12-hourly maintenance inspection with daily analysis of data and system/recovery performance. A summary of recovery volumes will be provided in the 2013 MARCR.

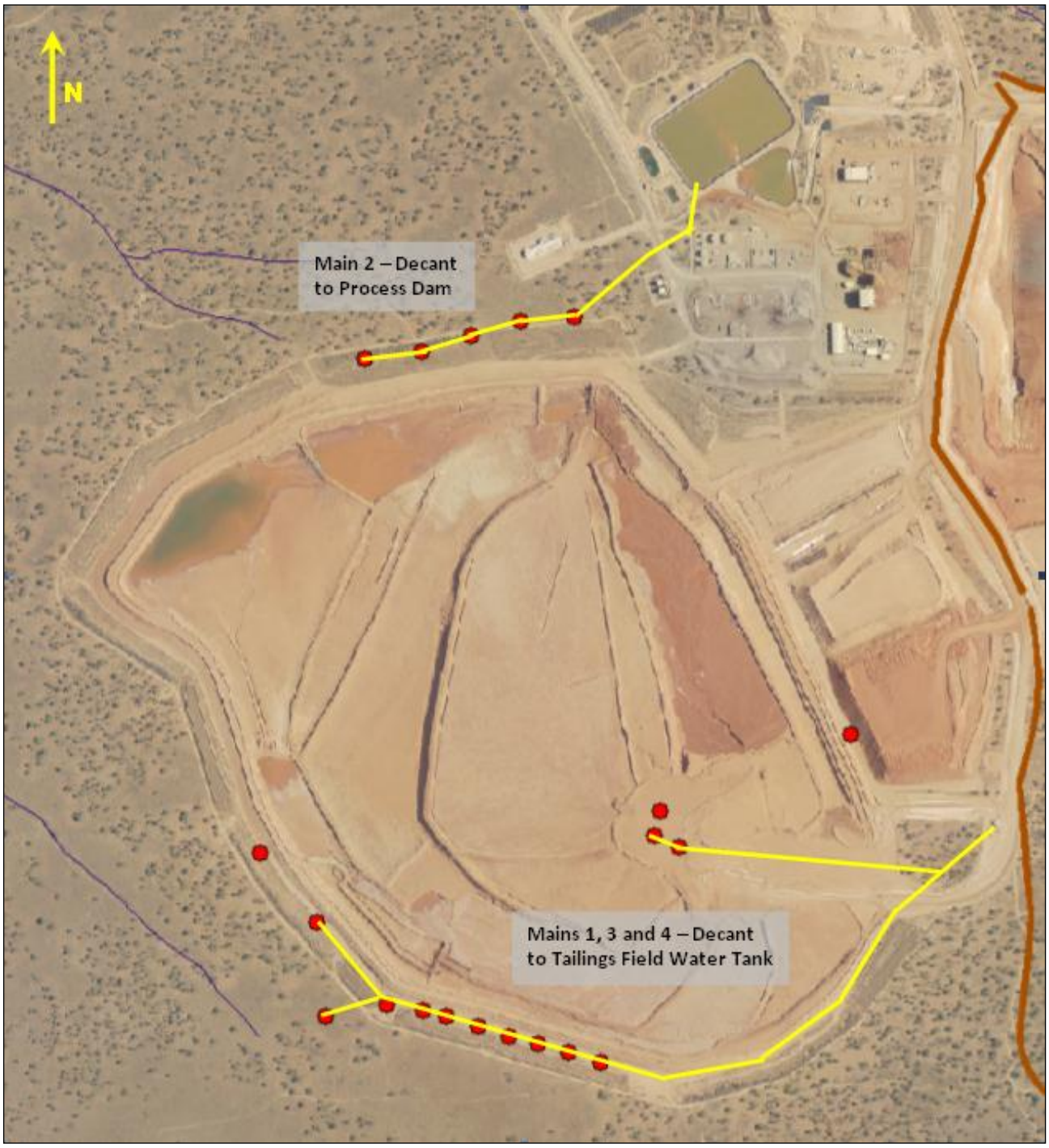


Figure 17 – Configuration of TSF groundwater interception scheme

Figure 18 – TSF interception scheme (southern ring main)

Figure 19 – Groundwater return to process water dam

5.7.2.2.2 Operating Parameters

Initial groundwater site-specific trigger levels (SSTL) were established within the *Jacinth-Ambrosia Groundwater Compliance Report and Management Plan*, submitted with the 2011 MARCR. The SSTL provide a risk-based framework for monitoring and managing groundwater levels on site.

These SSTL will be used until such time that sufficient groundwater monitoring data exists for the Jacinth site, at which time the SSTL will be reviewed and formalized in consultation with DMITRE. As the majority of groundwater wells at Jacinth were installed in 2011 and 2012, the groundwater level dataset is currently insufficient for this purpose.

5.7.2.3 Groundwater Levels

5.7.2.3.1 Cell 1

Water levels in Cell 1 wells continued to decline in 2012 (Figure 20), slowing in the latter half of 2012 with reduced recovery rates observed in dewatering wells. Dewatering wells were switched off in June/July to accommodate the change in mining path to the north of the ore body. Hydrogeological assessment of Cell 1 groundwater levels, including viability for continued dewatering, is underway at time of reporting.

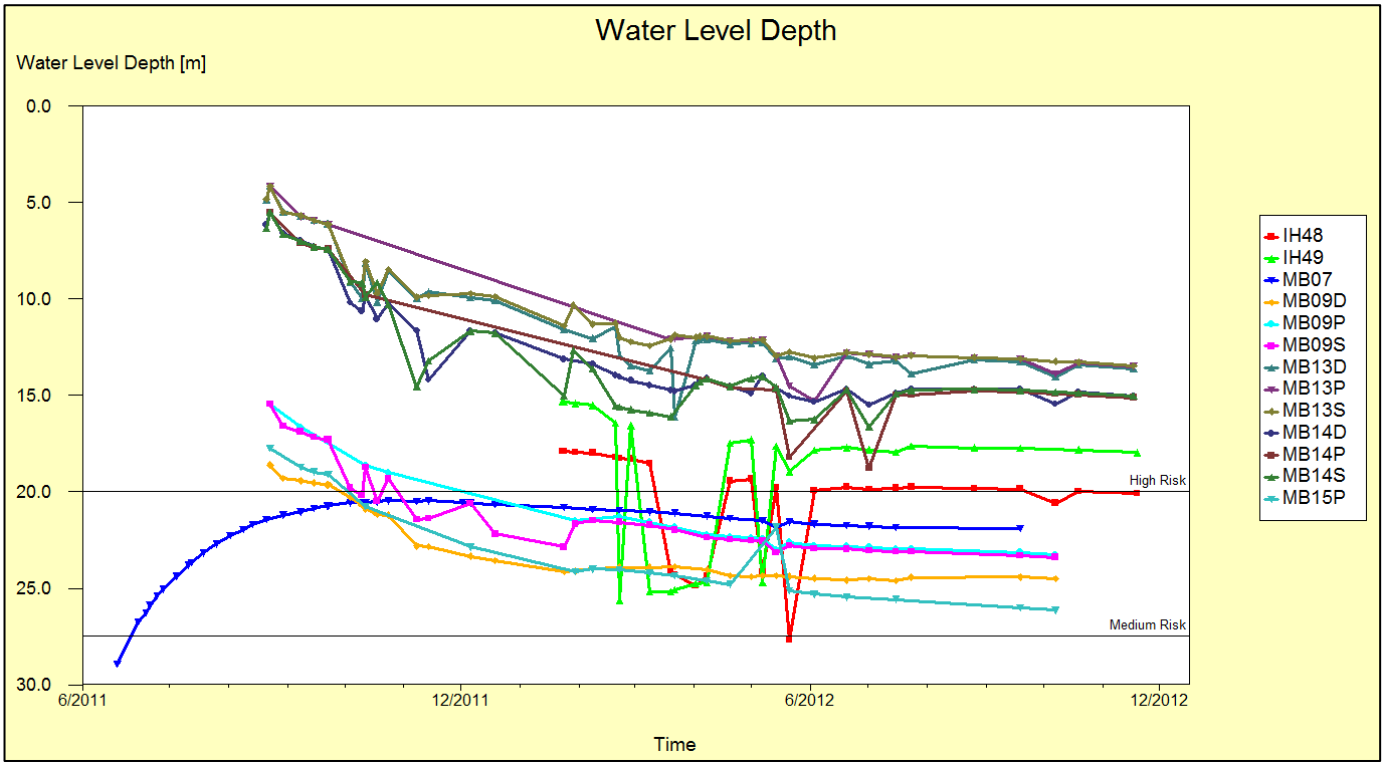


Figure 20 – Declining groundwater levels in Cell 1 bores, 01/01/11 – 31/12/12

5.7.2.3.2 Off-Path TSF

Monitoring Wells

All monitoring wells adjacent to the off-path TSF showed continued groundwater rise in 2012 (Figure 21). As noted in the 2011 MARCR and *Groundwater Compliance Report and Management Plan*, this rise was anticipated in response to continued tailings activity and pending the installation of the TSF dewatering scheme. Key points:

- MB03 and VWP13D, located west/north-west of the TSF, showed increased rise into the "high-risk" zone in the latter half of 2012.
- Similar upward trend observed in MB02D and MB02S, east of the TSF;
- Wells and piezometers bordering the E/NE boundary of the TSF showing gradual rise. This is particularly evident in IH58 adjacent to the TSF eastern tailings cell and showing a response to tailings seepage.
- Decline in MB01 and IH06, wells located nearest the TSF interception scheme, in response to localised drawdown of the aquifer.

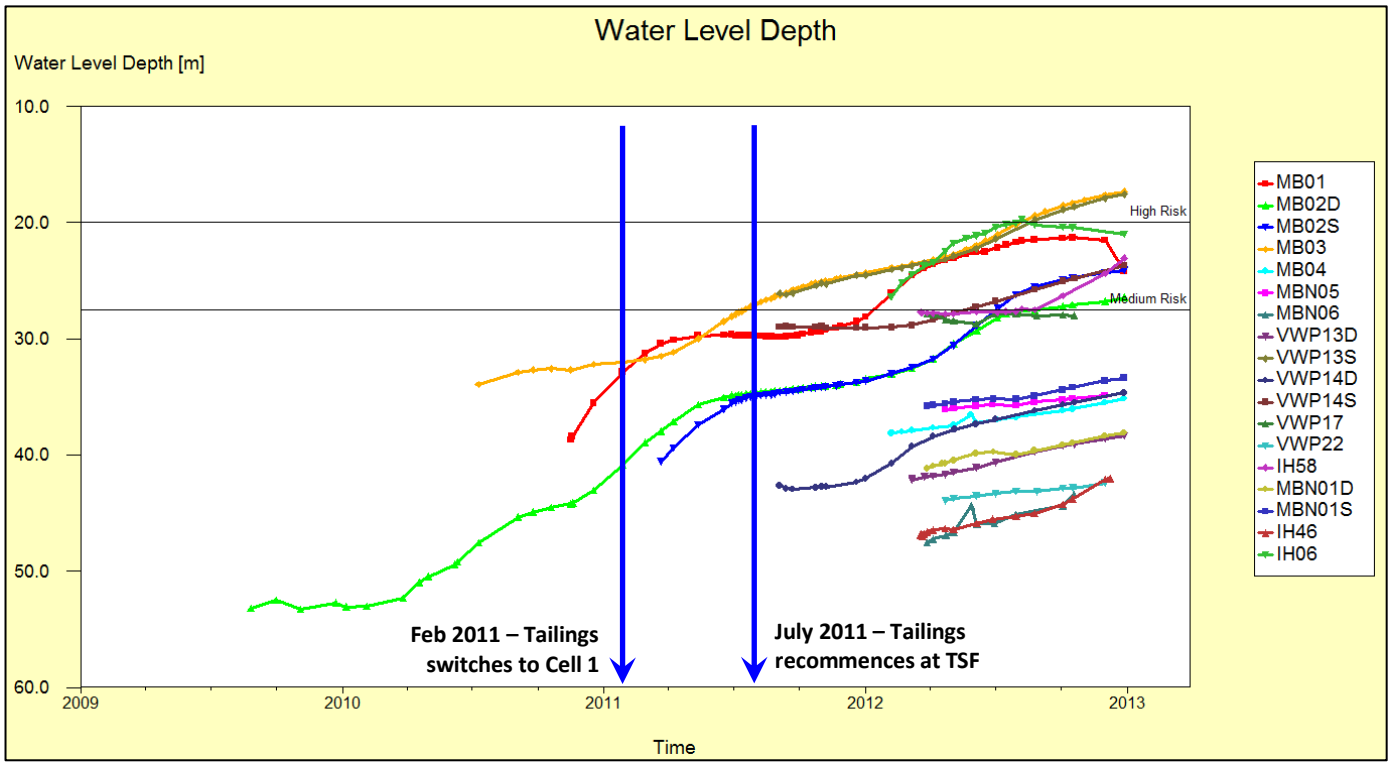


Figure 21 – Long-term trend in TSF monitoring wells and VWP's (01/01/09 – 31/12/12)

Further hydrogeological risk assessment of the groundwater rise east and west of the TSF, including options for the installation of additional interception wells, is currently underway at time of reporting.

Dewatering Wells - TSF Interception Scheme

Prior to installation and commissioning of the TSF interception scheme in November, these wells had exhibited gradual groundwater rise, although with fluctuations in response to tailings activity (i.e. wells showed a rise/fall pattern depending on the location of the tailings leg and tailings duration).

A box and whisker plot of water level elevation and depth for the interception wells is provided in (Figure 22). The plot shows the highest and lowest recorded levels for each well (i.e. 'min' and 'max') and the last observed reading (indicated by red marker, 'last value').

Levels in wells that had peaked above the 20m trigger level prior to installation of the interception system dropped following commencement of dewatering. It is important to note however that these levels are based on active pumping – levels rapidly return to pre-interception levels when pumps are offline.

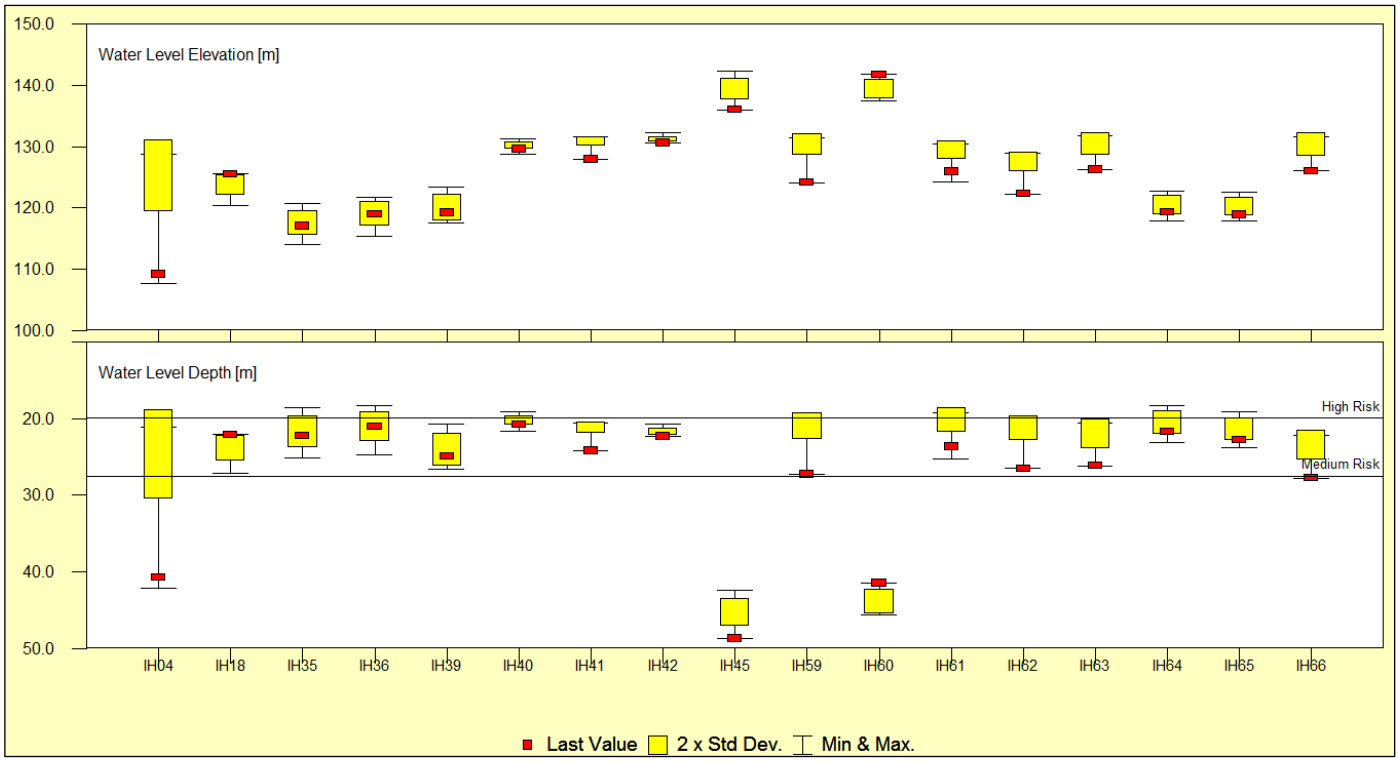


Figure 22 – Groundwater trend in TSF interception wells (01/02/12 – 31/12/12)

Further analysis on drawdown performance will be provided in the 2013 MARCR when more data is available.

5.7.2.3.3 Background Wells

Background monitoring wells – beyond the active mining footprint and influence of the Cell 1 / TSF groundwater mounds – continue to remain relatively static (Figure 23). Key points:

- MB06D and MB06S, a nested well north of Cell 1, now shows declining levels. This is likely a lag response to the cessation of tailings in July 2011. This trend mirrors those observed in Cell 1 wells;
- As noted in the 2011 MARCR and *Groundwater Compliance Report and Management Plan*, VWP18 and VWP21 show water levels in the "high risk" zone, which contradicts manual dipping levels at these locations. This anomaly suggests the presence of perched water tables;
- An updated "heat map", based on the current groundwater trigger levels and comparing years 2011 and 2012, is provided in Figure 24. As shown, data for background wells continues to suggest that groundwater mounding at Cell 1 and the off-path TSF is localised in its extent with little influence on broader groundwater levels.

  (**NOTE**: *heat map trends for interception wells are based on readings taken during active pumping and may not reflect actual static levels. Assessment of static water level in these wells requires ongoing assessment).*

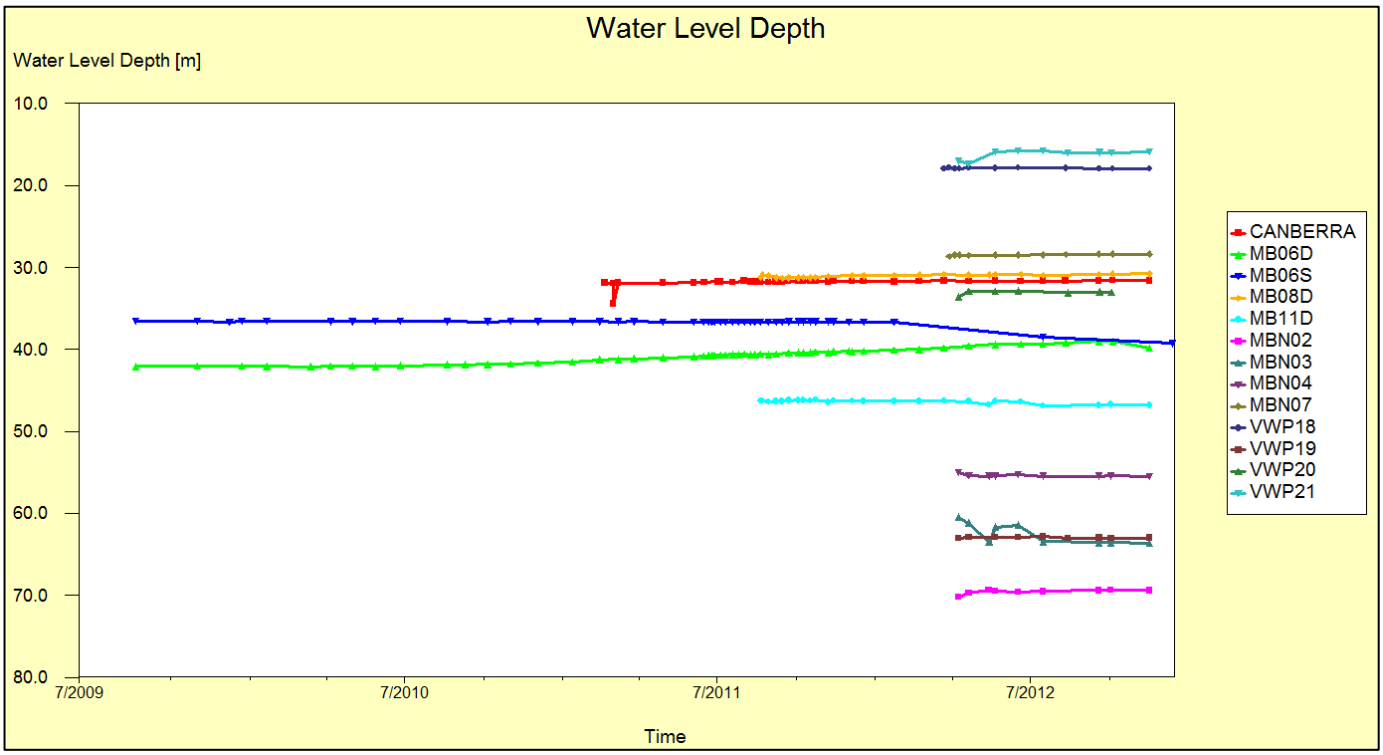
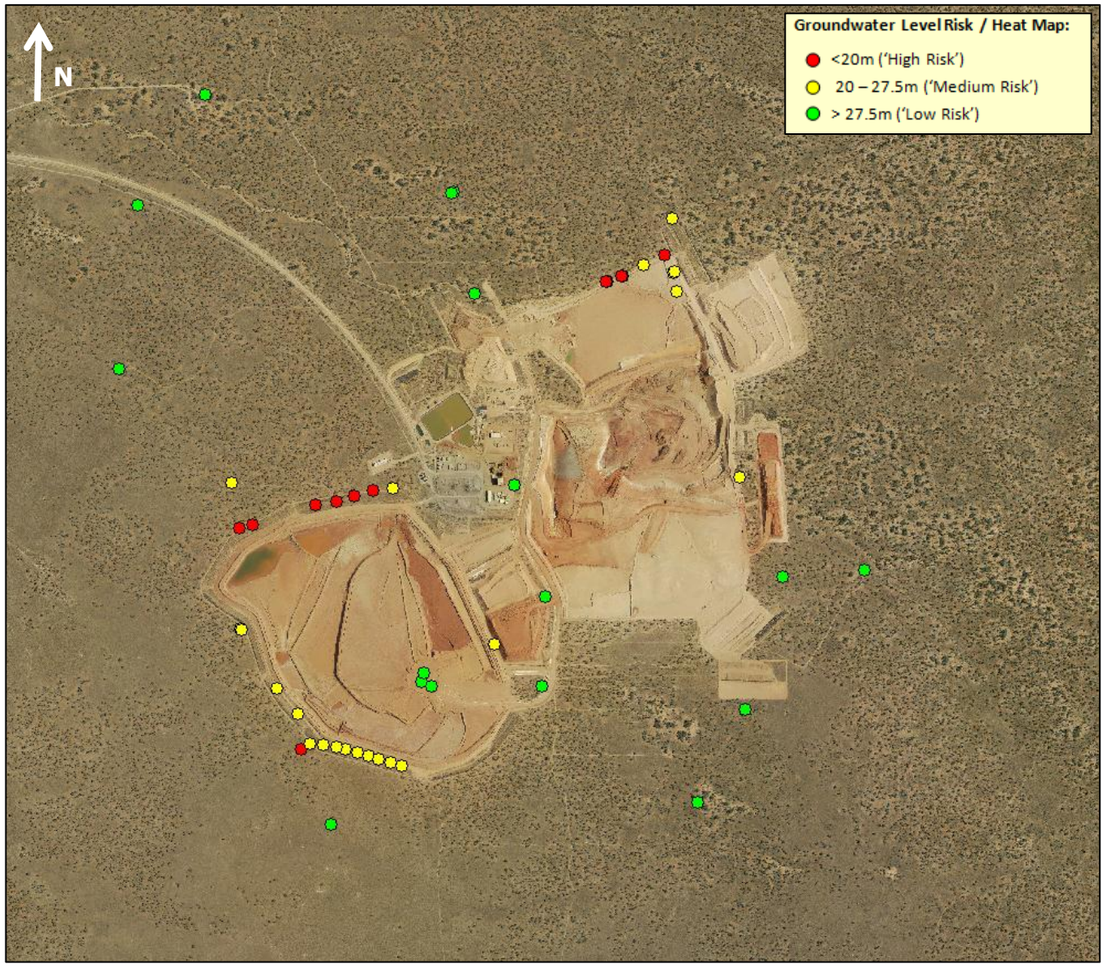
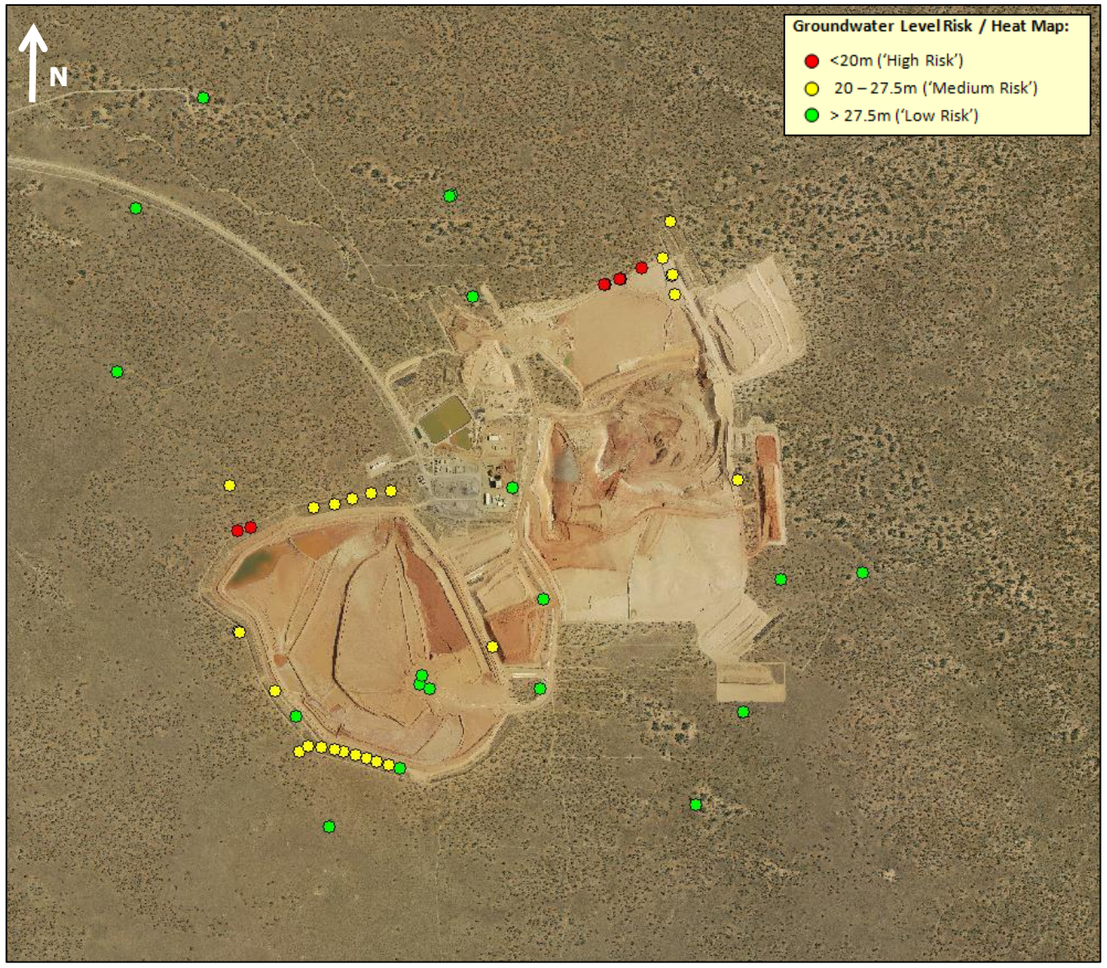


Figure 23 – Trend in outlying mine site monitoring wells and VWPs (01/06/09 – 31/12/12)



A) Groundwater Trend, 1/1/11 – 31/12/11



B) Groundwater Trend, 1/1/12 – 31/12/12

Figure 24 – Groundwater level heat map of JA groundwater bores, 2011 vs. 2012

5.7.2.4 Groundwater Quality

Iluka conducted groundwater quality monitoring in June 2012 and December 2012 in accordance with MARP commitments. Both monitoring events included wells established during the 2011 and 2012 groundwater mounding drilling programs.

The December 2012 groundwater monitoring event (GME) targeted quality parameters nominated within the *Groundwater Compliance Report and Management Plan.* As noted in the 2011 MARCR, these were established as site-specific parameters given that measurement against EPP guidelines for beneficial use was not relevant to the mine and operating environment.

No summary of groundwater quality is provided in this report – further monitoring is necessary to establish a robust baseline dataset for Jacinth (based on the new site-specific quality parameters) before any meaningful analysis can occur.

5.8 Dust and Air Quality

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
All clearance of native vegetation is authorised under appropriate legislation.	Demonstrate that actual clearance boundaries are within authorised clearance boundaries (output from GIS).	Annual Biological Survey – Monitor changes in abundance, composition or condition against control sites or background data to identify changes outside approved clearance boundaries. Monitoring to include: - Plant mortality - Plant health as measured by vigour of new growth, flowering and fruiting - Extent of smothering (monitoring by visual observation)	Compliant
All fuel burning equipment is operated in accordance with the requirements of the EPA.	Evidence demonstrates emissions from generators to comply with EPA requirements (design reports, audits, inspections and sampling results).	Visual observations - plant and equipment will not emit to atmosphere visible smoke for any period greater than: - 15 consecutive seconds (for plant not registered for use on public roads) - 10 consecutive seconds (for plant registered for use on public roads) Annual reporting (energy use): - Electricity, LPG, diesel and petrol - Greenhouse gas emissions	Compliant

5.8.1 Measurement of compliance

1) ***Clearance within authorised boundaries***: Iluka reconcile survey clearance data with an aerial photograph and calculate the difference between clearances permitted through the Vegetation Clearance Procedure and actual clearance as a measure of compliance to procedures. Field monitoring (vegetation health transects, photo-points, dust deposition gauges and plume mapping) is undertaken to determine/validate dust impacts on vegetation and dust fallout extent in line with the MARP monitoring parameters.

2) ***Emissions from plant and equipment***: Reporting on emissions from plant and equipment is undertaken using the LCC reporting system (e.g. smoke/exhaust discharge) and statutory reporting including Energy Efficiency Opportunity (EEO) and NGERS (National Greenhouse and Energy Reporting Scheme).

5.8.2 Summary of key measurements

5.8.2.1 Dust Impacts on Vegetation – Clearance within authorised boundaries

In line with the MARP assessment criteria, dust impact on vegetation is measured as follows:

- *Flora Survey*: monitoring and reporting on vegetation health and condition as part of annual flora surveys (EBS Ecology). EBS Ecology reports for 2012 spring survey noted that natural dust cover was evident on vegetation throughout the wider area around Jacinth, with good rainfall required to wash the dust off plants. EBS noted that dust coverage was highlighted by low rainfall totals in the lead up to the 2012 survey and was not expected to cause long-term negative health impacts to plants;
- *Pearl Bluebush* (*Maireana sedifolia*) *vegetation health transects and photo points* – established in 2011 and monitored annually and based on qualitative assessment of dust cover (%), plant mortality and plant health;
- *Fallout dust gauges* – As noted in the 2011 MARCR, the original fallout dust gauge network was reconfigured to include:
    - Impact gauges, near operational areas (mine and village)
    - Background gauges (control sites)
    - Transect gauges; setup in replicated groups at the start and end-points of pearl bluebush vegetation health transects, to provide a cross-reference between vegetation health and deposition data.
- *HMC dust traps* – monitored monthly, traps measure HMC drift from stockpiles. Data will validate the extent of HMC drift and provide an empirical measure of deposition rate and success of stockpile control strategies. A summary of trap data and trends will be provided in the 2013 MARCR.

Based on the Pearl Bluebush survey, Iluka confirms that no vegetation clearance was caused as a result of dust coating outside of authorised clearance boundaries. The full JA Dust Monitoring Report is attached in Appendix 13.4 – key points:

- 2012 was an extremely dry year and the once off timing of some mining operations was not conducive to effective dust control.
- 25 km/hr is the lower threshold wind speed for causing dust problems at J-A during such a dry year. A higher target should be achievable in such conditions with mine plan changes and increased equipment reliability.
- Pearl Bluebush is an excellent indicator plant for dust monitoring due to its dust trapping hairy leaves and stems.
- Dust extent and percentage of dust on plants increased markedly from 2011 to 2012. Dust from mining operations has increased in extent and the amount coating plants during 2012. Dust coated Pearl Bluebush now extend between 2 – 2.5 km to the south and east of the TSF, over 2.5 km to the north of the TSF and over 1 km to the west of the TSF.
- All Pearl Bluebush canopy densities viewed from the top were low in 2012 likely reflecting the extremely dry conditions.
- All Pearl Bluebush monitored in 2011 were still alive in 2012.
- Pearl Bluebush top and side canopy densities, as a measure of plant health, showed no effect from high saline and non-saline dust loads in 2012.
- Pearl Bluebush flowering and therefore seed set, as a measure of plant health, require careful monitoring in future. Data from 2012 suggests there may be a link between reduced flowering and shrub exposure to more frequent dust events.
- Each monitoring location on 2011 monitoring transects was replicated to increase sampling robustness and extended to ensure they contained control shrubs beyond the mining dust halo.

5.8.2.2 Emissions – plant and equipment

There were no incidents involving uncontrolled or non-compliant emissions (smoke, exhaust or other) from plant and equipment during the reporting period.

Iluka submitted statutory reports in accordance with EEO (Energy Efficiency Opportunities) and NGERS (National Greenhouse & Energy Reporting Scheme) legislation during the reporting period. Copies of these reports can be provided on request.

5.8.2.3 Emissions – dust

There were 24 incidents (Figure 25) related to pit and HMC emissions during the reporting period.

An increased awareness of dust impacts and reporting, coinciding with the pursuit of lower grade ore and clearing during the high-wind season at Jacinth (discussed below), were key factors.

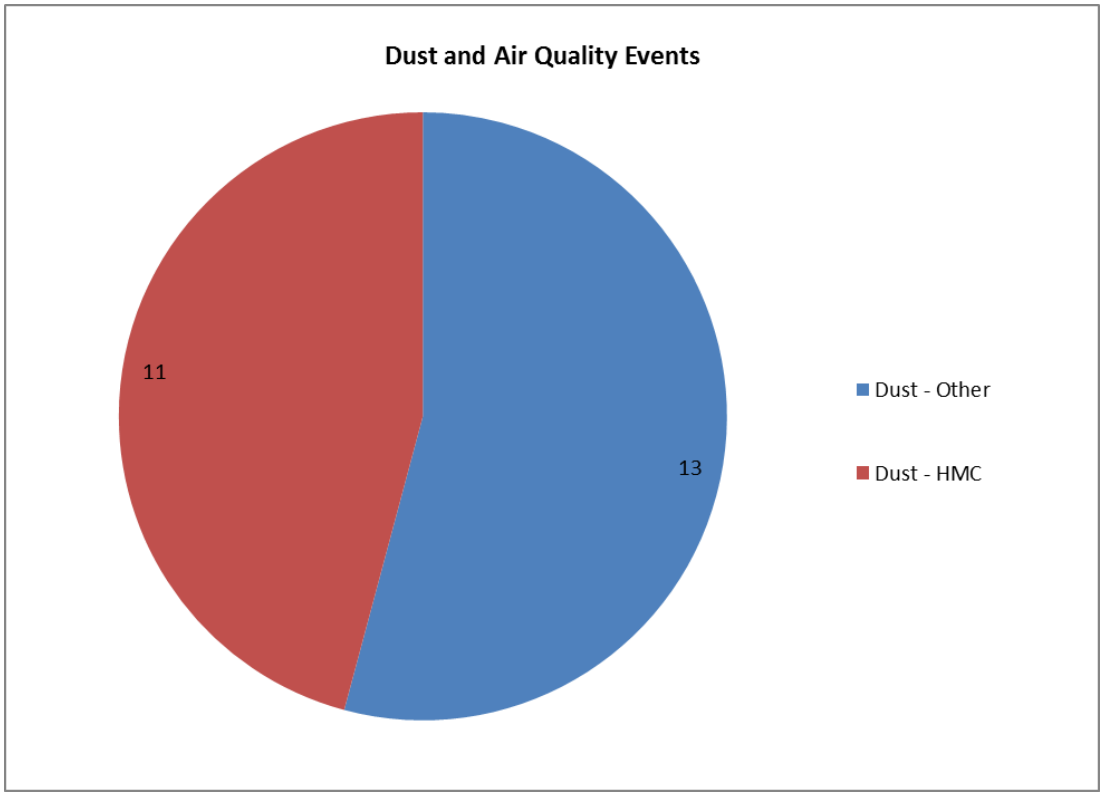


Figure 25 – Dust and air quality events

5.8.2.4 Operational dust management

In mid-2012, in response to increasing uncertainty in global economic markets and in particular a lower demand for zircon, the mining path was moved into a lower grade ore-body north of the mineral processing plant.

This move allowed for the sustainment of full-time mining operations and workforce retention while limiting the amount of heavy mineral concentrate (HMC) produced. The change in mining path required extensive vegetation clearance north and north-east of the existing pit, and stripping and stockpiling of topsoil and overburden resources. The timing of this clearance unfortunately coincided with the high wind season at Jacinth (October – November) and associated issues of wind erosion and dust emissions.

During this period the Jacinth Environment/Rehabilitation Technician was allocated on a full-time basis to manage the dust suppression program. Several major projects are currently in planning phase at time of reporting based on key learnings from this suppression program:

- *RO Plant Upgrade:* The Jacinth Reverse-Osmosis (RO) Plant will be upgraded to provide significantly increased volumes of potable water, including both drinking- and dust-suppression quality water;
- *Chemical Sealants:* Originally used for HMC stockpile suppression, chemical sealants for dust suppression were used in broad acre application during the above clearing and suppression program. Sealant demonstrations were conducted to determine optimum dilution and application rates (Figure 26). Systems allowing rapid batching and blending of sealant into water carts will be installed in 2013 to significantly improve suppression capability on site;
- *HMC Windbreaks*: Two fixed, engineered windbreaks will be installed in 2013 to mitigate wind erosion and mineral drift from HMC stockpiles;
- *Stockpile Sprinkler System*: Installation of a dedicated stockpile suppression system to control mineral erosion.

These projects are programmed for delivery in 2013.

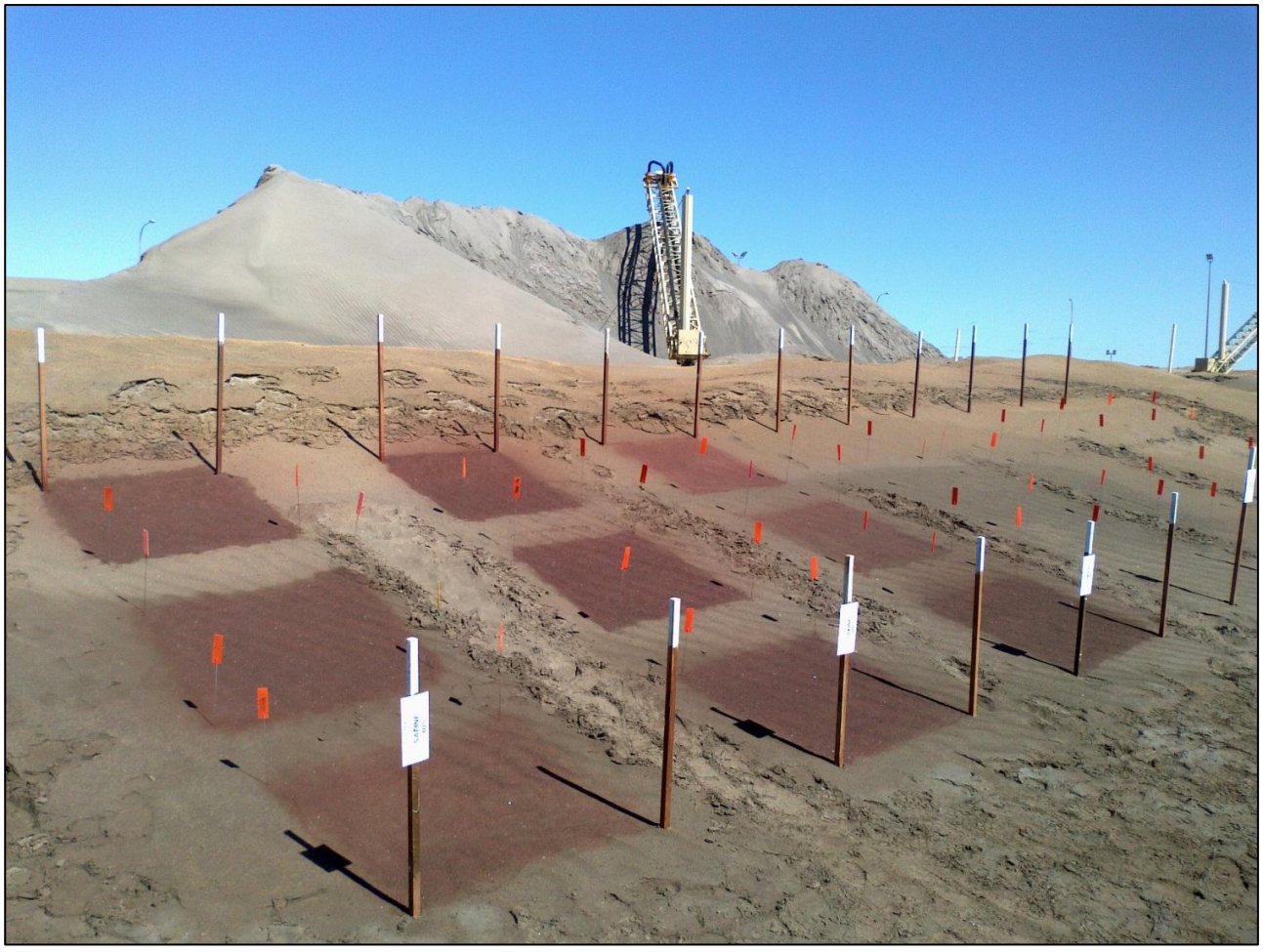


Figure 26 – Sealant demonstration assessing dilution rates, application rates and frequency

5.9 Solid Waste

ML & MPL Outcomes	Criteria	Monitoring Details	Compliance
No demolition, industrial or solid domestic wastes (other than treated sewerage) are to be disposed on site	Site register contains records of all waste movements from site. Audit and inspection records demonstrate waste correctly stored and managed on site (in accordance with *Waste Management Plan*)	Monthly – visual monitoring and inspection: - Appropriate waste disposal and segregation - Inspection of sewage infiltration area Annually – summary of total waste disposed: - Sewage - Chemical waste - Hydrocarbon-contaminated waste - Tyres - Paper/cardboard - Scrap metal - Waste oil and grease - Batteries	Compliant

5.9.1 Measurement of compliance

1) ***Waste Register***: Iluka, via its waste contractor, maintain a register of wastes removed from site.

2) ***Audit and inspection records***: Iluka maintains records of daily, weekly and monthly inspections completed on waste storage, treatment and disposal areas. Waste related issues and incidents are logged using the Iluka LCC reporting system.

5.9.2 Summary of key measurements

Waste Register: Iluka, via its waste contractor, maintained a register of wastes removed from site (volume and tonnes) and issues, e.g. bin contamination. Iluka waste contractor Ceduna Can & Bottle provides monthly waste data/reports for all waste streams, and EPA Waste Transport Certificates for applicable controlled wastes (e.g. hydrocarbon-impacted soils). An example monthly ***Waste Movement Report*** is provided in Appendix 13.6.

A detailed summary of waste movements has not been provided in this report but can be made available upon request.

The total waste generated at Jacinth for the 2012 reporting period was 387.73 tonnes, down by 35.23 tonnes since 2011 (Table 12). Decreased waste volumes reflect reduced operational activity in 2012 as a result of market economic conditions.

Table 12: Waste removed from site by category, by year (Tonnes)

Waste Stream		2009	2010	2011	2012	Total (Tonnes)
Landfill	**Batteries**	0.6	---	0.02	13.86	**14.48**
	Oil-Contaminated Waste [1]	---	---	21	17	**17**
	General Waste	235.35	175.4	209.91	157	**777.66**
	Tyres	10.5	4.5	0.95	1.33	**17.28**
Recycled	**Aluminium Cans**	---	---	0.52	0.75	**1.27**
	Cooking Oil	---	---	0.32	0.37	**0.69**
	Comingled Recycling [2]	21.98	40.04	46	31.31	**139.33**
	Scrap Metal	119	37.3	77.36	40.7	**274.36**
	Timber	---	29.2	7.2	3.41	**39.81**
	Waste Oil & Grease	15.75	2.1	60	63.5	**141.35**
	TOTAL – Landfill	246.5	179.9	231.88	189.19	**847.47**
	TOTAL – Recycled	156.7	108.6	191.08	140.04	**596.42**
		403.2	**288.5**	**422.96**	**329.23**	**1443.89**

[1] Oil-contaminated waste includes contaminated soils, absorbent and rags

[2] Comingled recycling includes paper, cardboard and plastic

Inspection records and reporting: Inspection of waste storage areas were undertaken weekly by Iluka contractor Ceduna Can & Bottle, with issues reported within monthly waste movement records (Appendix 13.6).

Sewage treatment plants were subject to daily inspection during the reporting period as a detailed record of cleanliness, maintenance performed and issues identified (refer example Inspection Log, Appendix 13.7). In accordance with DEH Approvals, discharges from the mine site sewage treatment plant were subject to monthly water quality testing. Records of test results and evidence of compliance can be provided on request.

Site personnel reported 27 incidents relating to waste management and disposal (Figure 27). An increased emphasis on litter during the reporting year is evident in these statistics. The Jacinth environmental team provided ongoing reports on Jacinth waste management performance via Toolbox Meetings, Site Notices and Weekly Updates.

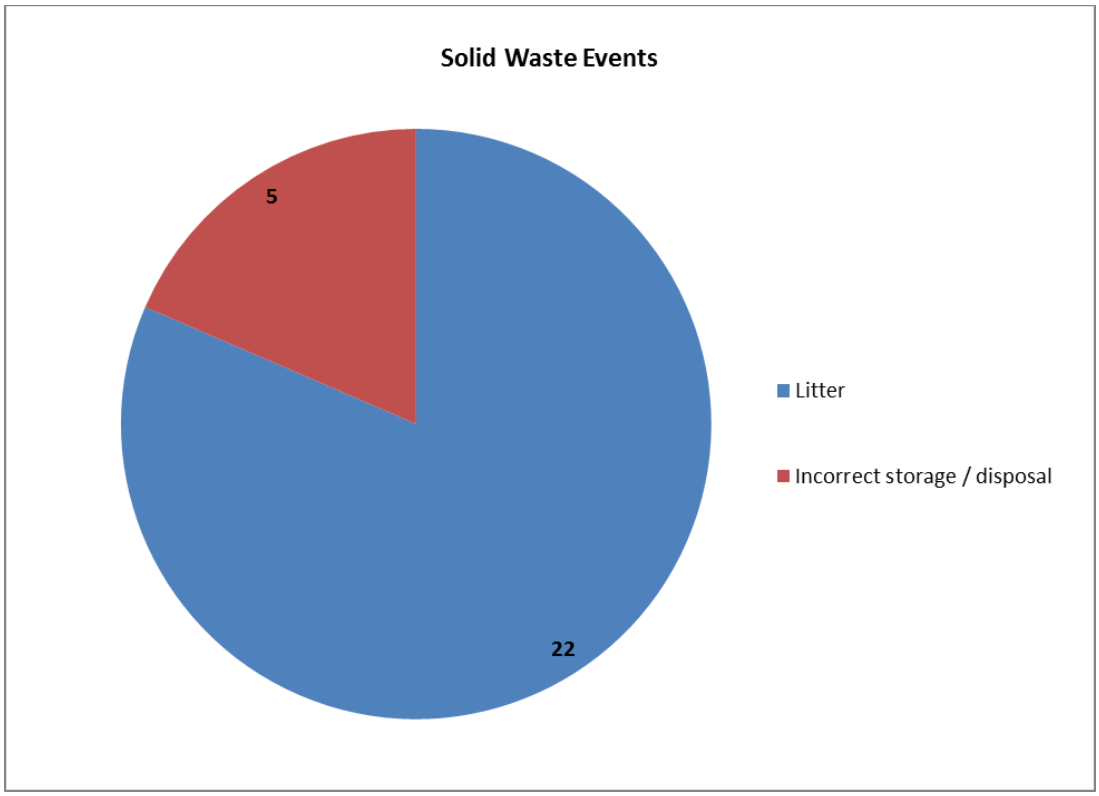


Figure 27 – Solid waste events

5.10 Hydrocarbon and Chemical Storage

ML & MPL Outcomes	Criteria	Monitoring Details	Compliance
Migration or infiltration of any spillage or leakage to the surrounding environment is prevented (in conformance with relevant Environment Protection Authority guidelines).	Demonstrate that facilities are designed in accordance with EPA Guidelines or as otherwise agreed with EPA (via a post construction audit). Records indicate all spills on site are managed in accordance with the *Spill Containment and Clean Up Procedure* (as contained in the Emergency Response Plan).	Visual monitoring: - Incidents (spills) including chemical analysis - Monthly site / facility inspection – preventative action Quarterly desktop review, hazardous chemical register in place and updated	Compliant

5.10.1 Measurement of compliance

1) ***New facilities****:* Post-construction audit of new facilities to ensure compliance with EPA Guidelines. Routine inspection and maintenance of existing facilities are also undertaken to ensure continued compliance.

2) ***Spill management and reporting:*** Timely management and reporting of all spills in accordance with the *Spill Containment and Clean-Up Procedure* and Iluka Environmental Incident and Guidelines. Spill management protocols extent to hydrocarbon, chemical, saline water (other than approved for dust suppression) and effluent. All spills are reported via the LCC system.

5.10.2 Summary of key measurements

New facilities*:* One refrigerated container was installed behind the village kitchen for cold food storage – no EPA guidelines apply to this facility with respect to the prevention of hydrocarbon and chemical spills. No other facilities were constructed or installed during the reporting period.

Spill management and reporting*:* Iluka personnel reported **72** spill incidents in 2012 (Figure 28) involving hydrocarbons, effluent and saline water. No spillage of chemicals or heavy mineral concentrate (HMC) occurred.

Visual monitoring: Preventative inspection of storage facilities and operational areas was undertaken throughout 2012:

- Safety Visits – opportunistic identification of spillage incidents or hazards associated with daily operational activities;
- Daily Borefield and bore-line Inspection – inspection of bore-line infrastructure with emphasis on incidents or hazards concerning saline water management;
- Weekly Planned Workplace Inspections – combined OH&S inspection (refer example, Appendix 13.6) assessing appropriate storage, access to MSDS and emergency response preparedness (e.g. fire control equipment, spill kits);

- Quarterly Hydrocarbon & Chemical Storage Audits – Monitoring conformance of storage facilities to EPA and AS1940-2004 (*Storage and Handling of Flammable & Combustible Liquids*) requirements (refer Appendix 13.9).

Hazchem Register: Registers of hazardous substances and chemicals were maintained electronically via ChemAlert (refer Appendix 13.10).

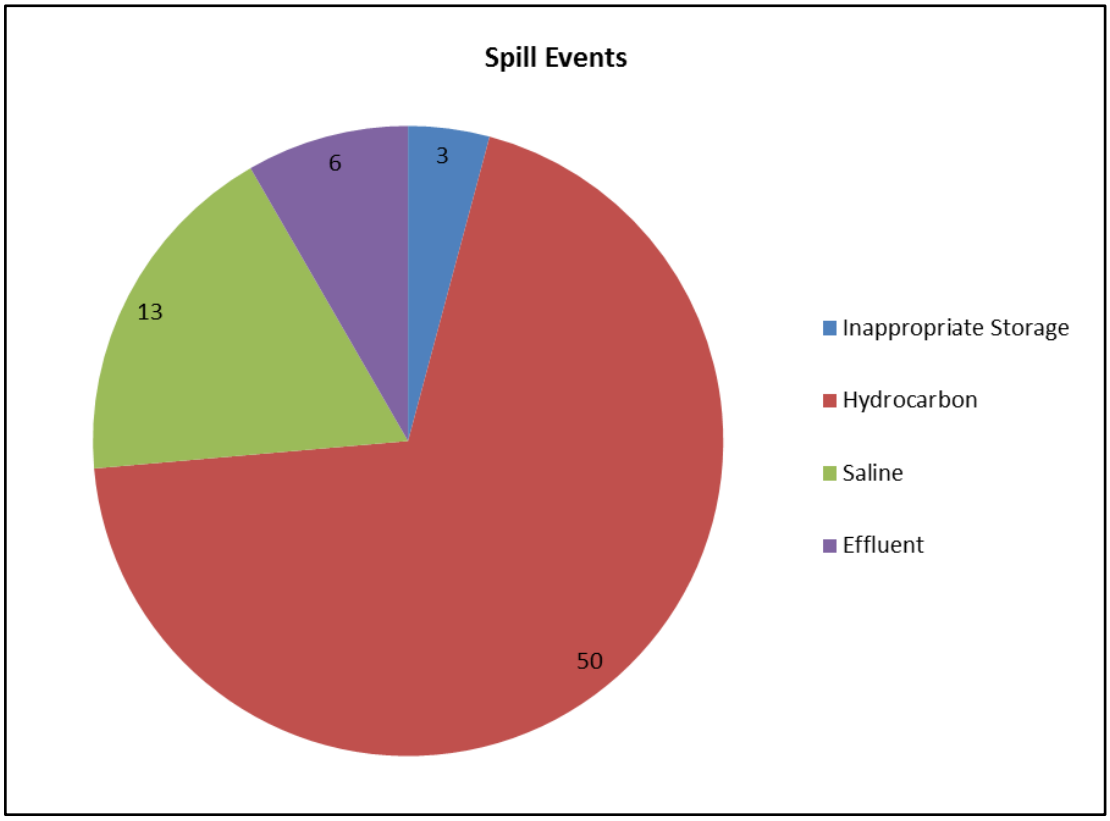


Figure 28 – Spill events reported in 2012

5.10.2.1 Hydrocarbon Spills

Fifty (50) hydrocarbon spills occurred in 2012 and line with previous years accounted for the majority of all spill events.

Significant focus was given to hydrocarbon spill prevention and management linked with contract-penalties and overhaul of the Iluka *Environmental Incident Classifications* in March 2012. The latter provided clear delineation between incident severity based on spill type, extent of impact and timeliness of response. Thus the increased number of spills in 2012 compared to 2011 is a reflection of improved reporting and operational focus rather than a decline in environmental performance.

39 incidents (78%) were minor 'Level 1' events (spills <15 litres and cleaned within one hour) predominantly plant and vehicle hydraulic failures. The remainder were 'Level 2' spills ranked at higher severity having not being ignored or not cleaned within an acceptable timeframe. All soils were collected for off-site remediation and disposal.

A summary of these incidents is provided in Appendix 13.2, Table 20. Copies of LCC incident reports can be provided on request.

5.10.2.2 Effluent Spills

Six (6) effluent spills occurred in 2012 all arising from overflows and mechanical failures at the Jacinth village and mine site wastewater treatment plants. Key events included:

- Jacinth village – overflow of wastewater from the humus float tank. All overflow events coincided with periods of peak camp occupancy (e.g. major shutdowns);
- Mine Site – failure of macerator screw pump causing back-flow of inbound septic waste (Figure 29). Pump fouled with debris.

In accordance with health approvals for these systems incident notifications were submitted to the Department of Health (DEH) on each occasion. A summary of these incidents is provided in Appendix 13.2, Table 20. Full LCC reports can be made available as required.

Figure 29 – Septic overflow from receiving tank and replacement of macerator pump

An engineering review of these systems was undertaken in August 2012. Key findings and outcomes include:

- Jacinth village overflows – humus build-up in draw-off pipe between humus tank and chlorine contact tank (Figure 30). Blockage causing water backflow and overflow of the humus tank. No repeat incidents recorded following implementation of daily plunging and purging program.
- Mine system pump failure – stocking of replacement macerator pumps as critical spares, implementation of weekly pump inspection and installation of trash screens to capture debris and eliminate pump fouling/blockage.

Figure 30 – Plunging and purge of humus draw-off pipe to reinstate normal flow

5.10.2.3 Saline Water Spills

Thirteen (13) saline spill events occurred in 2012 with varied cause including tailings line leaks, tank overflows, process dam liner failure and corrosion/failure of process water and bore-line infrastructure (refer Appendix 13.2, Table 20).

As in 2011, maintenance issues with the Jacinth bore-line and supply system persisted into 2012. Ongoing issues with bore-line pressure fluctuations and corrosion of valves and fittings culminated in two significant and identical bore-line air valve failures (AV4 and AV5) in April and May, respectively. The failure of AV5 on 25th April, as reported to DMITRE, resulted in saline flooding of surrounding vegetation and partial release beyond the adjacent lease boundary. Several root causes were identified through engineering review and ICAM (Incident Cause Analysis Method) and corrective outcomes implemented:

- Bleed ports on air valves worn and corroded due to a combination of physical wear due to pressure testing and corrosion in hypersaline conditions. Install a stand-off piece into the bleed port to allow pressure-testing without constant wear to the bleed port thread;
- Orientation of air valves allowed saline release onto vegetation in the event of bleed port failure. Adjust orientation of air valves to have bleed ports facing the bore-line access road, allowing containment of saline water on the road rather than vegetation, in the event of valve failure;

- Review issues associated with the incompatibility between stainless steel and cast-iron components under hypersaline conditions (anodic/cathodic reaction). Key outcomes:
    - Identify and replace cast-iron components with stainless steel equivalents where corrosion presented a high failure risk – e.g. isolation valves;
    - Trial use of polyethylene air valves;
    - Implement scheduled two-yearly replacement of valves (air valves and scour valves) to reduce the risk of failure;
    - Establish critical spares inventory for bore-line valves and components.

An engineering project to remedy bore-line pressure issues (pigging stations and scale catchment dams) is scheduled for early 2013.

5.11 Public Safety

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
There are no public injuries and or deaths resulting from mine operations traffic, dust generation or unauthorised entry to mine site that could have been reasonably prevented.	Incident investigation report concludes that the incident was not a result of mine operations or could not have been reasonably prevented.	Incident investigation (as required) – incident cause and corrective/preventative actions	Compliant
No uncontrolled fires caused by mining operations.	Incident investigation report concludes that the incident was not a result of mine operations or could not have been reasonably prevented	As above	Compliant

5.11.1 Measurement of compliance

Iluka use Incident Investigation report findings to monitor compliance.

5.11.2 Summary of key measurements

Iluka report no public injuries or deaths, or uncontrolled fires attributed to mining operations for during the reporting period.

5.12 Socio Economic

ML & MPL MARP Outcomes	Criteria	Monitoring Details	Compliance
There are no socio-economic impacts associated with the project that could have been reasonably prevented.	Implementation of closure plan / exit strategy that addresses socio-economic issues	Investigation evidence (records, reports etc.) as required. Monitoring of socioeconomic parameters	To be determined

5.12.1 Measurement of compliance

Closure Plan: Iluka resolves to develop a Socio-Economic Mine Closure Plan, in line with mine operating line, and which specifically addresses socioeconomic parameters. Interim measures of compliance several key indicators 1) Employment, and 2) Community Engagement – Iluka provide data on the number of community visits and the numbers of individuals attending programs.

In 2009, Iluka conducted a Social and Cultural impact assessment that outlined a range of issues concerning the community. An amendment to the MARP on 11 November 2009 included additional commitments relating to consultation with the Far West Coast Native Title Group. Progress is detailed in Table 15.

5.12.2 Summary of key measurements

Closure Plan: Iluka has not yet developed a Closure Plan examining the socioeconomic impacts and associated programs of closure. Stakeholder Relations planning for 2013 has commenced and closure impacts will be included as a discussion point with any relevant activities addressing closure impacts included in the 2013/14 Eucla Basin Stakeholder Relations Plan.

The Jacinth mine is currently in an early operating phase and hence development of the Socio-Economic Jacinth Closure Plan will be undertaken later in the mine operating life cycle when closure commitments and impacts will be better understood.

Employment: Iluka employ 72 people at Jacinth Ambrosia, 15 of which are local indigenous personnel, accounting for 20.8% of the workforce. Local employees from Ceduna and surrounding communities (indigenous & non-indigenous) make up 50% of the workforce (Table 13). In addition, Iluka has appointed a local indigenous person to the position of Community and Indigenous Relations Officer to manage indigenous employment, education and training initiatives at JA, including providing assistance with programs including pre-employment, recruitment and mentoring.

Iluka also provides casual labour hire opportunities to local people (indigenous & non-indigenous). Iluka have up to 6 individuals engaged through a labour hire agency at any one time, with up to 3 being indigenous.

Table 13: Summary of employees at Jacinth – local and other

Iluka Employees	Number	%
Other	36	50
Local non-indigenous	21	29.2
Local Indigenous	15	20.8
Total	72	100

Community Engagement: Iluka held or attended several community events in 2012 to engage over 3500 people from 24 communities (Table 14). In 2012 Iluka participated in Ceduna Oysterfest festival, hosted 300 people from six communities at JA, and reached over 650 children through its Talk in Schools Program and Ceduna Youth Hub Mentor Program.

Table 14: Summary of communities visited and individuals attending Iluka events and programs

Event	2010		2011		2012		Total No. of Individuals, 2010 – 2012
	Communities	Attendance	Communities	Attendance	Communities	Attendance	
Ceduna Oysterfest	1	> 700	1	> 700	1	> 800	**> 2,200**
Cleve field day	1	> 500	---	**---**	---	**---**	**> 500**
Road Train Safety Awareness Program	4	150	---	**---**	---	**---**	**150**
JA Site Visits	10	297	6	281	6	200	**778**
SACOME Education Program	---	---	5	618	---	---	**618**
Scholarship road show	3	260	---	---	---	---	**260**
Talk in Schools Program	---	---	---	---	3	> 450	**> 450**
CYP Mentor Program	---	**---**	---	**---**	1	>200	**>200**
TOTALS	**19**	**> 1,907**	**31**	**> 1,599**	**42**	**1,650**	**5,156**

Table 15: Summary and compliance assessment of socio-economic criteria addressed 2012

Outcomes – Socioeconomic	Criteria	Activities	Compliance
There are no socio-economic impacts associated with the project that could have been reasonably prevented.	Implementation of closure plan / exit strategy that addresses socio-economic issues	To be determined – Relevant closure impacts to be captured in the 2013/14 Eucla Basin Stakeholder Relations Plan.	To be determined
Iluka maintains its focus on providing information support and dialogue with Aboriginal People and agencies in the area through its presence of Human, Community and Indigenous Relations personnel.	Employment of Indigenous Liaison Officer	Employment of fulltime Indigenous Relations Advisor, Community Relations, Human Resources Officer – based in Adelaide office with regular visits to Ceduna, JA and surrounding communities.	Compliant
Iluka communicates community concerns regarding future traffic hazards, including signage and poor lighting to DTEI and the Ceduna Council.		2012 Meetings: Community Meeting (Ceduna), 23/10/12	Compliant
Iluka develop cultural guidelines for all mine staff, including employers and sub-contractors employing Aboriginal people, to ensure respectful work practices are followed.		Cultural guidelines have been developed, implemented across Iluka and all contractors. Respect for Traditional Owners, cultural heritage, sites of significance and the country is one of the Iluka's "Golden Rules" and is enforced by all management at JA (including exploration and corporate staff). Cultural Awareness Training, conducted by local business Iwara Nindini is delivered quarterly to all Iluka staff and contractors who will be employed for a period greater than three months.	Compliant

Outcomes – Socioeconomic	Criteria	Activities	Compliance
Iluka consider developing an information digital story highlighting the relationship, its Agreement process, activities, opportunities and future aspirations for Far West Coast Claimants, School children and government.		SA Works developed Aboriginal employment at JA mine video Developing NTA presentation (for internal use) and fact sheet (for external distribution) Case studies of successful scholarship awardees.	Compliant
Iluka consider developing an interpretive display– to be centrally located i.e. the Aboriginal Arts and Culture Centre or Town centre. The interpretive display could also be used to link the FWC story with the Cultural Awareness training course.		Cultural Awareness Training, conducted by local business Iwara Nindini is delivered quarterly to all Iluka staff and contractors who will be employed for a period greater than three months. Native Title Agreement: establishment of Cultural Heritage fund provides access to funding for all FWC Claimants for cultural events, activities etc.	Compliant
Iluka continue to update the Liaison Committee on potential employment opportunities for FWC people haulage mining and camp services.		All job advertisements distributed to communities by Indigenous Relations Advisor; notification in quarterly Liaison Committee meetings; put in the local paper *The Sentinel* and on Iluka website and seek.com.	Compliant
The FWCNTCG to provide ongoing transparent communication and engagement with Aboriginal communities to keep community members abreast of the Agreement and any outcome of discussions with Iluka Resources.		Regular visits to communities, presentations, awareness road-shows. Quarterly Liaison Committee meetings with Iluka and FWC representatives. Ongoing liaison with FWC Traditional Lands Association. Complaints form and process for the FWCNTCG implemented February 2011.	Compliant

Outcomes – Socioeconomic	Criteria	Activities	Compliance
Consideration be given to providing financial advice and/or counselling to those working at the mine who are interested in good financial management for their family.		Not applicable in 2012	Compliant
Once the mine is stable – from 2010 onwards, Iluka Resources host a series of site visits for community people, including school children, to learn about the mine and Iluka Resources activities.		2012 Site Visits: Community Mine Tour, 20/7/12 Community Mine Tour, 19/10/12 Investor Tour, 8/5/12 DMITRE and EPA Site Visit, 24/10/12	Compliant

6. RECTIFICATION OF NON-COMPLIANCES

6.1 Non-compliance

None applicable

6.2 Action list from 2012 MARCR

Future actions to complete or improve operational outcomes as identified within the 2011 MARCR are listed in Table 16. While these actions do not demonstrate non-compliance they do require resolution.

Table 16: Action List from 2012 MARCR

Item	Due	Status / Comments
Soil management: Iluka to undertake an engineering design review to identify alternative materials for at-risk fittings. Iluka to develop procedure to enable change-out of bore-line fittings that minimises or avoids release of saline water to the environment	2012	▪ **Complete** – full engineering review of the Jacinth bore-line (failure mode analysis) completed. Refer Section 5.10.2.3
Weeds – Iluka to review the achievability of weed management objectives and outcomes specified in the MARP	2013	▪ Major review and update of the Jacinth MARP programmed for 2013. This will include revision and re-negotiation of compliance outcomes and assessment criteria where applicable.
Surface water – achievability of monitoring surface water quality requires review	2013	▪ Major review and update of the Jacinth MARP programmed for 2013. This will include revision and re-negotiation of compliance outcomes and assessment criteria where necessary.
Dust & Air Quality – major review and update of the JA *Air Quality Management Plan*, based on the programs and initiatives outlined below.	2013	▪ To be captured within the 2013 MARP review
Mineral Stockpiles - review of HMC management techniques and strategies including windbreaks, wind-based stockpile orientation and design and dust suppression techniques and materials;	2013	▪ **In Progress** – Project planning underway and programmed for 2013 (windbreaks, stockpile sprinkler system, RO plant upgrade, new water cart and sealant batching/blending systems)
HMC dust – install traps to monitor HMC deposition rates around mineral storage areas	2013	▪ **Complete** – Implemented in 2012. Monthly sampling program.

Item	Due	Status / Comments
Dust & Air Quality / Flora – Trial soil sampling to compare soil salinity, pH and texture against vegetation health and foliage salinity and nominated photo-points.	2013	▪ **Complete**; refer Appendix 13.4 (Dust Monitoring Report)
Radiation – Soil-sample environmental radiation monitoring points to distinguish between background soil radiation levels and levels associated with HMC deposition;	2013	▪ **In Progress –** evaluation of new radiation monitoring equipment (e.g. RS125) for accurate field-based radiation monitoring underway. Review includes development of background vs. impact monitoring program for environmental radiation and links to rehabilitation and mine closure plans.

6.3 DMITRE/DENR Feedback – 2011 MARCR

DMITRE and DEWNR feedback on the Jacinth-Ambrosia 2011 MARCR is summarised in Table 17.

Table 17: DMITRE/DENR Feedback – Iluka MARCR Action List

MARCR	Item	Due	Iluka Response in 2011 MARCR
2010	Is there sufficient understanding of the pre-mining surface water flow regimes to enable re-establishment at mine closure? Provide information on a surface water flow model, groundwater quality and hydraulics, as baseline data, to compare with ecology at mine closure and assist in its rehabilitation.	2011 MARCR	▪ Surface water management plans and designs are being updated in 2013. A J-A Catchment Mining Rehabilitation Plan is currently in draft form (available upon request). ▪ Refer the Iluka Jacinth-Ambrosia Compliance Report and Groundwater Management Plan submitted as a supporting document to the 2011 MARCR. The plan provides a hydrogeological assessment of pre-mining groundwater levels, supported by JARMS 2011
2011	Fauna – suspected double-counting of fauna LCC's and sightings in the 2011 MARCR (data vulnerability)	2012 MARCR	▪ 2011 statistics incorrectly included non-mining related fauna incidents (e.g. public road kill). These are omitted from the 2012 data. ▪ Observations of *non*-significant fauna – misrepresented as fauna 'incidents' under the LCC system, and not involving fauna harm – are omitted from the 2012 data.
2011	Fauna – 2011 MARCR does not clearly demonstrate compliance with the *Prevention of Cruelty to Animals (Animal Welfare) Act and Regulations*.	2012 MARCR	▪ Specifically addressed in Section 5.2.2.2 (Animal Welfare)
2011	Surface water – no demonstrated measures to prevent impact on surface water (emphasis on corrective actions only)	2012 MARCR	▪ Refer Section 5.6.2 – management of bund/launder design and location is linked to Jacinth Mine Plan and coordinated as part of daily production and planning. Identification of bund/launder hazards (e.g. inadequate bunds, missing bunds) are captured via the LCC process.
2011	Groundwater extraction – total drawdown is not a relevant descriptor for this criterion. Need to provide clear comparison of borefield drawdown against the extraction model.	2012 MARCR	▪ Acknowledged – addressed in Section 5.7.2.1 ▪ Review of borefield aquifer model and drawdown (predicted vs. actual) undertaken by Iluka hydrogeology team.

MARCR	Item	Due	Iluka Response in 2011 MARCR
2011	Hazardous chemical register – no evidence that a register is in place	2012 MARCR	▪ Site hazchem registers are maintained electronically via "ChemAlert". Refer Appendix 13.10 for evidence of compliance.
2011	Socio-economic – no evidence of or reference to a closure plan / exit strategy which addresses socioeconomic parameters	2012 MARCR 2013 MARCR	▪ Socio-Economic Closure plan yet to be developed (in line with mine operating life cycle) ▪ In the interim, activities addressing closure impacts to be included in the 2013/2014 Eucla Basin Stakeholder Relations Plan
2010 2011	Weeds – Iluka to review the achievability of weed management objectives and outcomes specified in the MARP	2013 MARCR	▪ Refer Section 13.3. ▪ Major review and update of the Jacinth MARP programmed for 2013. This will include revision and re-negotiation of compliance outcomes and assessment criteria where applicable.
2011	Surface water – achievability of monitoring surface water quality requires review	2013 MARCR	▪ Major review and update of the Jacinth MARP programmed for 2013. This will include revision and re-negotiation of compliance outcomes and assessment criteria where necessary.
2011	New facilities – consider renegotiation of the MARP outcome to capture compliance in design, construction and maintenance	2013 MARCR	▪ Major review and update of the Jacinth MARP programmed for 2013. This will include revision and re-negotiation of compliance outcomes and assessment criteria where necessary.

7. MANAGEMENT SYSTEMS REVIEWS

Iluka's EHS Management System (EHSMS) consists of twelve corporate standards and associated procedures, guidelines, forms and training that describe the minimum requirements for all Iluka operations. The standards are listed below:

1. Leadership and Policy
2. Organisation and Responsibility
3. Communication
4. Contractor Management
5. Risk and Hazard Management
6. Incident Investigation and Reporting
7. Emergency and Crisis Preparedness
8. Procedures and Training
9. Operational Management
10. Environmental Management
11. Monitoring
12. Auditing and Assurance

No external verification audits of the Iluka EHSMS were undertaken in 2012 – in accordance with Iluka policy, external surveillance audits are undertaken every three (3) years with the last external audit conducted in 2011 (refer 2011 MARCR). At time of reporting an updated internal audit schedule was in development – internal audits, focusing on one standard per month, are scheduled for 2013.

8. FITNESS FOR PURPOSE REVIEWS OF PLANT, EQUIPMENT, INFRASTRUCTURE AND OTHER FACILITIES

Guidelines require reviews at least once every five years. Copies of practical completion sign-off records for various infrastructure and equipment have been provided in previous MARCR documents. Reviews will be undertaken when the five-year assessment period has been reached.

9. NEW ENVIRONMENTAL HAZARDS

No new environmental hazards were observed in 2012.

Per the 2011 MARCR, the following environmental hazards, while unrelated to mining activities, may impact on mine rehabilitation success and warrant further investigation:

Atriplex vesicaria (Bladder Saltbush): as described in MARCR 2010. Refer to JARMS 2011, Atriplex vesicaria (Bladder saltbush) health investigation, September 2010.

***Santalum acuminatum* (Quandong):** Refer to JARMS 2011, *Santalum acuminatum* observation.

***Myoporum platycarpum* (False Sandalwood):** similar to above.

10. ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT REPORTING

An EPBC referral was prepared and submitted to the Department of Environment and Natural Resources (DENR) for all aspects of the JA project. DENR subsequently advised that the project was “Not a Controlled Action” under the EPBC Act.

11. OTHER INFORMATION

Nil

12. REFERENCES

1. **EBS Ecology (2013)** *Jacinth-Ambrosia Fauna Monitoring November 2013.* Report to Iluka Resources. EBS Ecology, Adelaide.

2. **EBS Ecology (2013)** *Jacinth-Ambrosia Mine, Vegetation Monitoring Observations, November 2012.* Report to Iluka Resources. EBS Ecology, Adelaide.

3. **SWS (2013)** Graphical user interface for MODFLOW. Schlumberger Water Services. www.swstechnology.com/groundwater-modeling-software/visual-modflow-flex

4. **SKM (2011)** *Jacinth Mine Wellfield Groundwater Modelling – Development of a Groundwater Flow Model and Scenario Modelling*, Project No. VE23472.

13. APPENDICES

13.1 Maps

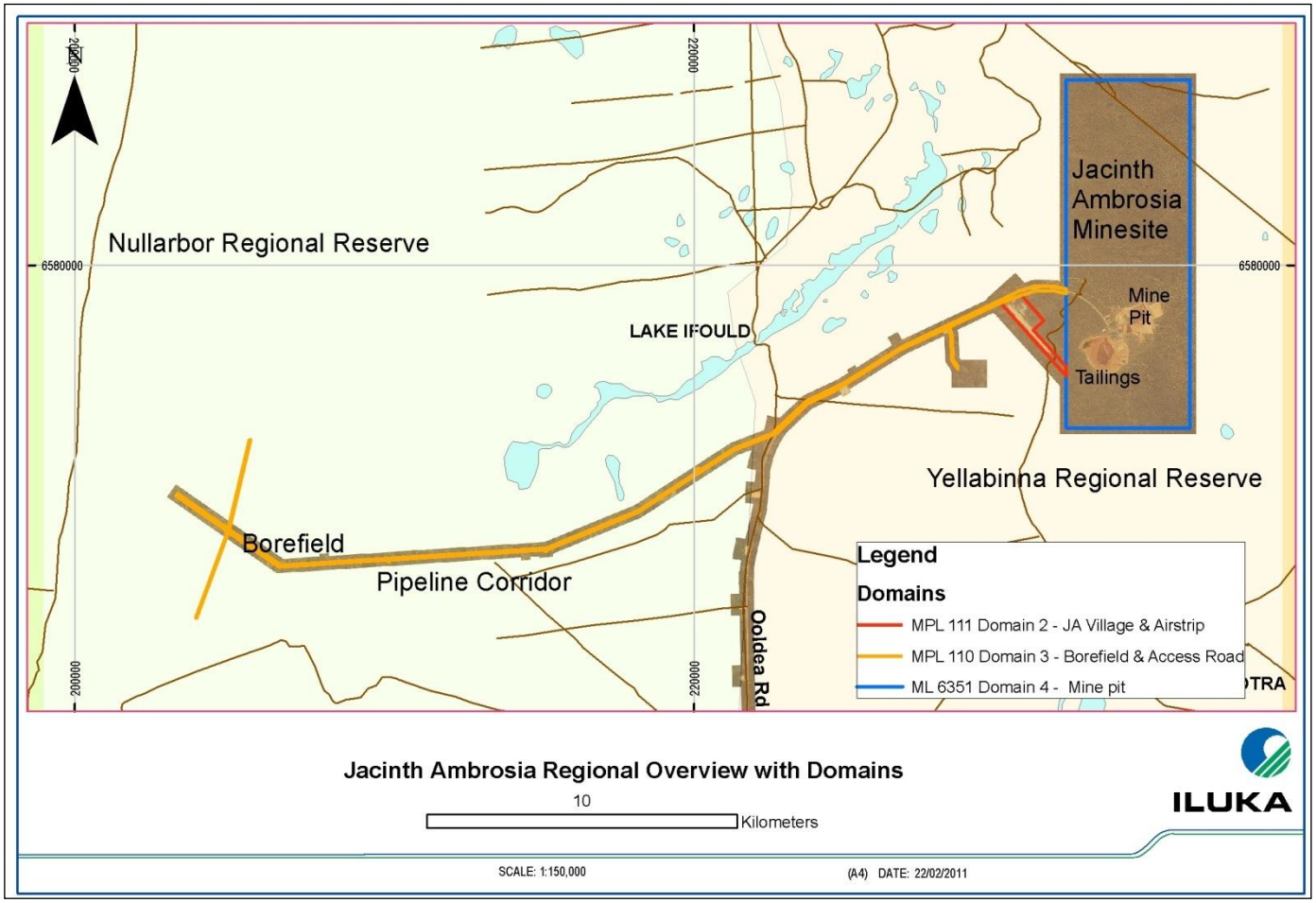


Figure 31 – Jacinth Ambrosia regional overview with domains

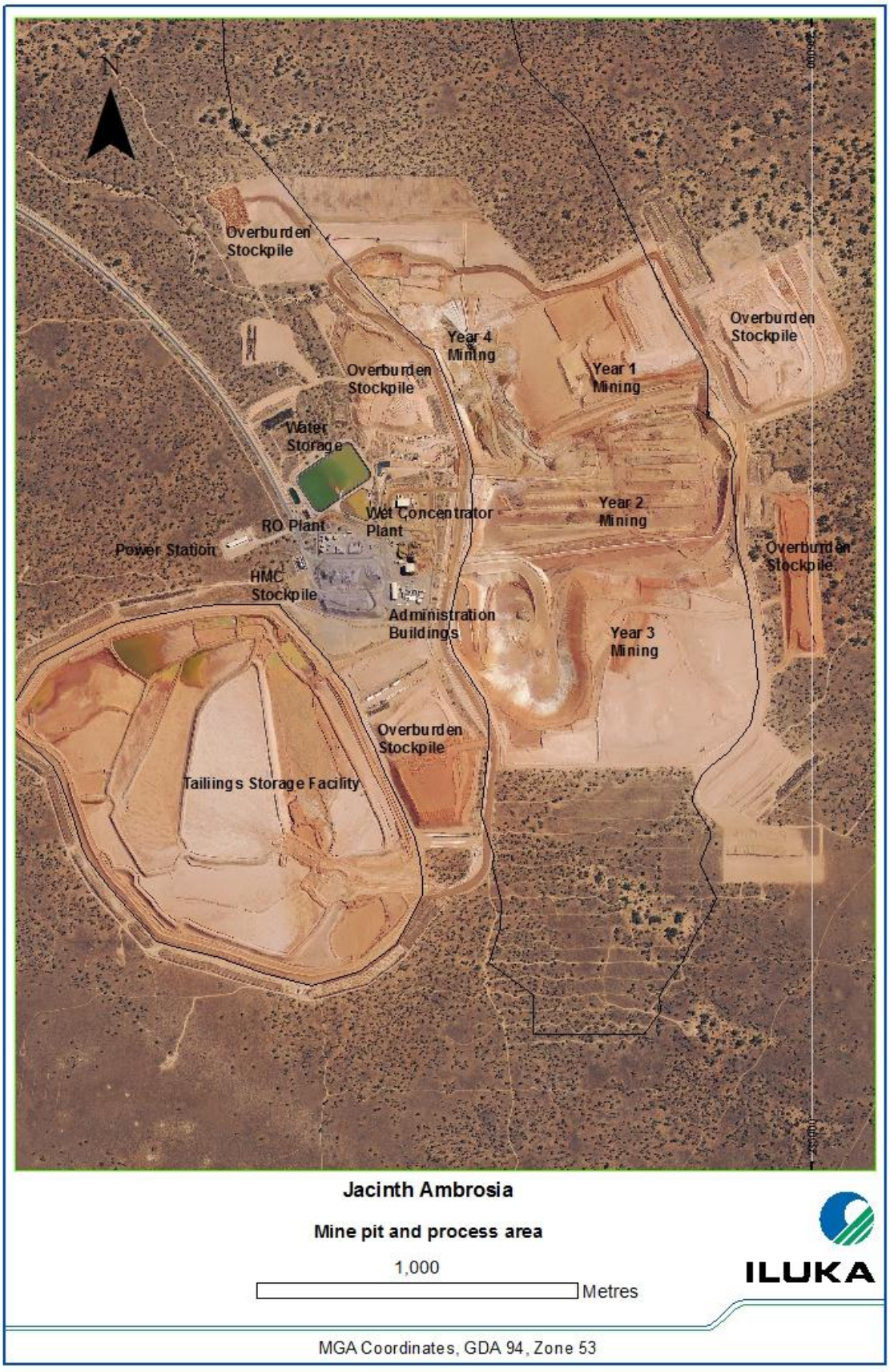


Figure 32 – Jacinth Ambrosia mine pit and process area

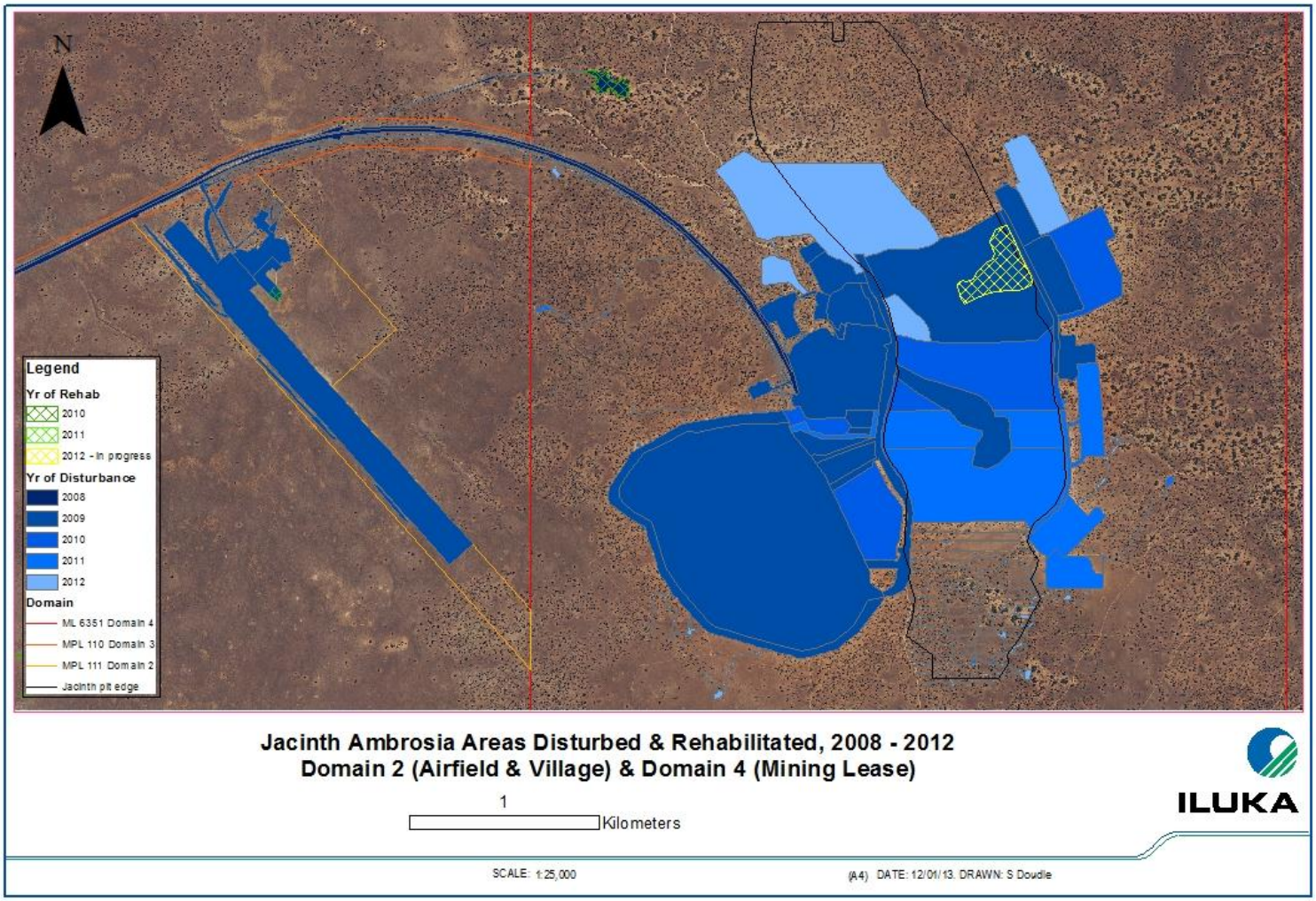


Figure 33 – JA mine site / village disturbed and rehabilitated areas, 2008 – 2012

Figure 34 – Refrigerated container installation – Clearance Permit

13.2 Tables

Table 18: Native flora incidents reported by via LCC, 2012

Report Type	QTY	Date	Details	Key Learning and Strategies
Flora Harm / Damage	1	24/11/2012	Sandalwood at mine camp backed into by light vehicle. Sandalwood is a listed species (vulnerable) Harm only – tree not destroyed.	▪ Upgrade bunding to protect tree ▪ Re-design of village parking layout to better protect remnant vegetation (bunding as demarcation)

Table 19: Native fauna incidents / records reported via Loss Control Card system, 2012

Report Type	Incident #	Date	Details	Action / Outcome
Fauna Rescue	INC128681	10/05/2012	Dingo found in pre-treatment collection pond. Issues with gates being left open and inadequate fencing	Dingo rescued. Contractor mobilised to upgrade existing cyclone fencing with chicken mesh to prevent dingo access through fencing wire.
	INC130138	1/06/2012	1 dead dingo and 2 live dingos in bottom of Turkey Nest	Dingos rescued. Repairs to electric fence.
	INC131164	16/06/2012	Dingo found stranded in borefield Turkey Nest. Animal was stranded for some time and exhausted –	Operator directed animal onto fauna escape matting and dingo escaped. Electric fence was operational but dingo still got through fence. Contractor mobilised to upgrade existing cyclone fencing with chicken mesh
	INC131622	20/06/2012	Dingo caught in borefield Turkey Nest. Not enough escape matting to enable him to get out.	Assisted dingo to escape. Additional rubber fauna escape matting installed.
	INC131569	20/06/2012	Dingo in overflow dam at tanks borefield. Second incident in two days.	Assisted dingo to escape. Additional rubber fauna escape matting installed.
	INC133792	21/07/2012	Dingo in RO Plant pre-treatment pond. Access gate had been left open.	Dingo rescued. Gate self-closing mechanism installed.
	INC120249	26/12/2012	Common bronze wing pigeon trapped inside RO plant sump	Maintenance teams removed mesh screen and released bird

Report Type	Incident #	Date	Details	Action / Outcome
Sick / Injured Fauna	INC143268	21/11/2012	Sick Barn Owl in mine pit – captured by mining contractor and given to environmental staff	Owl monitored for injuries; Adelaide Zoo contacted to discuss symptoms and potential issues. Zoo personnel advised to release Owl in suitable location away from mine site to let nature take its course. Unknown if Owl was sick or injured as a result of mining operations.
Fauna Euthanasia	INC143521	25/11/2012	Dingo hit by dump truck in mine pit and critically injured.	Environmental staff immediately notified. Animal assessed and subsequently euthanized by stunning the dingo with a quick blow to the head, ensuring immediate mitigation of pain and distress to animal. This act was done in accordance with the JA Fauna Management Procedure and *Animal Welfare Act*, achieving immediate humane destruction of the animal.
Fauna Feeding / Non-Compliant Interaction	INC145188	12/12/2012	Contractor feeding dingo's outside administration building	Contractor dismissed from site – non-compliance with Jacinth site rules and *Parks & Wildlife Act.* Site Notice and Toolbox Information Topic distributed. Fixed signage installed regarding prohibition on feeding of dingos.

Table 20: Hydrocarbon and other spill incidents reported via LCC, 2012

Report Type	Incident #	Date	Details	Actions
Hydrocarbon	INC120219	7/01/2012	Small hydrocarbon spill on bare ground next to Lucas fuel trailer	▪ Spill cleaned up ▪ Soil removed for remediation
	INC120214	7/01/2012	Fuel spillage when people are refilling water pump at the bottom of ramp A	▪ Spill cleaned up ▪ Soil removed for remediation ▪ Caution notice issued to operators
	INC120437	11/01/2012	Yakka 1500mm pump over fuelled	▪ Spill cleaned up ▪ Soil removed for remediation
	INC120443	11/01/2012	Diesel spill at Cell 1 pump, diesel overfilled and run into water pond	▪ Spill cleaned up ▪ Soil removed for remediation
	INC120906	18/01/2012	Oil spill outside of power station – date of occurrence and cause unknown. Amount < 1L	▪ Spill cleaned up ▪ Soil removed for remediation
	INC121115	20/01/2012	Fuel trailer tank split TR16 spilling fuel	▪ Fuel in trailer tank decanted to truck to prevent further spillage ▪ Spill absorbents applied ▪ Soils removed for remediation

	INC121459	25/01/2012	Several hydrocarbon stains noticed near B class pond pump	▪ Soil removed for remediation ▪ Engineering request submitted to replace diesel pump with electric pump to eliminate further risk
	INC123226	17/02/2012	Oil spill (less than 15L) on ground in front of Day Crew Dome from IT loader right front wheel	▪ Spill cleaned up ▪ Soil removed for remediation
	INC124132	28/02/2012	Diesel spill on Haul Rd (Ooldea Rd)	▪ Spill cleaned up ▪ Soil removed for remediation
	INC124196	29/02/2012	Oil leak on hydraulic pump about 5 litres of oil	▪ Spill cleaned up ▪ Soil removed for remediation
	INC125015	10/03/2012	Inspection found diesel spill HMC load area	▪ Spill cleaned up ▪ Soil removed for remediation
	INC124985	10/03/2012	Diesel was leaking from meter on pump from Exact service cart and was not cleaned up	▪ Spill cleaned up ▪ Soil removed for remediation ▪ Fuel nozzle repaired
Hydrocarbon	INC125278	15/03/2012	Old hydrocarbon spill found at MB11 (monitoring bore 11) by exploration.	▪ Spill cleaned up ▪ Soil removed for remediation
	INC125412	16/03/2012	Hydraulic hose split in Kalari loader	▪ Spill cleaned up ▪ Soil removed for remediation ▪ Hydraulic hose replaced
	INC125712	21/03/2012	TSF decant pump leaking oil out of dip stick	▪ Spill cleaned up ▪ Soil removed for remediation ▪ Pump tagged out of service for repair/maintenance
	INC126454	1/04/2012	Hydrocarbon leak from blue pump at standpipe	▪ Spill cleaned up ▪ Soil removed for remediation ▪ Pump tagged out of service for repair/maintenance
	INC126868	8/04/2012	Hose on dump truck failed causing spill to ground	▪ Spill cleaned up ▪ Soil removed for remediation ▪ Hydraulic hose replaced
	INC126875	8/04/2012	Hydrocarbon spill (grease/oil) on ramp B-entrance. Grease patches from grease gun servicing.	▪ Spill cleaned up ▪ Soil removed for remediation
	INC127569	21/04/2012	Grader had minor hydraulic spill with blown hose	▪ Spill cleaned up with mini digger ▪ Soil removed for remediation
	INC127795	25/04/2012	Testing equipment on fire truck had leak out of hydraulic line split 100ml of hydraulic oil on ground	▪ Spill cleaned up ▪ Soil removed for remediation ▪ Hydraulic line repaired
	INC127868	26/04/2012	Oil spill under skid steer loader - approx. 10-15 litres	▪ Spill cleaned up ▪ Soil removed for remediation ▪ Loader maintenance

	INC127956	28/04/2012	Service cart leaking hydrocarbons onto bare grounds (small amount) at Cell 1	▪ Spill cleaned up ▪ Soil removed for remediation
	INC128414	7/05/2012	Telehandler has faulty line (diesel) and un-driveable. Spill kit applied	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Inspection and service completed
	INC128582	9/05/2012	Hydraulic oil leak from EWP	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Hydraulic hose replaced
	INC129749	26/05/2012	Sump plug on lighting plant leaking	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Inspection and service completed
	INC130719	9/06/2012	Noticed oil residue sitting on top of puddle of water	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation
	INC130806	12/06/2012	Hydraulic leak from cable reeler; Fitting blown spilling Hydraulic oil on ground - Approx. 250ml.	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Hydraulic hose replaced
	INC131549	20/06/2012	Blown hydraulic hose on IT loader	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Hydraulic hose replaced
Hydrocarbon	INC131718	22/06/2012	PC1100 parked on bench with hydraulic fluid leaking from bucket ram pooling on ground	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Inspection and service completed
	INC132528	3/07/2012	10L diesel spilt at Go-line over flow on dump truck	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Inspection and service completed
	INC132775	6/07/2012	Oil leaking from hose on PU001 - gear box to cooling fan	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Inspection and service completed
	INC133733	20/07/2012	Blew a hydraulic hose on the IT loader	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Hydraulic hose replaced
	INC134883	2/08/2012	Diesel spill observed at B class pump. Approx. 2 litres onto bare ground	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation
	INC135172	6/08/2012	Hose blew on 45E digger. Small amount of oil (approx. 2L) spilling on ground.	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Hydraulic hose replaced
	INC135202	6/08/2012	Contractors refuelling nozzle when in operation produces a small steady stream/leak	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Drip tray system implemented

	INC135565	11/08/2012	Fuel spilled on ground at dozer refuel point (back of push) less than 5L	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation
	INC135697	14/08/2012	Contaminated soil skip bin over filled one end spilling on ground in compound area	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Bin emptied by contractor
	INC135763	14/08/2012	Slow diesel leak from valve on edge of bund on the diesel storage tank filling area. Leak contained in bund	▪ Valve repaired
	INC137097	2/09/2012	D10 leaked oil on Ramp A	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation
	INC137599	9/09/2012	Diesel or hydraulic spill at top of spine	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation
	INC138270	20/09/2012	Seal failure at B-class water pump - oil leak onto ground	▪ Soil removed for remediation ▪ Engineering request submitted to replace diesel pump with electric pump to eliminate further risk
Hydrocarbon	INC139559	7/10/2012	While training on the excavator, diesel leak was detected	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Inspection and service completed
	INC140511	21/10/2012	Truck pulling trailer 77028-S left puddle of oil approx. 5L. Trail of oil on village access road to haul road.	▪ Applied absorbent and cleaned ▪ Contractor driver notified of issue and requirements to address spills
	INC141960	7/11/2012	Hydraulic hose split on day crew IT	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Hydraulic hose replaced
	INC142732	18/11/2012	Spilt diesel from motor with split fuel filter	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Inspection and service completed
	INC143505	25/11/2012	Hydraulic hose on MUP ruptured during MUP move resulting in approx. 30-40 L of hydraulic fluid to bare ground	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Inspection and service completed
	INC144271	1/12/2012	Blown hydraulic hose on water cart	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation ▪ Hydraulic hose replaced
	INC146002	26/12/2012	Oil trace from west side Iluka workshop till stop sign screens	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation
	INC145978	26/12/2012	Oil cap left off of motor after topping up with oil. Approx. 1 litre of oil spilt	▪ Spill kit applied and spill cleaned ▪ Soil removed for remediation
	INC146080	28/12/2012	Sykes pump leaking diesel on to ground due to being over full on un-level ground	▪ Spill on hardstand surface – absorbent applied and disposed to contaminated soil bin

Inappropriate hydrocarbon / chemical storage	INC123348	19/02/2012	Pallet of 20L hammer oil drums not stored in a bunded spill area or on a spill pallet	▪ Contractor notified ▪ Spill pallet sourced and drums stacked appropriately
	INC133549	18/07/2012	Waste oil left in small drum. Not emptied into waste oil storage drum.	▪ Drum residue decanted to storage drum
	INC142333	12/11/2012	3 buckets with oil on the ground outside power station without drip trays	▪ Drums moved to waste transfer station for spill pallet storage pending collection for oil recycling
Saline	INC122755	13/02/2012	Transfer pumps 142 and 143 leaking (leaking on bore infrastructure area)	▪ Maintenance technicians notified ▪ Repairs completed
	INC122743	13/02/2012	Borefield Rd-valve AV28 leaking bore water onto road	▪ Maintenance technicians notified ▪ Repairs completed – valve wrapped with fibreglass bandage to mitigate leak
Saline	INC124118	28/02/2012	PU143 had a substantial leak around the vitolic coupling. As a result it was deemed to be out of service except for in an emergency.	▪ Pump tagged out-of-service and isolated ▪ Pump repaired
	INC125275	15/03/2012	Inspection of fence found that there is water under liner of process dam.	▪ Inspection identified water between top and bottom liner ▪ Dewatering hoses installed and water pumped out ▪ Seepage monitoring commenced along dam walls downstream of liner fault ▪ Liner repaired
	INC127113	11/04/2012	Expanding wet saline soil area developing on SW corner of turkey nest #7	▪ Seepage monitoring implemented
	INC127965	28/04/2012	AV5 blown out pouring water onto road and surrounding vegetation	▪ Maintenance technicians notified ▪ Air valve isolated and tagged out-of-service ▪ DMITRE notified ▪ ICAM investigation completed – suite of corrective actions implemented
	INC129174	19/05/2012	Borefield bore #11 discovered with puncture in side of isolation valve; spilling large amount of saline water onto turkeys nest #11 and adjacent road	▪ Maintenance technicians notified ▪ Bore pump isolated to shut off flow ▪ Repairs completed – valve wrapped with fibreglass bandage to mitigate leak ▪ Pump tagged out-of-service. New pump casing installed.

	INC129177	19/05/2012	AV4 air-bleed valve failed spilling saline water near boundary of mining lease	▪ Maintenance technicians notified ▪ Air valve isolated and tagged out-of-service ▪ ICAM investigation completed – suite of corrective actions implemented
	INC131631	20/06/2012	Saline water leak from broken valve at pre-treatment plant turkeys nests	▪ Maintenance technicians notified ▪ Valve tagged out-of-service, and valve replaced
	INC132888	9/07/2012	Two leaks in pipeline in mine pit. One minor, the other substantial. No impact to vegetation	▪ Tailings line isolated ▪ Lines repaired
	INC134389	30/07/2012	Both feed valves at TSF Modcod line change area are leaking. No impact to vegetation	▪ Tailings line isolated ▪ Lines repaired
Saline	INC144099	29/11/2012	Field water tank overflowed during night shift. Tank level probes did not operate automatically – tank was being fed by groundwater wells.	▪ Dewatering wells turned off to eliminate further overflow ▪ Tank pump auto-sequence reviewed and fault corrected ▪ Water overflow was contained to the tailings line corridor and haul road (already saline due to dust suppression program)
	INC146184	31/12/2012	Leak developed at the bore field pump station, running onto road and vegetation	▪ Maintenance technicians notified ▪ Pump station isolated ▪ Earthen bund erected to prevent further flow of saline water onto vegetation area ▪ Pump repaired ▪ Water flow impacted a small area of naturally rehabilitated land along the previously disturbed power line corridor
Effluent	INC126481	1/04/2012	Overflow of village waste water treatment plant on the 25th & 31st of March	▪ Notification to DEH ▪ Trialled closure of laundry facility during major mine shutdown to assess impacts on treatment plant ▪ New float tank installed in line with size and flow volumes through plant ▪ Water engineer engaged to review plant performance and issues ▪ Implemented purging of humus draw off pipe to re-instate normal flows. No repeat incidents since this program commenced.
	INC128380	7/05/2012	Waste water overflow at village waste water treatment plant	
	INC134110	26/07/2012	Mono pump failure at Exact Waste Water Treatment Plant causing overflow of raw septic. Repeat incident.	▪ Maintenance notified ▪ Mono pump immediately replaced ▪ Engineering review to identify alternative pump systems

	INC126847	7/04/2012	Overflow of septic tank at Exact WWTP	
	INC145410	17/12/2012	Septic waste overflow at Exact waste water plant-failure of mono screw pump	
	INC134383	30/07/2012	Pump truck contractor spilled small amount of effluent (approx. 5 L) at Village waste water plant	▪ Spill cleaned and material cycled back through waste treatment plant ▪ Contractor prohibited from site / work with Iluka

13.3 Weed Mapping & Management Program 2012

Samantha Doudle, Shane Doudle, Con Miller, Kerry Saunders
Iluka Resources Ltd, Jacinth Ambrosia Mine

13.3.1 Key Points

- Extremely low rainfall at J-A during the latter half of 2012.
- 621.8 ha of land have been disturbed by mining related activities of which 436.24 ha are considered to have potential to host weeds if a seed source became available. In 2012 weed management was required on 11.64 ha, as compared to 24.74 ha in 2011.
- The reduced area managed is largely as a result of the drought conditions over the latter half of the year.
- Recorded weed diversity decreased from 15 species in 2011 to seven species in 2012. There were no new species recorded.
- Two Buffel Grass plants were found and managed, one at the camp and the other adjacent the Haul Road near the turn off to Oak Valley.

13.3.2 Background

The background to the J-A Weed Mapping and Management Program is well documented in past MARCR reports. Refer to MARCR 2011 for further detail.

13.3.3 2011 Seasonal Conditions

After three years of above average rainfall at J-A the 2012 annual rainfall was extremely low with approximately 91.8 mm falling during the year (recordings from Jan to June Tarcoola, recordings from July to December JA actual). The winter months received 15.6 mm, most of which fell in June. From July to December J-A received only 13.6 mm (Figure 35).

NB: The only relevant long term rainfall data set for J-A is the compilation of data from Tarcoola, approximately 230 km NE of J-A: Tarcoola Aero (Station 016098), from October 1997 to present) and Tarcoola (Station 16044), from 1904 to 1999.

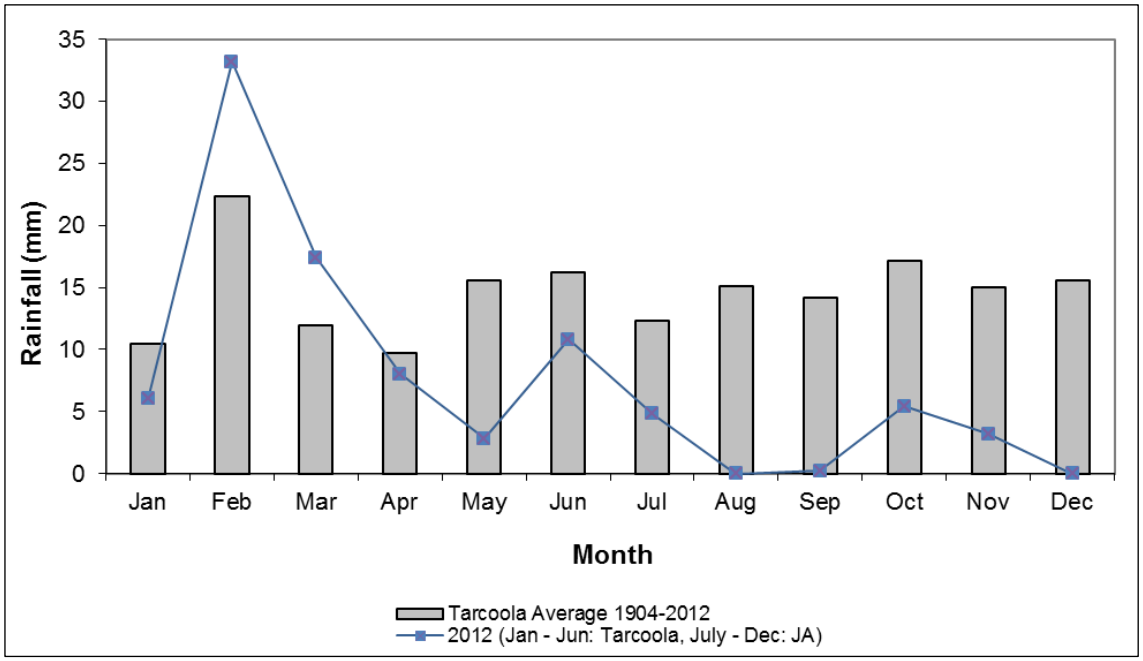


Figure 35 – Tarcoola historical monthly rainfall records and J-A 2012 actual rainfall

13.3.4 2011 Key Learnings

High rainfall in February triggered a wide spread weed germination. Fortunately this was followed by a period of very high temperatures while the weeds were still around the two-leaf stage and they were killed on masse. This event was of great benefit to the weed management program, reducing the size of the weed seed bank and allowing a huge weed kill across the landscape without the management team needing to do anything.

In 2011 a similar germination occurred in February however environmental conditions were such that the weeds were able to grow to maturity.

13.3.5 2011 JA Weed Diversity and Distribution x Domain

Weed species, abundance, location and management were recorded for all areas managed during 2011 using a Trimble Nomad or Yuma and ArcPad software. Records were maintained in the GIS data base and that data forms the basis of this report.

The J-A weed mapping and management program is prioritized on two levels;

- Location: the landscape types most prone to weed invasion are the highest priority areas. The three highest priority landscape types are rehabilitation areas, soil stockpiles and areas with frequent offsite vehicle movement (Figure 36). All weed species will be managed in these high priority areas, regardless of weed type priority.
- Weed Species; the weeds of highest management priority are Buffel Grass, Ruby Dock, Horehound, Onion Weed and Iceplant. These weeds will be managed across all high and medium priority landscape types. They will also be managed on low priority landscape types if they occur in an area that has the potential to influence mining operations, e.g. transport corridor.

Within the MARCR reporting area (Domains 2, 3 and 4) approximately 621 ha of land have been disturbed by mining related activities and 436.24 ha have been identified as having potential to host weeds if a weed seed source became available. During 2012 the majority of the highest risk area was checked on several occasions and weed management activities were required over 11.64 ha (Table 21).

Recorded weed diversity decreased from 15 species in 2011 to seven species in 2012 and none of these were newly recorded species. The three most common and widely distributed weeds continue to be Wild Turnip, Ward's Weed and Milk Thistle.

The weed species of greatest concern continue to be the records of individual Buffel Grass plants, one near the Oak Valley turn off and one at Camp. The potential threat of both of these species was discussed in the 2010 MARCR.

Further details of the 2012 JA weed management and mapping program have been analysed for each Domain and are presented below.

13.3.5.1 Domain 4 – Mining Lease

Of the 4,500 ha in the J-A mining lease, 437.2 ha have been disturbed by mining activities and 275.75 ha have been identified as having potential to host weeds if a weed seed source became available (Figure 36). All high priority management areas were checked in 2012, most of multiple occasions, and of the potential 275.75 ha, 11.6 ha actually required weed management (Table 22). The majority of weed management was required in soil stockpiles areas (B 1-5) and other disturbed areas around the pit (D1-3).

Mapping and surveys since 2005 have recorded 22 weed species occurring in the mining lease. In 2012 only 6 species were recorded, none of which were high priority weeds and none of which were new recordings for the domain (Table 23).

13.3.5.2 Domain 3 – Borefield & Haul Rd

Within the borefield and haul road domain 134.3 ha have been disturbed by mining related activities and 132.77 ha have been identified as having potential to host weeds if a seed source became available (map not shown). A total of 3.8 ha of turkey's nests were rehabilitated on the borefield in 2012 and these became a high priority landscape type (A1) for management. Despite the priority, only 0.03 ha required weed management as a result of the drought (

Table **25**). The roads leading to the borefield are a lower priority landscape type (E5) and were not checked or managed in 2012, except for one occurrence of Buffel Grass managed at the Oak Valley turn off (

Table **24**). The area was intensively managed to ensure a Buffel Grass seed source is not able to establish near the main haul road to the mine.

13.3.5.3 Domain 2 – Airfield & Village

Within the airfield and village domain 50.6 ha have been disturbed by mining related activities and 27.73 ha have been identified as having potential to host weeds if a weed seed source became available (Figure 37). Of a potential area of 27.73 ha, 1.53 ha actually required weed management (Table 21). No new species were recorded, however Buffel

Grass was found in a different location to where it occurred at the camp in 2010 (Table 26). The plant was removed and the area scalped of soil.

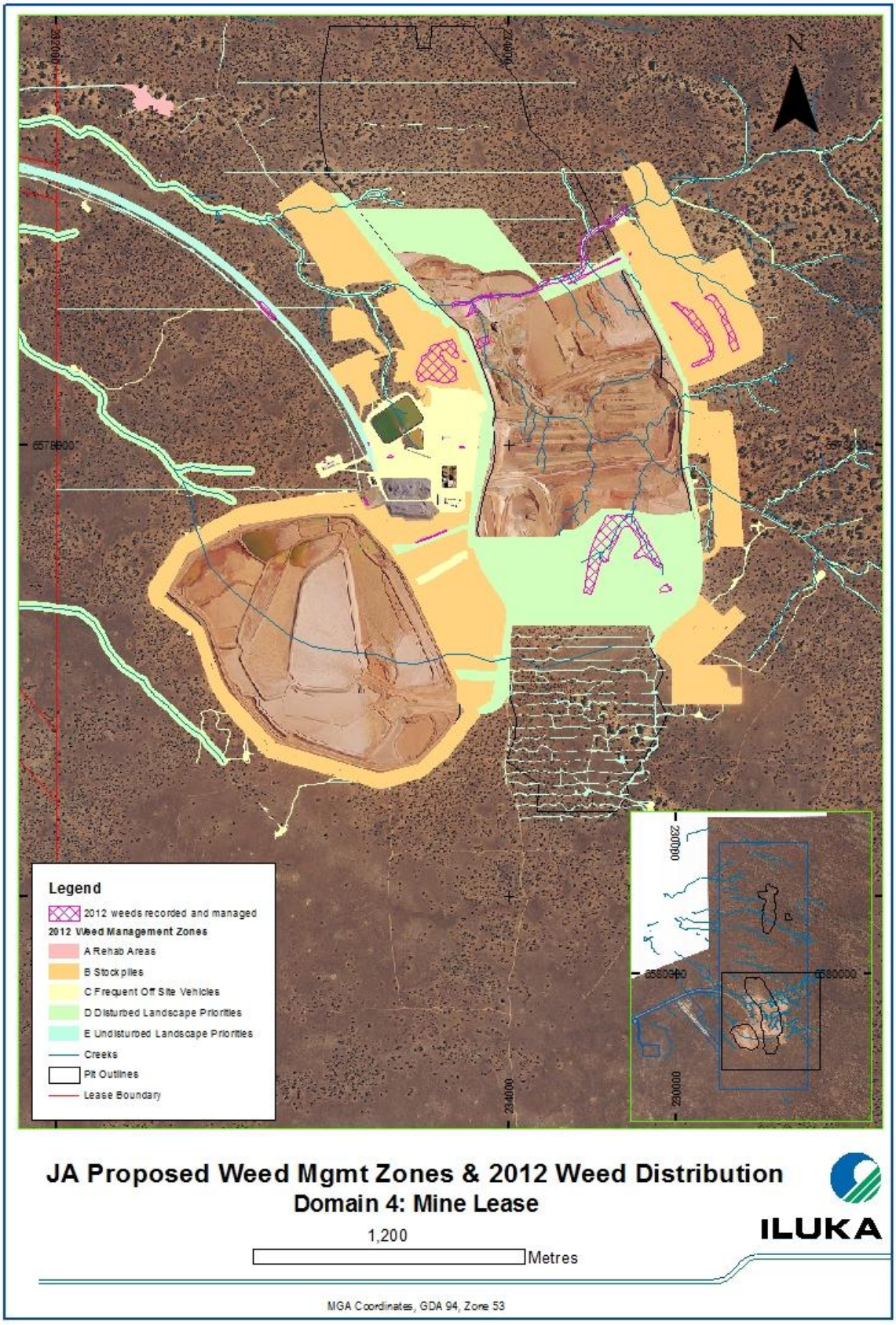


Figure 36 – Weed priority zones and weeds controlled in 2011, Domain 4, southern end

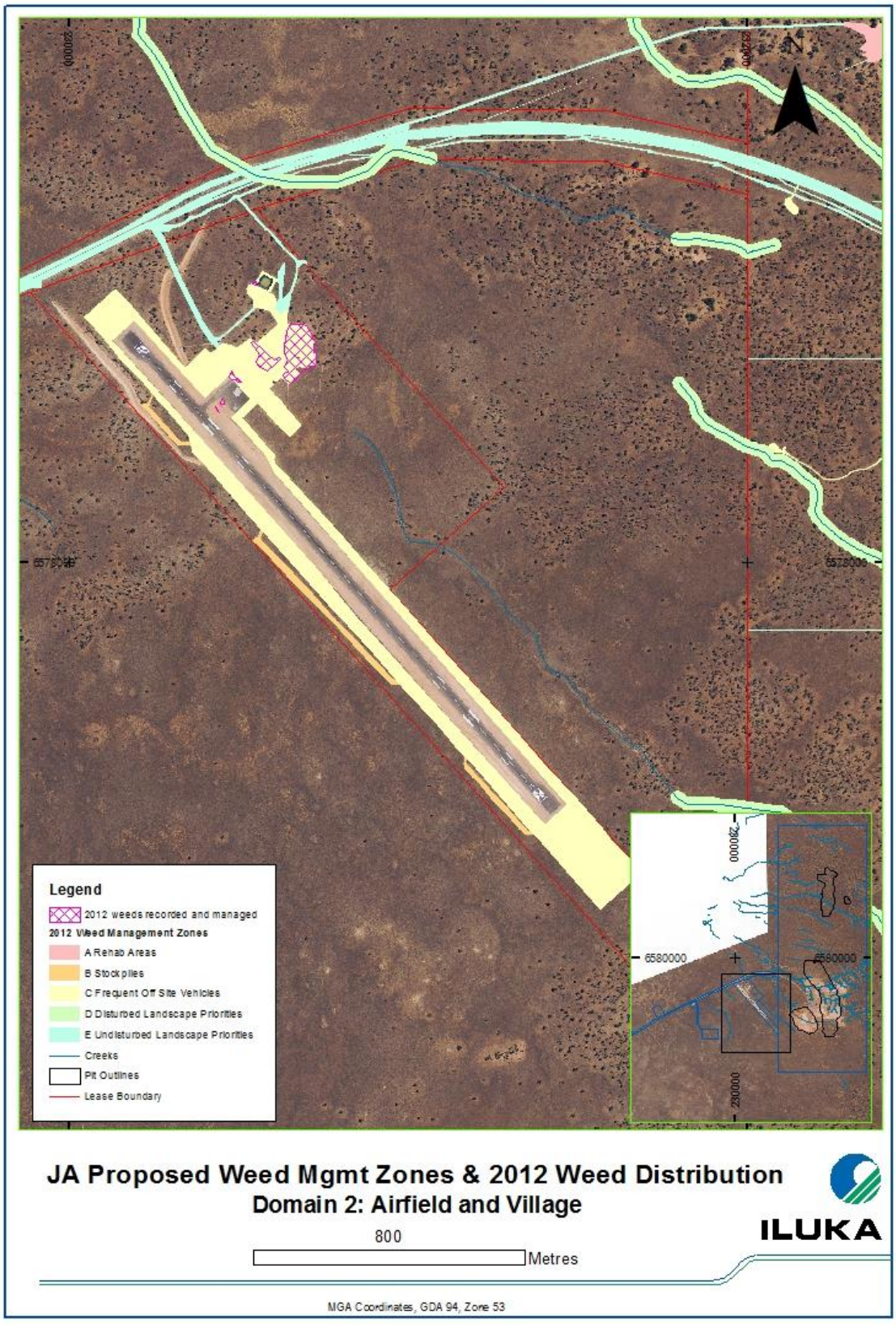


Figure 37 – Weed priority zones and weed controlled in 2012, Domain 2

Table 21: J-A weed management 2012 summary, Domains 2, 3 and 4

Zone	Priority	Description	Weed Potential Area 2012 (ha)	Area managed 2012 (ha)	% of potential area requiring 2012 mgmt
A Rehab Areas	A 1	Early (1-5 years...depending on seasonal conditions)	10.15	0	0%
	A 2	Mid (5-10 years) (after plant & BSC re-establishment		n/a	n/a
	A 3	Late (10+ years) (leading to closure)		na	n/a
B Soil Stockpiles	B 1	Topsoil stockpiles	12.06	0	0%
	B 2	Vegetation stockpiles	3.35	0	0%
	B 3	Subsoil stockpiles	12.33	0	0%
	B 4	Overburden stockpiles	36.08	3.90	11%
	B 5	Disturbed areas between stockpiles	62.65	0.00	0%
C Areas with frequent offsite vehicle movement	C 1	HMC Pad	0.80	0.01	2%
	C 2	Car Parks @ Process Plant & Camp	19.69	1.55	8%
	C 3	Laydowns	2.73	0.13	5%
	C 4	Monitoring areas – bores, dust traps, etc	25.43	0.00	0%
D Other areas where weeds occur in disturbed areas	D 1	Advance cleared areas	55.09	3.75	7%
	D 2	Haul roads & tracks adjacent and within pit	18.69	0.22	1%
	D 3	Creeks in the mine path	4.14	1.85	45%
	D 4	Creeks upstream of creeks removed in mine path	12.31	0.00	0%
	D 5	Creeks downstream adjacent currently disturbance	11.32	nc**	n/a
	D 6	Creeks downstream of mine path and disturbance	18.96	nc	n/a
E Roadside and haul roads	E 1	Exploration tracks in mine path	9.74	nc	n/a
	E 2	Exploration tracks near current or future disturbance	Nm*	nc	n/a
	E 3	Haul Rd - Tank Farm 1 to Camp Turn off	30.99	0.00	0%
	E 4	Haul Rd - Camp to Process Plant	18.75	0.20	1%
	E 5	Borefield Road	61.66	0.03	0%
	E 6	Ooldea Rd Nth	9.32	nc	n/a
	E 7	Ooldea Rd South	nm	nc	n/a
	E 8	Exploration tracks elsewhere	nm	nc	n/a
F Other areas where weeds occur in undisturbed areas	F 1	Lake Ifould	nm	nc	n/a
	F 2	Dune	nm	nc	n/a
	F 3	Wombat/Rabbit Holes/Depressions	nm	nc	n/a
		TOTALS	**436.24**	**11.64**	**3%**

*nm = not measured; ** not checked.

Mgmt Priority	Weed Target	# Visits Target
High	Zero	At least 3 (early, mid & late)
Medium	Minimise	2 only (early & mid)
Low	Reduce seed set	1 only, mid-season

Table 22: Weed diversity summary 2012, Domains 2, 3, 4

MARCR Reporting Area Summary: Mine Lease, Camp, Access Rd, Borefield Rd		**Yr Registered**					
Common Name	***Scientific Name***	2012	2011	2010	2009	2008	2005-06
Wards Weed	*Carrichtera annua*	X	X	X	X	X	X
Turnip	*Brassica tournefortii*	X	X	X	X	X	X
Oats - domestic[1]	*Avena sativa*			X			
Canola	*Brassica napus*						
London Rocket	*Sisymbrium sp*		x	X	X		
Milk Thistle	*Sonchus oleraceus*	X	X	X	X		
Barley Grass	*Hordeum sp*		x	X	X		
Wild Oats	*Avena sp*		x	X	X		
Iceplant	*Mesembryanthemum crystallinum*		x	x			
Ruby Dock	*Acetosa vesicaria*		x	X			
False Sowthistle	*Reichardia sp*	X	X	X	X		
Horehound	*Marrubium vulgare*						
Fleabane	*Conyza sp*	x	x	X	X		
Cape Weed	*Arcotheca calendula*	x	x	x			
Buffel Grass	*Cenchrus ciliaris*	x		x			
Saffron Thistle	*Carthamus lanatus*			x	X	X	
Blackberry Nightshade	*Solanum nigrum*			x			
Wild Lettuce	*Lactuca serriola*			x			
Rye Grass	*Lolium sp*		x	x			
Wild Radish	*Raphanus raphanistrum*			x			
Onion Weed	*Asphodelus fistulosus*						
Couch	*Cynodon dactylon*			x			
Fat Hen	*Chenopodium sp*		x	x			
Medic	*Medicago sp*		x	x			
Lincoln Weed	*Diplotaxis tenuifolia*						
Iceplant Angled	*Mesembryanthemum aitonis*		x				
Wheat	*Triticum sp*						
Paddy Melon	*Citrullus sp*				X		
Sea Rocket	*Cakile maritima*						
Common Heron's Bill	*Erodium cicutarium*					X	X
Native Tobacco	*Nicotania megalosifium*					X	

Number of separate areas where weed species managed (this is a reflection of abundance, not an actual measure and does not apply to pre 2009 surveys): **X** = 20+ locations, X = 5-20 locations, x = <5 locations

Table 23: Weed diversity summary 2012, Domain 4

Mining Lease (4 - ML, 4 - ML OOL)		Yr Registered											
		4 - ML						4 - ML OOL*					
Common Name	***Scientific Name***	2012	2011	2010	2009	2008	2005-06	2012	2011	2010	2009	2008	2005-06
Wards Weed	*Carrichtera annua*	X	**X**	**X**	**X**	**X**	**X**		x	X			
Turnip	*Brassica tournefortii*	X	**X**	**X**	**X**	**X**	**X**		x	x			
Oats - domestic[1]	*Avena sativa*			X									
Canola	*Brassica napus*												
London Rocket	*Sisymbrium sp*		x	x						x			
Milk Thistle	*Sonchus oleraceus*	X	**X**	**X**	**X**				x	x			
Barley Grass	*Hordeum sp*			x									
Wild Oats	*Avena sp*			x	**X**								
Iceplant	*Mesembryanthemum crystallinum*			x									
Ruby Dock	*Acetosa vesicaria*		x	X					x	x			
False Sowthistle	*Reichardia sp*	x	X	x	**X**				x				
Horehound	*Marrubium vulgare*												
Fleabane	*Conyza sp*	x	x	x	**X**								
Cape Weed	*Arcotheca calendula*	x	x										
Buffel Grass	*Cenchrus ciliaris*												
Saffron Thistle	*Carthamus lanatus*			x	**X**	**X**							
Blackberry Nightshade	*Solanum nigrum*			x									
Wild Lettuce	*Lactuca serriola*			x									
Rye Grass	*Lolium sp*		x	x									
Wild Radish	*Raphanus raphanistrum*									x			
Onion Weed	*Asphodelus fistulosus*												
Couch	*Cynodon dactylon*			x									
Fat Hen	*Chenopodium sp*		x										
Medic	*Medicago sp*		x	x									
Lincoln Weed	*Diplotaxis tenuifolia*												
Iceplant Angled	*Mesembryanthemum aitonis*		x										
Wheat	*Triticum sp*												
Paddy Melon	*Citrullus sp*				x								
Sea Rocket	*Cakile maritima*												
Common Heron's Bill	*Erodium cicutarium*					**X**	**X**						
Native Tobacco	*Nicotania megalosifium*					**X**							

Number of separate areas where weed species managed (this is a reflection of abundance, not an actual measure and does not apply to pre 2009 surveys): **X** = 20+ locations, X = 5-20 locations, x = <5 locations

Table 24: Weed diversity summary 2012, Domain 3, Access Road.

Access Rd (3 - AR, 3 - AR OOL, 3 - ARBP)		Yr Registered																	
		3 - AR						3 - AR OOL*						3 - ARBP**					
Common Name	***Scientific Name***	2012	2011	2010	2009	2008	2005-06	2012	2011	2010	2009	2008	2005-06	2012	2011	2010	2009	2008	2005-06
Wards Weed	*Carrichtera annua*		X	**X**	**X**											**X**			
Turnip	*Brassica tournefortii*		X	**X**	**X**					X						X			
Oats - domestic[1]	*Avena sativa*			X															
Canola	*Brassica napus*																		
London Rocket	*Sisymbrium sp*			X	**X**											X			
Milk Thistle	*Sonchus oleraceus*		X	**X**	**X**				X	X						X			
Barley Grass	*Hordeum sp*		X	X															
Wild Oats	*Avena sp*		X	X	**X**														
Iceplant	*Mesembryanthemum crystallinum*			X															
Ruby Dock	*Acetosa vesicaria*																		
False Sowthistle	*Reichardia sp*			X					X										
Horehound	*Marrubium vulgare*																		
Fleabane	*Conyza sp*																		
Cape Weed	*Arcotheca calendula*																		
Buffel Grass	*Cenchrus ciliaris*	X																	
Saffron Thistle	*Carthamus lanatus*																		
Blackberry Nightshade	*Solanum nigrum*																		
Wild Lettuce	*Lactuca serriola*																		
Rye Grass	*Lolium sp*			X															
Wild Radish	*Raphanus raphanistrum*																		
Onion Weed	*Asphodelus fistulosus*																		
Couch	*Cynodon dactylon*																		

Fat Hen	*Chenopodium sp*																		
Medic	*Medicago sp*																		
Lincoln Weed	*Diplotaxis tenuifolia*																		
Iceplant Angled	*Mesembryanthemum aitonis*		X																
Wheat	*Triticum sp*																		
Paddy Melon	*Citrullus sp*																		
Sea Rocket	*Cakile maritima*																		
Common Heron's Bill	*Erodium cicutarium*																		
Native Tobacco	*Nicotania megalosifium*																		

Number of separate areas where weed species managed (this is a reflection of abundance, not an actual measure and does not apply to pre 2009 surveys): **X** = 20+ locations, **X** = 5-20 locations, **X** = <5 locations

Table 25: Weed diversity summary 2012, Domain 3, Borefield

Borefield Road (3 - BFR)		Yr Registered					
Common Name	***Scientific Name***	2012	2011	2010	2009	2008	2005-06
Wards Weed	*Carrichtera annua*	X	X	X	X	X	
Turnip	*Brassica tournefortii*		X	X	X		
Oats - domestic[1]	*Avena sativa*						
Canola	*Brassica napus*						
London Rocket	*Sisymbrium sp*		X				
Milk Thistle	*Sonchus oleraceus*	X	X	X	X		
Barley Grass	*Hordeum sp*						
Wild Oats	*Avena sp*			X			
Iceplant	*Mesembryanthemum crystallinum*		X				
Ruby Dock	*Acetosa vesicaria*						
False Sowthistle	*Reichardia sp*		X				
Horehound	*Marrubium vulgare*						
Fleabane	*Conyza sp*						
Cape Weed	*Arcotheca calendula*						
Buffel Grass	*Cenchrus ciliaris*						
Saffron Thistle	*Carthamus lanatus*				X		
Blackberry Nightshade	*Solanum nigrum*						
Wild Lettuce	*Lactuca serriola*						
Rye Grass	*Lolium sp*						
Wild Radish	*Raphanus raphanistrum*						
Onion Weed	*Asphodelus fistulosus*						
Couch	*Cynodon dactylon*						
Fat Hen	*Chenopodium sp*						
Medic	*Medicago sp*						
Lincoln Weed	*Diplotaxis tenuifolia*						
Iceplant Angled	*Mesembryanthemum aitonis*		X				
Wheat	*Triticum sp*						
Paddy Melon	*Citrullus sp*						
Sea Rocket	*Cakile maritima*						
Common Heron's Bill	*Erodium cicutarium*						
Native Tobacco	*Nicotania megalosifium*						

Number of separate areas where weed species managed (this is a reflection of abundance, not an actual measure and does not apply to pre 2009 surveys): **X** = 20+ locations, X = 5-20 locations, X = <5 locations

Table 26: Weed diversity summary 2012, Domain 2

Airfield/Village (2 - AV)		Yr Registered					
Common Name	***Scientific Name***	2012	2011	2010	2009	2008	2005-06
Wards Weed	*Carrichtera annua*	X		X			
Turnip	*Brassica tournefortii*	X		X			
Oats - domestic[1]	*Avena sativa*			X			
Canola	*Brassica napus*						
London Rocket	*Sisymbrium sp*			X	**X**		
Milk Thistle	*Sonchus oleraceus*	X	X	**X**	**X**		
Barley Grass	*Hordeum sp*			X	**X**		
Wild Oats	*Avena sp*			X			
Iceplant	*Mesembryanthemum crystallinum*			X			
Ruby Dock	*Acetosa vesicaria*						
False Sowthistle	*Reichardia sp*	X		X			
Horehound	*Marrubium vulgare*						
Fleabane	*Conyza sp*	X	X	**X**			
Cape Weed	*Arcotheca calendula*			X			
Buffel Grass	*Cenchrus ciliaris*	X		X			
Saffron Thistle	*Carthamus lanatus*						
Blackberry Nightshade	*Solanum nigrum*						
Wild Lettuce	*Lactuca serriola*			X			
Rye Grass	*Lolium sp*						
Wild Radish	*Raphanus raphanistrum*						
Onion Weed	*Asphodelus fistulosus*						
Couch	*Cynodon dactylon*						
Fat Hen	*Chenopodium sp*			X			
Medic	*Medicago sp*						
Lincoln Weed	*Diplotaxis tenuifolia*						
Iceplant Angled	*Mesembryanthemum aitonis*						
Wheat	*Triticum sp*						
Paddy Melon	*Citrullus sp*						
Sea Rocket	*Cakile maritima*						
Common Heron's Bill	*Erodium cicutarium*						
Native Tobacco	*Nicotania megalosifium*						

Number of separate areas where weed species managed (this is a reflection of abundance, not an actual measure and does not apply to pre 2009 surveys): **X** = 20+ locations, X = 5-20 locations, X = <5 locations

13.4 J-A Dust Monitoring Report

THE EFFECT OF DUST ON PEARL BLUEBUSH AT THE J-A MINE - 2012 PROGRESS REPORT

Samantha Doudle, Shane Doudle (Iluka), Emma Steggles (UofA)

CONTENTS

1. KEY POINTS

- 2012 was an extremely dry year and the once off timing of some mining operations was not conducive to effective dust control.
- 25 km/hr is the lower threshold wind speed for causing dust problems at J-A during such a dry year. A higher target should be achievable in such conditions with mine plan changes and increased equipment reliability.
- Pearl Bluebush is an excellent indicator plant for dust monitoring due to its dust trapping hairy leaves and stems.
- Dust extent and percentage of dust on plants increased markedly from 2011 to 2012. Dust from mining operations has increased in extent and the amount coating plants during 2012. Dust coated Pearl Bluebush now extend between 2 – 2.5 km to the south and east of the TSF, over 2.5 km to the north of the TSF and over 1 km to the west of the TSF.
- All Pearl Bluebush canopy densities viewed from the top were low in 2012 likely reflecting the extremely dry conditions.
- All Pearl Bluebush monitored in 2011 were still alive in 2012.
- Pearl Bluebush top and side canopy densities, as a measure of plant health, showed no effect from high saline and non-saline dust loads in 2012.
- Pearl Bluebush flowering and therefore seed set, as a measure of plant health, require careful monitoring in future. Data from 2012 suggests there may be a link between reduced flowering and shrub exposure to more frequent dust events.
- Each monitoring location on 2011 monitoring transects was replicated to increase sampling robustness and extended to ensure they contained control shrubs beyond the mining dust halo.

2. INTRODUCTION

Prior to mining disturbance, the fragile topsoils of Jacinth – Ambrosia (J-A) mine were well stabilised by a combination of vegetation and biological soil crusts (SWC 2008, Doudle 2010). As a result, wind erosion from undisturbed soils in the area was very low. Observed dust sources in high wind events in the undisturbed landscape include new fire scars, rabbit and wombat burrows and the surface of Lake Ifould.

The soil profile is composed of five main soil types prior to ore exposure; topsoil, subsoil, sand (if in a dune landscape), brown loam and red loam. The first four are calcareous and alkaline whereas red loam is non-calcareous and has a lower pH (SWC 2008). All of these soil types are prone to wind erosion following disturbance events such as vegetation clearance, overburden removal, soil stockpiling and rehabilitation activities.

The high grade heavy mineral (HM) ore mainly occurs in the Ooldea sand beneath the red loam, however economic quantities are also extracted from the red and brown loam. After removing the HM via processing with hypersaline water, the tailings mass is composed of red and brown loam and Ooldea sand. This mass drains rapidly and the resulting dry surface is also prone to wind erosion. During periods of high wind, the fine fraction from the tailings blows from the TSF (Tailings Storage Facility) area into the surrounding environment and the coarser fraction moves about the TSF surface (S Doudle, observations 2009-2011. JARMS 2011, *The Effectiveness of Hypersaline 'Slimes' for Wind Erosion Management at the J-A Mine*).

Observations have identified particular plant species that are excellent visual indicators of dust. The leaves of each of these indicator species bear arrangements of fine hairs that sometimes extend to the stems. Hairy leaf and stem coverings provide protection against numerous biotic and abiotic stresses (Amme, 2005) but clogging of leaf stomata with dust can act to reduce photosynthetic activity and therefore growth (Turner, 2011). Respiration and transpiration can also be effected and may result in increases in water loss (Farmer, 1993) and changes in leaf temperature (Pradjapati, 2011). Chemical interactions with the leaf surface can also occur (Farmer, 1993).

Iluka are committed to a suite of environmental outcomes through the Mining and Rehabilitation Plan (MARP) for J-A. The outcomes and assessment criteria relating to dust impact on vegetation are outlined below:

ID: CJA_024

Aspect and Impact: Impacts to vegetation due to 'smothering' with dust from vehicle/equipment use and wind.

Outcome: All clearance of native vegetation is authorised under appropriate legislation.

Assessment Criteria: Demonstrate that actual clearance boundaries are within authorised clearance boundaries (output from GIS).

Monitoring Details:

Type: Biological survey mapping

Frequency: annually

Parameters monitored: Changes in abundance, composition or condition against control site or background data to identify changes outside approved clearance boundaries. Monitoring includes: plant mortality; plant health as measured by vigour of new growth, flowering and fruiting; extent of smothering (monitored by visual observations).

At J-A three types of surveys are conducted that contribute information for the dust MARP outcome. EBS Ecology conduct annual flora surveys of mine impact and control sites where changes in abundance, composition and condition are assessed. The Pearl Bluebush (*Maireana sedifolia*) monitoring study outlined in this report and the Myall (*Acacia papyrocarpa*) monitoring study (to be summarised in a later report) contributes information regarding dust extent, plant mortality and health at J-A.

3. METHODS

3.1. STUDY SPECIES

Pearl Bluebush (*Maireana sedifolia*) is one of the most widely distributed species at J-A. The leaves and stems of this species are covered with a thick layer of fine hairs, referred to as trichomes (Figure 1). Dust from light to medium wind events appears to be deposited on top of these hairs and readily washed off in rainfall events. Dust from heavy wind events appears to penetrate the hairy layer and is captured and held by the plant (S Doudle, observations 2009-2011, Figure 1). Other local species with dust trapping trichomes include: *Acacia papyrocarpa, Rhagodia* species (Table 7) *Maireana trichoptera, Maireana integra, Maireana erioclada* (stems only), *Eriochiton schleroionoides and Sclerolaenea patenticuspis, S. obliquicuspis and S. diacantha* .

Figure 1. Hairs of Pearl Bluebush coated with dust on the left and without on the right at 80x magnification above and 8x magnification below

3.2. MONITORING TECHNIQUES

3.2.1. EBS VEGETATION DUST STUDY, 2008 AND 2009

Mine haul road construction was conducted on Ooldea Road in 2008 and 2009. The process of road construction required the application of large quantities of saline water and produced dust that coated the adjacent vegetation.

EBS Ecology were contracted to establish two sets of transects for monitoring potential dust and saline water impacts on vegetation to the east and west of the road. The plant species targeted in this study were Pearl Bluebush and Bladder Saltbush (*Atriplex vesicaria*) (EBS 2008 & 2009). The plant health measurements included percentage of canopy dieback. Vegetation dust cover was monitored at replicated points established at increasing intervals extending from the road: 20, 50, 100 and 1,000 m.

3.2.2. J-A VEGETATION DUST STUDY, ESTABLISHED 2011

A set of 6 transects were established by the J-A rehabilitation team in June 2011 in locations adjacent to a range of different dust sources at the J-A mine. Transects extend north, south, east and west, away from the source of the dust. Only Pearl Bluebush was chosen for plant health measurements due to its ability to trap and hold dust, thereby clearly indicating the presence or absence of dust along these transects. There are plans to introduce Bladder Saltbush into future monitoring at the same locations as a second monitor species to assess the effect of dust on plants with a waxy leaf covering (Table 7).

An additional 2 transects were added to the network in 2012 and all 8 have been assessed for baseline plant health and dust covering levels. Four of these transects have 3 replicated bushes at each monitoring location and these form the long term monitoring project. The remaining transects have had initial baseline measurement taken only and can be reactivated in the future if they are required or if additional monitoring resources become available (Figure 7).

The vegetation at the mine is subjected to three main dust sources: 1) highly saline dust of up to 45 ECe dS/m (Figure 2) from the tailings storage facilities (sand and clay fines); 2) highly saline dust from the Heavy Mineral Concentrate storage area (sand only); 3) non saline, calcareous dust from mine path clearance and new stockpile areas (sand and fines). Erosion levels and dust types were categorised based on field observations during the year. Four erosion level categories were used (Table 4) and the two dust type categories used were: saline and non-saline.

Health monitoring data capture forms were developed in ArcPad 8.0 Studio (ESRI®) (Table 3). Field data capture was conducted with either a Trimble Nomad or Trimble Yuma using ArcPad 8 software, a mobile mapping and geographic information system.

At each monitor shrub an assessment was made of old and new leaf health, presence or absence of flowers and fruit, the percentage of canopy cover looking from the top and from the side of the bush closest to the dust source, and the percentage of dust covering on the bush (Figure 3). Photos were taken of canopy cover percentage from the top and side. Upon return to base the data was downloaded, edited and stored in a desktop GIS system (ArcMap 9.3.1, ESRI®).

Canopy cover measurements were an adaptation of those used in the vegetation assessment component of Landscape Function Analysis (Tongway & Hindley, 2004).

Table 1: Wind erosion categories.

Erosion Rating	Coarse Soil Fraction	Fine Soil Fraction
Nil	Stable	Stable
Low	Saltation across stabilised surfaces	Mostly stable
Medium	Leaving vicinity via saltation in high wind events	Mostly stable
High	Leaving vicinity via saltation in high wind events	Leaving vicinity via dust plume in high wind events

Table 2: Pearl Bluebush dust monitoring transects.

Transect #	Potential dust sources at start of transect (status in December 2012)	Approx. distance from dust source (m)	Purpose
T5	Cell 2 – saline tailings (mid 2013+), previously active red loam stockpile	0, 25, 50, 150, 350, 500, 700, 1000	Baseline (Est: 2011)
T6	TSF - saline tailings (active) Tracks - calcareous sandy loam (active)	0, 25, 50, 100, 250, 1000, 1500, 2,000, 2,500, 3,000	Replicated, long term monitoring (Est: 2011)
T7	TSF - saline tailings (active) Jacinth Pit – calcareous brown loam (future) Tracks - calcareous sandy loam (active)	0, 25, 50, 100, 250, 400, 1000	Baseline (Est: 2011)
T8	Jacinth Pit– calcareous brown loam (future)	0, 25, 50, 100, 250, 500, 1000	Baseline (Est: 2011)
T9	Jacinth Pit– calcareous brown loam (future)	0, 25, 50, 100, 250, 500, 1000, 1500, 2000, 2500	Replicated, long term monitoring (Est: 2011)
T10	Clearance – calcareous brown loam (active)	0, 25, 50, 100, 250, 350, 450, 1000	Baseline (Est: 2011)
T11	TSF and Jacinth pit – saline tailings (active), saline HMC (active) calcareous brown loam (active)	0, 25, 50, 100, 250, 500, 700, 1000, 1500, 2000	Replicated, long term monitoring (Est: 2012)
T12	TSF – saline tailings (active)	0, 25, 50, 100, 250, 750, 1000	Replicated, long term monitoring (Est: 2012)

Table 3: Plant data capture form categories.

Tree Feature	Characteristic	Score Options
Health	Mature Leaf Health	healthy, coating of dust, dying & dropping
	New Leaf	nil, healthy, dusty, unhealthy
	Flowering	Yes or No
	Fruit	Yes or No
	Overall Plant Health	Score: 0 - 100 %
	Canopy down	Score: 0 - 100 %
	Canopy side	Score: 0 – 100%
Dust	% of plant covered in dust	Score: 0 - 100 %
	Dust direction (dust source)	N, E, S, W

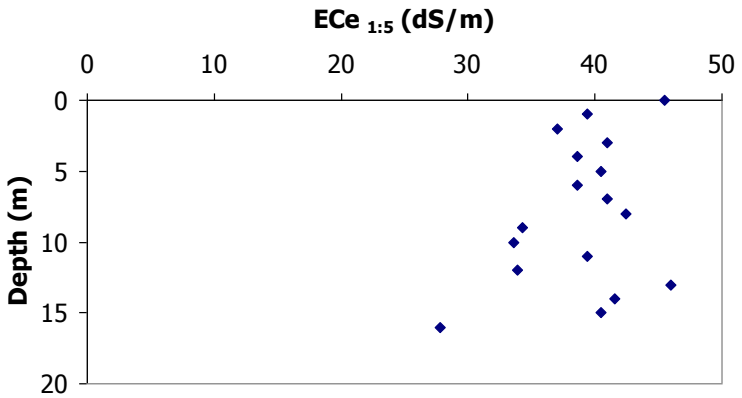


Figure 2: TSF ECe 1:5 (dS/m). Data from TSF drilling program, JA Capillary Break Study, 2011.

Figure 3: Pearl Bluebush canopy monitoring perspectives. Left: top of canopy. Right: windward side of canopy.

4. RESULTS & DISCUSSION

4.1. SEASONAL WEATHER AND MINING CONDITIONS

4.1.1. RAINFALL

Historical weather records do not exist for J-A so Tarcoola data (200 km NE) is used for long term analysis. The J-A Weather Station (JAWS) has proven unreliable from 2009 to mid 2012 but has been recording accurately since.

The average annual rainfall for Tarcoola is 175 mm. Annual rainfall for 2011 was well above average with 310 mm, including 138 mm during February which stored significant soil water for plant germination and growth throughout the year. In contrast, annual rainfall during 2012 was well below average with only 102 mm recorded. A mere 24 mm fell between July 1 and the end of December, half of which occurred during December.

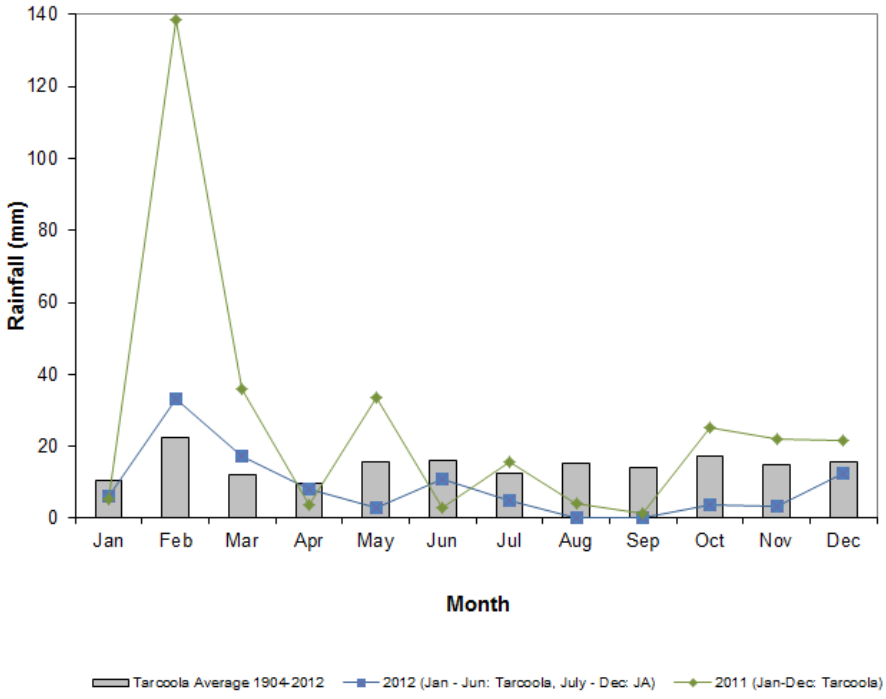


Figure 4: Rainfall data, Tarcoola 108 year average; 2011 (Jan-Dec: Tarcoola BOM); 2012 (Jan-June: Tarcoola, July – Dec: JAWS).

4.1.2. WIND

Tarcoola experiences calm conditions on average less than 4% of the time. Prevailing winds are from the south west, with the majoriy of wind events over 20 km/hr from the west and south west. Since operations commenced, the windiest months at J-A have been from September through to December (pers. obs).

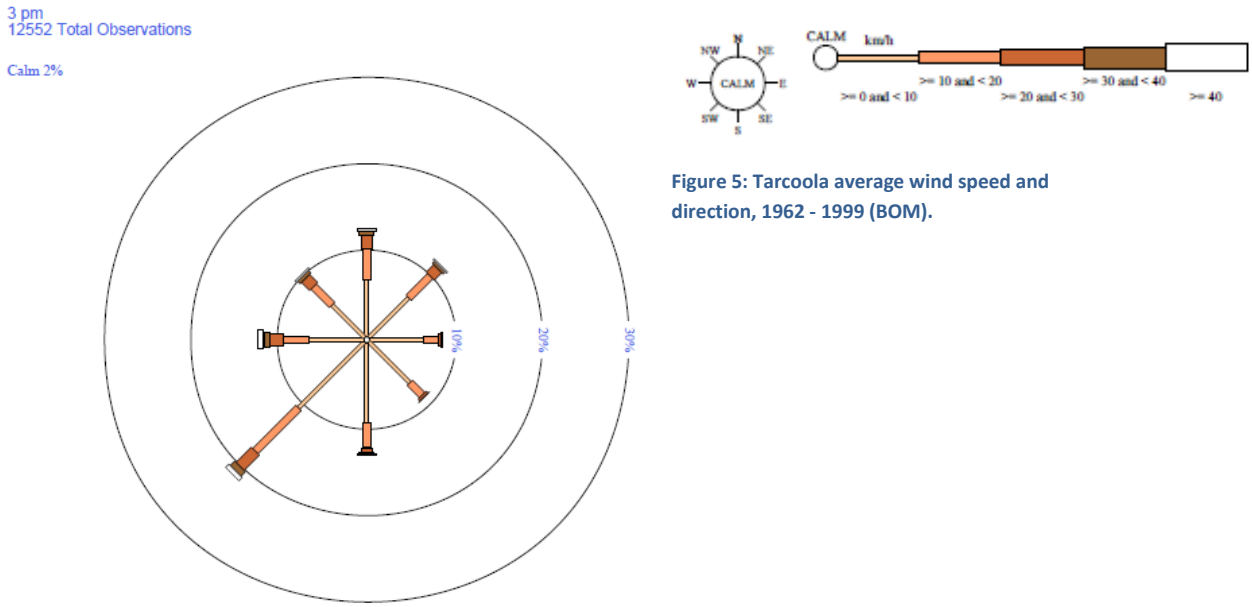


Figure 5: Tarcoola average wind speed and direction, 1962 - 1999 (BOM).

4.1.3. MINING OPERATIONS AND DUST TYPES

In 2011 approximately 442 ha of land was open within the mining lease and camp and of that 396 ha generated some level of wind erosion (Table 4, Figure 7).

In 2012 approximately 505 ha of land was open within the mining lease and camp and of that 475 ha generated some level of dust, a 17% increase from 2011 (Table 4, Figure 9). The biggest area of increase by 51 ha was the low non saline category, largely due to the sealing of the airstrip changing the category of that area. Due to mine scheduling changes, the high non saline category also increased in size by 36 ha as a result of vegetation clearing and soil stripping activities occurring during some of the windiest months in the spring and summer periods. The high saline sources remained similar in size, with the Cell 1 tailings area changing to non-saline dust approximately mid-year as rehabilitation with clean soils began.

Table 4: Dust level and dust type in 2011 and 2012.

Dust Level and Type	Area Open (ha)		
	2011	2012	Area change
Nil	46	30	-16
Low, Saline	1	8	+7
Low, Non Saline	60	111	+51
Medium, Saline	119	121	+2
Medium, Non Saline	63	51	-12
High, Saline	141	137	-4
High Non, Saline	11	47	36
TOTAL	**442**	**505**	**63**

4.1.4. ENVIRONMENTAL CONDITIONS THAT CREATE DUST

High wind erosion days are sometimes reported at J-A via the Loss Control Card system. Examples of the types of wind conditions that caused high wind erosion events in 2012 include: an average of over 30 km/hr from SW on 22/09/2012 (Figure 15), an average of over 30 km/hr from SE on 20/10/2012 (Figure 16) and an average of over 25 km/hr from SE 15/12/2012 (Figure 17).

This coarse analysis suggests that in a very low rainfall year such as 2012, 25 km/hr and above winds can cause high wind erosion events at J-A (Figure 6). Figure 3 suggests there were far more wind erosion events than were reported by LCC cards and field observations support this.

No data is available to assess the wind erosion threshold for 2011 during a higher rainfall year.

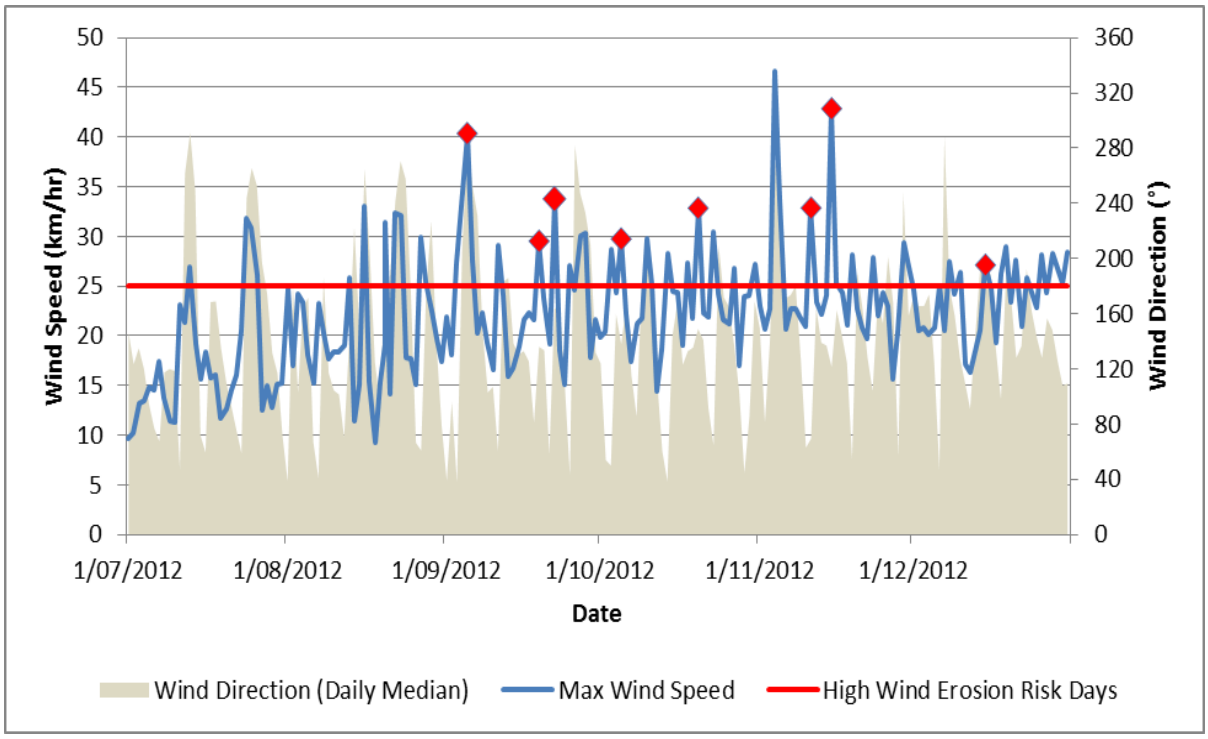


Figure 6: Wind data from J-A weather station, 01/07/2012 - 31/12/2012. Average maximum wind speed/day, median wind direction/day, high wind erosion lower threshold (25 km/hr) and high wind erosion days (Level 2) reported by LCC (red dots).

4.2. MONITORING RESULTS: DUST DISTRIBUTION AND DENSITY

4.2.1. 2011 DUST DISTRIBUTION

A total of 29 shrubs were monitored across four transects with only one monitoring shrub established at each location (Figure 7).

The most dust coated transect in 2011 was Transect 11 extending north from the TSF, with dust on all plants in the transect extending out to 700 m (Figure 7). All shrubs showed dust on the southern side only, indicating the prime dust source was from the south i.e. the TSF.

Transect 12 to the west of the TSF showed dust only on the eastern side of the shrub closest to the TSF dust source (Figure 7). There was no dust on the shrubs close to the airstrip indicating the unsealed airstrip was not acting as a dust source for adjacent shrubs.

Transect 6 to the south of the TSF had two dust coated plants, one immediately adjacent the TSF and another 100 m away, with the shrub in between showing no dust (Figure 7). This type of result indicated a need for replication at each monitoring point in the future, which was addressed in 2012. The northern side of the two shrubs were dusted indicating the TSF was the dust source.

Transect 9 started on the proposed edge of the Jacinth pit approximately 800 m south east of the TSF (Figure 7). Despite being some distance away from major dust sources four plants at the start of the transect still showed dust on their northern/north western sides. It is not clear if the source was the TSF, the newly established soil stockpile area approximately 400 m to the north east or whether there was some localised dust source such as a drilling track or unstabilised sand dune.

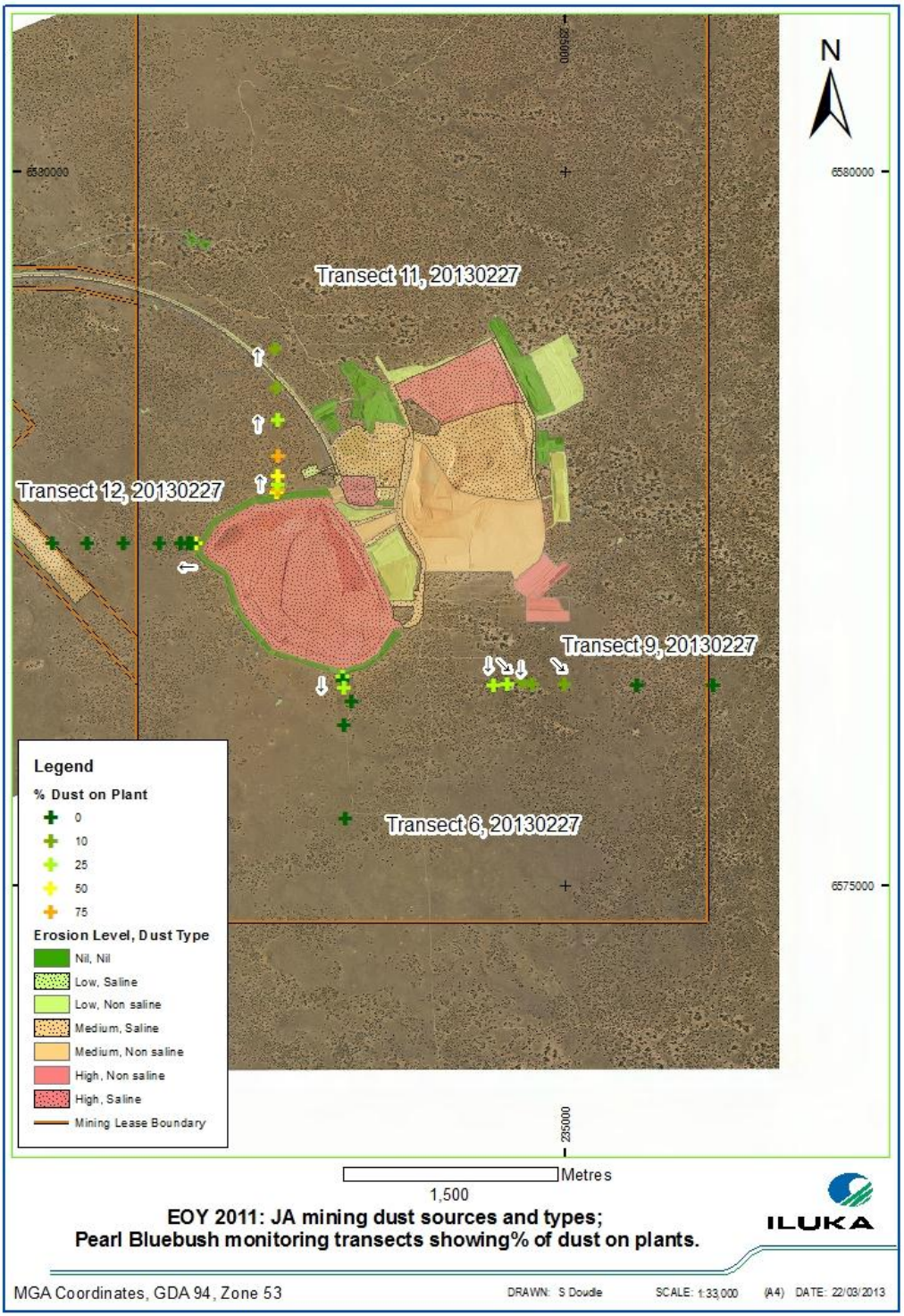


Figure 7: 2011 J-A areas open and their erosion level and dust type. 2011 Pearl Bluebush health monitoring transects, showing location, dust %. Arrows indicate prevailing wind direction responsible for the dust coating.

4.2.2. 2012 DUST DISTRIBUTION

A total of 117 plants were monitored across four transects in 2012 (Figure 9). Each monitoring point on each transect was established with an additional two replicate shrubs, giving a total monitoring population of 84 shrubs compared to 29 in 2011 along the same transect distance. Transect 6, 9 and 11 were then extended to widen the range of monitoring (Figure 9).

The most dust coated transect in 2012 was again Transect 11, which despite a transect extension of 1300 m still showed dust on all plants (Figure 8, Figure 9). The shrubs in the first 100 m where fully coated in dust but from there until 700 m only the southern side was dusted, indicating the TSF as the dust source. Shrubs on the remainder of the transect were dust affected on the north eastern side indicating the new clearance and stockpile areas as the dust sources. Transect 11 requires further extension to ensure it reaches an area where shrubs are unaffected by dust (i.e. transect control shrubs).

Transect 12 showed only the shrubs at the monitoring point closest to the TSF were fully coated in dust. These shrubs and those extending to 500 m away, showed dust on their eastern side, indicating the TSF is the source to that distance (Figure 9). The last two monitoring locations showed dust on their north eastern sides, once again discounting the airfield as a source. The source of dust is not yet clear for the last two locations on this transect. Similarly to Transect 11, Transect 12 requires further extension to ensure it reaches an area unaffected by dust.

Transect 6 showed shrubs fully coated in dust up to 75 m away from the TSF and from then onwards dust only coated the northern side (Figure 9). Dust coated shrubs continued over 2 km away from the TSF, with dust ceasing at 2.5 km.

Transect 9 showed no fully dust coated shrubs, with dust showing on the north or north western side for 1 km along the transect, at which point it was 2 km away from the TSF (Figure 9). The dust source for these shrubs is also not clear but is likely to be as a result of the mine pit and stockpile activities to the north.

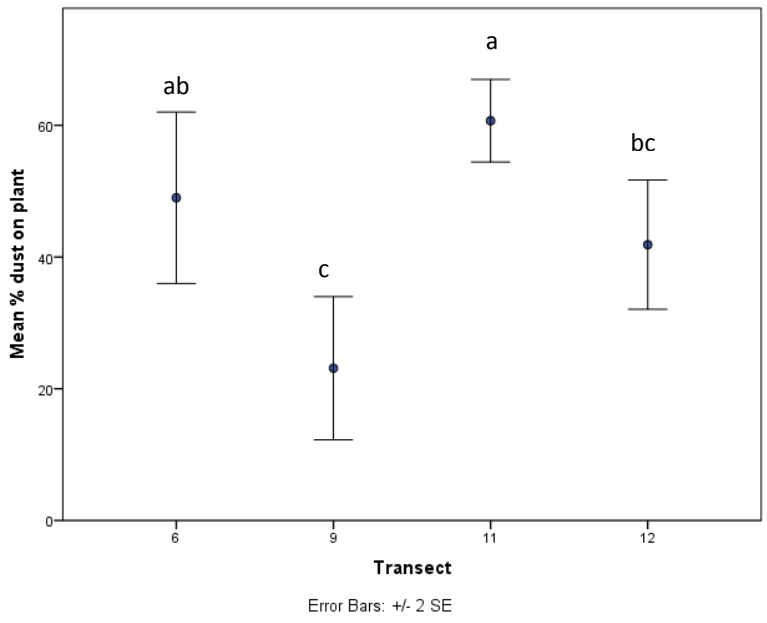


Figure 8: 2012 Pearl Bluebush dust monitoring: % dust on plant vs transect (treatments with different letters are statistically different, P=.05. One-way ANOVA, Tukey post-hoc, SPSS).

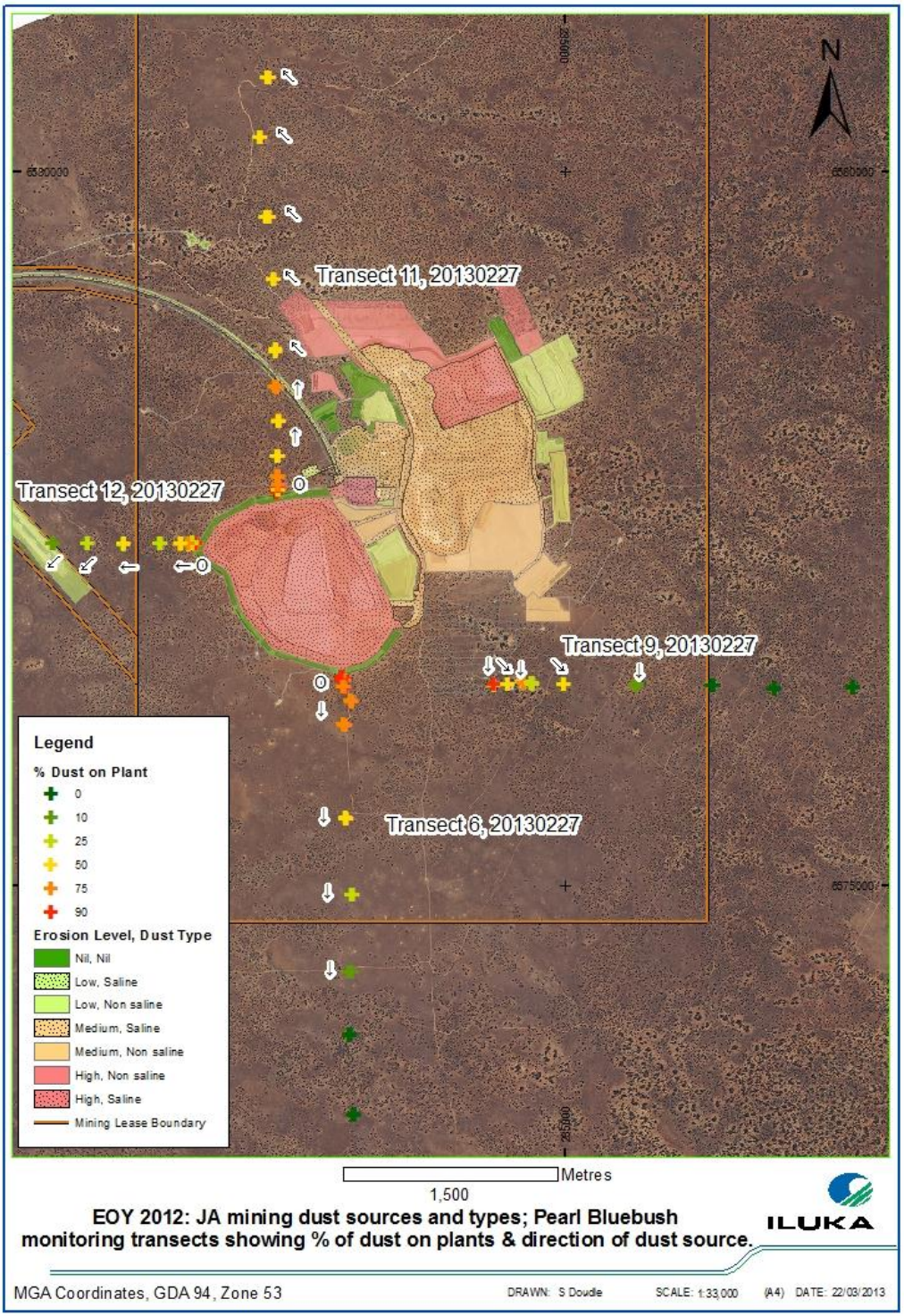


Figure 9:2012 J-A areas open and their erosion level and dust type. 2012 Pearl Bluebush health monitoring transects, showing location, dust %. Arrows indicate prevailing wind direction responsible for the dust coating.

4.2.3. 2011 AND 2012 DUST COMPARISON

As previously described, transects 6, 9 and 11 were extended in 2012. To compare the 2011 and 2012 data only the shorter 2011 transect lengths have been used.

Due to the un-replicated nature of the 2011transects, a statistical comparison between the two years and the amount of dust on the plants was not possible. Data is presented in map format for this report.

Transect 6 shows that in 2011 only 33% of the transect had dust coated shrubs and by the end of 2012 the entire original transect had dust coated shrubs (Table 5). The distance from the TSF at which dust coated plants were recorded increased by 1.9 km between 2011 and 2012 monitoring events (Figure 9) and the amount of dust on shrubs also increased markedly (Table 5).

Transect 9 to the east shows a minimal increase in percentage of dust coated shrubs, with shrubs along 71% of the transect affected by dust in 2011 compared with 83% of the original transect length in 2012 (Table 5). The extent of dust coated shrubs has not increased to the east in this location however the amount of dust per plant has increased (Figure 7, Figure 9).

Transect 11 to the north shows a major increase in extent of dust coated shrubs and the amount of dust per plant (Table 5, Figure 7, Figure 9). As previously mentioned the dust source for the first 700 m of this transect is saline tailings from the TSF and the remainder of the transect appears to be mostly affected by non-saline dust from the 2012 clearance areas. It is unclear how far dust has extended to the north as the transect did not reach dust free shrubs when it was established in 2011. Despite a 2 km extension in 2012, Transect 11 still has not reached beyond the extent of dust from the mine, necessitating a further transect extension in 2013.

There are two likely causes that account for the extension of dust affected areas around the mine site at J-A. The first is the very low soil moisture levels that have resulted from almost no rainfall occurring during winter and spring in 2012 (Figure 4). The second reason was the requirement to clear vegetation and strip topsoil, subsoil and overburden during spring and summer of 2012. Conducting such activities during this windy and often dry time of the year is contrary to Iluka procedure, however a change to mining schedule in response to changing market conditions necessitated clearing. Low water truck reliability and staffing availability exacerbated these issues.

Table 5: Comparison of % of plants with dust covering from 2011 and 2012 transects

Transect	2011		2012 (2011 transect length)		2012 Extension
	# shrubs with dust	% of shrubs with dust	# shrubs with dust	% of shrubs with dust	
T6	2 (n=6)	33%	18 (n=18)	100%	Additional 4 monitoring locations over 2 km (24 with dust coat = 80% (n=30)).
T9	5 (n=7)	71%	15 (n=18)	83%	Additional 2 monitoring locations over 1 km (15 with dust coat = 56% (n=27)).
T11	8 (n=8)	100%	24 (n=24)	100%	Additional 4 monitoring locations over 2 km, not to dust free shrubs yet (36 with dust coat =100% (n=36)).
T12	1 (n=8)	13%	24 (n=24)	100%	Not extended – airstrip

4.3. MONITORING RESULTS: PLANT HEALTH

4.3.1. WHAT IS THE NORMAL RANGE OF PEARL BLUEBUSH CANOPY DENSITY?

No published data could be found to provide a baseline for the range of canopy densities considered 'normal' for Pearl Bluebush.

As reported in JARMS 2010/2011, an EBS study near J-A in July 2008 and December 2009 measured the percentage of canopy dieback in Pearl Bluebush as a result of dust from road construction. Non dust coated plants were deemed as those greater than 100 m from the road in 2008 and all plants in the 2009 study. The EBS data showed that undisturbed Pearl Bluebush canopy cover over the two years ranged from 60 – 90 % (quartile 1 and 3 values) but canopy covers as low as 40% and as high as 98% were also recorded (Figure 10). Rainfall records showed 2008 annual rainfall to be well below average proceeding the survey and 2009 to be well above average (Figure 11).

The shrubs at J-A with no dust coverage between December 2011 and December 2012 show the canopy cover range over the two years was 40 – 60% (quartile 1 and 3 values) but canopy covers as low as 30 % and as high as 80 % were also recorded. Rainfall records showed 2011 annual rainfall to be well above average and 2012 to be well below average (Figure 4).

Combined, the four surveys provide a baseline top canopy cover percentage range for healthy Pearl Bluebush across a wide range of seasonal conditions. This ranges from 40 – 90%, with extremes as low as 30% and as high as 98% recorded.

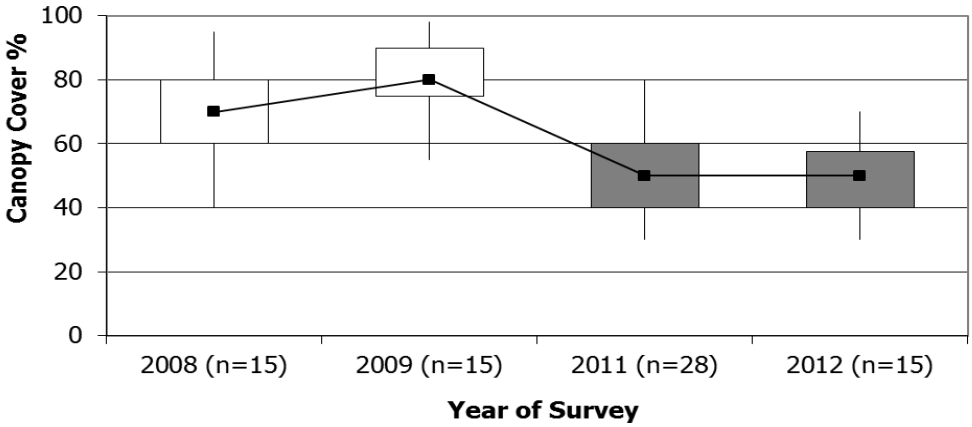


Figure 10: EBS (white box) and J-A (grey box) vegetation surveys, canopy cover on Pearl Bluebush unaffected by dust.

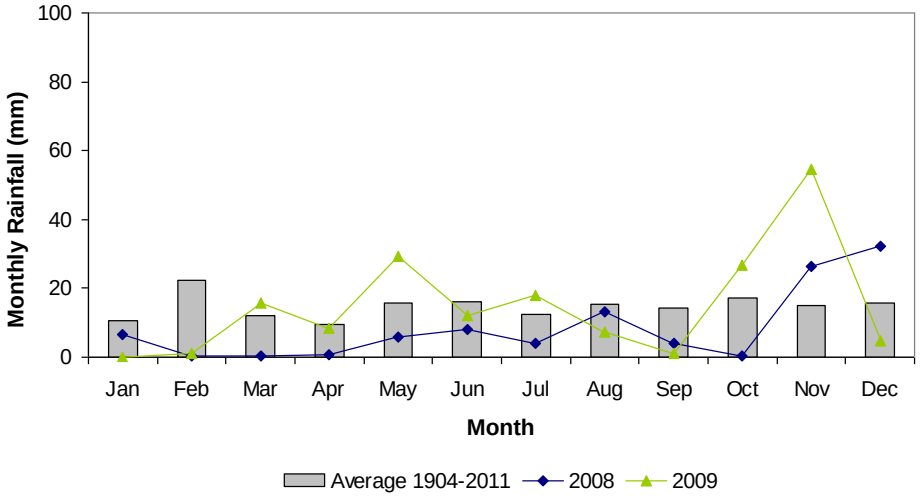


Figure 11: Monthly rainfall figures for Tarcoola, average, 2008 and 2009 (BOM 2012. Tarcoola is approximately 230 km ENE of JA).

4.3.2. CANOPY DENSITY

4.3.2.1. TOP CANOPY DENSITY

Top canopy densities of all shrubs were lower compared to those of the non-dust coated baseline shrubs from previous surveys. Given nearly all shrubs show this characteristic in 2012 it is highly likely that the very low rainfall in the latter half of the year is the cause.

There were no differences between the top canopy density of shrubs coated in dust compared to no dust (Figure 12, Figure 18). Continuing this monitoring over a longer time frame will determine whether Pearl Bluebush top canopy density truly is unaffected by high dust loadings or whether it just takes several years for an effect to become apparent.

The 2013 extension of transects 11 and 12 into areas unaffected by dust will increase the future sample population of unaffected control shrubs.

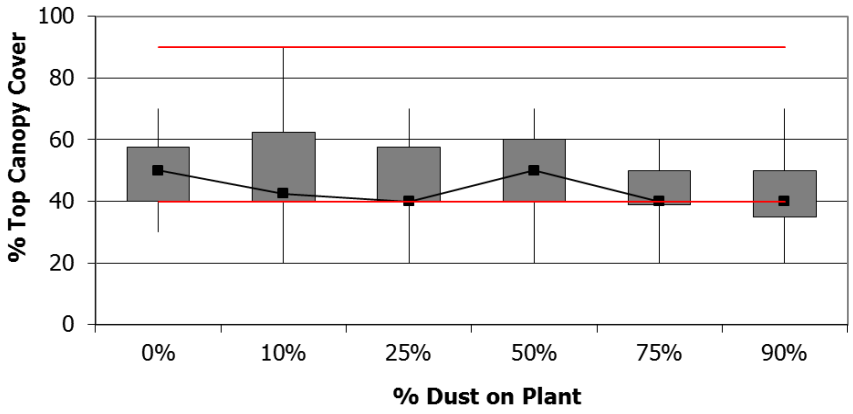


Figure 12: 2012 J-A Pearl Bluebush transects, % of dust on shrub vs % of top canopy. Red lines show canopy range of shrubs unaffected by dust from previous EBS and J-A surveys.

4.3.2.2. WINDWARD SIDE CANOPY DENSITY

There is no baseline data for non dust affected canopy density on the windward side of the plant and this will only be gained over time in future monitoring studies.

Similarly to the top canopy data, the side canopy data shows no relationship between percentage dust and percentage side canopy in 2012 (Figure 13, Figure 19).

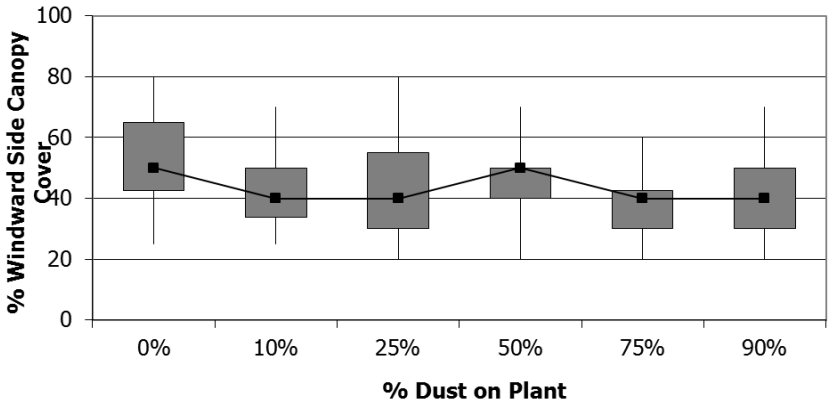


Figure 13: 2012 J-A Pearl Bluebush transects, % of dust on shrub vs % of the windward side canopy.

4.3.3. FLOWERING

Pearl Bluebush viable seed production has always been sporadic and low at J-A, and is a constant concern. To date, very little is known about their fecundity and no detailed references have been found on the subject. The shrubs within the mine lease set seed on a large scale during March 2009, however no viable seed was found from hundreds of viability checks made in many locations. Pearl Bluebush flowers have been elusive to find since then and only a handful of records had been noted. During 2012 small areas of shrubs with flowers followed by viable seed were found at the main camp and along the roadside to Tank Farm 1, both were sources of increased water availability during a drought.

There were also small numbers of flowering Pearl Bluebush found on monitoring transects 6, 9 and 12 in 2012 (Table 6, Figure 14). No follow up checks were conducted to determine if these flowers progressed into viable seed.

Shrubs on transect 11 to the north that had been exposed to the most frequent wind erosion events during 2011 and 2012 showed no flowering at all. Careful attention needs to be paid to this monitoring characteristic in the future to determine if repeated dust coating events are impacting flowering. It is also recommended that follow up sampling occurs in future to determine if flowering plants are developing viable seed.

Table 6: J-A Pearl Bluebush monitoring, # of flowing shrubs on transects.

Transect	# plants on transect	# flowering	% flowering
Transect 6	30	10	33%
Transect 9	27	2	7%
Transect 11	36	0	0%
Transect 12	24	4	17%

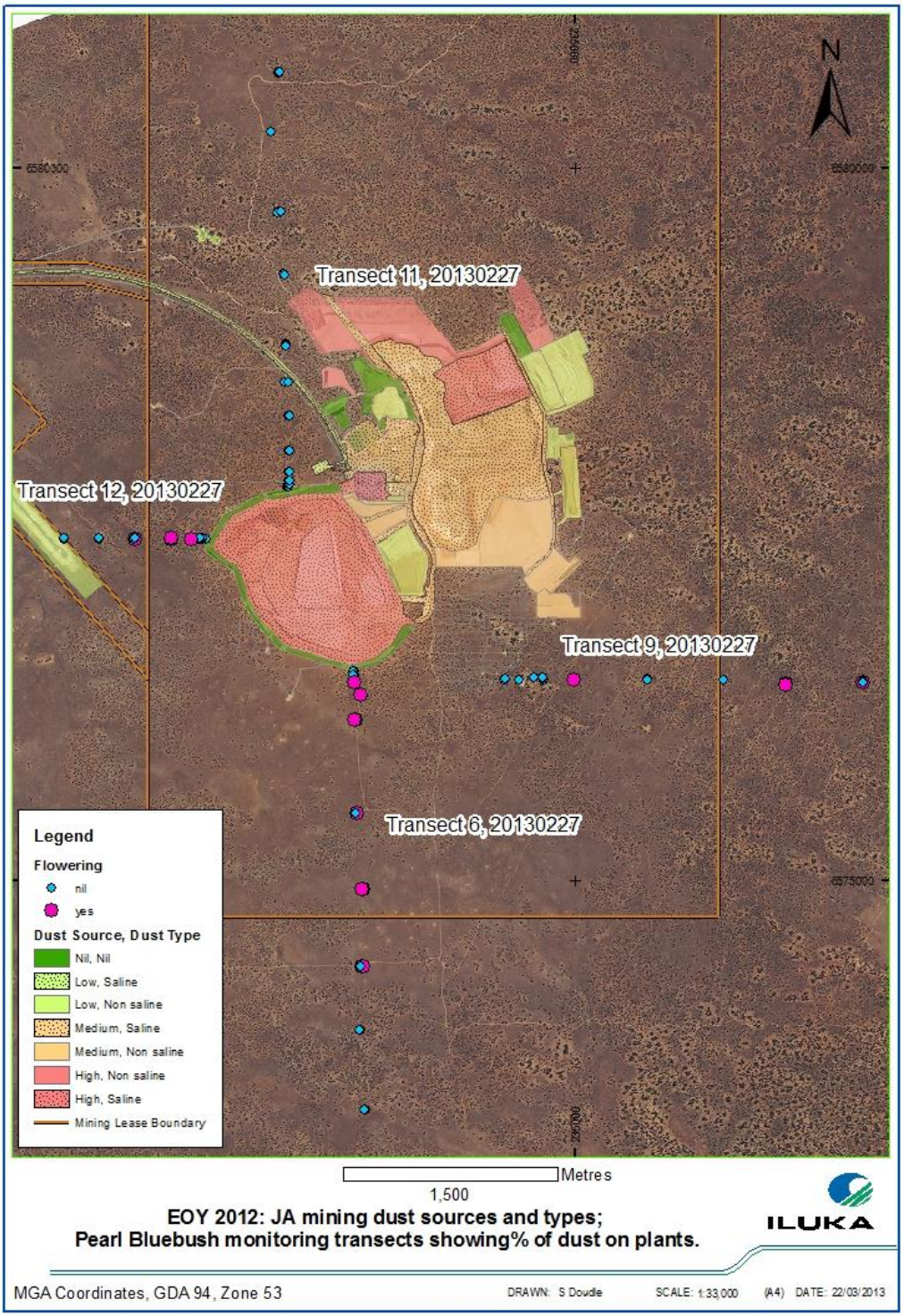


Figure 14: J-A Pearl Bluebush monitoring transects and locations of flowering shrubs.

5. RECOMMENDATIONS

5.1. MONITORING RECOMMENDATIONS

Continue monitoring transects over time with the following improvements:

- Extend transect 11 and 12 to include at least three non-dust coated locations.
- Analyse the salinity of the dust trapped on the plants using 1:5 shake method. Some 2012 samples ready for processing.
- Bladder Saltbush have shown that soil salinity can increase under their canopy as a result of salt accumulation in their leaves (Charley and McGarity, 1964). It is not known if the same process occurs under Pearl Bluebush canopies. By monitoring soil salinity along the Pearl Bluebush transects over time it may be possible to distinguish between background soil salinity levels and salt deposited from saline tailings dust. This additional data should be included in the 2013 sampling protocol. Soil samples should be collected and tested for EC, pH and texture. The possibility of using shallow electromagnetics (EM-38 measurement of soil conductivity to either 1 m or 1.5 m) should also be explored.
- Assess both stems and leaves for dust capture to avoid senescence (leaf dropping) effects. Investigate the lifecycle of Pearl Bluebush leaves to determine if the dust drops with the leaves annually or remains attached to the plant for several years.
- Collect soil samples along transects and measure soil salinity, EC, pH, texture and soil conductivity.
- Investigate the effects of TSF dust on other local species particularly those with dust capturing structures e.g. *Sclerolaena* sp, *Rhagodia* sp.
- Additional analysis – divide data into saline and non-saline dust sources and analyse plant health indicators
- Use dust bottle data to calculate approximate dust densities/ha and include in this analysis.

5.2. MANAGEMENT RECOMMENDATIONS

- J-A should aim to improve proactive dust management so that high wind erosion events occur less often and at a higher threshold wind speed, potentially 35 km/hr.
- Vegetation clearance and topsoil and subsoil removal should be avoided whenever possible during spring and summer, as per JA Soil Stripping Procedure.
- Reliable equipment and staffing levels should be made available dust control activities.
- A dust management strategy is required for the TSF and should be implemented immediately when tailing ceases and relocates to Cell 2.

6. REFERENCES

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7. APPENDIX

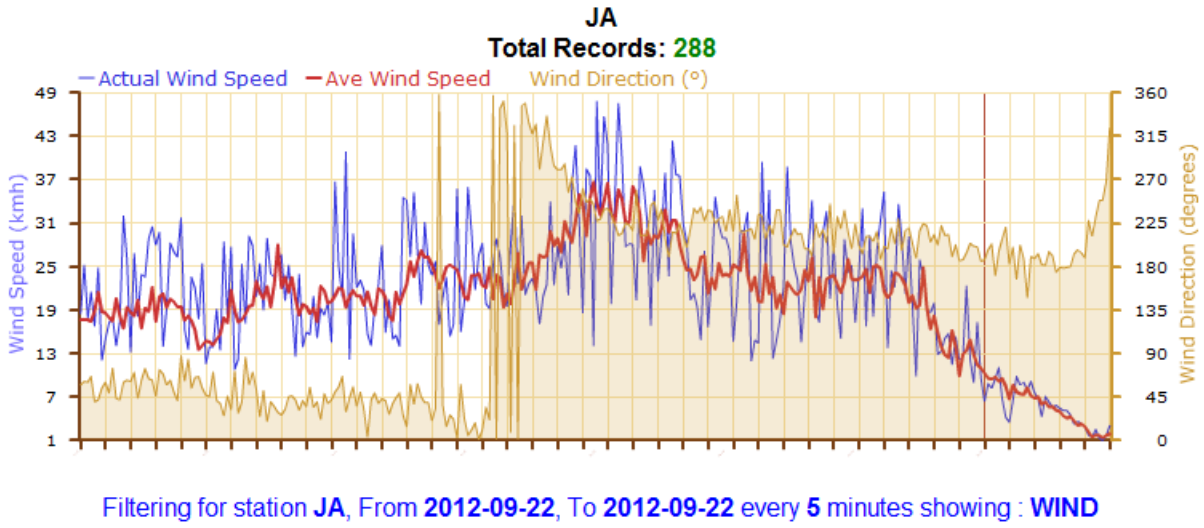


Figure 15: J-A wind data 22/09/2012.

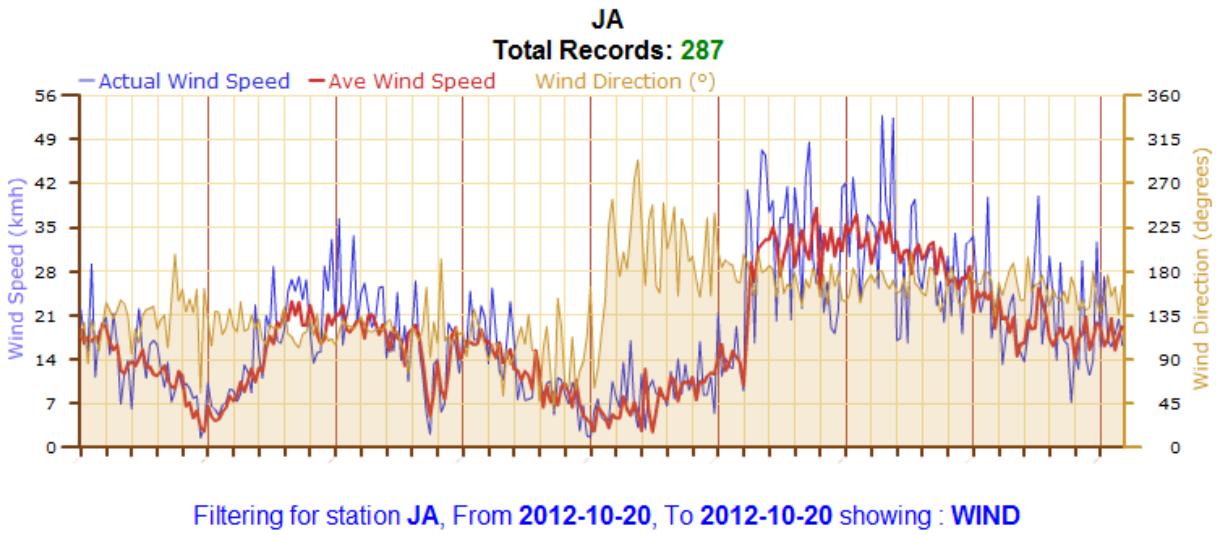


Figure 16: JA wind data 20/10/2012

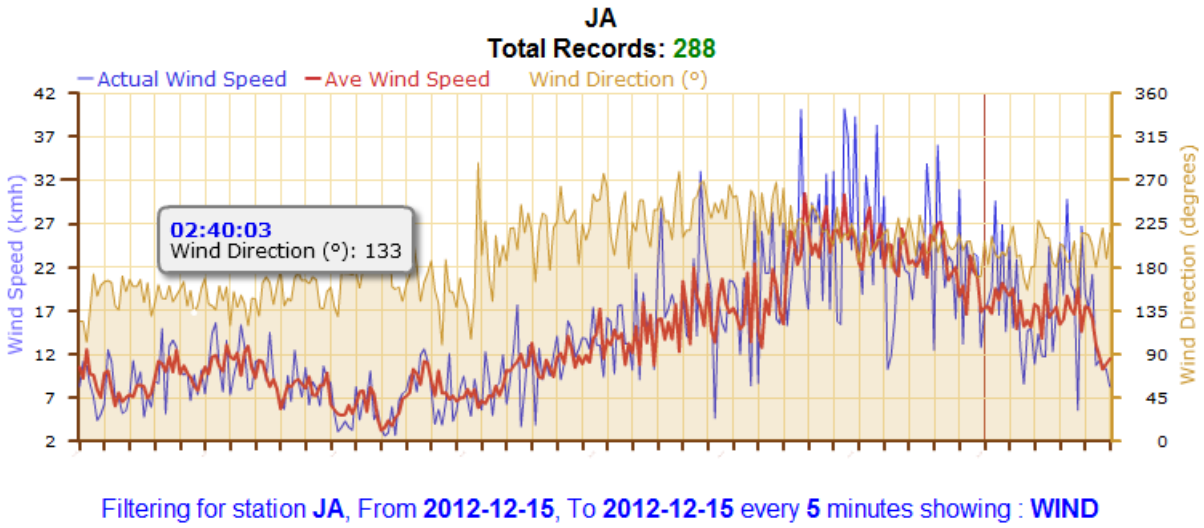
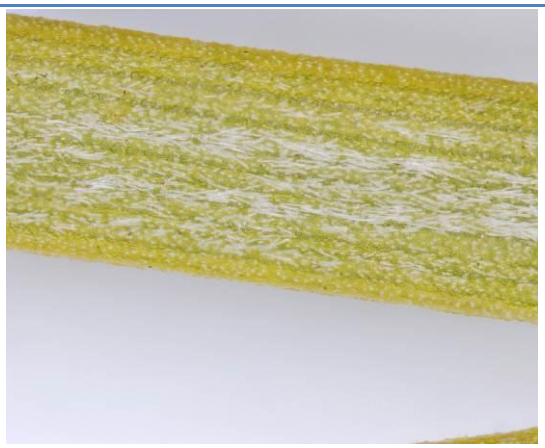
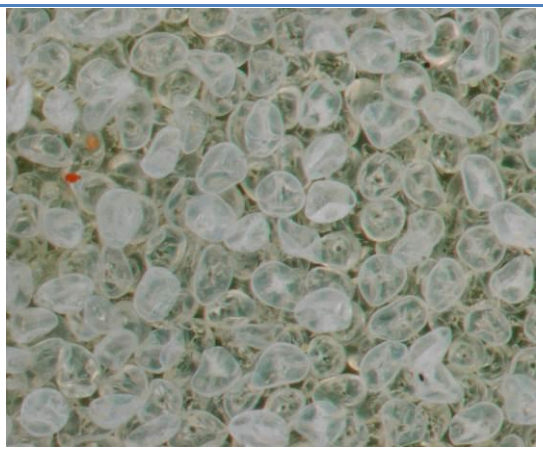


Figure 17: : J-A wind data 15/12/2012

Table 7: Various J-A vegetation species showing leaf structure and hairy trichome leaf coverings (Photos courtesy of Dr M Schneemilch and University of South Australia).

Magnification	Species	
	Maireana sedifolia (Pearl Bluebush)	
8x		
80x		
	Acacia papyrocarpa (Myall)	
8x		

80x		
	Rhagodia sp.	
8x		
80x		
	Atriplex vesicaria (Bladder Saltbush)	

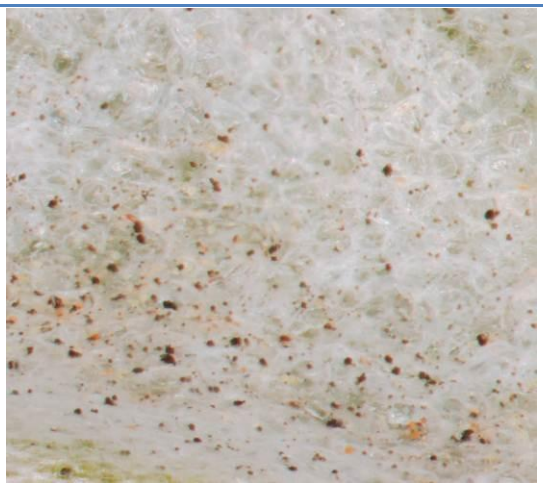
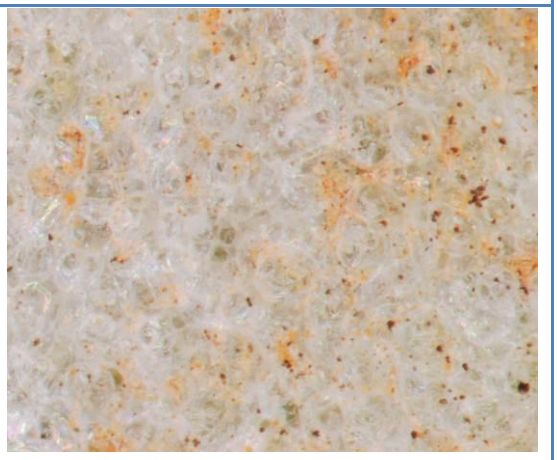
8x		
80x		

Table 8: J-A Pearl Bluebush monitoring transects, photopoints from Transect 12.

	10/03/2012	26/01/2013
1201A		
1202A		
1203A		
1204A		

1205A		
1206A		
1207A		
1208A		

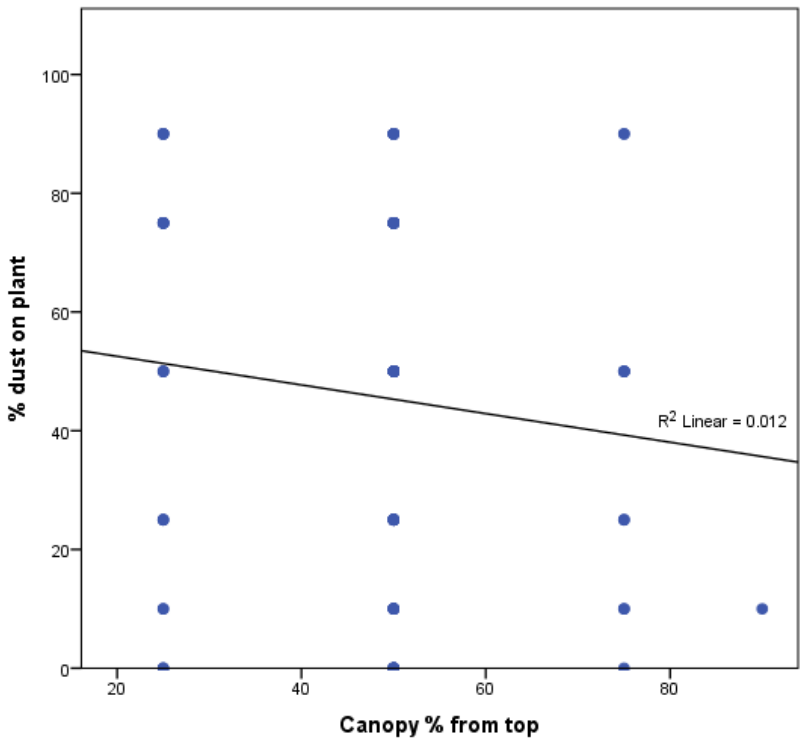


Figure 18: 2012 J-A Pearl Bluebush transects, % of dust on shrub vs % of top canopy.

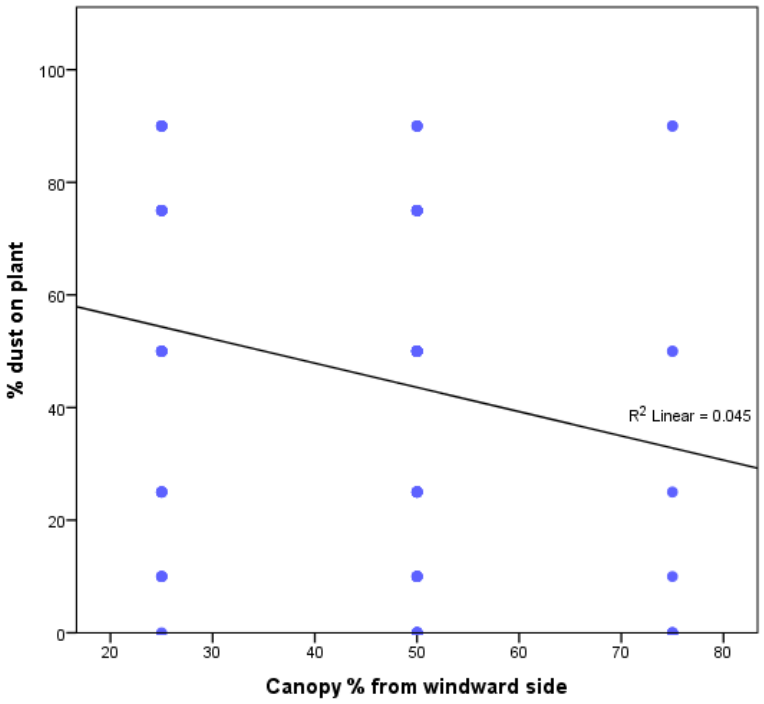


Figure 19: 2012 J-A Pearl Bluebush transects, % of dust on shrub vs % of side canopy on dust source side of shrub.

13.5 Daily Production and Planning Record

Example Daily Production and Planning Meeting record – planning for pit operations, earthworks and inspections are captured – e.g. bund installation and maintenance.

JA - Daily Production Meeting								Sunday 14/10/2012	
7.30am to 7.45am									
H&S									
Week	Vehicles Exceptions	0	Workplace Ins	4	Safety Visits (Total)	30	Safety Visits (Unsafe)	3	
Focus on scheduled workplace inspections Wear dust goggles today 5pm – testing of fire alarms and pages									
Environmental/Rehab:									
Sara offsite this swing – tasks have been assigned to various team members									
Borefields Line Inspection:									
Jessie Cooke									
Warehouse:									
Fuel Target	400,000 Litres		**Storage Tanks**	393,132 Litres		**Trans Tank**	32,490 Litres		
Gensets:	Running: 6		Available: 3		Down: 1 (no 6)				
Sump Pumps Status:	Pump 54: Running		Pump 55: Running		Pump 56: Running				
Shift Coordinator:									

Source	Tonnes	Tonnes / Hr	Run Time	Maintenance Issues
MUP	18099	806	22.43	• Running on one screen whilst maintenance is being carried out
Primary Feed	17422	738	23.58	
HMC	419	17		
Process Dam Level: (%)			75%	
Potable Water Level: (%)			88%	
Flocculant Level: (%)			88%	
Mining Unit Downtime: (Hrs)			1.57	
Concentrator Downtime: (Hrs)			0.42	
Mining Unit Capability Loss: (Hrs)			20.85	
Concentrator Capability Loss: (Hrs)			22.08	

Maintenance/Reliability:					
Attainment to Plan	50%		Labour Utilisation	60%	
Unscheduled Works					
Today's Works					
Transmitter inspection/Calibration on probe Screens/Covert grease lines Hangers at back of screen/Guarding at the bottom					

Metallurgist Results: - 12/10/2012 24 Hour Results

	Feed Grade	Concentrate		8 Day	Tails	Recovery		TI
		<425um	Total	Trend		HMC	ZR	
Target	7.00%	98.00%	96.00%	96.00%	1.80 %	88.00%	97.40%	
Results	2.30%	98.42%	96.79%	97.20%	0.60%	74.57%	89.88%	56.58%

Various changes

Geologist:	Blend: 2W, 2G	Blending Target Grade: 30tph +/- 15
Dozer 1: (Grey/White) Slice 1 Dozer 2: (White/Grey) Slice 2		
Administration:		
ACS toolbox/Purchase Reqs Service Entries/Manifest		

8.00am to 8.20am	
Earth Moving/ Day Services:	
T/A – maintenance on screens Charlie assisting with ops Baldy cleaning up around RO-workshop	
Exact:	
Workshop	DZ920/Moxy (aircon & broken canon)/DZ325 (defects)/Tractor Scoop (light)
Breakdowns	
Push trees north Push rock out Lifting bunds at topsoil/subsoil Grade HMC pad	
Tech Services/Survey:	
Pegs at red loam Pick up at HMC and pegs for bund Short term plan for remainder of year Site instruction	
Chair: Jason Scarmon	**Mup Move 25th October**

HMC Haulage and Stocks

Actual at 26/09/2012	
Trucked MTD	**0**
Tonnes at Wharf	**7,031**

Accommodation	
Occupancy (pp)	**74**
Rooms	**157**

13.6 Waste Movement Records

Example monthly waste movement report as provided by Iluka waste contractor Ceduna Can & Bottle. All waste data is stored within the Jacinth Environmental Database (Monitor Pro 5).

DATE	WASTE STREAM	Skip (Tonnes)	Skip (m3)	MATERIAL DESCRIPTION	INFORMATION	Recycled (Tonnes)	Recycled (m3)	Landfill (Tonnes)	Landfill (m3)	DESTINATION	DESTINATION EPA LIC NO	VEHCILE REG NO
01/11/12	solid/ putrescible waste	2.7	13	FOOD /SOLID WASTE	IANDFILL	0.03	0.01	2.67	12.99	CEDUNA LANDFILL	3070	SB18CT
04/11/12	Timber	1.1	15	Pallets/stillages/mixed timber	IANDFILL	0.1	0.5	1	14.5	CEDUNA LANDFILL	3070	SB18CT
08/11/12	Solid/ putrescible waste	2.1	13	FOOD /SOLID WASTE	LANDFILL			2.1	13	CEDUNA LANDFILL	3070	SB18CT
0811/12	Solid Waste	4.1	13	Mixed workshop waste	LANDFILL	0.12	0.05	3.98	12.95	CEDUNA LANDFILL	3070	SB18CT
15/11/12	solid/ putrescible waste	2	13	FOOD /SOLID WASTE	LANDFILL			2	13	CEDUNA LANDFILL	3070	SB18CT
18/11/12	Recycling	2.1	20	Cardboard Plastic etc	Recycling Centre	2.1	20	0	0	CEDUNA RECYCLING	13480	SB18CT
22/11/12	solid/ putrescible waste	2	13	FOOD /SOLID WASTE	IANDFILL			2	13	CEDUNA LANDFILL	3070	SB18CT
29/11/12	solid/ putrescible waste	1.9	13	FOOD /SOLID WASTE	IANDFILL			1.9	13	CEDUNA LANDFILL	3070	SB18CT

13.7 Waste Treatment Plant – Daily Inspection Log

TO BE COMPLETED DAILY THEN EMAILED MONTHLY TO:

Operation and Maintenance Schedule for Rotating Disc Wastewater Treatment Plant

Type: Aerobic / Anaerobic

Month: Oct 12

done weekly by Paul.

Date:	Time:	Primary Tanks and Disc System: Grease rotor bearings	Primary Tanks and Disc System: Inspect external area for leaks	Primary Tanks and Disc System: Weir at primary is clean	Primary Tanks and Disc System: Disc System is on	Clarifier - Humus Tank: Recirc. Pump is operating	Clarifier - Humus Tank: Spray holes are open	Clarifier - Humus Tank: Clean/brush tank down with brush	Disinfection System: Check effluent pumps (on/off)	Disinfection System: Check and add chlorine tablets	Disinfection System: Clean/brush chlorine tank with brush	Control: Check time on timer	Control: Area Clean	Notes / Remarks
		Quarterly	Weekly	Weekly	Daily	Daily	Daily	~~Monthly~~	Daily	Weekly	Quarterly	Daily	Weekly	
1			✓	✓	✓	✓	✓	weekly	✓					hosed out humus tank.
2					✓	✓	✓		✓					
3				✓	✓	✓	✓		✓					Think scum on small pipe tk
4			✓											
5			✓	✓	✓	✓	✓		✓					
6														
7			✓		✓	✓	✓	✓	✓		✓			Purged float tank, heavy scunge on chlorine tank – plunged the goose neck pipe and backwashed w/ hose to clear build up. This needs to be done quite often
8														
9					✓	✓	✓		✓			✓		
10														
11														
12														
13														
14														
15														
16														
17			✓	✓	✓	✓	✓		✓					
18			✓	✓	✓	✓	✓	✓	✓		✓			Purged + brushed ✓
19														
20			✓		✓	✓	✓	✓	✓			✓		All good
21														
22														
23														
24					✓	✓	✓		✓					
25				✓	✓	✓	✓		✓	✓ topped up		✓		not on daylight saving time
26					✓	✓	✓		✓					
27					✓	✓	✓		✓					purged
28					✓	✓	✓		✓					
29					✓	✓	✓		✓					
30					✓	✓	✓		✓					purged
31					✓	✓	✓		✓					

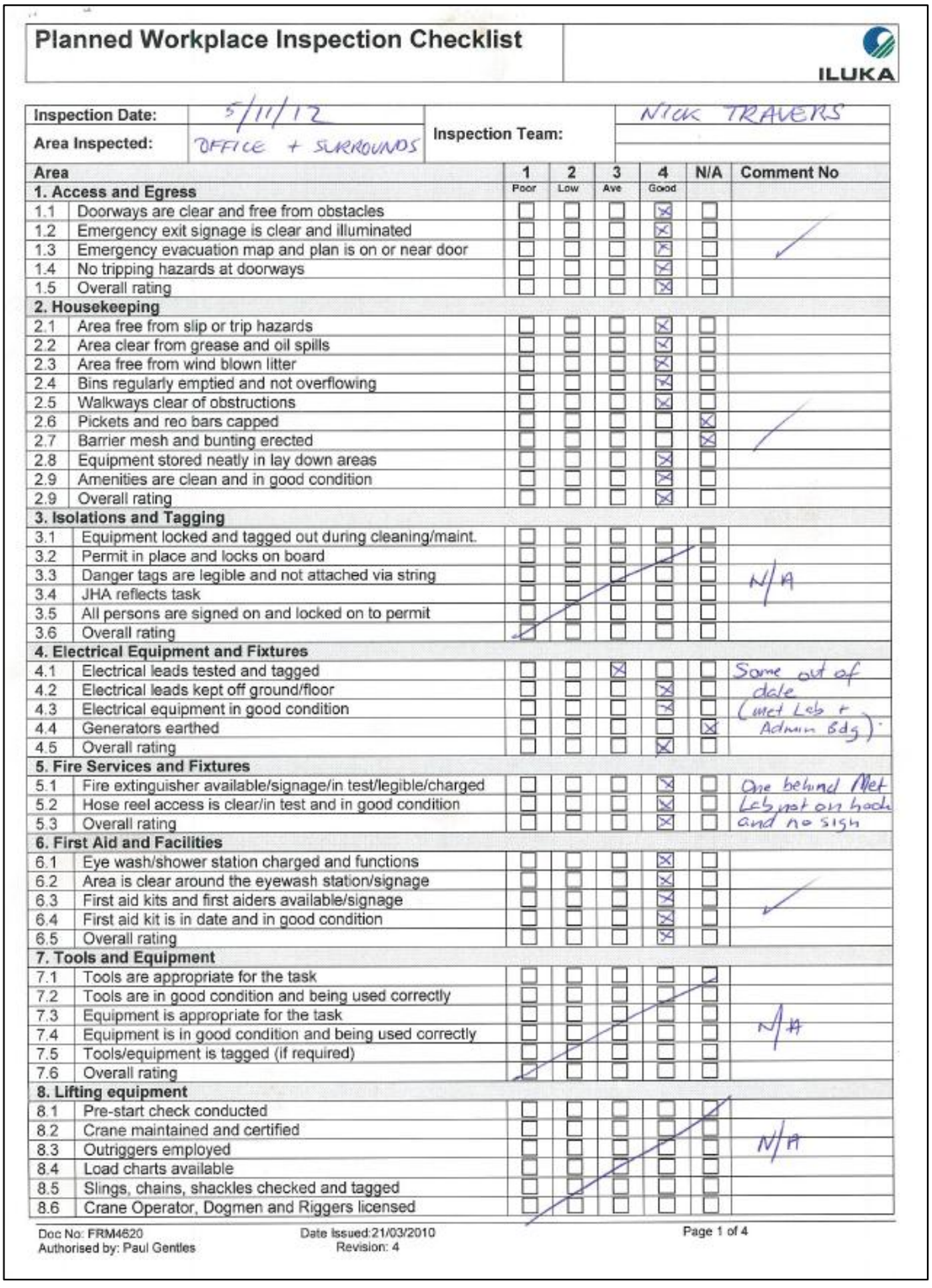
Notes: Open valve in sludge draw-off tank for 10 - 20 minutes, 3 to 4 times a week.
Primary tanks to be de-sludges according to the provided schedule.

Cl dosed
1/10 ~ 100L.
2/10 ~ 100L.
5/10 Dosed 200l [illegible] 1/2 [illegible] dipstick [illegible] 3

Dsc Chl [illegible] 1-2 [illegible]
28/10

13.8 Planned Workplace Inspection Records

Example weekly Planned Workplace Inspection (PWI) record; Inspections include assessment of hydrocarbon and chemical storage and emergency preparedness.



Planned Workplace Inspection Checklist — ILUKA

Inspection Date:	5/11/12	**Inspection Team:**	NICK TRAVERS
Area Inspected:	OFFICE + SURROUNDS		

Area		1 Poor	2 Low	3 Ave	4 Good	N/A	Comment No
1. Access and Egress							
1.1	Doorways are clear and free from obstacles	☐	☐	☐	☒	☐	
1.2	Emergency exit signage is clear and illuminated	☐	☐	☐	☒	☐	
1.3	Emergency evacuation map and plan is on or near door	☐	☐	☐	☒	☐	✓
1.4	No tripping hazards at doorways	☐	☐	☐	☒	☐	
1.5	Overall rating	☐	☐	☐	☒	☐	
2. Housekeeping							
2.1	Area free from slip or trip hazards	☐	☐	☐	☒	☐	
2.2	Area clear from grease and oil spills	☐	☐	☐	☒	☐	
2.3	Area free from wind blown litter	☐	☐	☐	☒	☐	
2.4	Bins regularly emptied and not overflowing	☐	☐	☐	☒	☐	
2.5	Walkways clear of obstructions	☐	☐	☐	☒	☐	
2.6	Pickets and reo bars capped	☐	☐	☐	☐	☒	
2.7	Barrier mesh and bunting erected	☐	☐	☐	☐	☒	✓
2.8	Equipment stored neatly in lay down areas	☐	☐	☐	☒	☐	
2.9	Amenities are clean and in good condition	☐	☐	☐	☒	☐	
2.9	Overall rating	☐	☐	☐	☒	☐	
3. Isolations and Tagging							
3.1	Equipment locked and tagged out during cleaning/maint.	☐	☐	☐	☐	☐	
3.2	Permit in place and locks on board	☐	☐	☐	☐	☐	
3.3	Danger tags are legible and not attached via string	☐	☐	☐	☐	☐	N/A
3.4	JHA reflects task	☐	☐	☐	☐	☐	
3.5	All persons are signed on and locked on to permit	☐	☐	☐	☐	☐	
3.6	Overall rating	☐	☐	☐	☐	☐	
4. Electrical Equipment and Fixtures							
4.1	Electrical leads tested and tagged	☐	☐	☒	☐	☐	Some out of date (incl Lab + Admin Bdg).
4.2	Electrical leads kept off ground/floor	☐	☐	☐	☒	☐	
4.3	Electrical equipment in good condition	☐	☐	☐	☒	☐	
4.4	Generators earthed	☐	☐	☐	☐	☒	
4.5	Overall rating	☐	☐	☐	☒	☐	
5. Fire Services and Fixtures							
5.1	Fire extinguisher available/signage/in test/legible/charged	☐	☐	☐	☒	☐	One behind Met Lab not on hook and no sign
5.2	Hose reel access is clear/in test and in good condition	☐	☐	☐	☒	☐	
5.3	Overall rating	☐	☐	☐	☒	☐	
6. First Aid and Facilities							
6.1	Eye wash/shower station charged and functions	☐	☐	☐	☒	☐	
6.2	Area is clear around the eyewash station/signage	☐	☐	☐	☒	☐	
6.3	First aid kits and first aiders available/signage	☐	☐	☐	☒	☐	✓
6.4	First aid kit is in date and in good condition	☐	☐	☐	☒	☐	
6.5	Overall rating	☐	☐	☐	☒	☐	
7. Tools and Equipment							
7.1	Tools are appropriate for the task	☐	☐	☐	☐	☐	
7.2	Tools are in good condition and being used correctly	☐	☐	☐	☐	☐	
7.3	Equipment is appropriate for the task	☐	☐	☐	☐	☐	N/A
7.4	Equipment is in good condition and being used correctly	☐	☐	☐	☐	☐	
7.5	Tools/equipment is tagged (if required)	☐	☐	☐	☐	☐	
7.6	Overall rating	☐	☐	☐	☐	☐	
8. Lifting equipment							
8.1	Pre-start check conducted	☐	☐	☐	☐	☐	
8.2	Crane maintained and certified	☐	☐	☐	☐	☐	
8.3	Outriggers employed	☐	☐	☐	☐	☐	N/A
8.4	Load charts available	☐	☐	☐	☐	☐	
8.5	Slings, chains, shackles checked and tagged	☐	☐	☐	☐	☐	
8.6	Crane Operator, Dogmen and Riggers licensed	☐	☐	☐	☐	☐	

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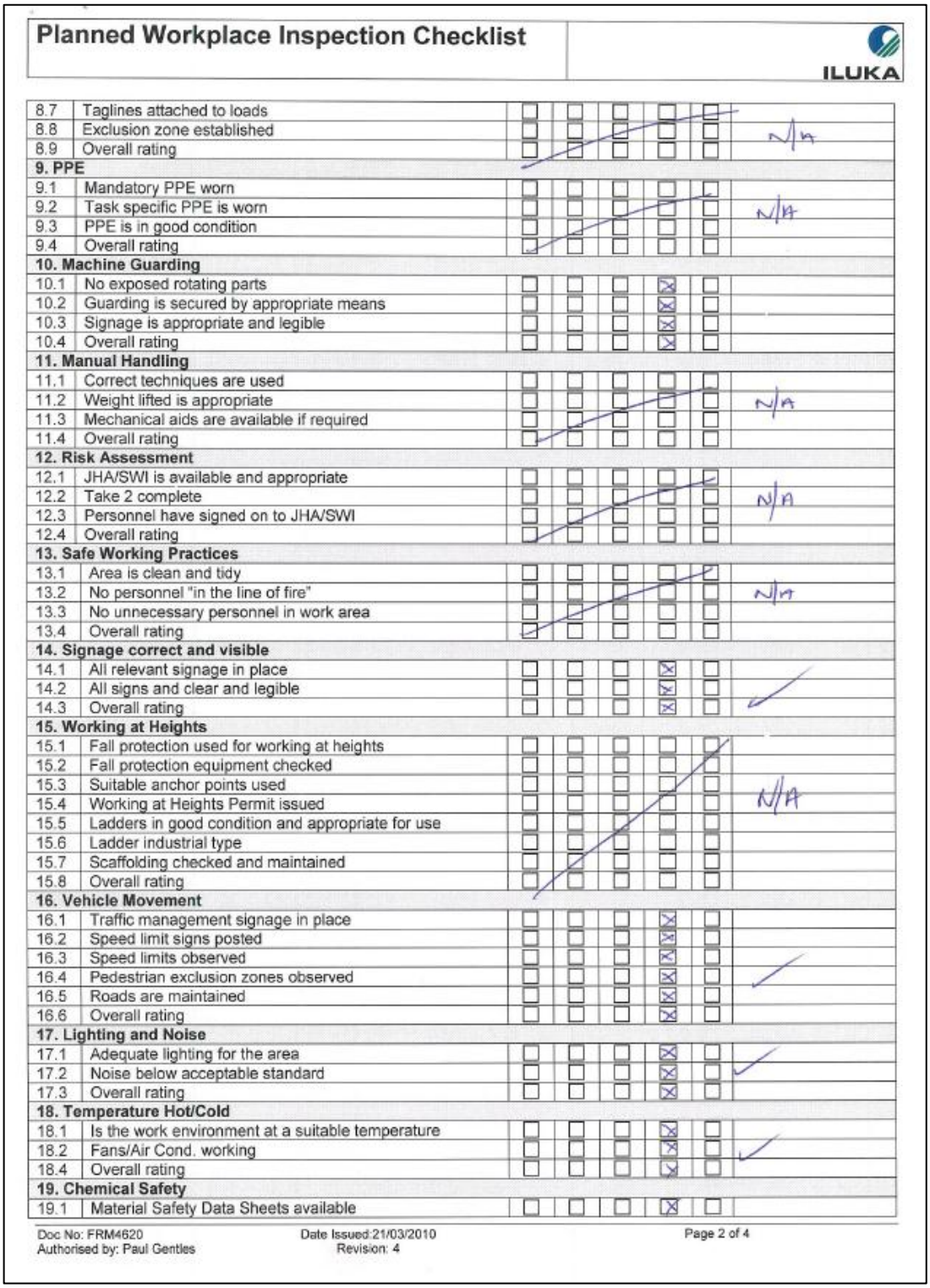

Planned Workplace Inspection Checklist

ILUKA

8.7	Taglines attached to loads	☐	☐	☐	☐	☐	
8.8	Exclusion zone established	☐	☐	☐	☐	☐	N/A
8.9	Overall rating	☐	☐	☐	☐	☐	
9. PPE							
9.1	Mandatory PPE worn	☐	☐	☐	☐	☐	
9.2	Task specific PPE is worn	☐	☐	☐	☐	☐	N/A
9.3	PPE is in good condition	☐	☐	☐	☐	☐	
9.4	Overall rating	☐	☐	☐	☐	☐	
10. Machine Guarding							
10.1	No exposed rotating parts	☐	☐	☐	☒	☐	
10.2	Guarding is secured by appropriate means	☐	☐	☐	☒	☐	
10.3	Signage is appropriate and legible	☐	☐	☐	☒	☐	
10.4	Overall rating	☐	☐	☐	☒	☐	
11. Manual Handling							
11.1	Correct techniques are used	☐	☐	☐	☐	☐	
11.2	Weight lifted is appropriate	☐	☐	☐	☐	☐	N/A
11.3	Mechanical aids are available if required	☐	☐	☐	☐	☐	
11.4	Overall rating	☐	☐	☐	☐	☐	
12. Risk Assessment							
12.1	JHA/SWI is available and appropriate	☐	☐	☐	☐	☐	
12.2	Take 2 complete	☐	☐	☐	☐	☐	N/A
12.3	Personnel have signed on to JHA/SWI	☐	☐	☐	☐	☐	
12.4	Overall rating	☐	☐	☐	☐	☐	
13. Safe Working Practices							
13.1	Area is clean and tidy	☐	☐	☐	☐	☐	
13.2	No personnel "in the line of fire"	☐	☐	☐	☐	☐	N/A
13.3	No unnecessary personnel in work area	☐	☐	☐	☐	☐	
13.4	Overall rating	☐	☐	☐	☐	☐	
14. Signage correct and visible							
14.1	All relevant signage in place	☐	☐	☐	☒	☐	
14.2	All signs and clear and legible	☐	☐	☐	☒	☐	✓
14.3	Overall rating	☐	☐	☐	☒	☐	
15. Working at Heights							
15.1	Fall protection used for working at heights	☐	☐	☐	☐	☐	
15.2	Fall protection equipment checked	☐	☐	☐	☐	☐	
15.3	Suitable anchor points used	☐	☐	☐	☐	☐	
15.4	Working at Heights Permit issued	☐	☐	☐	☐	☐	N/A
15.5	Ladders in good condition and appropriate for use	☐	☐	☐	☐	☐	
15.6	Ladder industrial type	☐	☐	☐	☐	☐	
15.7	Scaffolding checked and maintained	☐	☐	☐	☐	☐	
15.8	Overall rating	☐	☐	☐	☐	☐	
16. Vehicle Movement							
16.1	Traffic management signage in place	☐	☐	☐	☒	☐	
16.2	Speed limit signs posted	☐	☐	☐	☒	☐	
16.3	Speed limits observed	☐	☐	☐	☒	☐	
16.4	Pedestrian exclusion zones observed	☐	☐	☐	☒	☐	✓
16.5	Roads are maintained	☐	☐	☐	☒	☐	
16.6	Overall rating	☐	☐	☐	☒	☐	
17. Lighting and Noise							
17.1	Adequate lighting for the area	☐	☐	☐	☒	☐	
17.2	Noise below acceptable standard	☐	☐	☐	☒	☐	✓
17.3	Overall rating	☐	☐	☐	☒	☐	
18. Temperature Hot/Cold							
18.1	Is the work environment at a suitable temperature	☐	☐	☐	☒	☐	
18.2	Fans/Air Cond. working	☐	☐	☐	☒	☐	✓
18.4	Overall rating	☐	☐	☐	☒	☐	
19. Chemical Safety							
19.1	Material Safety Data Sheets available	☐	☐	☐	☒	☐	

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Planned Workplace Inspection Checklist

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19.2	Containers clearly labelled	☐	☐	☐	☒	☐	
19.3	Petrol stored in locked containers	☐	☐	☐	☒	☐	
19.4	Spill kits and spill protection such as bunding provided	☐	☐	☐	☒	☐	
19.5	Gas cylinders upright and restrained	☐	☐	☐	☐	☒	
19.6	Storage areas adequately ventilated	☐	☐	☐	☒	☐	✓
19.7	Dangerous substances signage in place	☐	☐	☐	☒	☐	
19.8	Fire protection provided	☐	☐	☐	☒	☐	
19.9	PPE used for handling substances	☐	☐	☐	☐	☒	
19.0	Overall rating	☐	☐	☐	☒	☐	
20. Ventilation/Dust							
20.1	Area is well ventilated	☐	☐	☐	☒	☐	
20.2	If area or work is dusty – PPE is worn	☐	☐	☐	☐	☒	✓
20.3	Overall rating	☐	☐	☐	☒	☐	
21. Hot Works							
21.1	Gas cylinders adequately restrained	☐	☐	☐	☐	☐	
21.2	Hoses and connections in good condition	☐	☐	☐	☐	☐	
21.3	Extinguisher on standby	☐	☐	☐	☐	☐	
21.4	Flashback arrestors in place	☐	☐	☐	☐	☐	N/A.
21.5	Screens or shields in place	☐	☐	☐	☐	☐	
21.6	Electrical equipment grounded	☐	☐	☐	☐	☐	
21.7	Goggles, gloves and clothing adequate	☐	☐	☐	☐	☐	
21.8	**Overall Rating**	☐	☐	☐	☐	☐	

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13.9 Hydrocarbon & Chemical Stores Audit Records

Audit records for AS1940-based hydrocarbon and chemical storage facility audits undertaken in 2012. Audits provide ongoing assessment of storage facility conformance to AS1940 and SA EPA Bunding and Containment Guidelines.

ILUKA

Cintellate No:

ILUKA RESOURCES LIMITED

MONTHLY INSPECTION CHECKLIST - JA LUBRICANT STORES Date: 6/11/12

CIRCLE ONE Exact Sea container ☐ Exact Outdoor area ☐ Iluka Sea Container ☐ Fuel Tower ☐ KPS ☐

ITEM	STANDARD AS1940	ITEM CONFORMS TO STANDARD			Exact	Exact	Iluka	Fuel To	KPS	NON CONFORMANCE IDENTIFIED
A	**INTENDED USE**	**N/A**	**NO**	**YES**						
1	<2500 litres of C1 Diesel fuel Biocide	N/A	0	1	1		1			
2	<5000 litres of C2 Engine, gearbox, hydraulic oils & grease	N/A	0	1	1		1			
3	No chemicals	N/A	0	1	1		1			
B	**SIGNAGE AS1940 pp32**	**N/A**	**NO**	**YES**						
1	DANGER - No Smoking, No Naked Flames	N/A	0	1	1		1			
2	Combustible liquid	N/A	0	1	1		1			
3	WARNING - Restricted Area, Authorised Personnel Only	N/A	0	1	1		1			
4	Emergency Contacts - Title & Phone numbers	N/A	0	1	1		1			
5	Iluka name & address	N/A	0	1	1		1			
6	Layout diagram	N/A	0	NA	NA		NA			
C	**FIRE REQUIREMENTS AS1940 pp122-124**	**N/A**	**NO**	**YES**						
1	Powder extinguishers x 2	N/A	0	1	0		0			Only 1 x powder extinguisher installed at Iluka oil store
2	Foam extinguisher x 2	N/A	0	1	0		0			No Foam extinguishers installed @ Iluka oil store. Only one installed at Exact Store.
D	**SAFETY REQUIREMENTS AS1940 pp51**	**N/A**	**NO**	**YES**						
1	Eye wash facilities within 10 mtrs	N/A	0	1	1		1			
2	Handwashing facility within 10 mtrs	N/A	0	1	1		1			
3	A safety shower within 10 mtrs	N/A	0	1	1		1			

E	HOUSEKEEPING & SPILLAGE	N/A	NO	YES						
1	Hydrocarbon store clean and tidy inside and around	N/A	0	1	1		1			
2	No leaks	N/A	0	1	1		1			
3	No evidence of spills	N/A	0	1	1		1			
4	Drum and hoses within store area	N/A	0	1	1		1			
5	MSDS	N/A	0	1	1		1			
6	Spill kit	N/A	0	1	1		1			
7	Clear access	N/A	0	1	1		1			

	Exact 1	Exact 2	Iluka	Towers	KPS
TOTAL SCORE:	18	0	18	0	0
MAXIMUM POSSIBLE SCORE:	20	20	20	20	20
PERCENT CONFORMANCE SCORE:	90.0%	0.0%	90.0%	0.0%	0.0%

INSPECTION CONDUCTED BY:

Name: **Sign:** **Date:** 6/11/1

NICK TRAWERS

INSTRUCTIONS

1) Circle the applicable score for each item on the Planned Inspection Checklist (i.e. N/A, 0 or 1).

2) Write Non Conformance identified in the space provided

3) Install name, date and signature in the space provided below each item

4) Hand inspection to Area Supervisor for corrective actions to be issued.

5) Hand completed inspection to safety department for processing.

6) Send copies of completed inspection to relevant department heads and place copies on notice boards.

13.10 HAZCHEM Register

Jacinth-Ambrosia – ChemAlert electronic hazardous substances register (***Extract only*** – *full register available on request*).

ChemAlert.

Printed from Chem Alert

Stock Register By Site

(Site Name: ILUKA/ SA OPERATIONS/ JACINTH AMBROSIA, Child Sites Included)

Sort By: Product Name, Filter By: None

RMT Risk Management Technologies

Stock Number	Product Name	Colour Rating	Stock Status	Manufacturer
143	5.56 AEROSOL	Amber	Approved	CRC INDUSTRIES (AUST) PTY LIMITED
1434	819-LINE BERGER JET DRY NON SLIP	Amber	None	DULUX AUSTRALIA
1405	889-LINE DULUX QUICK DRY SPRAYPAK	Amber	None	DULUX AUSTRALIA
1443	889-LINE DULUX QUICK DRY SPRAYPAK	Amber	None	DULUX AUSTRALIA
1462	ACE PACK (PRODUCT OBSOLETE)	Amber	None	OSMOFLO PTY LTD
114	ACETYLENE	Amber	Approved	BOC LIMITED (AUSTRALIA)
1360	ADW 35	Amber	None	JASOL AUSTRALIA
1387	AJAX SPRAY N WIPE ANTIBACTERIAL	Green	None	COLGATE-PALMOLIVE PTY LTD
861	ALBRITE TSPP FOOD GRADE AND TECHNICAL GRADE	Amber	Approved	ALBRIGHT & WILSON (AUSTRALIA) LIMITED
1525	ALFLOC LB510	Amber	TRIAL	NALCO AUSTRALIA PTY LTD
1367	AMC BACKFILL	Amber	None	AMC
1368	AMICIDE 625 SELECTIVE HERBICIDE	Amber	Approved	NUFARM AUSTRALIA LIMITED
109	AQUADHERE INTERIOR	Green	Approved	SELLEYS PTY LIMITED
373	ARGON, COMPRESSED	Amber	Approved	BOC LIMITED (AUSTRALIA)
202	ARGOSHIELD UNIVERSAL	Amber	Approved	BOC LIMITED (AUSTRALIA)
418	BARRIER CREAM (LIGHTNING PRODUCTS)	Green	Approved	LIGHTNING PRODUCTS PTY LTD
1366	BC2 - SANITISER	Green	None	JASOL AUSTRALIA
1021	BC4 - GLASS CLEANER	Green	Approved	JASOL AUSTRALIA
1436	BODYGUARD	Green	None	SEPTONE PRODUCTS PTY LTD
102	BORIC ACID	Amber	Approved	AJAX FINECHEM
362	BOSTIK CONTACT BOND	Amber	Approved	BOSTIK AUSTRALIA PTY LTD
1445	BOSTIK NEVER SEEZ REGULAR GRADE	Green	None	BOSTIK AUSTRALIA PTY LTD
624	BOSTIK PLUMB-WELD PVC PIPE CEMENT GREEN TYPE P	Amber	Approved	BOSTIK AUSTRALIA PTY LTD
1453	CASTROL LSX 90	Green	None	BP AUSTRALIA PTY LTD
1442	CASTROL RX SUPER 15W-40	Green	None	BP AUSTRALIA PTY LTD
1999	CAUSTIC SODA - LIQUID (46%-50%)	Red	Approved	ORICA AUSTRALIA PTY LTD
1333	CAUSTIC SODA - LIQUID (5%-45%)	Red	Approved	ORICA AUSTRALIA PTY LTD
1535	CCD 01 / FLOPAM AN905SH	Green	TRIAL	SNF (AUSTRALIA) PTY LTD
1460	CITRICLEAN 2 (PRODUCT OBSOLETE)	Amber	None	OSMOFLO PTY LTD
1412	CO CONTACT CLEANER (AEROSOL) (POST JUNE 2010)	Amber	None	CRC INDUSTRIES (AUST) PTY LIMITED
1040	CO CONTACT CLEANER (AEROSOL) (PRE JUNE 2010)	Amber	Approved	CRC INDUSTRIES (AUST) PTY LIMITED
1419	CONCENTRATE ROUNDUP WEEDKILLER	Amber	None	MONSANTO AUSTRALIA LIMITED
1435	CT18 SUPERWASH	Green	None	APPLIED AUSTRALIA PTY LTD
923	CUMMINS TEC PGXL COOLANT	Green	Approved	CUMMINS SOUTH PACIFIC PTY LTD

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