



Assessment on Referral Information

**Empire Oil Company (WA) Ltd,
Mullering 3D Onshore Seismic Survey**

September 2007
we08016_1_v6



Empire Oil Company (WA) Limited

Mullering 3D Onshore Seismic Survey

Assessment on Referral Information



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Version/s:	Distribution:
we08016_1_v1 December 2006	Empire Oil – 1 copy (Via email)
we08016_1_v2 December 2006	Empire Oil – 1 copy (via email) DEC – 1 copy (via email)
we08016_1_v3 December 2006	DEC – 3 copies DoIR – 3 copies Empire Oil – 1 copy Enesar – 1 copy
we08016_1_v4 May 2007	DEC – 2 copies DoIR – 2 copies Empire Oil – 1 copy Enesar – 1 copy Woodman Environmental – 1 copy
we08016_1_v5 August 2007	DEC – 3 copies DoIR – 1 copy Empire Oil – 1 copy Enesar – 1 copy Woodman Environmental – 1 copy
we08016_1_v6 September 2007	DEC – 1 copy (via email) DoIR – 1 copy (via email) Empire Oil – 1 copy (via email)

Executive Summary

Empire Oil are proposing to conduct a three dimensional (3D) seismic exploration survey (Mullering 3D Onshore Seismic Survey) in order to define potential oil and gas reserves of the Mullering Anticline in EP 432. It is expected that approximately 345 km of seismic lines will be surveyed, covering an area of 53 km². The project is located approximately 20 km west of the Brand Highway, northwest of Cataby, on Woolka Road. The Mullering 3D Onshore Seismic Survey is scheduled to occur between November and December 2007. This time of year is likely to provide for dry soil conditions, avoiding potential erosion impacts.

The project area is primarily located within Unallocated Crown Land (UCL) with a number of other land tenure types present within the project area including Vacant Crown Land (VCL) and a 'water and stopping place' reserve around the Wooka Wooka Well, which is vested in the Shire of Dandaragan ('C' Class Reserve 729). There is one privately managed property in the project area. This pastoral lease is held by Mr C. Wedge of the Mimigarra Pastoral Company and is located at the western side of the project area.

A seismic crew generally varies between 30 to 50 people and will be accommodated in a purpose built camp on site. The campsite will be located at Cataby No. 1 well site. On completion of the survey, the campsite and all associated infrastructure will be removed.

Seismic operations allow the identification of geological structures below the surface of the earth where oil and gas deposits may have accumulated. Vibroseis trucks are used as the source of vibrations (sound waves) that travel into the earth and are reflected from subsurface geological structures. The seismic signal is then detected at the surface with the use of geophones. For the Mullering 3D Onshore Seismic Survey, source lines (allowing access for the Vibroseis trucks) will run north-south and are approximately 3-4 m wide. Receiver lines (allowing access to lay geophones) will run east-west and are approximately (1-2 m wide). Source and receiver lines are generally placed 300 m apart. The Mullering 3D Onshore Seismic Survey will involve the use of 3-4 Vibroseis trucks, and 3 light cable trucks for laying out the geophone lines during this operation.

There are numerous access tracks or historic survey lines in the area, in various conditions. These existing tracks will be used for access and as source lines as far as practicable to minimise disturbance to undisturbed land. Seismic line route planning also considered the results of the botanical surveys (Woodman 2006) and were developed in consultation with DEC and DoIR.

An uphole drill survey will be undertaken as part of the seismic program. A crew, using a truck-mounted drilling rig, associated water truck and support vehicle, will drill holes of approximately 10 cm diameter to a depth of 50 m to 100 m. A special geophone is lowered into the hole and records the seismic waves created with a weight drop impact at the surface. This provides information on the weathering layer. Approximately 50 upholes are required for the project, these are located at approximately 1 km intervals along each receiver line. All upholes will be located on the cleared seismic lines so no additional clearing is required to conduct the uphole survey. Commitments are in place to manage and minimise any possible environmental impacts from drilling.

The locations of the proposed source and receiver lines have been plotted onto detailed maps, taking into account environmentally sensitive locations. In general, seismic line routes have been planned to avoid, or where required, minimise environmental impacts of:

- Areas where DRF or Priority flora are likely to occur.
- Wetlands and associated riparian zones.
- Areas with high erosion potential or sensitive to disturbance.
- Areas of high environmental risk (e.g., weed-infested areas).
- Areas of Aboriginal and cultural significance.

A risk assessment of the potential environmental impacts of the project has been undertaken. Provided the commitments and management measures contained within this ARI and associated Environmental Management Plans (EMPs) are carried out, all activities are considered to be of a low or moderate risk. Those activities identified as moderate risk have been addressed through an EMP or contingency plan. There are no activities assessed as being of high risk for the project, this reflects the temporary and low impact nature of the activity.

The main impacts of the project derive from formation of source and receiver lines, including clearing or trampling of vegetation. These impacts are temporary, localised and, for all practical purposes, recoverable. There is the potential for ongoing impacts associated with unauthorised public use of the source and receiver lines as a thoroughfare. Plans are in place for the management of this risk through preventative measures to prevent unauthorised access of the source and receiver lines.

There are three DRF species found from the project area. One of these species, *Macarthuria keigheryi*, is locally common and cannot be completely avoided by this survey. A Permit to Take has been granted for this species. Clearing near the two other DRF species will be avoided by a buffer of at least 50 m. Priority flora species have been avoided by seismic line planning as far as practicable. No more than 3% of the habitat for any Priority species, within the seismic survey area, will be impacted by this project.

A number of measures to avoid weed or dieback introduction or spread will be implemented including:

- Clean on entry for all vehicles entering the survey area.
- Survey to be conducted from east to west, from weed free areas into areas where weeds are present.
- Vehicle and personnel hygiene points at the boundary of weed infested areas.

A comprehensive Rehabilitation Management Plan has been developed that outlines auditing and line closure, post survey inspection, rehabilitation monitoring, completion criteria and rehabilitation contingencies that will result in the restoration of the vegetation overtime.

Minimising and mitigating potential impacts associated with the proposed project relies significantly on consultation with key stakeholders. Empire Oil has undertaken extensive consultation with all relevant stakeholders to identify regulatory processes, potential environmental issues and management requirements.

Empire Oil entered into a Native Title agreement, which covers EP 432, with the Yued people and the South West Aboriginal Land and Sea Council on 10 February 2004. Empire Oil have contacted the Yued people and the South West Aboriginal Land and Sea Council to inform them of the project and to seek their input into Aboriginal heritage investigations. Empire Oil have been advised that a heritage survey is required and is currently preparing to undertake this survey, in consultation with the Yued people. The Aboriginal heritage survey will be undertaken prior to seismic field work and Empire Oil have committed to avoid all areas of Aboriginal heritage significance identified during the heritage survey.

The following table provides a summary of the environmental commitments made in this EMP.

Table ES2 Summary of Environmental Commitments

No.	Commitment	ARI Reference
Native Vegetation		
1	Where required, overhanging branches will be trimmed rather than removing whole trees or shrubs. Branch trimming will be undertaken using chainsaws or handsaws and not excavators.	Appendix A-1
2	Disturbance to all known populations of the DRF species <i>A. gracilis</i> and <i>A. viridis</i> subsp. <i>terraspectans</i> will be avoided with a disturbance buffer of at least 50-m maintained around these locations. A <i>Permit to Take DRF</i> has been granted for <i>Macarthuria keigheryi</i> .	Appendix A-1
3	Populations of Priority flora within 30 m of seismic activity will be flagged to ensure that accidental disturbance is avoided.	Appendix A-1
4	Clearing of wetland areas will be avoided.	Section 3.5 Appendix A-1
5	Large trees (greater than 3m) will not be cleared during seismic line preparation.	Section 3.5 Appendix A-1 Appendix C
6	Line preparation methods will be undertaken as per Appendix C Table 5: Line preparation methods recommended for the Mullering Onshore 3D Seismic survey.	Appendix A1
7	Slow growing species will be avoided where possible during seismic line preparation. These species include <i>Macrozamia fraseri</i> and <i>Xanthorrhoea</i> spp.	Section 3.6 Appendix A1
8	Clearing within 10 metres of DEC monitoring plots within the Mullering Project Area will be avoided.	Section 3.5 Appendix A1
9	All personnel will be inducted on the significance of the flora and fauna of the project area and the management measures put in place to ensure their protection.	Appendix A1
10	Existing tracks will be used for access and as seismic lines as far as practicable to minimise disturbance to undisturbed land.	Section 3.5 Appendix A1
Fauna		
11	Vermin-proof bins will be installed at the camp to discourage foraging behaviour by native and introduced fauna.	Appendix A1
12	Inductions will stress potential project impacts on native fauna and how these will be addressed.	Appendix A1
13	The seismic survey will be conducted during daylight hours only to avoid impacts to nocturnal species.	Appendix A1

Table ES2 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Fauna (cont'd)		
14	Fauna injuries or fatalities will be reported through the internal incident reporting system and reported to the DEC regional office. Rebecca Carter (Programme Leader Nature Conservation) will be the first point of contact (phone number 9652 1911).	Appendix A1
15	All practicable measures to rehabilitate any injured animal found within the operations boundaries will be implemented.	Appendix A1
16	Vehicle speeds will be restricted to 60 km/h along Woolka Road and 40 km/h on seismic lines to minimise noise disturbance to fauna.	Appendix A1 and A4
17	Obstructions to the passage of terrestrial fauna (e.g. equipment on the ground) will be minimised.	Appendix A1
18	Lighting requirements will be kept at levels as low as reasonably practical.	Appendix A1
19	The feeding of animals, hunting, fire-arms and pets on the construction site will be prohibited.	Appendix A1
20	Measures will be in place to avoid encouraging Foxes including minimal tracks, no feeding and no accessible food scraps.	Appendix A1
Weed and <i>P. cinnamomi</i> Hygiene		
21	Hygiene management as outlined in Appendix A2 will be implemented to prevent weed and pathogen introduction to the project area.	Appendix A2
22	If post-survey rehabilitation monitoring indicated that weeds have been introduced or spread as a result of the Mullering 3D seismic survey, Empire Oil will undertake an active weed eradication programme as outlined in Appendix A2.	Appendix A2
23	All vehicles and equipment entering the sites will be required to follow clean down procedures as outlined in Appendix A2.	Appendix A2
24	Vehicles will remain within the cleared seismic lines and on designated access roads and tracks.	Appendix A2
25	Daily movements of vehicles and line rolling equipment will be planned to minimise transit between weed prone and weed free areas.	Appendix A2
26	Access to the project area will be restricted to Woolka Road. All vehicles must pass through a clean on entry hygiene station as depicted in Figure A2.1.	Appendix A2
27	All access to and from the D2 vegetation community will occur via one of the designated hygiene points.	Appendix A2
28	Where receiver lines are hand carried, (as designed on swath maps), personnel will inspect and clean clothing.	Appendix A2
29	Weed and <i>P. cinnamomi</i> hygiene management will be detailed to all employees prior to commencing work on the seismic survey as part of the environmental induction program, and training will be provided in the correct use of hygiene stations.	Appendix A2
30	At the commencement of work on the Mullering seismic program all vehicles and equipment shall be washed down and inspected prior to entering the project area.	Appendix A2
Wetland Management		
31	Source lines will be deviated to avoid all wetlands in the proposed seismic survey area or stopped outside riparian zones, recommencing on the other of the riparian zones, so that the wetland can be 'undershot'	Appendix A3
32	Wetland areas that experience significant periods of inundation will not be traversed by vehicles to protect the surface from compaction and to ensure surface drainage patterns are not compromised.	Appendix A3

Table ES2 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Wetland Management (cont'd)		
33	All personnel working on the Mullering 3D Onshore Seismic Survey will be inducted on the significance of wetlands in the project area and the management measures put in place to ensure their protection.	Appendix A3
Pollution Prevention		
34	Wastes produced by survey activities will be disposed of in accordance with relevant regulations as outlined in Section A4.4.1 of Appendix A4.	Appendix A4
35	Handling of hazardous material will be done in accordance with contractor dangerous goods procedures.	Appendix A4
36	Refueling and drilling will not occur within 50 m of a watercourse. Non-return valves will be used for refueling and no chemical additives will be used in drilling fluid.	Appendix A3 Appendix A4
37	Procedures for equipment maintenance will ensure that risk of spills is minimised and clean up response is rapid.	Appendix A4
38	Up-holes will be backfilled and cement-sealed if an aquifer is intersected.	Section 3.7 Appendix A3
39	Drill wastes, consisting of broken rock and soil matter, will be temporarily stored on the drilling rigs in transportable containers and returned to the up-hole once drilling and testing is complete. Excess cuttings will be spread over topsoil in a thin layer and raked in.	Appendix A4
40	Domestic wastes (food scraps, light paper, cardboard, putrescible and plastic waste), including rubbish produced by the workforce operating in the field, will be collected according to contractor management procedures and treatment systems and disposed in line with local Shire requirements.	Appendix A4
41	Domestic sewage (black and grey water) will be temporary stored in a buried septic tank system installed at the camp and operated as per the Contractor management procedures and treatment systems. The tank will be pumped out as required and the waste transported to an appropriate waste management facility for disposal.	Appendix A4
42	Industrial wastes (wood, scrap steel and other metals, scrap tyres, rubber and synthetic materials, and other inert, mixed industrial wastes) will be collected according to Contractor management procedures and treatment systems and disposed in line with local Shire requirements.	Appendix A4
43	Hazardous materials will be clearly labelled (including an MSDS that conforms with the WorkSafe Australia Code of Practice), stored and banded as per the requirements of Australian Standard AS 1940 – 1993 and disposed of in line with local Shire requirements.	Appendix A4
44	Spill kits, bio-remedial products, drip trays and shovels will be provided in the case of a spill of hazardous materials or wastes and workers required to access dangerous goods will be trained in the use of this equipment.	Appendix A4
45	A waste log will be kept detailing waste types, volumes and disposal methods.	Appendix A4
Soil Conservation		
46	The survey is scheduled to be carried out in the dry period when the potential for soil compaction is at its lowest.	Section 6.5 Appendix A2
47	Compacted or rutted soils may be lightly scarified to improve aeration and prevent channeling of surface water flows.	Section 3.10 Appendix A6

Table ES2 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Soil Conservation (cont'd)		
48	Any vegetation pushed to one side of the seismic lines during operations will be pulled back over the lines.	Appendix A6
49	A post-survey inspection will be carried out to confirm that all line closure activities have been successfully carried out and to determine if there is any need for additional closure activities or active rehabilitation.	Appendix A6
Visual Amenity and Third Party Access		
50	The camp and laydown area will not be visible from public roads.	Section 3.4 Appendix A6
51	No seismic lines will enter onto Woolka Road and it is unlikely that any seismic lines will be visible from Woolka Road.	Section 6.5 Appendix A6
52	All intersections of seismic lines with public roads will be disguised to prevent third party access.	Section 3.10 Appendix A6
53	Closure of seismic lines will occur as soon as practicable, and no later than two weeks after the last required use of the seismic line.	Section 6.5 Appendix A6
Air Quality and Noise		
54	The camp will be located at a sufficient distance from residences to minimise noise nuisance from traffic, generators or general noise.	Section 6.5 Appendix A6
55	Operations will only be undertaken during daylight hours and local lease holders will be kept informed of progress and areas of operations throughout the survey.	Appendix A4
56	Vibroseis trucks move slowly and stop frequently therefore generate minimal dust.	Section 6.5
Bushfire Prevention and Management		
57	All personnel will attend a site induction that includes a component on the fire prevention requirements of the Mullering 3D Onshore Seismic Survey and the use of the fire extinguisher fitted to all vehicles.	Section 7
58	Personnel will be made aware of fire restrictions and fire weather information, including information on harvest and vehicle movement bans during daily toolbox meetings.	Section 7
59	Appropriate contractor personnel will be trained in fire-fighting techniques and equipment/vehicle use and will man the fire fighting equipment as part of an Emergency Response Team (ERT).	Section 7
60	No petrol vehicles will be used for the Mullering 3D Onshore Seismic Survey except for activities associated with maintaining the camp.	Section 7
61	Personnel will inspect vehicles daily and remove vegetation build-up around the belly plates and exhaust systems of vehicles: <ul style="list-style-type: none"> • At each hygiene check point. • As part of the daily vehicle pre-start inspection. 	Section 7
62	The Chief Bushfire Control Officer from the Shire of Dandaragan will conduct an inspection at mobilisation.	Section 7
63	Every vehicle directly involved in the seismic survey will carry: <ul style="list-style-type: none"> • A rake to assist in suppressing a small fire if it occurs. • A 9 kg pressurised water fire extinguisher applicable to scrub fires. 	Section 7
64	Each Vibroseis truck will carry two 2 kg fire extinguishers.	Section 7

Table ES2 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Bushfire Prevention and Management (cont'd)		
65	Two (2) Light Tankers equipped with 800 L tank and petrol driven pump will be stationed proximal to the daily seismic crew activities and a 12,000 L fire tender will be stationed on site, complete with: <ul style="list-style-type: none"> • A motor driven pump. • A fire fighting hose on a suitable hose reel fitted with an approved nozzle (minimum length 50 m). 	Section 7
66	The 12,000 L fire truck will be backed up by two fast attack vehicles equipped with a high pressure pump. These vehicles will be deployed central to seismic activities to best minimise response time.	Section 7
67	All fire-fighting equipment will be maintained in good working order, including full water levels, and all personnel will be trained in the use of this equipment and notified of nearby available sources of water.	Section 7
Rehabilitation		
68	Closure of seismic lines will occur as soon as practicable, not later than two weeks after the last required use of the seismic line.	Section 6.5 Appendix A6
69	On completion of the survey, the campsite and all associated infrastructure will be removed.	Section 3.4 Appendix A6
70	Wastes produced by the survey activities will be disposed of in accordance with relevant regulations as outlined in Section A4.4.2 of Appendix A4.	Appendix A4
71	All drill collars, steel pegs and other drilling and seismic materials will be removed from the seismic lines, drill sites and camp site.	Appendix A6
72	The time between clearing of the seismic survey lines and rehabilitation will be minimised to limit the time of exposure to the elements of the cleared survey lines.	Section 6.5 Appendix A6
73	A post-survey inspection will be carried out to determine if there is any need for active rehabilitation.	Appendix A6
74	Post survey inspection will identify any compaction or rutting and initiate active rehabilitation of these areas.	Section 6.5 Appendix A6
75	Permanent monitoring quadrats will be established in key locations to allow for assessment of rehabilitation success against the completion criteria.	Appendix A6
76	Quadrats will be surveyed within six months, after the winter rain, following completion of the seismic survey and then annually for at least three years or until completion criteria are achieved, whichever is longer.	Appendix A6
77	Monitoring will be conducted by a qualified botanist using a quadrat based assessment and will consider: <ul style="list-style-type: none"> • Percentage cover and distribution of declared and environmental weeds. • Total vegetation percentage cover. • The presence of keystone flora species. • Any evidence of erosion, soil compaction and disruptions to surface water drainage. • Any evidence of <i>P.cinnamoni</i> introduction to seismic lines. • Any evidence of third party access to the seismic lines that were not already on established tracks. 	Appendix A6
78	The period surfaces are exposed will be minimised by prompt closure of the seismic lines and worksites at the completion of construction.	Section 6.5 Appendix A6
79	The results of monitoring will be reported annually.	Appendix A6

Table ES2 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Rehabilitation (cont'd)		
80	After two years the progress of rehabilitation will be assessed and, if monitoring identifies poorly rehabilitation seismic lines, appropriate contingency actions will be implemented.	Section 6.5 Appendix A6
Aboriginal Heritage		
81	A heritage survey of the project area will be conducted prior to the commencement of the project by a suitably qualified person, in consultation with the Yued people. All known Aboriginal heritage sites will be avoided.	Appendix A5 Section 6.5
82	In the event that any archaeological material, including human skeletal material is uncovered as a result of line preparation, all work in the area will stop immediately and the discovery will be immediately reported to the relevant authorities.	Appendix A5
83	All personnel involved in the project will be inducted in Aboriginal heritage management procedures and provided with information for identifying heritage artefacts so as to prevent unintentional damage.	Section 6.5 Appendix A5
Stakeholder and Social Impacts		
84	Landholders will be consulted regarding the timing of operations and every effort will be made to conduct operations so that disturbance to normal farming practices is minimised	Section 6.5 Appendix A5
85	An access agreement will be made with the Mimigarra Pastoral Company once the timing of the survey is known.	Section 3.1 Appendix A5
86	Any damaged infrastructure will be reinstated to its prior condition (as a minimum) in consultation with the asset owner.	Section 6.5 Appendix A5
87	Erect appropriate access barriers (e.g. temporary fencing) and warning signs, as necessary.	Section 6.5 Appendix A5
88	Liaison with landholders prior to, during and on completion of seismic program.	Section 6.5 Appendix A5
89	Liaise with the landholder to make appropriate arrangements to minimise disruption.	Section 6.5 Appendix A5
90	Any damage to property will be rectified as soon as possible.	Section 6.5 Appendix A5
91	Consultation with relevant utility authorities and site inspection will be undertaken for the early identification of existing buried cables, pipes, water mains and other infrastructure.	Section 6.5 Appendix A5
92	Empire Oil will contact all apiary permit holders within the Mullering 3D Onshore Seismic Survey project area prior to conducting the survey to inform them of the project and consult on ways to minimise interruption to their operations.	Appendix A5
93	Temporary fencing/gates will be installed at any location where it is necessary to remove fences or gates.	Section 6.5 Appendix A5
94	Temporary fencing will be removed and permanent fencing re-instated.	Section 6.5 Appendix A5
95	All fences and farm infrastructure will be returned to pre-survey conditions as agreed with the lease holder and appropriate compensation agreements negotiated.	Section 6.5 Appendix A5
General		
96	Upholes plugged and backfilled to an appropriate depth to prevent collapse and avoid hazard.	Section 6.5
97	All source and receiver lines will be prepared in accordance with the recommendations of Woodman Environmental Consulting 2006.	Appendix A1

Contents

Executive Summary	i
1. Introduction	1
1.1 Project Outline	1
1.2 Project Proponent	1
1.3 Environmental Commitment	3
1.4 Project Objectives	3
1.5 Purpose of the ARI/EMP	3
2. Legislative Framework	5
2.1 Approvals Process	5
2.2 State Legislation	5
2.2.1 <i>Petroleum Act 1967</i>	5
2.2.2 <i>Environmental Protection Act 1986</i>	5
2.2.3 Other State Legislation	5
2.3 Commonwealth Legislation	6
2.3.1 <i>Environmental Protection and Biodiversity Conservation Act 1999</i>	6
2.3.2 Other Commonwealth Legislation	6
2.4 Industry Codes of Practice and Guidelines	6
3. Description of Proposed Seismic Operations	7
3.1 Site Location, Land Tenure and Access	7
3.2 Timeline of Operations	9
3.3 Environmental Objectives	9
3.4 Camp Site	9
3.5 Survey Planning	10
3.6 Line Preparation	10
3.7 Data Acquisition	11
3.8 Uphole Survey	12
3.9 Line Checking	12
3.10 Seismic Line Rehabilitation	12
3.11 Auditing and Monitoring Program	14
4. Stakeholder Consultation	15
4.1 Consultation to Date	15
5. The Existing Environment	19
5.1 Regional Description and Context	19
5.2 Physical Environment	19
5.2.1 Landform and Soils	19
5.2.2 Climate	20
5.2.3 Surface Water and Drainage	21
5.2.4 Groundwater	21
5.2.5 Air Quality and Noise	22
5.3 Biological Environment	22
5.3.1 Flora	22
5.3.2 Dieback	28
5.3.3 Fauna	29
5.4 Socio-economic Environment	33

5.4.1	Natural and European Heritage	33
5.4.2	Aboriginal Heritage and Native Title	33
5.4.3	Land Use and Economic Environment	34
5.4.4	Traffic and Infrastructure	34
6.	Environmental Risk Assessment and Mitigation Measures	35
6.1	Hazard Identification	35
6.2	Hazard Scenario	36
6.3	Risk Matrix	36
6.4	Risk Reduction Measures	37
6.5	Environmental Hazard and Risk Assessment	38
7.	Natural Disaster Contingency Planning	47
7.1	Bushfire Prevention and Management	47
7.1.1	Bushfire Prevention	47
7.1.2	Fire-Fighting Equipment	47
7.1.3	Bush Fire Response	48
7.1.4	Post Fire Requirements	48
7.2	Cyclone and Flood Management	50
7.2.1	Management Actions	50
8.	Environmental Management	51
8.1	Environmental Objectives and Standards	51
8.2	Training and Education	51
8.3	Environmental Roles and Responsibilities	51
8.4	Monitoring and Auditing	52
8.5	Environmental Reporting	54
9.	Summary of Environmental Commitments	55
10.	References	61

Figures

1.1	Mullering 3D Seismic Survey location and regional context	2
3.1	Land tenure and access routes	8
5.1	Average monthly rainfall, mean daily temperature maximum and mean daily temperature minimum for Lancelin, Western Australia	20
5.2	Vegetation communities, flora of conservation significance and drainage systems	23
7.1	Mullering 3D Onshore Seismic Survey Bush Fire Incident Response	49

Tables

ES2	Summary of Environmental Commitments	iii
1.1	Key Characteristics of Project	1
3.1	Project boundary coordinates	7

3.2	Proposed program schedule	9
4.1	Key environmental concerns raised during stakeholder consultation	16
5.1	Declared Rare Flora species recorded from the Mullering 3D Onshore Seismic Survey project area	26
5.2	Priority Flora species recorded from the Mullering 3D Onshore Seismic Survey project area	27
5.3	Potential number of species of conservation significance occurring in the Mullering 3D Onshore Seismic Survey project area	30
5.4	Fauna species of conservation significance	31
5.4	Fauna species of conservation significance (cont'd))	32
6.1	Qualitative measures of environmental consequence or impact	36
6.2	Qualitative measures of likelihood	36
6.3	Qualitative risk analysis matrix – level of risk	37
6.4	Risk reduction philosophy	37
6.5	Environmental Risk analysis and mitigation measures	39
8.1	Environmental management responsibilities	52
8.2	Environmental Inspection and Monitoring Program	53
9.1	Summary of Environmental Commitments	55

Appendices

A	Project Environmental Management Plans
B	Empire Oil Environmental Policy
C	Flora, Vegetation and <i>Phytophthora cinnamomi</i> Assessment
D	Fauna Values of Empire Oil's Mullering Prospect EP 432
E	Review of Regeneration on 1989 Seismic Lines

Attachments

1	2007 Seismic Survey Vegetation
2	2007 Seismic Survey Layout

1. Introduction

1.1 Project Outline

Empire Oil Company (WA) Limited (Empire Oil) is the operator of Petroleum Exploration Permit EP 432, located in the onshore Perth Basin, Western Australia. Empire Oil owns 75% of EP 432 with Allied Oil and Gas Plc owning 25%. The site is located approximately 20 km west of Cataby in the Wheatbelt region of Western Australia (Figure 1.1).

Empire Oil are proposing to conduct a three dimensional (3D) seismic exploration survey (Mullering 3D Onshore Seismic Survey) in order to define potential oil and gas reserves of the Mullering Anticline in EP 432. It is expected that approximately 345 km of seismic lines will be surveyed, covering an area of 53 km².

The seismic survey program is being managed by Empire Oil and requires an Assessment on Referral Information (ARI) document and supporting Environmental Management Plans (EMPs) as part of an application to conduct a geophysical survey.

This document describes the existing environment in the immediate vicinity of the project area and evaluates the potential environmental impacts of the proposal. Management and mitigation measures to minimise the potential impacts associated with the seismic activities are also outlined. A brief summary of the key characteristics of the proposal is found in Table 1.1 below.

Table 1.1 Key Characteristics of Project

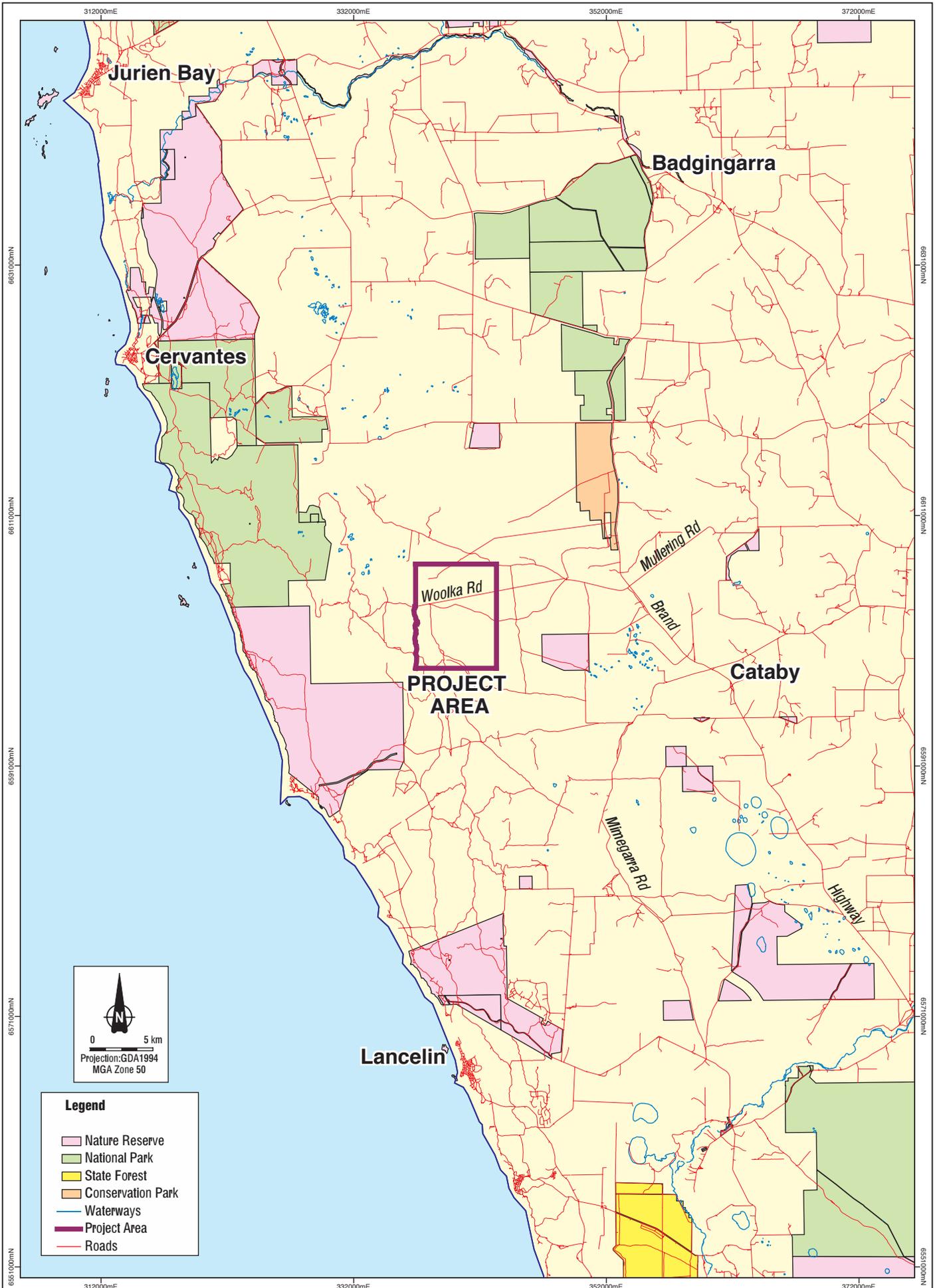
Key Characteristic	Description
Timing of Seismic Survey	November-December 2007
Duration of Seismic Survey	2 months
Total area of seismic survey	53 km ² (5,300 ha)
Maximum area of line clearing ¹	1.38 km ² (138 ha)
Total length of seismic lines	345 km
Total length of line clearing required ²	309 km
Approximate total number of up-holes	50

¹This is a conservative number; based on an average line width of 4 m. Receiver lines are up to 2 m wide, less where geophones are hand carried.

²Total length of seismic lines, minus the length of seismic lines that are on existing tracks or which will be hand carried.

1.2 Project Proponent

The proponent, Empire Oil, is a Western Australian onshore petroleum exploration and production company. They have major holdings in the Perth, Carnarvon and Canning Basins through exploration permits.



Job No:
we0816

File No:
g1186_ef01

Empire Oil Company (WA) Ltd

Mullering 3D Onshore Seismic Project

Location and Regional Context

Figure No:
1.1

Their corporate office is located in Nedlands, Perth:

Empire Oil Company (WA) Ltd.
Suites 7 & 8, 154 Hampden Road
Nedlands 6009
Western Australia
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The nominated proponent contact for this proposal is:

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Further information on the company can be obtained from their website, www.empireoil.com.au.

1.3 Environmental Commitment

Empire Oil is committed to ensuring that the environmental impacts of its operations are minimal and of a transient nature, particularly in environmentally sensitive areas. Empire Oil considers that all potential adverse environmental effects can be effectively managed by means described in this ARI document and accompanying EMPs. The company's Environmental Policy outlines the intention of Empire Oil to engage in sound management of the environmental aspects of all projects. The Empire Oil environmental policy is included in Appendix C.

1.4 Project Objectives

The objective of the Mullering 3D Onshore Seismic Survey is to provide comprehensive seismic data, which will assist in determining the potential for reservoirs of oil and gas in the Mullering Anticline underlying the survey area. The seismic data generated will be used to more accurately define anticlinal structures and/or tilted fault blocks, which may contain commercial quantities of hydrocarbons. The 3D nature of the survey will allow accurate mapping of the complex faulting of the Mullering Anticline. In addition, seismic data may eliminate some areas from future exploratory drilling and help to focus drilling in areas where resources are most likely to be present.

1.5 Purpose of the ARI/EMP

This ARI has been produced to support project approval applications for an onshore survey under the Western Australian *Petroleum Act 1967* and the *Environmental Protection Act 1986*.

Specifically, this ARI contains:

- A description of the legislative framework for onshore seismic surveys in WA.
- A description of the proposed seismic operation.

- A description of the stakeholder consultation carried out in relation to this project.
- A description of the existing environment.
- The identification and assessment of potential environmental risks associated with the project.
- Mitigation measures by which potential risks will be avoided or minimised.
- Performance objectives and measurable standards by which environmental performance can be quantitatively assessed.
- Emergency and contingency planning.
- Empire Oil's environmental management and implementation strategy.
- A range of EMP's to minimise environmental impacts associated with the proposal.

This environmental assessment covers all activities concerned with the acquisition of seismic data within the petroleum permit area EP 432.

2. Legislative Framework

2.1 Approvals Process

The Western Australian state government, through the Western Australian *Petroleum Act 1967*, has regulatory jurisdiction for the exploration and development of all onshore petroleum resources. This act requires that other state and federal environmental laws and regulations are met, as described by the *Environmental Protection Act 1986* and the *Environmental Protection and Biodiversity Act 1999*. A brief description of the major legislation is included below, as well as a list of other relevant legislation that has been considered in the preparation of this ARI/EMP.

2.2 State Legislation

2.2.1 *Petroleum Act 1967*

Exploration for oil and gas reserves, including by 3D seismic survey, is defined under the *Petroleum Act 1967* as a petroleum operation and as such comes under the jurisdiction of this act. Any petroleum operation must also satisfy the conditions of the *Environmental Protection Act 1986* (EP Act 1986). DoIR require an Environmental Management Plan to demonstrate how the EP Act 1986 will be complied with and identify any potential or actual impacts the proposed activity may have and the proponent's commitments to manage, monitor and mitigate these impacts, prior to granting permission to conduct the proposed activity.

2.2.2 *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* legislates for the prevention, control and abatement of pollution and environmental harm, including clearing of native vegetation. Further, it provides for the conservation, protection, enhancement and management of the environment in Western Australia. All projects referred to the Environmental Protection Authority (EPA) are assessed under Part IV of this act.

2.2.3 Other State Legislation

Seismic operations must comply with other relevant Western Australian Legislation including:

- *Schedule of Onshore Petroleum Exploration and Production Requirements 1991.*
- *Aboriginal Heritage Act 1972.*
- *Dangerous Goods Safety Act 2004.*
- *Conservation and Land Management Act 1984.*
- *Wildlife Conservation Act 1950.*
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.*
- *Bushfires Act 1954.*
- *National Heritage Trust 1997.*

2.3 Commonwealth Legislation

2.3.1 *Environmental Protection and Biodiversity Conservation Act 1999*

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) allows for the protection of matters of national environmental significance. Under the EPBC Act, actions that are likely to have a significant impact on a matter of national environmental significance will trigger a Commonwealth assessment and approval process.

Matters defined as nationally significant are:

- World Heritage properties.
- Ramsar wetlands of international importance.
- Nationally threatened animal and plant species and ecological communities.
- Internationally protected migratory species.
- Commonwealth land and marine areas.
- Nuclear actions.

The project area is not within a World Heritage area or a National Heritage place. There are no wetlands of international significance (Ramsar sites) in the project area and it is not a commonwealth marine area or a nuclear action. There are six threatened species (one bird, one mammal and four plant species) and one migratory species listed as likely to occur within the project area; however, this project is unlikely to have significant impacts on any of these species (see Section 5.3 for details).

Based on the above, this proposal has not been referred by the proponent to the Department of Environment and Water Resources (DEWR) under the EPBC Act.

2.3.2 **Other Commonwealth Legislation**

Seismic operations must comply with other relevant Commonwealth Legislation including:

- *Native Title Act 1993*.

2.4 Industry Codes of Practice and Guidelines

The petroleum exploration and production industry operates within an industry code of practice and individual member environmental policies, as follows:

- Australian Petroleum Production and Exploration Association (APPEA) Code of Environmental Practice (1996).

3. Description of Proposed Seismic Operations

3.1 Site Location, Land Tenure and Access

The survey area covers an area of approximately 53 km² and is located approximately 20 km west of the Brand Highway, northwest of Cataby, on Woolka Road (Figure 1.1). The proposed seismic survey is located wholly within the Shire of Dandaragan. Table 3.1 gives the coordinates of the project boundary.

Table 3.1 Project boundary coordinates

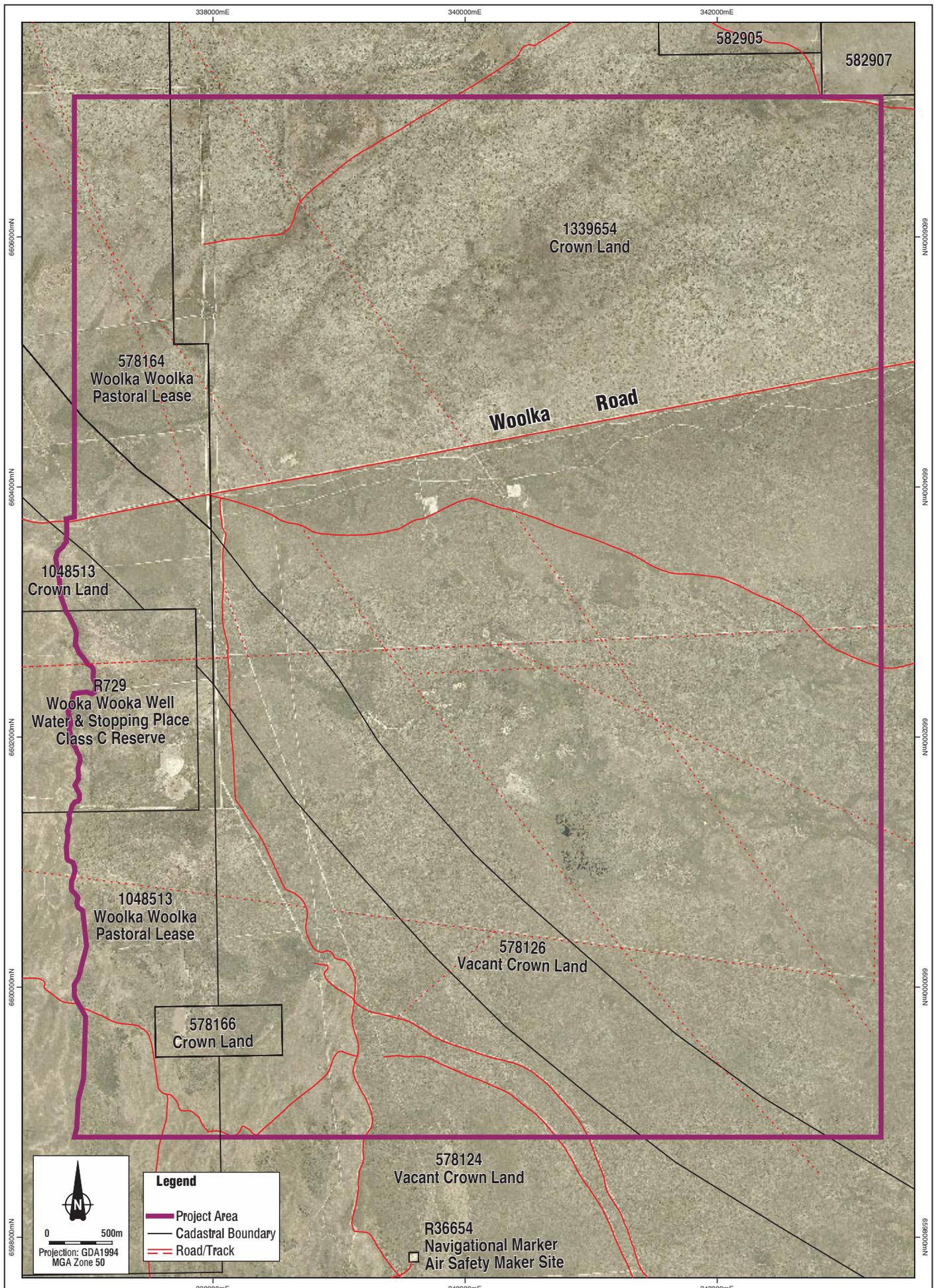
Corner	Northing	Easting	Zone
Northwest	6607120mN	336900mE	50
Northeast	6607120mN	343300mE	50
Southeast	6598800mN	343300mE	50
Southwest	6598800mN	336900mE	50

The project area is primarily located within Unallocated Crown Land (UCL) with a number of other land tenure types present within the project area including Vacant Crown Land (VCL) and a 'water and stopping place' reserve around the Wooka Wooka Well, which is vested in the Shire of Dandaragan ('C' Class Reserve 729). All land tenure for the project area is shown on Figure 3.1, together with access routes to the project area.

Primary access to the site is via Woolka Road and Cooljarloo Road. These roads are well maintained, two lane gravel roads currently used for access to the Cooljarloo Mineral Sands Mine to the east of the project area. There are numerous access tracks or historic survey lines in the area in various conditions. These existing tracks will be used for access and as source lines as far as practicable to minimise disturbance to undisturbed land.

Permitting involves discussions with leaseholders and land managers whose land may be traversed by a seismic line to explain the seismic program, gain access to land and identify other relevant issues. Empire Oil is committed to respecting the rights and desires of all individuals who are directly affected by the project and to abide by all relevant legislation.

There is one privately managed property in the project area. This pastoral lease is held by Mr C. Wedge of the Mimigarra Pastoral Company and is located at the western side of the project area. Mr Wedge has been contacted by Empire Oil and notified of the proposed 3D seismic survey. An access agreement will be entered into with the Mimigarra Pastoral Company once the timing of the survey is known. This agreement will address any issues the leaseholder may have. Seismic crews are made fully aware of the environmental requirements and the need to respect the rights and interests of leaseholders and land users.



3.2 Timeline of Operations

The Mullering 3D Onshore Seismic Survey is now scheduled to occur in November and December 2007. This time of year is likely to provide for dry soil conditions, avoiding potential erosion impacts. This is however a key nesting time for some bird species (Bancroft & Bamford, 2006) and management measures to reduce the impact on the project on potential nesting birds is provided in Appendix A1. Table 3.2 presents the proposed schedule for the project. The field work for the proposed 3D seismic survey is expected to take 50 days to complete and will be followed immediately by rehabilitation work and de-permitting.

Table 3.2 Proposed program schedule

Project Stage	Proposed Timing
Exploration Permit granted	October 2004
Vegetation survey and fauna study	September 2005 to October 2006
Application to conduct a geophysical survey and supporting EMP submitted to DoIR	December 2006
Revised ARI/EMP lodged with DEC and DoIR	April 2007
Surveying and line preparation	November 2007
Seismic Recording	November 2007
Uphole survey	November/December 2007
Seismic line rehabilitation	December 2007

Note: The timing of survey operations is dependent on weather and crew availability. Please refer to Section 7.2 for wet weather contingencies.

3.3 Environmental Objectives

The environmental objectives of the Mullering 3D Onshore Seismic Survey are to:

- Protect flora and fauna species of conservation significance.
- Minimise the disturbance to environmental sensitivities including wetlands, riparian zones, large or slow growing flora, flora sensitive to disturbance and areas with high erosion potential.
- Minimise the disturbance to all native flora and fauna across the proposed seismic survey area.

3.4 Camp Site

A seismic crew generally varies between 30 to 50 people and will be accommodated in a purpose built camp on site. The campsite will be located at Cataby No. 1 well site. This location was chosen as it is central to operations, reducing travel time each day, is located on previously disturbed land and does not require any additional clearing. This location is also not visible from any major public roads. Seismic operation campsites normally consist of a number of mobile trailer-mounted units including a kitchen facility, bathrooms, offices and bedrooms. On completion of the survey, the campsite and all associated infrastructure will be removed.

3.5 Survey Planning

Seismic operations allow the identification of geological structures below the surface of the earth where oil and gas deposits may have accumulated. Vibroseis trucks are used as the source of vibrations (sound waves) that travel into the earth and are reflected from subsurface geological structures. The seismic signal is then detected at the surface with the use of geophones. For the Mullering 3D Onshore Seismic Survey, source lines (allowing access for the Vibroseis trucks) will run north-south and are approximately 3-4 m wide. Receiver lines (allowing access to lay geophones) will run east-west and are approximately (1-2 m wide). Source and receiver lines are generally placed 300 m apart. The Mullering 3D Onshore Seismic Survey will involve the use of 3-4 Vibroseis trucks, and 3 light cable trucks for laying out the geophone lines during this operation.

Seismic line planning has been completed using existing roads or tracks wherever possible to minimise the need for clearing. Seismic line route planning also considered the results of the botanical surveys (Woodman 2006) and were developed in consultation with DEC and DoIR.

The locations of the proposed source and receiver lines have been plotted onto detailed maps, taking into account environmentally sensitive locations as outlined in Enclosure 2: Flora Survey Mapping.

In general, seismic line routes have been planned to avoid or minimise environmental impacts to:

- Areas where DRF or Priority flora are likely to occur.
- Wetlands and associated riparian zones.
- Areas with high erosion potential or sensitive to disturbance.
- Areas of high environmental risk (e.g., weed-infested areas).
- Areas of Aboriginal and cultural significance.
- Existing DEC long term monitoring locations.

Where a seismic line is close to an existing DEC long term monitoring location, the location will be flagged in the field and will be avoided by at least 10 m.

Source lines will be accessed from the fire breaks on either side of Woolka Road as much as possible. This will minimise third party access following completion of survey. Source lines accessed directly from Woolka Road and other major tracks will be 'bent' to disguise the entrance to the line and discourage third party access to the lines once the survey is complete.

Major waterways will be undershot removing the need for waterway crossings and receiver lines will be hand-carried minimising disturbance. Botanical surveys have identified wetland areas. These areas are avoided by sources lines and receiver lines will be carried through wetlands by hand.

3.6 Line Preparation

In the field surveyors peg out the location of each seismic line by placing markers at 40 m intervals along the lines. Line will follow the agreed swath path but will be modified by surveyors as needed to avoid areas of high erosion potential and or large or slow

growing flora. Fencing crews construct temporary gates and fence crossings along the lines that cross into the pastoral lease.

Empire Oil is committed to only clearing the minimum amount of vegetation required to allow for the passage and operation of the Vibroseis trucks and crew. Clearing of mature trees will be avoided and the route will be deviated around environmentally sensitive areas as far as practicable.

Seismic line preparation will be carried out in accordance with the recommendations of Woodman Environmental Consulting (2006) for each vegetation community type (see Enclosure 2: Flora Survey Mapping). Methods that will be employed to reduce the environmental impact of the survey include:

- *Rolling Source Lines:* This method preserves valuable seed stock and provides a microhabitat for regeneration of vegetation after the survey has taken place.
- *Hand Cut and Carry Receiver Lines:* Cutting vegetation by hand is suitable for shorter sections of receiver line and reduces environmental impact relative to mechanical methods.
- *Hand Carry Receiver Lines Only:* Where the vegetation allows, geophones can be walked out with no vegetation clearing necessary.

Rolling will be carried out using the methods established during ARC Energy's Denison Seismic Survey by ARC Energy and DEC (then CALM). That is, rolling will be done by a bulldozer equipped with a scrub rake or blade attached to the front and set above ground level, to push over larger vegetation. A heavy roller attached to the back of the bulldozer will be used to flatten down the vegetation. All rolled vegetation will be returned to the lines on line decommissioning.

Specific recommendations on where each of these methods will be employed are contained in Appendix C.

3.7 Data Acquisition

Once lines are prepared using the approved swath maps, the seismic crew, consisting of cable laying trucks, line crews, Vibroseis trucks and a recording truck move onto the line. The Vibroseis trucks each have a vibrator pad that is lowered to the ground at each energy source position and vibrated with a range of low to medium frequencies (6 Hz to 90Hz). Geophones, which detect the seismic signal, are placed at 40 m intervals along the receiver lines. The electrical signals generated by the geophones are converted to digital signals and transmitted along a cable to the recording truck. The energy source is systematically applied along the line every 13.3 m. Once a section of the line is completed, the geophones and cables are picked up and moved to the next section of the line.

The seismic acquisition crew will remain within the marked out seismic lines and will hand-carry receiver equipment into designated hand-carry areas. Daily toolbox meetings will be used to highlight sensitive areas requiring conservation and rehabilitation management within each days working area to the work parties.

3.8 Uphole Survey

Accurate processing of seismic data requires characterisation of the weathered, near-surface geological formations. A crew, using a truck-mounted drilling rig, associated water truck and support vehicle, will drill holes of approximately 10 cm diameter to a depth of 50 m to 100 m. A special geophone is lowered into the hole and records the seismic waves created with a weight drop impact at the surface. This provides information on the weathering layer. Approximately 50 upholes will be required for the project. These will be located at approximately 1 km intervals along receiver lines. All upholes will be located on the cleared seismic lines so no additional clearing is required to conduct the uphole survey. On closure, a cap is placed in the hole below the surface and holes are then backfilled with the original drill cuttings allowing natural recovery of the disturbed area. Any cuttings not used as backfill into the drill hole will be spread over the topsoil in a thin layer and raked in. The drilling fluid (mud) required to for drilling operations will consist of water and naturally occurring clays.

To minimise possible environmental impacts, the up-hole drilling crew will:

- Drill upholes on cleared land.
- Stockpile drilled cuttings during drilling.
- Use only bore water and naturally occurring clays to drill up-holes.
- Shovel drill cuttings back into each hole on the completion of drilling.
- Spread excess cuttings over the topsoil surrounding the up-hole in a thin layer and rake into the soil as required.
- Retain water used for drilling in a sump-truck and dispose of off-site.
- 'Clean on departure' all equipment from each up-hole to avoid the spread of weeds and dieback to other holes.
- Up-holes will be backfilled and cement-sealed if an aquifer is intersected.

3.9 Line Checking

Whilst a small number of permanent markers will be left along some fence lines at the end of the seismic program, the survey pegs and all other equipment are removed from the line. Any temporary fencing will be removed and permanent fencing re-instated.

Mr Wedge (Mimigarra Pastoral Company) will be contacted at the end of the survey and, once requirements are satisfied, Empire Oil will obtain a release form signed by the leaseholder to demonstrate satisfaction with the outcomes of the survey.

3.10 Seismic Line Rehabilitation

Proper rehabilitation of seismic lines will ensure that the Mullering 3D Onshore Seismic Survey will avoid land degradation on both Crown Land and pastoral lease within the seismic survey area. Thorough planning up front to ensure minimum disturbance of native vegetation and using seismic survey methods that have the least environmental

impact (e.g., rolling seismic lines instead of clearing) will improve the likelihood of successful rehabilitation.

Once the seismic survey is complete all equipment and any waste will be removed from the site. Any temporary fencing will be removed and any permanent fencing, which may have been removed to allow access for the seismic crew, will be reinstated. A detailed rehabilitation strategy for the Mullering 3D Onshore Seismic Survey is provided in Appendix A6 and some of the key points are summarised below.

As the survey lines are rolled, not cleared completely, there is sufficient seed stock naturally occurring to expect full, natural regeneration of the survey area. Avoiding the introduction of seeds into the area, ensures local provenance and the risk of weed introduction is lessened.

To promote successful rehabilitation of the seismic lines the following will be carried out on completion of the survey:

- Closure of seismic lines will occur as soon as practicable after data acquisition, no later than two weeks after the last required use of the line.
- All drill collars, steel pegs and other drilling and seismic materials will be removed from the seismic lines, drill sites and camp site.
- No drill spoil stock-piles, open holes nor sumps will be left on the seismic lines, drill sites or camp site.
- All intersections of seismic lines with public roads will be disguised to prevent third party access.

A post-survey inspection will be carried out to determine if there is any need for active rehabilitation. The methods used for line rehabilitation will be determined on a case-by-case basis. The following measures to improve rehabilitation performance will be carried out immediately following completion of the seismic survey, as required for each seismic line:

- Any vegetation pushed to one side of the seismic lines during operations will be pulled back over the lines.
- Compacted or rutted soils may be lightly scarified to improve aeration and prevent channelling of surface water flows.
- At the boundary between degraded vegetation and native vegetation movement of native and introduced fauna along the seismic lines may be discouraged by placing brush across the seismic line. Brush, or possibly one or two whole Banksia plants, would be harvested from nearby native vegetation as appropriate.

Permanent monitoring quadrats will be established in key locations to allow for assessment of rehabilitation success against the completion criteria outlined in this ARI. Quadrats will be surveyed within six months, after the winter rain, following completion of the Seismic Survey and then annually for at least three years or until completion criteria are achieved.

3.11 Auditing and Monitoring Program

An audit of all closed line access points and native vegetation recovery along rolled seismic lines will be conducted following the conclusion of the survey. In addition, rolled lines will be monitored annually after the first wet season, to identify any third party activity and the progress of rehabilitation, for at least three years or until the completion criteria have been met, whichever is longer. Completion criteria are detailed in Appendix A6.

Monitoring will be conducted by a qualified botanist using a quadrat based assessment. All monitoring will ensure that there are no additional environmental impacts to the site as a result of the monitoring program. In particular all personnel will comply with standard weed and disease hygiene protocols including ensuring that vehicles are clean on entry and that the spread of soil and vegetation material through the project area is minimised.

The results of monitoring will be reported annually. After two years the progress of rehabilitation will be assessed and, if monitoring identifies poorly rehabilitating seismic lines, appropriate contingency actions will be implemented.

4. Stakeholder Consultation

Minimising and mitigating potential impacts associated with the proposed project relies significantly on consultation with key stakeholders. Empire Oil has undertaken extensive consultation with all relevant stakeholders to identify regulatory processes, potential environmental issues and management requirements. Stakeholders of relevance to the Mullering 3D Onshore Seismic Survey include:

Government Departments:

- Department of Industry and Resources.
- Department of Environment and Conservation:
 - Environmental Services (Department of Environment (DoE) prior to July 2006).
 - Parks and Conservation Services (Department of Conservation and Land Management (CALM) prior to July 2006).

Non-government Organisations:

- WA Conservation Council (Chris Tallentire).
- WA Wildflower Society (Brian Moyle).

Landowners

Land Access Agreements with the pastoral lease holder will contain recommended practice for minimising impact on privacy, farming routine, access through fences, control of noxious weeds and disease, rehabilitation/amelioration of wheel track damage to paddocks and compensation for loss of earnings as required by the *Petroleum Act 1967*.

Native Title Agreement and Aboriginal Heritage

Empire Oil entered into a Native Title agreement, which covers EP 432, with the Yued people and the South West Aboriginal Land and Sea Council on 10 February 2004. Under this agreement, Empire Oil contacted the senior legal officer for the Yued Native Title claim group (Ettienne van Tonder) on 13 December with details of the proposed Mullering 3D Onshore Seismic Survey. Empire Oil followed up this initial contact to the Yued people with submission of their formal proposal to them on the 31 May 2007 and again in a reminder letter was sent on the 5 July 2007. The Yued people have advised Empire Oil (16 July 2007) that a heritage survey will be required. Empire Oil is currently preparing to conduct an Aboriginal heritage survey, in consultation with the Yued people, which will be undertaken prior to seismic fieldwork. Empire Oil is committed to avoiding all areas of Aboriginal heritage significance identified during the heritage survey.

4.1 Consultation to Date

The following section outlines the key outcomes and issues raised during a number of discussions with various stakeholders. The key environmental concerns for the project raised during these discussions are outlined in Table 4.1 and specific sections where they have been addressed are indicated.

Table 4.1 Key environmental concerns raised during stakeholder consultation

Environmental Concern	Raised By	Section Addressed
Some areas in the region, particularly claypans, are likely to support Threatened Ecological Communities (TECs)	EPA Services Unit	Section 5.3.1
Potential impacts to surface hydrology due to the passage of heavy vehicles	EPA Services Unit	Section 6.5
Prevention of third party access to the seismic lines for recreational use post closure	CALM, DoIR and NGOs	Section 3.10
Ongoing rehabilitation of seismic lines	NGOs	Section 3.10
Management of impacts to DRF and Priority Flora species	DEC and DoIR	Appendix A1
Appropriate weed and dieback hygiene management	DEC and DoIR	Appendix A2
Contingency planning for major storm or flooding events	DEC and DoIR	Section 7.2
Use of suitable completion criteria	DEC and DoIR	Appendix A1

Discussion with EPA Services Unit (Tim Gentle & Jaclyn Goad) by phone and fax on flora and vegetation assessment methods July/August 2005.

Flora and fauna survey methodology was discussed. The Gibson et al. (1994) methodology was recommended for determining floristic communities on the Swan Coastal Plain. At this stage, insufficient information was available to determine if a Level 1 or Level 2 fauna survey was required for the project. Other issues raised included the likelihood that some areas in the region, particularly claypans, are likely to support Threatened Ecological Communities (TEC) and the potential impacts to surface hydrology from the passage of heavy vehicles.

Discussion with lease holder of 'Tombstone Rocks' 6 September 2006

Mr Colin Wedge of Mimigarra Pastoral Company was notified of the proposed seismic survey. Access was agreed to allow botanical surveys to be carried out.

CALM/DoIR briefing 7 April 2006

The principle issue raised at this briefing was preventing third party access to the seismic lines for recreational use post-closure. It was agreed that a Level 1 fauna survey was adequate for the project with a site reconnaissance occurring in April 2006. It was also agreed that the management strategies employed for the Apium and Dennison 3D Seismic Surveys by ARC Energy would form a good basis for the environmental management of the Mullering 3D Onshore Seismic Survey. CALM requested an opportunity to comment on the draft EMP before referral to the EPA (this opportunity was provided with a draft EMP issued to DEC on 18 December 2006). Empire Oil indicated that an Aboriginal Heritage Survey would be conducted closer to the survey date, including input from the Yued Native Title claimants.

NGO briefing

7 April 2006

Third party access to the seismic lines post-closure and ongoing rehabilitation were raised as major issues for the project. The environmental management of the Dennison 3D Seismic Survey by ARC Energy was commended, particularly the handouts provided to the seismic crew.

Discussions with Bronwen Keighery (DEC) re flora survey methods

21 April 2006

Requests by DEC for plot based floristic analysis of the Mullering 3D Onshore Seismic Survey project area were discussed and objections put forward to DEC's request for plot based floristic analysis for the Mullering 3D Onshore Seismic Survey. Additional information on the known floristic structure and environment of the survey area was provided. The issue remained unresolved at this time and discussions were ongoing.

DEC/DoIR site visit

8 September 2006

Key issues for the environmental management of the Mullering 3D Onshore Seismic Survey include managing impacts to DRF and Priority flora species. Flora survey methodology was discussed and Empire Oil and Woodman Environmental Consulting informed DEC that plot based floristic analysis is not proposed for this project. DEC did not put forward any objections to the proposed flora survey methodology.

DEC/DoIR/EPA workshop

20 November 2006

Environmental management strategies for the planning, operating and rehabilitation stages of the project were discussed. Key topics discussed included seismic line preparation, hygiene management, contingency planning and completion criteria.

Yued People

13 December 2006

The senior legal officer for the Yued Native Title claim group (Etienne van Tonder) was contacted by Empire Oil and informed of the project. The Yued people indicated that they would like to meet with Empire Oil to discuss the project however no further response from the Yued people was forthcoming. There were no objections to the project raised during this initial contact the focus of the meeting that is yet to take place will be to discuss methods for a heritage survey of the project area.

Yued People

31 May 2007

Formal notification of Empire Oil's intention to undertake ground disturbing works in EP 432 was submitted to the Yued people via the South West Aboriginal Land Corporation. This letter included a brief description of the project and sought advice on Aboriginal heritage concerns for the project.

Yued People

5 July 2007

Empire Oil attempted to contact Mr Stefan Le Roux, Future Act Lawyer with the South West Aboriginal Land Corporation, by phone and by mail to advise that the 30 day clause in the Native Title Agreement between Yued and Empire Oil had expired and sought advice on Aboriginal heritage concerns for the project.

Yued People

16 July 2007

Yued people advised Empire Oil that an Aboriginal heritage survey would be required for the project.

5. The Existing Environment

5.1 Regional Description and Context

Exploration Permit EP 432 is located in the Shire of Dandaragan with the majority of the proposed survey area on unclaimed crown land (UCL). The survey area is approximately 20 km northwest of Cataby and road access is via Cooljarloo Road and Woolka Road, both of which branch off the Brand Highway. The northeastern boundary of the proposed survey area is constrained by the Cooljarloo Sand Mining operations while the western part of the survey area encroaches on a pastoral lease held by the Mimigarra Pastoral Company.

The survey is located within the Bassendean Interim Bioregion, as defined by Griffin (1989). The vegetation is comprised of woodlands, consistently of *Banksia attenuata*, *Banksia menziesii* (and in wetter areas *Banksia ilicifolia*), with *Eucalyptus todtiana* and *Nuytsia floribunda* on the dunes. There are also heath communities, and teatree, paperbark and reed swamps in dune swales (Beard 1990).

5.2 Physical Environment

5.2.1 Landform and Soils

In a regional context, the survey area is located within the Perth Basin geological province, which extends from the Murchison River to the south coast, and eastwards to the Darling fault. Mesozoic (225 – 65 Ma) sedimentary units are the major sources for groundwater and hydrocarbons in the Basin (DPUD 1994).

More specifically, the survey area itself is located on the Coastal Backplain, which is comprised of Aeolian, alluvial sands and clays comprising the Bassendean Sand and Guildford Formation. This formation is interspersed with pockets of swamp and lacustrine deposits, composed of diatomite, clay, loam, silt and sand. The Bassendean Sands are of Pleistocene age and consist of seashore sands blown up over time and are characterised by large areas of podsolised sand rises and wetlands, with deep yellow sands or deep white sands, over waterlogged flats of humus rich, peaty sands, or sand over clay mottled duplex soils. There is a large variability in the permeability and water holding capacity of these sands. The most important superficial aquifer in this system is the groundwater held in sand mounds. The Bassendean Sands were originally comprised of lime sand with a small proportion of quartz sand, with the lime sand almost entirely leached out (DPUD 1994).

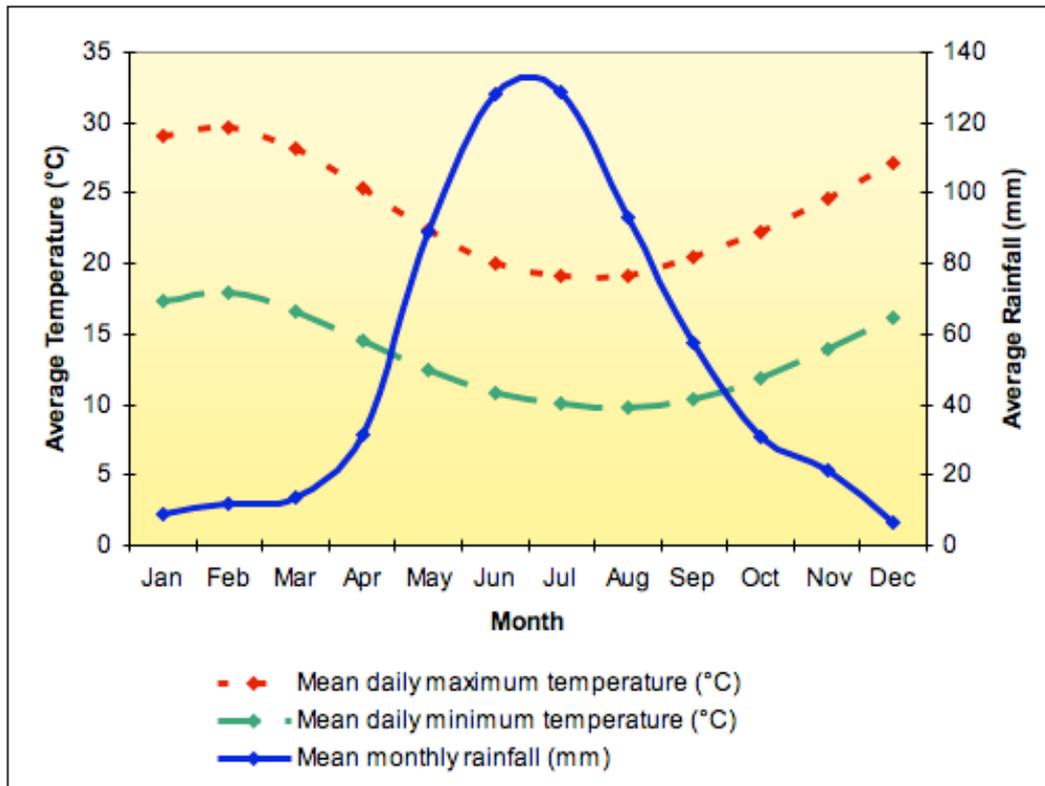
Soil mapping at Cooljarloo, located immediately to the east of the survey area, were grouped into three soil associations including:

- Soils of the gently undulating, latertised surface - comprised of sands overlying ferruginous gravel, deep white sands and pale grey, light clays.
- Soils of the dune fields – comprised of deep white sands and deep yellow sands.
- Soils adjacent to the Mullering Brook – comprised of clayey sand, deep gradational sands and shallow clayey sands.

The soils in this area are known for their low nutrient levels, and high water infiltration rates but limited capacity for water retention (with a soil drying phase commencing in October and extending to May) (Tiwest Pty Ltd 1999).

5.2.2 Climate

The survey area experiences a Warm Mediterranean climate, with hot, dry summers, and cooler, wet winters. The area experiences on average 4 to 6 dry months a year, where precipitation may be less than what is required for plant growth (Beard, 1990). Figure 5.1 presents the average daily maximum and minimum temperatures, and average precipitation for Lancelin, the closest BOM weather station, located approximately 30km to the south west of the survey area.



Data Source: Australian Bureau of Meteorology, 2005.

Figure 5.1 Average monthly rainfall, mean daily temperature maximum and mean daily temperature minimum for Lancelin, Western Australia

The average maximum temperature at Lancelin ranges from 29.7°C in February, to 19.1°C in July and August, with an average precipitation of 619.9 mm per year (Bureau of Meteorology, 2005). The mean number of rain days for Lancelin is 108.3 days per year, the majority falling in June, July and August. At the Cooljarloo Mine site located immediately to the east, the highest average maximum temperature for 2004 occurred in February, with a temperature of 34.5°C, with a lowest minimum temperature experienced in July, with 8.2°C (Tiwest Pty Ltd 2001; on-site data).

5.2.3 Surface Water and Drainage

The project area lies on the Bassendean Sand hydrological zone (Semenuk 1994) and collects runoff from the surrounding Minyulo catchment area (NACC 2002).

The surface water drainage in the project area is largely ephemeral and occurs where series of wetlands connect to form streams (Semenuk 1994). The wetlands in the project area form part of the Mullering Wetlands chain (DPUD 1994) which themselves form part of the Minyulo Suite, described as microscale sumplands, damplands and creeks (Semenuk 1994). The Minyulo Suite is located at Minyulo and Mullering Brooks and in the Bassendean Dunes in the intermediate area.

Mullering Brook enters the project area from the northeast while a series of small swamps associated with Minyulo Brook entering the project area from the southeast. Both of these water courses culminate in Cooljarloo and Coomado Swamps in the northwest corner of the proposed project area. The area of land inundated is seasonally dependant and can range from dry to saturated to inundated depending on the recent rainfall and runoff. Water in the Minyulo Suite can range from fresh to hypersaline with permanent pools maintained through ponding and groundwater rise.

The wetlands are an area of diverse habitat providing critical habitat functions for many flora and fauna species. The wetland chains also provide a pathway for sediment transport and for the movement of flora and fauna. Wetlands can also act as a flushing mechanism to basin wetlands and the floodplain (Semenuk 1994).

In addition to the wetlands/swamps, Minyulo Brook and Mullering Brook are themselves locally to regionally significant (Semenuk 1994).

5.2.4 Groundwater

The geology of the project area is highly faulted and complex leading to significant local variation in hydraulic conductivity and connectivity. An extensive superficial aquifer is present throughout the Midwest region along the coast, extending 10 km to 30 km inland (NACC 2002).

The most important superficial aquifer in this area is the groundwater held in sand mounds. This is an unconfined groundwater system that flows very slowly towards the west (NACC 2002). Water levels in the superficial aquifer vary in response to rainfall events with the majority of recharge occurring in the winter months. Recharge is by direct infiltration with episodic recharge from watercourses on the Dandaragan Plateau and Arrowsmith Region (NACC 2002). The salinity of the groundwater in the project area is generally low, less than 500 mg/L (NACC 2002).

Underlying the superficial aquifer are the confined Eneabba and Lesueur aquifers (NACC 2002). Recharge of these aquifers occur north of the project area in the Mt Lesueur Region and Gardner Range or in areas overlain by Bassendean Sand and Tamala Limestone (Kern 1997 in NACC 2002). Discharge of the Eneabba and Lesueur Aquifers occurs indirectly at the coast (NACC 2002).

5.2.5 Air Quality and Noise

The air quality of the local area is excellent given the remote location, sparse population and subsequent low level of air pollutant emissions. The near by coast between Cervantes to the north and Lancelin to the south experiences strong onshore south-westerly winds from the Indian Ocean and is a contributing factor to the region's clean air quality. Regional sources of air emissions are primarily from near by mineral sand mining operations and vehicle use.

No surveys of noise have been conducted in the area. Existing sources of noise in the local region are dominated by natural noise such as wind and fauna (i.e., birds, insects and livestock). Vehicle noise from local roads is also a primary source of noise.

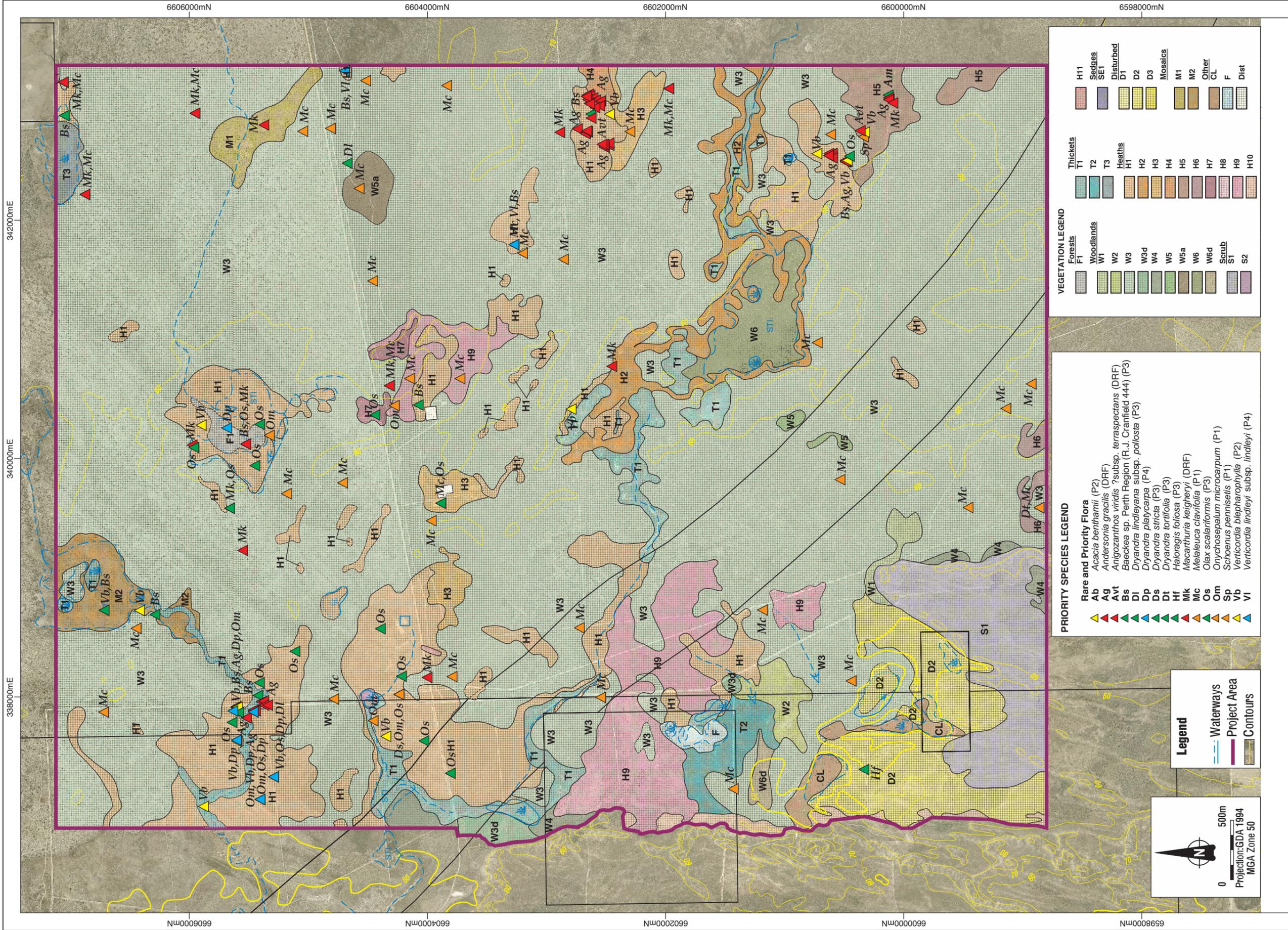
5.3 Biological Environment

5.3.1 Flora

Baseline data and impact assessment for flora for the Mullering 3D Onshore Seismic Survey was conducted by Woodman Environmental Consulting Pty Ltd. Vegetation community mapping was conducted in September and November 2005 and May 2006. Targeted searching for Declared Rare Flora (DRF) and other flora species of conservation significance was conducted in May and October 2006. Full results and methods for these surveys are provided in Appendix 2 (Flora, vegetation and *Phytophthora cinnamomi* Assessment). In addition an inspection of historic survey lines through the project area was carried out in December 2006 in order to provide information of on the likely response of flora and vegetation communities to this kind of disturbance. All lines were regenerating well and it was difficult to distinguish the lines in some cases. There was a lack of upper storey tree species highlighting the importance of avoiding large tree species during the survey. There was also no observed soil compaction on the lines. The full report from this inspection is included in Appendix 4.

The Mullering 3D Onshore Seismic Survey is located within an area recognised as a species rich region (Griffin *et al* 1990). This is reflected in the results of the flora surveys which recorded a high number of flora species. A total of 486 vascular plant taxa, belonging to 71 plant families, many of which are endemic to the region were recorded from the project area. A total of 25 structural plant communities and 7 other communities (including disturbed and mosaic areas) were described and mapped within the Mullering 3D Onshore Seismic Survey project area. The number of flora species of conservation significance recorded was also high. Figure 5.2 shows the location of all recorded populations of DRF in the context of the vegetation community mapping and provides a brief description of each vegetation community type.

In a state wide context, the survey area is also within the Swan Coastal Plain IBRA (Interim Biogeographic Regionalisation for Australia), close to the boundary with the Geraldton Sandplains (Department of Environment and Heritage 2005). On a more regional scale, the survey area is located within the Bassendean Interim Bioregion, as defined by Griffin (1989). This bioregion contains much uncleared land (mainly Crown Land).



- PRIORITY SPECIES LEGEND**
- ▲ Rare and Priority Flora
 - ▲ *Acacia benthamii* (P2)
 - ▲ *Andersonia gracilis* (DRF)
 - ▲ *Anigozanthos viridis* ?subsp. ?terraspectans (DRF)
 - ▲ *Baeckea* sp. Perth Region (R.J. Cranfield 444) (P3)
 - ▲ *Dryandra lindleyana* subsp. *pollostia* (P3)
 - ▲ *Dryandra platycarpa* (P4)
 - ▲ *Dryandra stricta* (P3)
 - ▲ *Dryandra tortifolia* (P3)
 - ▲ *Haloragis foliosa* (P3)
 - ▲ *Macarthuria keighenyi* (DRF)
 - ▲ *Melaleuca clavifolia* (P1)
 - ▲ *Olix scalariformis* (P3)
 - ▲ *Onychosepalum microcarpum* (P1)
 - ▲ *Schoenus pennisetis* (P1)
 - ▲ *Verticordia blepharophylla* (P2)
 - ▲ *Verticordia lindleyi* subsp. *lindleyi* (P4)

- VEGETATION LEGEND**
- | Forests | Woodlands | Thickets | Disturbed | Mosaics |
|---------|-----------|----------|-----------|---------|
| F1 | W1 | T1 | D1 | M1 |
| W2 | W2 | T2 | D2 | M2 |
| W3 | W3 | T3 | D3 | Other |
| W3d | W3d | H1 | | CL |
| W4 | W4 | H2 | | F |
| W5 | W5 | H3 | | Dist |
| W5a | W5a | H4 | | |
| W6 | W6 | H5 | | |
| W6d | W6d | H6 | | |
| Scrub | S1 | H7 | | |
| S2 | S2 | H8 | | |
| | | H9 | | |
| | | H10 | | |

Legend

- Waterways
- Project Area
- Contours

0 500m
Projection: GDA 1994
MGA Zone 50



Job No: **we0816**
File No: **g1186_e103**

Empire Oil Company (WA) Ltd
Mullering 3D Onshore Seismic Project

Vegetation Communities, Flora of Conservation Significance and Drainage Systems

Figure No: **5.2**

Vegetation Communities

The vegetation communities within the Mullering 3D Onshore Seismic Survey can be broadly described as woodlands, heaths, forests, scrub, thickets, sedgeland, disturbed areas and mosaics. Cleared land and the seasonally inundated wetland associated with the T1 plant community were also recorded. No known Threatened Ecological Communities (TEC) are located within the project area and no potential TECs were identified during the flora surveys conducted for the project (Woodman Environmental 2006). The nearest TEC (TEC 18: Thetis-microbialite community) is located approximately 30 km away.

Woodland communities are the most common and widespread communities in the Mullering 3D Onshore Seismic Survey project area. In particular the W3 community, a low woodland of *Eucalyptus tottiana*, *Banksia attenuata* and *Banksia menziesii* over mixed shrubs on grey sand, is very widespread. These communities occur throughout most of the project area and are generally in excellent condition with little disturbance and few weeds.

Heath communities are the second most common vegetation community in the Mullering 3D Onshore Seismic Survey project area. The H1 heath community, a dense heath dominated by *Banksia telmatiaea* with mixed shrubs on grey sand, is the most widespread and is associated with the drainage lines occurring across the project area.

Scrub communities occur along the western edge of the project area with the S1 community in the southwest section on Guilderton soils, dominated by *Melaleuca systena*, and the S2 community, dominated by *Halosarcia indica* subsp. *bidens*, on private property in the northwest of the project area. Both communities are in excellent condition with few weeds.

There are three thicket communities in the project area associated with wet areas, such as drainage lines and swamps, or limestone outcropping. The most common thicket community (T1) consists of *Melaleuca viminea* subsp. *viminea* over herbs and sedges on grey sand in swamps and creeks. The T1 community often forms narrow belts in wet depressions and along the edge of wetlands and often has features of the surrounding communities present within it.

A single sedge community, dominated by *Gahnia trifida*, is confined to swampy areas in the northwestern section of the project area. Despite its proximity to cleared areas, this vegetation community was in excellent condition with few weeds.

Three communities described as disturbed are located on private property. These communities contain a higher abundance of weed species and have lost the majority of their original floristic structure.

Areas mapped as mosaics contain two or more vegetation communities which can be distinguished in the field but cannot be separated on aerial photography. Two mosaic communities were identified, M1 is a mosaic of low woodland and low heath while M2 is a mosaic of heath and low sedgeland. Both communities are located north of Woolka road and while the M1 community is in excellent condition the M2 community shows evidence of some past disturbance.

Flora Species of Conservation Significance

A total of three DRF species (Table 5.1) and thirteen Priority Flora species (Table 5.2) were recorded in the project area. A number of other DRF species are listed on state and commonwealth databases and were identified as possibly occurring in the project area. No known populations of *Andersonia gracilis* or *Anigozanthos viridis* subsp. *terraspectans* will be impacted by the proposal. *Macarthuria keigheryi* is locally common and cannot be entirely avoided by the proposed seismic survey. Empire Oil has a permit to take this species.

Woodman Environmental have identified the vegetation community types that form the habitat for each Priority flora species. The percentage of each habitat, within the project survey area, that will be disturbed by the project has been estimated for each Priority flora species and is presented in Table 5.2.

Table 5.1 Declared Rare Flora species recorded from the Mullering 3D Onshore Seismic Survey project area

Scientific Name	Common Name	C'wealth Status	Comment
<i>Andersonia gracilis</i>	Slender Andersonia	Endangered	<i>Andersonia gracilis</i> is usually found in winter-wet areas, near swamps. Five locations of <i>Andersonia gracilis</i> were recorded in Heath communities bordering drainage lines or basins with Thickets (H1, H5, T1). Seismic lines will avoid known populations resulting in little to no disturbance of this species.
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	Dwarf Green Kangaroo Paw	Vulnerable	Two populations were recorded in the wet portions of a H1 and an H5 area in the southeast of the project area. Identification of this species from specimens collected and pressed can be difficult. Seismic lines will avoid known locations of this species and the project is unlikely to have a significant impact on this species.
<i>Macarthuria keigheryi</i>	Keighery's Macarthuria	Endangered	<i>M. keigheryi</i> was recorded on a number of occasions within the Mullering project area. It would appear to be locally common within the W3 community as well as occurring sporadically in F1, M1 and in H2 and H5 communities. Less than 1.8% of the population has been estimated to be impacted and a 'permit to take' granted by the DEC for this disturbance.

Table 5.2 Priority Flora species recorded from the Mullering 3D Onshore Seismic Survey project area

Species	Status	Veg Type	Local habitat cleared	Comment
<i>Onychosepalum microcarpum</i>	P1	H1	1.7%	Rhizomatous, tufted perennial, herb, 0.07 m to 0.15 m high. Found on white or yellow sand in dry heath or low woodland. This species is very common within the H1 community.
<i>Schoenus pennisetis</i>	P1	H5	0.6%	Tufted annual, grass-like or herb (sedge), 0.05 m to 0.15 m high. Found on grey or peaty sand, sandy clay in swamps or winter-wet depressions. This species was found at a single location in H5 in the southeast of the project area.
<i>Acacia benthamii</i>	P2	H10	2.6%	This species is a perennial shrub to 1 m in height found on sands on limestone breakaways on the coastal strip between Perth and Geraldton. Restricted to H10 dunal community in western section of project area.
<i>Verticordia blepharophylla</i>	P2	H1	1.7%	This species is a perennial shrub to 1 m in height found on white, grey or yellow sands or sandy clays in wet depressions. It was found commonly in wet heath communities including H1, H5 and M2.
<i>Baeckea</i> sp. Perth Region (R.J.Cranfield 444)	P3	F1, H1, M2, T1	1.4%	This species is very common within the H1 community.
<i>Dryandra lindleyana</i> subsp. <i>pollostata</i>	P3	H1, W5a	1.7%	This species was recorded three times in the survey area within H1 and in W3 beside a wet community. This is a prostrate lignotuberous shrub found on sands in flats and on lateritic rises. It is likely that it is more common elsewhere in the project area.
<i>Dryandra stricta</i>	P3	H1	1.7%	This species is a non-lignotuberous species to 3 m in height. It is found on white, grey, red sands often with laterite, clays or loams. This species was found at a single location on the margin between W3 and H1 communities.
<i>Dryandra tortifolia</i>	P3	W3	1.9%	<i>Dryandra tortifolia</i> is a low, lignotuberous shrub up to 0.25 m high. <i>D. tortifolia</i> is found on white, grey or yellow sand over laterite. This species has been found commonly from Cataby north to Dongara with many records from both the Tiwest leases and the Iluka Eneabba leases (Woodman Environmental 2002) <i>D. tortifolia</i> has been found in a number of locations within and outside Tiwest's Leases (Landcare Services 2002). Research conducted by Landcare Services (2002) suggests that <i>D. tortifolia</i> is more common than existing records show.
<i>Haloragis foliosa</i>	P3	D2	1.9%	This species was found at a single location southwest of the project area on Guilderton complex soils. This species is a perennial shrub to 0.5 m in height found on white or grey sands on limestone. It is common to the coastal vegetation communities of the Midwest.

Table 5.2 Priority Flora species recorded from the Mullering 3D Onshore Seismic Survey project area (cont'd)

Species	Status	Veg Type	Local habitat cleared	Comment
<i>Olax scalariformis</i>	P3	H3, W3, H1, F1	1.9%	Widespread throughout project area, especially in H1 community. <i>Olax scalariformis</i> is a shrub which grows to 1 m in height. <i>Olax scalariformis</i> is found on sandy soils in the Southwest of Western Australia. It is unlikely that the project will have a significant impact on this species.
<i>Dryandra platycarpa</i>	P4	H1	1.7%	<i>Dryandra platycarpa</i> is a non-lignotuberous shrub, that occurs on sandy soils, often with gravel or over laterite. <i>Dryandra platycarpa</i> has been recorded from a number of locations within the Geraldton Sandplains and Swan Coastal Plain Bioregions. It is unlikely that the proposed project will significantly impact this species.
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	P4	H1	1.7%	Erect shrub, 0.2 m to 0.75 m high. Found on sand, sandy clay in winter-wet depressions. This species was found at a single location within H1 community. It is likely that this species is more widespread within the project area in this community type.

Source: Woodman Environmental 2006.

Introduced Flora

During flora surveys conducted in spring 2005, winter 2006 and spring 2006 the project area was found to be remarkably weed free. Thirty-two introduced (weed) flora species were recorded in the project area with weed densities representing less than 1% of the total foliage cover in most instances. The W6, W6d, T1, and W3d vegetation communities had the highest weed densities while the D2 community had a very high diversity of introduced flora. The highest number of weeds was recorded in the western third of the project area, on private property used for stock grazing.

Only one weed species, *Moraea flaccida* (Cape Tulip) is listed as a Declared Plant (P1) by the Department of Agriculture and Food. Movement of this plant, or its seeds, within the state is prohibited, including the movement of contaminated vehicles or machinery.

5.3.2 Dieback

There are four species of *Phytophthora* that are regularly identified in natural ecosystems in the south-west of Western Australia including; *P. cinnamomi*, *P. citricola*, *P. megasperma* and *P. drechsleri*. Of these species, only *P. cinnamomi* has been shown to cause disease epidemic in natural ecosystems, with the remainder behaving like native pathogens and causing little harm to vegetation. *P. megasperma* and *P. citricola* have the potential to cause localised disease outbreaks where site conditions have been modified to favour their survival and pathogenicity (Podger *et al.* 1996). A number of plant families are particularly susceptible to *P. cinnamomi* including:

- Proteaceae (*Banksias*, *Grevilleas* etc.).
- Epacridaceae (Heaths).
- Myrtaceae (Eucalypts, *Calothamnus* etc.).
- Xanthorrhoeaceae (Grass Trees).

P. cinnamomi requires moist conditions to propagate, spread and infect host plants and areas which receive more than 800 mm of rain per year are considered high risk areas for the spread of this disease while a rainfall of 400 mm to 600 mm is considered at moderate risk of disease spread (Podger *et al* 1996). *P. cinnamomi* can spread unaided via root to root contact, native and introduced animals and along water drainage systems however the movement of soil on machinery and footwear is the most common vector for pathogen spread and invasion (CALM 2003).

Dieback fronts have been identified in the vicinity of the Mullering 3D Onshore Seismic Survey, either within the Lancelin Defence Force Training Area, along roads in the region or on the Tiwest Cooljarloo mine site to the east of the project area.

Despite the high risk of *P. cinnamomi* invasion, there are currently no areas in the project area identified as displaying symptoms of *P. cinnamomi* infestation and none of the soil samples collected recorded the presence of *P. cinnamomi*. The project area was interpreted for dieback by Mr Evan Brown of Glevan Consulting in October and November 2005. Mr Brown is experienced in the detection and mapping of *P. cinnamomi* and is accredited by DEC (Parks and Conservation) to conduct dieback interpretation.

5.3.3 Fauna

The faunal assemblage in the vicinity of the proposed Mullering 3D Onshore Seismic Survey is likely to be typical of the northern Swan Coastal Plain but with the distinct influence of wetlands and the close proximity of the project's western boundary to the coast (Bancroft and Bamford 2006). Literature review has identified 242 species of vertebrates that could potentially occur in the project area including four species of fish, 11 species of frogs, 54 reptile species, 147 bird species and 26 mammal species.

All fish species require permanent water bodies for their survival. During the site inspection (April 2006), all four species of fish were noted in the wetland/swamp area at 341000E, 6601000N (GDA 94) indicating the presence of a perennial water body. Alternatively these species may disperse into the wetland, possibly from Mullering Brook, during flood events.

None of the eleven frog species identified as likely to occur in the project area were observed during the site visit however ten of the eleven species have been recorded in nearby areas by Bamford Consulting Ecologists (Bancroft and Bamford 2006) and the swamp and wetland areas present are likely to provide an important role in the breeding ecology of amphibian fauna in the vicinity. None of the frog species identified in the literature review have any particular conservation significance.

None of the 54 reptile species were observed during the site visit however many of these species prefer the sandy substrates that are prevalent in the project area. The reptile fauna of the project area is dominated by legless lizards (Pygopodidae), skinks (Scincidae) and elapid snakes (Elapidae) with 41 of the possible 54 species falling into one of these three groups. The later family (Elapidae) represent the venomous land snakes that may be present in the project area.

Of the 147 species of bird which may occur in the project area, 40 are considered to be vagrants to the area and 34 species are dependent on wetland habitats (Bancroft and Bamford 2006). Of the remaining 73 species it is reasonable to expect a relatively intact

banksia woodland bird assemblage including a large number of honeyeaters (14 species), which are likely to make use of the diverse flora of the region. In addition, up to 13 bird of prey species may be present in the area.

Of the 26 mammal species expected to occur in the project area, eight are bat species and six are introduced. The Quenda, Woylie and Tammar Wallaby have been reintroduced into the Nambung National park (approximately 20 km northwest of the project area) in conjunction with regional fox baiting programs. If these species are not currently present in the project area they have the potential to move into this area in the future.

Wetlands in the project area may support short-range, endemic invertebrates (Bancroft and Bamford, 2006). Short-range, endemic species are generally defined by life history characteristics such as poor powers of dispersal and/or confinement to discontinuous habitats. A poor understanding of the taxonomy of short-range, endemic invertebrates hampers the ability to fully define and assess project impacts on these species.

Fauna Species of Conservation Significance

There are 35 fauna species of conservation significance that may occur in the project area. Table 5.3 provides an indication of the potential number of species by fauna type and by level of conservation significance. The conservation significance of the fauna species listed in the following tables is described below:

- Conservation Significance 1: Species listed under State or Commonwealth Acts.
- Conservation Significance 2: Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by DEC.
- Conservation Significance 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution. Species at this level may have links to preserving genetic biodiversity, may be at the edge of their range or may be sensitive to impacts such as habitat fragmentation.

Table 5.3 Potential number of species of conservation significance occurring in the Mullering 3D Onshore Seismic Survey project area

Fauna	CS1	CS2	CS3	Total
Fish	0	0	2	2
Amphibians	0	0	0	0
Reptiles	1	2	2	5
Birds	10	4	8	22
Mammals	0	4	1	5
Invertebrates	0	1	0	1
Total	11	11	13	35

There are four species considered most at risk from the Mullering 3D Onshore Seismic Survey.

- *Carpet Python*: This large, slow moving snake is vulnerable to road kill and may be affected by increased traffic along Cooljarloo and Woolka roads.

- *Rainbow Bee-eater*: This migratory bird species constructs nesting burrows in sandy habitats, often choosing nesting sites near areas of human disturbance. Breeding usually occurs from mid-spring to mid-summer. When present, these birds are obvious and prominent. The density of nesting burrows in the project area is likely to be low however they are at risk of being inadvertently crushed by survey vehicles.
- *Brush Wallaby*: This species is highly likely to occur within the project area and is vulnerable to road kill due to increased traffic along Cooljarloo and Woolka Roads.
- *Ground Parrot*: This species is now believed to be restricted to Waychinicup, Fitzgerald River and Cape Arid National Parks on the south coast however a recent, unconfirmed report near the mouth of the Hill River (between Cervantes and Jurien) suggests that a northern population may survive. Heath areas, especially with sedges, may provide suitable habitat for the Ground Parrot in the project area. Ground parrots are sensitive to fire and probably predation by foxes.

Provided seismic lines are rehabilitated (including prevention of third party use as access tracks), the majority of fauna species of conservation significance are unlikely to be impacted by the Mullering 3D Onshore Seismic Survey as the area of disturbance is small, dispersed over a wider area and will be temporary. More detailed management strategies for ensuring a low risk of impact on any fauna species is provided in Section 8.

Table 5.4 provides a list of the species of conservation significance that may occur in the project area together with a very brief indication of their habitat type. More detailed information on each species is provided in the full fauna report (Appendix E).

Table 5.4 Fauna species of conservation significance

Scientific Name	Common Name	C.S.	Likely Habitat
Fish			
<i>Galaxias occidentalis</i>	Western Minnow	CS3	Permanent water
<i>Edelia vittata</i>	Western Pygmy Perch	CS3	Permanent water
Reptiles			
<i>Aprasia</i> sp. nov. aff. 'fusca'	-	CS3	Sands
<i>Ctenotus gemmula</i>	Jewelled Ctenotus	CS2	Sandy Heath
<i>Morelia spilota</i>	Carpet Python	CS1	Bushland
<i>Neelaps calonotos</i>	Black-striped Snake	CS2	Sandy Heath
<i>Notechis scutatus</i>	Tiger Snake	CS3	Wetlands
Birds			
<i>Actitis hypoleucos</i>	Common Sandpiper	CS1 ^{w,v}	Wetlands
<i>Apus pacificus</i>	Fork-tailed Swift	CS1 ^{a,v}	Aerial habitat
<i>Ardea alba</i>	Great Egret	CS1 ^w	Wetlands
<i>Ardeotis australis</i>	Australian Bustard	CS2 ^v	Open scrub
<i>Calamanthus campestris</i>	Rufous Fieldwren	CS2	Low shrub
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	CS1 ^{w,v}	Wetlands
<i>Calidris ruficollis</i>	Red-necked Stint	CS1 ^{w,v}	Wetlands

Table 5.4 Fauna species of conservation significance (cont'd)

Scientific Name	Common Name	C.S.	Likely Habitat
Birds (cont'd)			
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	CS1	Sand Plains
<i>Eopsaltria georgiana</i>	White-breasted Robin	CS3	Heath
<i>Eopsaltria griseogularis</i>	Western Yellow Robin	CS3	Woodlands
<i>Falco peregrinus</i>	Peregrine Falcon	CS1	Watercourses
<i>Hylacota cauta</i>	Shy Heathwren	CS2	Heath
<i>Lophoictinia isura</i>	Square-tailed Kite	CS3	Heath & woodland
<i>Merops ornatus</i>	Rainbow Bee-eater	CS1	Open Woodland
<i>Oreoica gutturalis</i>	Crested Bellbird	CS2	Woodlands
<i>Petroica multicolor</i>	Scarlet Robin	CS3	Woodlands
<i>Pezoporus wallicus</i>	Ground Parrot	CS1	Heath
<i>Phaps elegans</i>	Brush Bronzewing	CS3	Heath & Scrub
<i>Polytelis anthopeplus</i>	Regent Parrot	CS3 ^v	Farmlands
<i>Porphyrio porphyrio</i>	Purple Swamphen	CS3 ^w	Wetlands
<i>Strepera versicolor</i>	Greg Currawong	CS3 ^v	Heath & woodland
<i>Tringa nebularia</i>	Common Greenshank	CS1 ^{w,v}	Wetlands
Mammals			
<i>Bettongia penicillata</i>	Brush-tailed Bettong, Woylie	CS2	Dry forests
<i>Isodon obesulus</i>	Southern Brown Bandicoot, Quenda	CS2	Wetlands
<i>Macropus eugenii</i>	Tammar Wallaby	CS2	Coastal heath
<i>Macropus irma</i>	Brush Wallaby	CS2	Open, dry forest
<i>Mormopterus sp.</i>	Western Freetail Bat	CS3	Woodland & heath
Invertebrates			
<i>Austrosaga spinifer</i>	-	CS2	Heath

^wThis species is generally dependent on wetlands.

^v This species is considered to be a vagrant to the project area.

^a This species is highly aerial.

Key Habitats

In addition to species of conservation significance the freshwater swamps and wetlands in the project area are key habitats that support a range of fauna, including fauna of conservation significance. These areas, particularly the permanent freshwater swamp in the northwest of the site (see Figure 5.2), are highly likely to support faunal communities and ecosystem processes that differ from surrounding areas (e.g., breeding and refuge sites and a permanent water source). Any disturbance to this area may have disproportionately large impacts on the fauna dependent on this habitat (Bancroft and Bamford 2006).

Introduced Fauna

There are six introduced fauna species that probably, or are known to, occur in the project area; mice, rats, rabbits, foxes, feral dogs and feral cats. Rabbits in particular are abundant within the grazed area on private property but do not appear to be present in high numbers within the native vegetation.

The project area is within a Fox Control Zone and the success of the reintroduction of the Quenda, Woylie and Tammar Wallaby to Nambung Nature Reserve depends on fox control in the region. Foxes often utilise tracks and are attracted to human activity where they attempt to scavenge food or are directly fed by humans.

5.4 Socio-economic Environment

5.4.1 Natural and European Heritage

There are two places of natural or European heritage significance recorded on the Australian Heritage Database or the Register of the National Estate within the proposed survey area however neither is wholly within the project area.

Lancelin Defence Training Area

The Lancelin Defence Training Area (Lancelin DTA) (Mimegarra Rd, Lancelin, WA), situated at the northern end of the Swan Coastal Plain, is listed on the Register of the National Estate (Place ID: 103296) and on the Commonwealth Heritage List (Place ID: 105578).

Much of the Lancelin DTA is dominated by species-rich Banksia woodlands and Myrtaceous/Proteaceous heaths. The floristic mosaic of low woodlands, wet heaths and low-heath communities represent significant vegetation remnants that are poorly conserved and under-represented in the conservation reserve system (DEH, 2006).

Northern Bassendean Dunes Area

To the North of the proposed survey site is the Northern Bassendean Dunes Area (Wongonderrah Road, Cataby, WA Place ID: 18584), which is also listed on the Register of the National Estate. This area covers about 60,000 ha and comprises the Wongonderrah, Mullering, Eneminga, South Mimegarra and Namming Nature Reserves. The area is considered to have important conservation values including a high species diversity of flora and fauna and a number of endemic and rare species. The proposed survey area does not encroach on the Northern Bassendean Dunes Area but is within 1 km of this area (DEH 2006).

5.4.2 Aboriginal Heritage and Native Title

Aboriginal cultural heritage remains are a record of the past occupation of the landscape by Aboriginal people. There is the potential for isolated Aboriginal archaeological artefacts (e.g., stone tools) or surface scatters (e.g., shell middens) to be present on land within the project area. In addition, a number of sites have been identified as being of significant to the local Aboriginal people either as traditional lands (e.g., hunting places, water sources and campsites) or as sites of mythological significance.

The land around the Mullering 3D Onshore Seismic Survey project area was traditionally occupied/owned by the Yued Aboriginal People (O'Connor 2003). The Yued are currently registered as Native Title Claimants on the National Native Title Tribunal register (registry number WC97/71).

A search of the Aboriginal Heritage Inquiry System, which is maintained by the Department of Indigenous Affairs (DIA), records three registered Aboriginal sites.

- Cooljarloo Swamp was a camp site, hunting place and water source for the Aboriginal people of the area.
- Coomado Swamp was a birthplace, camp site and hunting place for the local Aboriginal people.
- Mullering Brook is a site of mythological significance to the Aboriginal people of the area. There are currently no restrictions on the access to this site.

5.4.3 Land Use and Economic Environment

The current land tenure of the majority of the survey area is Unclaimed Crown Land (UCL), with a section of VCL stretching diagonally through the area, for the purpose of a Stock Route. One 'water and stopping place' reserve ('C' Class 729) is located within the survey area, around Wooka Wooka Well, on an old stock route. This reserve is vested within the Shire of Dandaragan.

The Tiwest Cooljarloo Mineral Sands Mine, located to the east and north of the project area, generates the principle economic activity in the area. Farming is the second largest economic driver with cattle grazing on the pastoral lease located adjacent to the western boundary of the project area.

A number of Apiary Site Permits located in the project area and a small number of seed collectors and wildflower pickers may utilise the project area. Tourist traffic is very low with the majority of tourists utilising the nearby nature reserves and national parks at Nambung, Mt Lesuer and Wanagarren.

5.4.4 Traffic and Infrastructure

The closest public road to the proposed survey area is the Woolka Road which runs east to west through the project area. Cooljarloo Road intersects with the north east corner of the project area but then continues towards the north west. The Brand Highway is the closest major road, approximately 10 km to the east of the project area. There a number of 4WD tracks running through the project area, many of which will be utilised by the proposed seismic survey.

Traffic along Woolka Rd, west of the Tiwest Cooljarloo Mineral Sands Mine, is very sparse, dominated by private 4WD traffic from the adjacent private property and beekeepers with apiary licences in the area.

Farm property gates, roads and fences are the most common above ground infrastructure. None of this infrastructure will be impacted by the project.

6. Environmental Risk Assessment and Mitigation Measures

This section examines the potential environmental impacts outlined in Section 5 and provides an analysis of the potential hazards and risks associated with both planned and unplanned operations. This section also identifies appropriate risk reduction and mitigation measures that will be applied to the Mullering 3D Onshore Seismic Survey to minimise the risk of adverse environmental, social and economic impacts from the project.

The methods for identifying hazards, assigning the likelihood and consequences of each hazard, and assessing each hazard are outlined in below. The risk assessment and mitigation measures for the Mullering 3D Onshore Seismic Survey is provided in Table 6.5.

When assessing environmental impacts the following definitions are critical to the understanding of the hazards and risks associated with this activity:

<i>Accident:</i>	An event capable of causing critical, major, moderate or minor damage to the environment, or negligible damage with no significant environmental effect.
<i>Hazard:</i>	A physical situation with the potential for damage to the environment, human injury, damage to property or a combination of these.
<i>Likelihood:</i>	The likelihood of a hazard resulting in an accident.
<i>Consequence:</i>	The severity of the outcome of an accident and its resulting impact.
<i>Risk:</i>	Risk is measured in terms of likelihood and consequence and is a measure of the outcome of an accident and the likelihood of the hazard occurring.

6.1 Hazard Identification

The process of hazard identification and risk management are divided in three main sections (reproduced from AS/NZS 4360:2004):

- External and environmental hazards (global hazards):
 - Project-specific hazards (project implementation issues).
 - Personnel health hazards (a global hazard).
- Individual and special operations hazards during construction operations that are exceptional because of size, complexity or timing (for example, site preparation and clearance close to underground utilities).
- General and routine work performed according to standard procedures (for example, welding, scaffolding, lifting and use of power tools).

6.2 Hazard Scenario

A scenario for realisation of each environmental and safety hazard was developed based on the knowledge and experience of Empire Oil and Enesar Consulting in onshore seismic survey environmental management in Australia as well as the findings of the ecological assessment undertaken by Woodman Environmental and Bamford Consulting Ecologists. Each scenario included:

- A description of the scenario and root cause of the hazard.
- Existing risk mitigation or prevention measures (that is, protection systems and management mechanisms) that are currently in place or are standard safety measures.

The likelihood and consequence of each hazard scenario was identified and assessed using Table 6.1 and Table 6.2.

Table 6.1 Qualitative measures of environmental consequence or impact

Level	Descriptor	Description
1	Insignificant	Alteration/disturbance within the limits of natural variability; effects not transmitted or accumulating; resources not impaired.
2	Minor	Temporary alteration/disturbance beyond natural variability effects confined to site and not accumulating resources temporarily affected.
3	Moderate	Alteration/disturbance of a component of an ecosystem; effects not transmitted or accumulating; potential resource loss, but sustainability unaffected.
4	Major	Alteration to one or more ecosystems or component levels, but which are recoverable; effects can be transmitted/accumulating.
5	Catastrophic	Irreversible alteration to one or more ecosystems or several components levels; effects can be transmitted/accumulating; lost sustainability of most resources.

Source: Based on AS/NZS 4360:2004.

Table 6.2 Qualitative measures of likelihood

Level	Descriptor	Description
A	Almost certain	Is expected to occur in most circumstances.
B	Likely	Will probably occur in most circumstances (one per year).
C	Possible	Might occur at some time.
D	Unlikely	May occur in exceptional circumstances.
E	Rare	Not known within industry.

Source: Based on AS/NZS 4360:2004.

6.3 Risk Matrix

Each scenario was then assessed using the risk matrix approach (Table 6.3). A risk estimate was made on the basis of the likelihood of the event occurring and its consequence.

Table 6.3 Qualitative risk analysis matrix – level of risk

Likelihood	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
	Level of Risk				
A (almost certain)	M	H	E	E	E
B (likely)	L	M	H	E	E
C (possible)	L	L	M	H	E
D (unlikely)	L	L	L	M	H
E (rare)	L	L	L	L	M

Legend

E	Extreme/intolerable risk; immediate action required.
H	High/undesirable risk; senior management attention needed.
M	Moderate/undesirable risk; management responsibility must be specified.
L	Low/tolerable risk; manage by routine procedures.

6.4 Risk Reduction Measures

Risk reduction measures were applied to initial risks that were deemed to be too high. That is, 'Extreme' or 'High' on the risk matrix. The hazard scenario was then reassessed and so on. All risks are considered as low as reasonably possible (ALARP), there were no residual risks unable to be reduced to an acceptable level.

Philosophy of Risk Reduction

A four-point scale of management action has been used to guide appropriate management strategies according to the risk classes of Table 6.4.

Table 6.4 Risk reduction philosophy

Level of Risk	Philosophy
Extreme/ intolerable risk	Unacceptable risk that will not be tolerated by Empire Oil under any conditions and must be engineered down to a lower risk level. The amount by which such risks can be reduced will depend on the control that the project has over the factors involved in the hazardous event. For example, where a major risk-producing factor is the project's interface with the general public, fewer options are available to reduce that risk than in cases where the general public are not involved.
High/ undesirable risk	High/undesirable risks require that the engineering design or method should be altered to remove the hazardous event or to reduce the associated frequency or consequence severity so as to place the risk in a lower risk level.
Moderate/ undesirable risk	Moderate/undesirable risks require that a management plan be determined for the hazardous event to prevent its occurrence and to monitor changes that could place the risk in a higher level. The management responsibility must be specified.
Low/tolerable risk	Low/tolerable risks require no further treatment other than monitoring as the project progresses to ensure that there is no potential for the risk level to increase with time. These risks can be managed by routine procedures.

6.5 Environmental Hazard and Risk Assessment

Table 6.5 presents the environmental hazard and risk assessment for the proposed project. The risk analysis impact and likelihood (in columns 4 and 5) draw from the definition of risk in Table 6.1 and likelihood in Table 6.2. The risk evaluation draws from the matrix in Table 6.3.

The mitigation measures presented in Table 6.5 are based on the Australian Petroleum Production and Exploration Association (APPEA) *Code of Environmental Practice* (1996) along with the combined experience of Empire Oil and Enesar in developing environmental management measures for similar projects.

There are no activities assessed as being of 'high' risk for the proposed project. This reflects the temporary and low impact nature of the activity, and the application of appropriate mitigation measures. Specific management measures and performance criteria have been developed for activities or hazards assessed as being of 'moderate' risk (initial or residual). These management measures are provided in Appendix A.

Table 6.5 is itemised to individual impacts and potential impacts however some perspective of the risks associated with this operation can be gained from the following summary of the major hazards and risks.

- The main impacts derive from formation of source and receiver lines, including clearing or trampling of vegetation. These impacts are temporary, localised and, for all practical purposes, recoverable.
- There is the potential for ongoing impacts associated with unauthorised public use of the source and receiver lines as a thoroughfare. Plans are in place for the management of this risk through preventative measures to prevent unauthorised access of the source and receiver lines.

Table 6.5 Environmental Risk analysis and mitigation measures

Hazard Identification		Risk Treatment and Implementation		Risk Assessment		
Activity	Hazard	Potential Consequence	Prevention/Mitigation Measures	Likelihood	Impact	Risk
Campsites and lay down area	Visual impact.	Reduced visual amenity.	The camp and laydown area will not be visible from public roads.	D	1	L
	Vegetation clearance.	Impacts to native flora.	The camp and laydown area will not require additional vegetation clearing.	E	3	L
	Noise.	Nuisance to nearby residents.	The camp will be located at a sufficient distance from residences to minimise noise nuisance from traffic, generators or general noise.	D	2	L
	Waste hydrocarbon and chemical spills.	Soil or water contamination.	Appropriate waste management will be implemented for all wastes including: <ul style="list-style-type: none"> • Segregation of recyclable material. • Putrescible wastes contained and regularly disposed to a licensed landfill. • Septic tank sewage disposal for camps or porta-loos. 	D	3	L
Seismic survey line preparation	Attract native and introduced fauna.	Injury of native fauna. Disruption of natural foraging patterns. Encourage feral fauna.	Vermmin-proof bins will be installed at the camp to discourage foraging behaviour by native and introduced fauna. Inductions will outline potential project impacts on native fauna how these will be managed.	C	2	L
	Impacts to wetlands and water courses.	Disruption to key flora and fauna habitats.	Source lines will be deviated to avoid all wetlands in the proposed seismic survey area or stopped outside riparian zones, recommencing on the other of the riparian zones, so that the wetland can be 'undershot'. All personnel working on the Mullering 3D Onshore Seismic Survey will be inducted on the significance of wetlands in the project area and the management measures put in place to ensure their protection.	D	3	L

Table 6.5 Environmental Risk analysis and mitigation measures (cont'd)

Hazard Identification		Risk Treatment and Implementation		Risk Assessment		
Activity	Hazard	Potential Consequence	Prevention/Mitigation Measures	Likelihood	Impact	Risk
Seismic survey line preparation (cont'd)	Impacts to terrestrial flora.	Weed and pathogen invasion. Unplanned native vegetation loss and fragmentation. Disturbance to ecologically significant sites.	Project Weed and <i>P. cinnamomi</i> hygiene control procedures (see Appendix A) will be applied. Planning has been undertaken to avoid the most sensitive environmental locations. The extent of clearing will be clearly identified in regulator approved swath maps and marked in the field. Clearing of mature trees will be avoided wherever possible. If required, overhanging branches will be trimmed rather than removing whole trees or shrubs. Branch trimming will be undertaken using chainsaws or handsaws and not excavators. Rehabilitation of the seismic lines will be carried out according to Appendix A. Closure of seismic lines will occur as soon as practicable after seismic data acquisition and no later than two weeks after the last required use of the seismic line.	D	4	M
	Compaction, erosion and sedimentation.	Degradation of soil and water quality. Interruption of surface water drainage.	The survey is scheduled to be carried out in the dry period when the potential for soil compaction is at its lowest. Contingency actions in the case of a significant early break in the season or cyclone are outlined in Section 7. The time between clearing of the seismic survey lines and rehabilitation will be minimised to limit the time of exposure to the elements of the cleared survey lines. Closure of seismic lines will occur as soon as practicable, no later than two weeks after the last required use of the seismic line, in accordance with the Rehabilitation Plan (Appendix A6). Post survey inspection will identify any compaction or rutting and initiate active rehabilitation of these areas.	C	3	M
				D	3	L

Table 6.5 Environmental Risk analysis and mitigation measures (cont'd)

Hazard Identification		Risk Treatment and Implementation		Risk Assessment		
Activity	Hazard	Potential Consequence	Prevention/Mitigation Measures	Likelihood	Impact	Risk
Seismic survey line preparation (cont'd)	Spills (hydraulic hose rupture, fuel etc.).	Soil, surface water and groundwater contamination.	<p>Spill prevention and response procedures (prepared by the construction contractor) will be followed and applied. Refueling will be restricted to a small number of locations and will not occur within 50 m of a watercourse or wetland. In the event of a spill occurring. The spill response procedures will outline:</p> <ul style="list-style-type: none"> • Refueling locations. • Spill response equipment and locations. • Maintenance program of equipment. • Spill response measures. • Spill reporting procedures. • Spill response training. 	D	2	L
	Impacts to Aboriginal heritage.	Damage to known and/or unknown heritage material.	<p>A heritage survey of the project area will be conducted prior to commencement of the project by a suitably qualified person, in consultation with the Yued people.</p> <p>All known Aboriginal heritage sites will be avoided.</p> <p>In the event that potential Aboriginal heritage material is uncovered, management actions outlined in Appendix A will be applied.</p> <p>All personnel involved in the project will be inducted in Aboriginal heritage management procedures and provided with information for identifying heritage artefacts so as to prevent unintentional damage.</p>	D	3	L
	Impacts to agricultural land use.	Interruption to farm operations.	Landholders will be consulted regarding the timing of operations and every effort will be made to conduct operations so that disturbance to normal farming practices is minimised.	C	1	L

Table 6.5 Environmental Risk analysis and mitigation measures (cont'd)

Hazard Identification		Risk Treatment and Implementation		Risk Assessment		
Activity	Hazard	Potential Consequence	Prevention/Mitigation Measures	Likelihood	Impact	Risk
Seismic survey line preparation (cont'd)	Damage to utility infrastructure.	Temporary loss of essential services (e.g., water, electricity, phone, fencing).	Any damaged infrastructure will be reinstated to its prior condition (as a minimum) in consultation with the asset owner.	D	2	L
	Reduction of visual amenity.	Visibility of line clearing equipment and cleared lines in an otherwise rural/native environment.	The seismic survey lines and all work sites will be maintained in an orderly manner, free of litter. Closure of seismic lines will occur as soon as practicable, no later than two weeks after the last required use of the seismic line. No seismic lines will enter onto Woolka Road and it is unlikely that any seismic lines will be visible from Woolka Road.	B	1	L
Construction of temporary gates and fence crossings along seismic lines	Unauthorised access to survey site.	Safety or uncontrolled behaviour.	Erect appropriate access barriers (e.g., temporary fencing) and warning signs, as necessary.	D	2	L
	Obstruction of existing right of way and restrictions on land access.	Disturbance to land uses (e.g., seed collecting and bee keeping) and farm infrastructure.	Liaison with landholders prior to, during and on completion of seismic program. Temporary fencing removed and permanent fencing re-instated.	D	2	L
Vehicle access to and along the seismic lines	Dust generation.	Nuisance to other road users and road hazard.	Vehicle speeds on unsealed tracks, the seismic lines and work sites will be restricted. The period surfaces are exposed will be minimised by prompt closure of the seismic lines and worksites at the completion of construction.	C	1	L

Table 6.5 Environmental Risk analysis and mitigation measures (cont'd)

Hazard Identification		Risk Treatment and Implementation		Risk Assessment	
Activity	Hazard	Potential Consequence	Prevention/Mitigation Measures	Likelihood	Risk
Vehicle access to and along the seismic lines (cont'd)	Increased traffic.	Weed and pathogen invasion.	Control procedures will be established to prevent weed and pathogen introduction to the project area. Weed and <i>P. cinnamomi</i> hygiene management is discussed in Appendix A2. Follow up weed control will be undertaken post construction for a minimum of two years where weeds have been introduced or exacerbated by the seismic survey.	D	4 M
		Impacts to native flora and fauna. Impacts to land use i.e., limiting road access for other users.	Vehicles will remain within the cleared seismic lines and on designated access roads and tracks. Vehicle speeds on unsealed tracks, seismic lines and work sites will be restricted.	D	2 L
	Increased fire risk.	Unplanned bushfire.	A bushfire contingency plan is outlined in Section 7 and includes bushfire prevention and response measures.	D	4 M
Increased noise and vibration.	Increased soil compaction.	Reduced rehabilitation performance and potential surface water flow disruption.	The survey is scheduled to be carried out in the dry period when the potential for soil compaction is at its lowest. Post-survey inspections will determine if any soil compaction has occurred and recommend specific measures to address this.	C	3 M
		Disruption and impact on native fauna. Disturbance to nearby human noise receptors.	Vehicle speeds on unsealed tracks, seismic lines and work sites will be restricted. There are no permanent residences within earshot of the proposed seismic survey.	C	2 L

Table 6.5 Environmental Risk analysis and mitigation measures (cont'd)

Hazard Identification		Risk Treatment and Implementation		Risk Assessment		
Activity	Hazard	Potential Consequence	Prevention/Mitigation Measures	Likelihood	Impact	Risk
Receiver cable laying	Impacts to terrestrial flora.	Unplanned disturbance to native vegetation. Weed and pathogen invasion.	Cable laying is carried out on foot in sensitive areas; therefore disturbance to native and other vegetation and soil will be minimal. The weed and <i>P. cinnamomi</i> hygiene measures outlined in the EMP (Section 8) will be followed.	D	3	L
Seismic acquisition	Compaction, erosion and sedimentation.	Degradation of soil and water quality. Interruption of surface water drainage.	The survey is scheduled to be carried out in the dry period of the year. Contingency actions in the case of a significant early break in the season or cyclone are outlined in Section 7. The time between clearing of the seismic survey lines and rehabilitation will be minimised to limit the time of exposure to the elements of the cleared survey lines. Vegetation will be re-established as soon as is practicable to stabilise the exposed soils in accordance with the Rehabilitation Management Plan (Appendix A). Post survey inspection will identify any compaction or rutting and initiate active rehabilitation of these areas.	D	2	L
	Operation of vibroseis trucks.	Introduction of weeds and other exotic threats to areas of natural vegetation and farmland. Movement of stock and damage to property.	At the commencement of work on the Mullering seismic program all vehicles and equipment shall be washed down and inspected prior to arriving on-site. Weed and <i>P. cinnamomi</i> hygiene management will be carried out according to Appendix A2. Liaise with the landholder to make appropriate arrangements to minimise disruption. Any damage to property will be rectified as soon as possible.	D	4	M
				D	2	L

Table 6.5 Environmental Risk analysis and mitigation measures (cont'd)

Hazard Identification		Risk Treatment and Implementation		Risk Assessment		
Activity	Hazard	Potential Consequence	Prevention/Mitigation Measures	Likelihood	Impact	Risk
Seismic acquisition (cont'd)	Operation of Vibroseis Trucks (cont'd).	Disturbance and damage to third party private property and service utilities.	Consultation with relevant utility authorities and site inspection will be undertaken for the early identification of existing buried cables, pipes, water mains and other infrastructure. Temporary fencing/gates will be installed at any location where it is necessary to remove fences or gates. All fences and farm infrastructure will be returned to pre-survey conditions as agreed with the lease holder and appropriate compensation agreements negotiated.	D	2	L
	Vibrations, dust and noise.	Impacts to fauna and flora.	Vibroseis trucks move slowly and stop frequently therefore generate minimal dust.	D	2	L
Uphole survey	Refuelling vehicles.	Contamination of nearby watercourses, soil and groundwater.	Refueling will be restricted to a small number of locations and will not occur within 50 m of a watercourse or wetland. Non-return valves will be used.	D	3	L
	Operation of drilling equipment.	Compaction of soils.	Minimised through use of existing tracks and roads. Post survey inspection will identify any compaction and initiate active rehabilitation of these areas.	D	3	L
		Injury to native animals or livestock if holes subside.	Upholes will be plugged and backfilled to an appropriate depth to prevent collapse and avoid hazard.	D	2	L
		Contamination to soil and groundwater resources.	Drilling will not occur within 50 m of a watercourse or wetland with no chemical additives used in drilling fluids. Procedures for equipment maintenance will ensure that risk of spills is minimised and clean up response is rapid. Up-holes will be backfilled and cement-sealed if an aquifer is intersected.	D	3	L

7. Natural Disaster Contingency Planning

7.1 Bushfire Prevention and Management

While a bushfire may not have a long lasting environmental impact, bushfires have the potential to seriously endanger life and property, cause short term environmental degradation and increase the risk of invasion by weeds or introduced fauna.

7.1.1 Bushfire Prevention

All personnel will attend a site induction that includes a component on the fire prevention requirements of the Mullering 3D Onshore Seismic Survey and the use of the fire extinguisher fitted to all vehicles. The Mullering 3D Onshore Seismic Survey will comply with the Bush Fires Act 1954 and Regulations and the requirements of the relevant local authorities. Personnel will be made aware of fire restrictions and fire weather information, including information on harvest and vehicle movement bans during daily toolbox meetings.

Appropriate contractor personnel will be trained in fire-fighting techniques and equipment/vehicle use and will man the fire fighting equipment as part of an Emergency Response Team (ERT).

No petrol vehicles will be used for the Mullering 3D Onshore Seismic Survey except for activities associated with maintaining the camp. Personnel will inspect vehicles daily and remove vegetation build-up around the belly plates and exhaust systems of vehicles:

- At each hygiene check point.
- As part of the daily vehicle pre-start inspection.

The Chief Bushfire Control Officer from the Shire of Dandaragan will conduct an inspection at mobilisation to ensure compliance with fire regulations, including inspections of all vehicles and equipment for possible sources of ignition.

7.1.2 Fire-Fighting Equipment

Every vehicle directly involved in the seismic survey will carry:

- A rake to assist in suppressing a small fire if it occurs.
- At least one fire extinguisher suitable for a Class B (flammable liquid) fire.
- A 9 kg pressurised water fire extinguisher applicable to scrub fires.

In addition, each Vibroseis truck will carry two 2 kg fire extinguishers. Fire extinguishers will be maintained in accordance with the manufacturers directions.

Two (2) Light Tankers equipped with 800 L tank and petrol driven pump will be stationed proximal to the daily seismic crew activities and a 12,000 L fire tender will be stationed on site, complete with:

- A motor driven pump.
- A fire fighting hose on a suitable hose reel fitted with an approved nozzle (minimum length 50 m).

The 12,000 L fire truck will be backed up by two fast attack vehicles equipped with a high pressure pump. These vehicles will be deployed central to seismic activities to best minimise response time.

All fire-fighting equipment will be maintained in good working order, including full water levels, and all personnel will be trained in the use of this equipment and notified of nearby available sources of water.

7.1.3 Bush Fire Response

On discovery of a fire on the Mullering 3D Onshore Seismic Survey site, all personnel are required to follow the chain of communication for Bush Fire Response shown in Figure 7.1. All information with regard to bushfire outbreaks on the project area, either due to seismic activities or from outside activities, shall be reported via the site environmental incident reporting system.

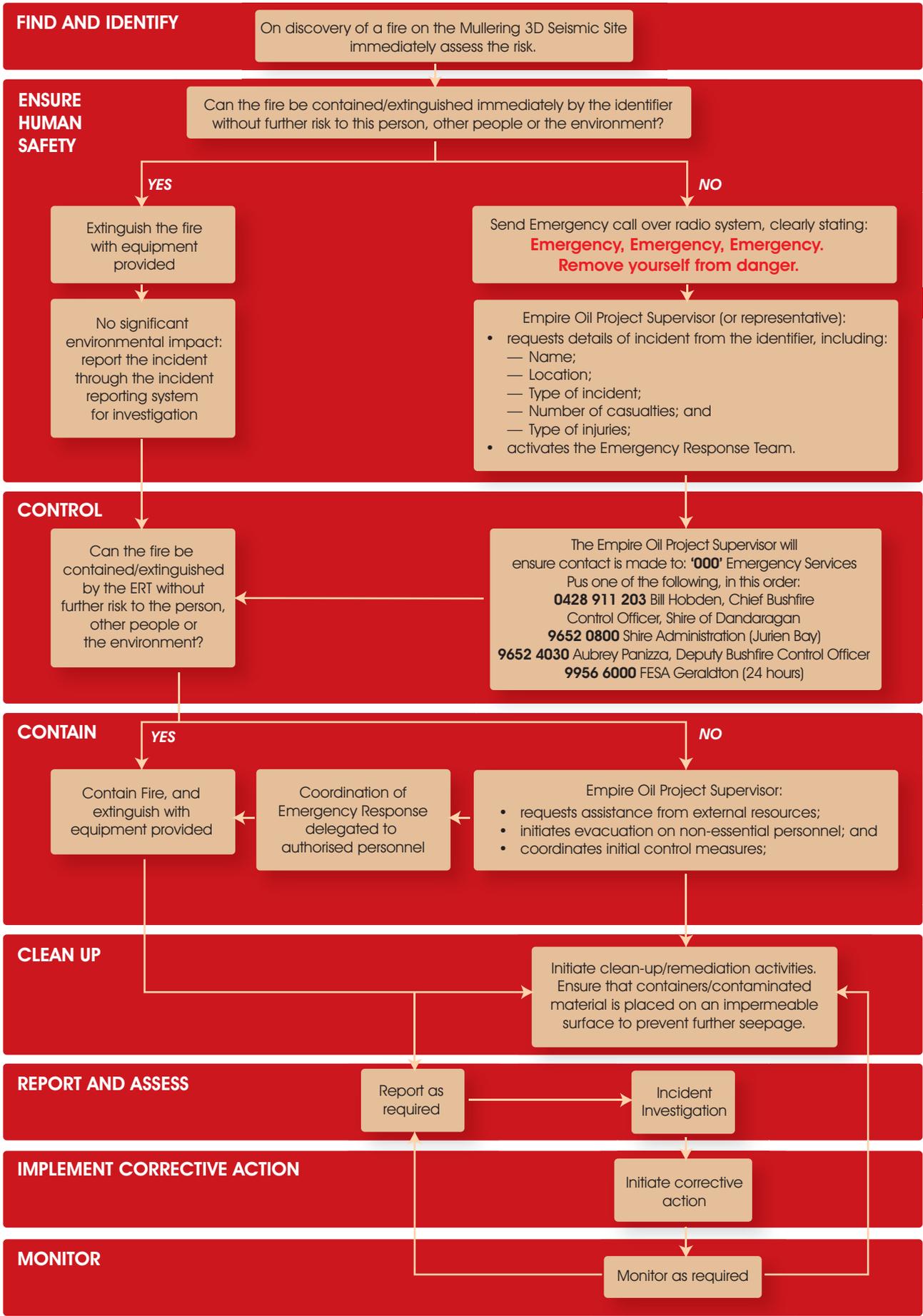
7.1.4 Post Fire Requirements

If a bushfire occurs on the project area, either due to seismic activities or from outside activities, it will be reported via the site environmental incident reporting system.

Following the control of a fire, short and long term activities to be implemented include:

- Debriefing all stakeholders.
- Compiling records relating to the fire for future reference.
- Investigating the cause of the fire.
- Contacting the Wildfire Investigation Action Team (WIAT) if required.
- Assessing public and private facilities affected by the fire.
- Assess any public safety hazards created by the fire.

Animal rescue may commence once the fire ground has been declared safe. Weed eradication measures will be implemented to reduce the potential for early domination of non-endemic species. Access to the site will be restricted to authorised personnel to reduce damage to regrowth and the potential to increase erosion.



7.2 Cyclone and Flood Management

While a cyclone or flood may not seriously endanger life and property, if the project area becomes too wet conducting a seismic survey in these conditions could have a long lasting environmental impact, environmental degradation and increase the risk of invasion by weeds, dieback (*P. cinnamomi*) or introduced fauna. In addition, inundated or sodden ground may prevent access to parts of the project area.

If a cyclone, floods or heavy rain occurs in the Minyulo Catchment the project area may be subject to inundation and subsequently the wet and muddy conditions impose certain risks and restrictions on the Mullering 3D Onshore Seismic Survey. For example:

- Bogging and rutting have greater potential to disrupt surface water flow and become a focus point for erosion.
- The likelihood of spreading weeds or dieback is greater as mud is more likely to adhere to vehicles and be transported throughout the site.
- Access to sites may be restricted with vehicles more likely to get bogged.

7.2.1 Management Actions

In the event of heavy rainfall immediately prior to or during the survey, DEC will be invited to carry out a site inspection in conjunction with Empire Oil's environmental specialists in order to determine management actions which will be put in place to minimise environmental impact to the site from the remaining operations. The following management actions may be applied in order to reduce the risks associated with conducting a 3D seismic survey in wet conditions:

- Hygiene stations on Woolka Road will have a hardstand that is capable of converting into a wash-down station.
- The use of tarps at hygiene points surrounding the D2 vegetation community will allow these points to become wash-down points.
- Vehicles will not traverse soft or boggy ground as far as is practicable. Where this is unavoidable the location will be noted and a close inspection carried out immediately after the survey to determine if and what active rehabilitation is required.
- Consideration will be given to hand carrying of cables and geophones along previously cleared receiver lines where appropriate.

8. Environmental Management

8.1 Environmental Objectives and Standards

The overall environmental objective of the Mullering 3D Onshore Seismic Survey is to plan and conduct the survey in such a way that environmental impacts are avoided or, if this is not possible, are as low as reasonably practical.

8.2 Training and Education

The seismic crew will undergo environmental inductions designed to inform them of their obligations and project-specific environmental management procedures. Environmental inductions will be linked with safety inductions for efficiency with additional training undertaken on an as-needs basis.

Inductions will cover the issues addressed in Table 6.5, including:

- Soil and water management.
- Flora management and importance of minimising clearing required.
- Land use and infrastructure.
- Aboriginal heritage.
- Air and noise emissions.
- Traffic.
- Waste and hazardous materials management.
- Visual amenity.
- Weeds and weed hygiene.
- Plant and animal pathogens.
- Bushfire prevention and response.
- Gate management protocols.
- Rehabilitation.
- Incident reporting.

Empire Oil, in conjunction with the seismic contractor, will develop a Safety Management Plan for this seismic survey program. The plan will detail key safety processes such as induction, safety meetings, reporting lines, Permit to Work system, job safety analysis, hazard and management control and oil/chemical spill contingency. Copies of this ARI and the Safety Management Plan will be available at the site office, located at the campsite.

8.3 Environmental Roles and Responsibilities

The proposed project will be managed by a seismic survey contractor, on behalf of Empire Oil. Empire Oil has overall responsibility for the conduct of the project.

In order to effectively manage the environmental aspects of the Mullering 3D Onshore Seismic Survey, Empire Oil will appoint an on-ground Environmental Manager for the duration of the survey. The Environmental Manager will report to the Project Supervisor who will be responsible for ensuring that all activities associated with the project are undertaken in full compliance with all statutory regulation and are consistent with this ARI. The Project Supervisor will provide daily reports to the Empire Oil Director on the

compliance with this EMP and will ensure that any non-compliance is investigated and rectified as soon as possible.

The responsibilities for the various personnel involved in the Mullering 3D Onshore Seismic Survey are outlined in Table 8.1.

Table 8.1 Environmental management responsibilities

Personnel	Responsibilities
Empire Oil Director	Overall responsibility for the project. Coordinate Empire Oil and contractor personnel to ensure the survey runs smoothly and complies to all applicable policies, procedures, legislative requirements and management plans.
Seismic Contractor Manager	Coordinate all seismic survey processes and operations, ensuring all applicable policies, procedures, legislative requirements and management plans are complied with.
Empire Oil Project Supervisor	Coordinate and supervise seismic survey processes and operations in the field on behalf of Empire Oil. Responsible for daily feedback to the Empire Oil Director on technical data and environmental compliance.
Environmental Manager	Coordinate and supervise implementation of the ARI and EMPs. Responsible for daily feedback to the Empire Oil Project Supervisor regarding on-ground environmental management and compliance.
Seismic Crew Manager	Coordinate all seismic survey processes and operations in the field, ensuring all applicable policies, procedures, legislative requirements and management plans are complied with.
Consulting Environmental Specialists	Provide specialist advice to Empire Oil on environmental and approval matters, as required.

8.4 Monitoring and Auditing

Empire Oil has established a monitoring and auditing program for its operated and non-operated assets in Australia. The Empire Oil Environmental Manager will undertake regular inspection of seismic activities to assess compliance with the environmental assessment and risk mitigation plan.

Empire Oil has formulated environmental management measures for the seismic survey that form the basis for monitoring and corrective action criteria to be determined. These are outlined in Table 8.2 according to issue. During the survey, the Empire Oil Environmental Manager will undertake regular monitoring and auditing of the survey and associated activities.

Table 8.2 Environmental Inspection and Monitoring Program

Monitoring Subject	Potential Issue	Corrective Action
Vegetation Clearing	Damage to native vegetation outside survey area	Reinstate fencing, barriers or flagging to delineate clearing boundaries. Placed cleared vegetation over cleared area to provide erosion control and seed stock. Undertake a remedial toolbox session for all personnel. Note area and include in post-survey rehabilitation program.
	Soil erosion	Install/reinstate erosion control structures where appropriate. Reapply sheeting material in areas where losses have occurred, if appropriate. Note area and include in post-survey rehabilitation program.
Traffic	Dust	Minimise vehicle speeds.
	Soil erosion	Install/reinstate erosion control structures where appropriate. Reapply sheeting material in areas where losses have occurred, if appropriate. Note area and include in post-survey rehabilitation program.
Existing infrastructure	Loss or damage	Install/reinstate temporary fencing or project flagging (for avoidance). Repair infrastructure to pre-existing condition as soon as possible.
Heritage material	Damage to artefacts	Follow measures provided in Appendix A Social and Cultural Management.
Air quality	Air pollution	Service vehicles and machinery to ensure they are in good working order.
Weed management	Introduction and spread of weed species	Instruct all personnel that all vehicles are to be washed down prior to arriving at site. Inspect vehicles arriving at site to ensure they are not carrying foreign soil and plant matter (e.g., undercarriage, under wheel arches, tyres, etc). Treat or rehabilitate infected area as soon as practicable.
Waste and hazardous Storage	Spill or leak	Maintain regular sewage collection and disposal service. Ensure correct storage of hazardous material. Spill clean up material.
	Litter	Ensure all rubbish receptacles do not overflow, are well contained and regularly collected for disposal. Regularly inspect that all wastes are appropriately separated into their various waste streams in properly labelled receptacles and that any litter on site is collected and appropriately disposed.

8.5 Environmental Reporting

The outcomes of the auditing and monitoring programs will be reported to the Empire Oil Board and appropriate corrective action undertaken where required.

Reporting of auditing and monitoring results to regulatory authorities will be undertaken in accordance with regulatory requirements.

The Empire Oil incident reporting procedure is used for all field activities conducted by employees and contractors. Any environmental incident, near miss, or newly identified hazard is reported under this procedure. The procedure identifies any follow up action and provides for field suggestions to minimise the existing or future environmental risk. The reporting system has an incident and action tracking process to facilitate timely and effective close out of any identified actions arising from the incident. All environmental incident/spill reporting will also be in accordance with regulatory guidelines.

In addition, the principal seismic survey contractor maintains an incident reporting system to minimise environmental harm and to encourage the prevention of more serious incidents. All personnel are encouraged to report minor events to act as an alert to environmental risks and to maintain a program of continual improvement.

At the completion of the survey, a close out audit and report will be prepared and distributed to regulators. The purpose of this report is to record the environmental performance of the seismic survey and provide recommendations for future surveys and to identify any areas that may require an active rehabilitation effort.

Annual rehabilitation monitoring will be undertaken for at least three years or until the completion criteria for the Mullering 3D Onshore Seismic Survey are achieved, whichever is longer. The results of this monitoring will be reported annually and made available to regulators.

9. Summary of Environmental Commitments

The following table (Table 9.1) provides a summary of the environmental commitments made in this EMP.

Table 9.1 Summary of Environmental Commitments

No.	Commitment	ARI Reference
Native Vegetation		
1	Where required, overhanging branches will be trimmed rather than removing whole trees or shrubs. Branch trimming will be undertaken using chainsaws or handsaws and not excavators.	Appendix A-1
2	Disturbance to all known populations of the DRF species <i>A. gracilis</i> and <i>A. viridis</i> subsp. <i>terraspectans</i> will be avoided with a disturbance buffer of at least 50-m maintained around these locations. A <i>Permit to Take DRF</i> has been granted for <i>Macarthuria keigheryi</i> .	Appendix A-1
3	Populations of Priority flora within 30 m of seismic activity will be flagged to ensure that accidental disturbance is avoided.	Appendix A-1
4	Clearing of wetland areas will be avoided.	Section 3.5 Appendix A-1
5	Large trees (greater than 3m) will not be cleared during seismic line preparation.	Section 3.5 Appendix A-1 Appendix C
6	Line preparation methods will be undertaken as per Appendix C Table 5: Line preparation methods recommended for the Mullering Onshore 3D Seismic survey.	Appendix A1
7	Slow growing species will be avoided where possible during seismic line preparation. These species include <i>Macrozamia fraseri</i> and <i>Xanthorrhoea</i> spp.	Section 3.6 Appendix A1
8	Clearing within 10 metres of DEC monitoring plots within the Mullering Project Area will be avoided.	Section 3.5 Appendix A1
9	All personnel will be inducted on the significance of the flora and fauna of the project area and the management measures put in place to ensure their protection.	Appendix A1
10	Existing tracks will be used for access and as seismic lines as far as practicable to minimise disturbance to undisturbed land.	Section 3.5 Appendix A1
Fauna		
11	Vermin-proof bins will be installed at the camp to discourage foraging behaviour by native and introduced fauna.	Appendix A1
12	Inductions will stress potential project impacts on native fauna and how these will be addressed.	Appendix A1
13	The seismic survey will be conducted during daylight hours only to avoid impacts to nocturnal species.	Appendix A1
14	Fauna injuries or fatalities will be reported through the internal incident reporting system and reported to the DEC regional office. Rebecca Carter (Programme Leader Nature Conservation) will be the first point of contact (phone number 9652 1911).	Appendix A1
15	All practicable measures to rehabilitate any injured animal found within the operations boundaries will be implemented.	Appendix A1

Table 9.1 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Fauna (cont'd)		
16	Vehicle speeds will be restricted to 60 km/h along Woolka Road and 40 km/h on seismic lines to minimise noise disturbance to fauna.	Appendix A1 and A4
17	Obstructions to the passage of terrestrial fauna (e.g. equipment on the ground) will be minimised.	Appendix A1
18	Lighting requirements will be kept at levels as low as reasonably practical.	Appendix A1
19	The feeding of animals, hunting, fire-arms and pets on the construction site will be prohibited.	Appendix A1
20	Measures will be in place to avoid encouraging Foxes including minimal tracks, no feeding and no accessible food scraps.	Appendix A1
Weed and <i>P. cinnamomi</i> Hygiene		
21	Hygiene management as outlined in Appendix A2 will be implemented to prevent weed and pathogen introduction to the project area.	Appendix A2
22	If post-survey rehabilitation monitoring indicated that weeds have been introduced or spread as a result of the Mullering 3D seismic survey, Empire Oil will undertake an active weed eradication programme as outlined in Appendix A2.	Appendix A2
23	All vehicles and equipment entering the sites will be required to follow clean down procedures as outlined in Appendix A2.	Appendix A2
24	Vehicles will remain within the cleared seismic lines and on designated access roads and tracks.	Appendix A2
25	Daily movements of vehicles and line rolling equipment will be planned to minimise transit between weed prone and weed free areas.	Appendix A2
26	Access to the project area will be restricted to Woolka Road. All vehicles must pass through a clean on entry hygiene station as depicted in Figure A2.1.	Appendix A2
27	All access to and from the D2 vegetation community will occur via one of the designated hygiene points.	Appendix A2
28	Where receiver lines are hand carried, (as designed on swath maps), personnel will inspect and clean clothing.	Appendix A2
29	Weed and <i>P. cinnamomi</i> hygiene management will be detailed to all employees prior to commencing work on the seismic survey as part of the environmental induction program, and training will be provided in the correct use of hygiene stations.	Appendix A2
30	At the commencement of work on the Mullering seismic program all vehicles and equipment shall be washed down and inspected prior to entering the project area.	Appendix A2
Wetland Management		
31	Source lines will be deviated to avoid all wetlands in the proposed seismic survey area or stopped outside riparian zones, recommencing on the other of the riparian zones, so that the wetland can be 'undershot'	Appendix A3
32	Wetland areas that experience significant periods of inundation will not be traversed by vehicles to protect the surface from compaction and to ensure surface drainage patterns are not compromised.	Appendix A3
33	All personnel working on the Mullering 3D Onshore Seismic Survey will be inducted on the significance of wetlands in the project area and the management measures put in place to ensure their protection.	Appendix A3

Table 9.1 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Pollution Prevention		
34	Wastes produced by survey activities will be disposed of in accordance with relevant regulations as outlined in Section A4.4.1 of Appendix A4.	Appendix A4
35	Handling of hazardous material will be done in accordance with contractor dangerous goods procedures.	Appendix A4
36	Refueling and drilling will not occur within 50 m of a watercourse. Non-return valves will be used for refueling and no chemical additives will be used in drilling fluid.	Appendix A3 Appendix A4
37	Procedures for equipment maintenance will ensure that risk of spills is minimised and clean up response is rapid.	Appendix A4
38	Up-holes will be backfilled and cement-sealed if an aquifer is intersected.	Section 3.7 Appendix A3
39	Drill wastes, consisting of broken rock and soil matter, will be temporarily stored on the drilling rigs in transportable containers and returned to the up-hole once drilling and testing is complete. Excess cuttings will be spread over topsoil in a thin layer and raked in.	Appendix A4
40	Domestic wastes (food scraps, light paper, cardboard, putrescible and plastic waste), including rubbish produced by the workforce operating in the field, will be collected according to contractor management procedures and treatment systems and disposed in line with local Shire requirements.	Appendix A4
41	Domestic sewage (black and grey water) will be temporary stored in a buried septic tank system installed at the camp and operated as per the Contractor management procedures and treatment systems. The tank will be pumped out as required and the waste transported to an appropriate waste management facility for disposal.	Appendix A4
42	Industrial wastes (wood, scrap steel and other metals, scrap tyres, rubber and synthetic materials, and other inert, mixed industrial wastes) will be collected according to Contractor management procedures and treatment systems and disposed in line with local Shire requirements.	Appendix A4
43	Hazardous materials will be clearly labelled (including an MSDS that conforms with the WorkSafe Australia Code of Practice), stored and banded as per the requirements of Australian Standard AS 1940 – 1993 and disposed of in line with local Shire requirements.	Appendix A4
44	Spill kits, bio-remedial products, drip trays and shovels will be provided in the case of a spill of hazardous materials or wastes and workers required to access dangerous goods will be trained in the use of this equipment.	Appendix A4
45	A waste log will be kept detailing waste types, volumes and disposal methods.	Appendix A4
Soil Conservation		
46	The survey is scheduled to be carried out in the dry period when the potential for soil compaction is at its lowest.	Section 6.5 Appendix A2
47	Compacted or rutted soils may be lightly scarified to improve aeration and prevent channeling of surface water flows.	Section 3.10 Appendix A6
48	Any vegetation pushed to one side of the seismic lines during operations will be pulled back over the lines.	Appendix A6
49	A post-survey inspection will be carried out to confirm that all line closure activities have been successfully carried out and to determine if there is any need for additional closure activities or active rehabilitation.	Appendix A6

Table 9.1 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Visual Amenity and Third Party Access		
50	The camp and laydown area will not be visible from public roads.	Section 3.4 Appendix A6
51	No seismic lines will enter onto Woolka Road and it is unlikely that any seismic lines will be visible from Woolka Road.	Section 6.5 Appendix A6
52	All intersections of seismic lines with public roads will be disguised to prevent third party access.	Section 3.10 Appendix A6
53	Closure of seismic lines will occur as soon as practicable, and no later than two weeks after the last required use of the seismic line.	Section 6.5 Appendix A6
Air Quality and Noise		
54	The camp will be located at a sufficient distance from residences to minimise noise nuisance from traffic, generators or general noise.	Section 6.5 Appendix A6
55	Operations will only be undertaken during daylight hours and local lease holders will be kept informed of progress and areas of operations throughout the survey.	Appendix A4
56	Vibroseis trucks move slowly and stop frequently therefore generate minimal dust.	Section 6.5
Bushfire Prevention and Management		
57	All personnel will attend a site induction that includes a component on the fire prevention requirements of the Mullering 3D Onshore Seismic Survey and the use of the fire extinguisher fitted to all vehicles.	Section 7
58	Personnel will be made aware of fire restrictions and fire weather information, including information on harvest and vehicle movement bans during daily toolbox meetings.	Section 7
59	Appropriate contractor personnel will be trained in fire-fighting techniques and equipment/vehicle use and will man the fire fighting equipment as part of an Emergency Response Team (ERT).	Section 7
60	No petrol vehicles will be used for the Mullering 3D Onshore Seismic Survey except for activities associated with maintaining the camp.	Section 7
61	Personnel will inspect vehicles daily and remove vegetation build-up around the belly plates and exhaust systems of vehicles: <ul style="list-style-type: none"> • At each hygiene check point. • As part of the daily vehicle pre-start inspection. 	Section 7
62	The Chief Bushfire Control Officer from the Shire of Dandaragan will conduct an inspection at mobilisation.	Section 7
63	Every vehicle directly involved in the seismic survey will carry: <ul style="list-style-type: none"> • A rake to assist in suppressing a small fire if it occurs. • A 9 kg pressurised water fire extinguisher applicable to scrub fires. 	Section 7
64	Each Vibroseis truck will carry two 2 kg fire extinguishers.	Section 7
65	Two (2) Light Tankers equipped with 800 L tank and petrol driven pump will be stationed proximal to the daily seismic crew activities and a 12,000 L fire tender will be stationed on site, complete with: <ul style="list-style-type: none"> • A motor driven pump. • A fire fighting hose on a suitable hose reel fitted with an approved nozzle (minimum length 50 m). 	Section 7
66	The 12,000 L fire truck will be backed up by two fast attack vehicles equipped with a high pressure pump. These vehicles will be deployed central to seismic activities to best minimise response time.	Section 7

Table 9.1 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Bushfire Prevention and Management (cont'd)		
67	All fire-fighting equipment will be maintained in good working order, including full water levels, and all personnel will be trained in the use of this equipment and notified of nearby available sources of water.	Section 7
Rehabilitation		
68	Closure of seismic lines will occur as soon as practicable, not later than two weeks after the last required use of the seismic line.	Section 6.5 Appendix A6
69	On completion of the survey, the campsite and all associated infrastructure will be removed.	Section 3.4 Appendix A6
70	Wastes produced by the survey activities will be disposed of in accordance with relevant regulations as outlined in Section A4.4.2 of Appendix A4.	Appendix A4
71	All drill collars, steel pegs and other drilling and seismic materials will be removed from the seismic lines, drill sites and camp site.	Appendix A6
72	The time between clearing of the seismic survey lines and rehabilitation will be minimised to limit the time of exposure to the elements of the cleared survey lines.	Section 6.5 Appendix A6
73	A post-survey inspection will be carried out to determine if there is any need for active rehabilitation.	Appendix A6
74	Post survey inspection will identify any compaction or rutting and initiate active rehabilitation of these areas.	Section 6.5 Appendix A6
75	Permanent monitoring quadrats will be established in key locations to allow for assessment of rehabilitation success against the completion criteria.	Appendix A6
76	Quadrats will be surveyed within six months, after the winter rain, following completion of the seismic survey and then annually for at least three years or until completion criteria are achieved, whichever is longer.	Appendix A6
77	Monitoring will be conducted by a qualified botanist using a quadrat based assessment and will consider: <ul style="list-style-type: none"> • Percentage cover and distribution of declared and environmental weeds. • Total vegetation percentage cover. • The presence of keystone flora species. • Any evidence of erosion, soil compaction and disruptions to surface water drainage. • Any evidence of <i>P.cinnamoni</i> introduction to seismic lines. • Any evidence of third party access to the seismic lines that were not already on established tracks. 	Appendix A6
78	The period surfaces are exposed will be minimised by prompt closure of the seismic lines and worksites at the completion of construction.	Section 6.5 Appendix A6
79	The results of monitoring will be reported annually.	Appendix A6
80	After two years the progress of rehabilitation will be assessed and, if monitoring identifies poorly rehabilitation seismic lines, appropriate contingency actions will be implemented.	Section 6.5 Appendix A6

Table 9.1 Summary of Environmental Commitments (cont'd)

No.	Commitment	ARI Reference
Aboriginal Heritage		
81	A heritage survey of the project area will be conducted prior to the commencement of the project by a suitably qualified person, in consultation with the Yued people. All known Aboriginal heritage sites will be avoided.	Appendix A5 Section 6.5
82	In the event that any archaeological material, including human skeletal material is uncovered as a result of line preparation, all work in the area will stop immediately and the discovery will be immediately reported to the relevant authorities.	Appendix A5
83	All personnel involved in the project will be inducted in Aboriginal heritage management procedures and provided with information for identifying heritage artefacts so as to prevent unintentional damage.	Section 6.5 Appendix A5
Stakeholder and Social Impacts		
84	Landholders will be consulted regarding the timing of operations and every effort will be made to conduct operations so that disturbance to normal farming practices is minimised	Section 6.5 Appendix A5
85	An access agreement will be made with the Mimigarra Pastoral Company once the timing of the survey is known.	Section 3.1 Appendix A5
86	Any damaged infrastructure will be reinstated to its prior condition (as a minimum) in consultation with the asset owner.	Section 6.5 Appendix A5
87	Erect appropriate access barriers (e.g. temporary fencing) and warning signs, as necessary.	Section 6.5 Appendix A5
88	Liaison with landholders prior to, during and on completion of seismic program.	Section 6.5 Appendix A5
89	Liaise with the landholder to make appropriate arrangements to minimise disruption.	Section 6.5 Appendix A5
90	Any damage to property will be rectified as soon as possible.	Section 6.5 Appendix A5
91	Consultation with relevant utility authorities and site inspection will be undertaken for the early identification of existing buried cables, pipes, water mains and other infrastructure.	Section 6.5 Appendix A5
92	Empire Oil will contact all apiary permit holders within the Mullering 3D Onshore Seismic Survey project area prior to conducting the survey to inform them of the project and consult on ways to minimise interruption to their operations.	Appendix A5
93	Temporary fencing/gates will be installed at any location where it is necessary to remove fences or gates.	Section 6.5 Appendix A5
94	Temporary fencing will be removed and permanent fencing re-instated.	Section 6.5 Appendix A5
95	All fences and farm infrastructure will be returned to pre-survey conditions as agreed with the lease holder and appropriate compensation agreements negotiated.	Section 6.5 Appendix A5
General		
96	Upholes plugged and backfilled to an appropriate depth to prevent collapse and avoid hazard.	Section 6.5
97	All source and receiver lines will be prepared in accordance with the recommendations of Woodman Environmental Consulting 2006.	Appendix A1

10. References

- Bancroft, W. and Bamford, M. 2006. Fauna values of Empire Oil's Mullering prospect EP 432. Report prepared by W. Bancroft and M Bamford of M.J. and A.R. Bamford Consulting Ecologists, Kingsley, WA, for Woodman Environmental Consulting, Applecross, WA.
- Beard, J. S. 1979. The Vegetation of the Moora and Hill River Areas, Western Australia. Map and Explanatory Memoir, 1: 250 000 series. Published by Vegmap Publications, Perth.
- Beard, J. S. 1981. Vegetation Survey of Western Australia, Swan 1:1 000 000. Map and Explanatory Notes to Sheet 7. Published by University of Western Australia Press, Perth.
- Beard, J. S. 1990. Plant Life of Western Australia. Published by Kangaroo Press, NSW.
- Bureau of Meteorology, Western Australia. 2005. Climate Averages for Australian Sites – Lancelin. www.bom.gov.au/climate. Sourced September, 2005
- Department of Environment and Heritage. 2005. Interim Biogeographic Regionalisation for Australia (version 5.1), Western Australia. <http://www.deh.gov.au/parks/nrs/libra/version5-1/wa.html>
- DEH. 2006. Sites on the Australian Heritage Database. 12 September 2005. Department of the Environment and Heritage, Canberra, ACT.
- Department of Planning and Urban Development. 1994. Central Coast Regional Profile. Published by the Department of Planning and Urban Development, Perth.
- Griffin, E. A., and Keighery, B. J. 1989. Moore River to Jurien Sandplain Survey. Published by the Western Australian Wildflower Society Inc., Nedlands WA.
- Griffin, E.A. 1994. Floristic Survey of Northern Sandplains between Perth and Geraldton. Resource Management Technical Report 144. Department of Agriculture, WA.
- Gulliver Productions Pty Ltd. 2004. Exploration Permit EP-432, Application for Approval to Conduct the Mullering Onshore 3D Seismic Survey, December 2004. Unpublished report prepared for the Department of Industry and Resources, Petroleum Division
- Landcare Services. 2002. Regional Priority and DRF Survey for the Cooljarloo Mine site 2000-2002. Unpublished report prepared for Tiwest Joint Venture.
- Northern Agricultural Catchments Council Inc (NACC). 2002. West Midlands hydrological project stage one report: The impacts of hydrological issues on biodiversity and agriculture in the West Midlands region. Prepared by Earth Tech, Melbourne
- Podger F.D., James S.H. and Mulcahy M.J. 1996. Review of Dieback in Western Australia: report to the Western Australian Minister for the Environment. Report prepared by the Western Australian Dieback Review Panel.

Standards Australia. 1999. AS/NZS 4360:1999. Risk Management. Standards Association of Australia. N.S.W.

Tiwest Pty Ltd. 1999. Cooljarloo Mine Mining of Titanium Minerals Orebodies 27 200 and 28 000 Public Environmental Review. Unpublished report to the Environmental Protection Authority.

Tiwest Pty Ltd. 2001. Soil and Vegetation Assessment Preliminary Figures. Unpublished Report.

Woodman Environmental Consulting. 2002. Keystone Species for Main Rehabilitation Vegetation Types at Cooljarloo. Unpublished report prepared for Tiwest Joint Venture.

Woodman Environmental Consulting. 2006. Mullering Onshore 3D Seismic Survey: flora, vegetation and *Phytophthora cinnamomi* assessment. Unpublished report prepared for Empire Oil Company (WA) Ltd, Nedlands, Western Australia.