Amy 2D Seismic Survey 2013

ENVIRONMENTAL MANAGEMENT PLAN

SUMMARY

PetroFrontier
Level 1, 262 Franklin Street
ADELAIDE SA 5000
08 8104 3250

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1. INTRODUCTION

PetroFrontier Corp. is a publicly listed Canadian company focused on exploring and developing petroleum resources in the Georgina Basin in the Northern Territory. PetroFrontier Corp. operates in Australia through its wholly owned subsidiary, PetroFrontier (Australia) Pty Ltd (collectively referred to as PFC). PFC is the custodian of the EMP and has overall responsibility for its implementation.

PFC Corporate Environmental Policy

PFC undertakes all operations with a commitment to health, safety and environmental management. PFC adopts specific procedures to minimise the impact of the project on the local environment. The key environmental objectives are:

- Minimise the total area of disturbance.
- Maximise the use of existing tracks, existing seismic lines and firebreaks for access.
- Minimise the potential for the introduction of weeds.
- Avoid disturbance to significant habitat.
- Avoid clearing trees where possible.
- Minimise soil damage by operating during dry season and using dust abatement techniques if required.
- Avoid sensitive sites, such as areas prone to erosion, where possible.
- Minimise the risk of fire.
- Minimise any adverse effects on amenity.
- Prevent land and water contamination; and
- Promote effective rehabilitation of disturbed areas.

Overview

PFC will run regional seismic lines within exploration permits (EPs) 103, 104, 127 and 128 in the Southern Georgina Basin. The survey will build upon seismic data collected in 2009 by Texalta Australia Pty Ltd, in 2010 by Georgina Basin Energy Pty Ltd and in 2011 by PFC. The proposed seven seismic lines will mainly be on existing highways and roads with a minor amount of clearing of tracks in EPs 127, 128 and 104. The survey will be conducted in the Sandover and Plenty Rivers region approximately between 180km and 440km north-east of Alice Springs.

The seismic program is scheduled to commence in July 2013. Environmental, heritage and Traditional Owner clearances were undertaken in July 2012 with environmental information updated to May 2013.

Table 1: Seismic Survey Data Sheet

Element	Description
Type of survey	2D seismic
Commencement of line preparation	Mid-July 2013
Timing of survey	July-August 2013
Maximum duration of survey	Preparatory work ~10 days Survey 38 days Demobilisation ~ 2 days Rehabilitation – until completion criteria achieved
Total length of seismic lines (line kilometres)	Approximately 385 km
Maximum width of line	4.5 m, blade up wherever possible Note: some 'turning areas' or 'passing areas' (up to 5 m × 5 m) will be required to reduce the requirement for connecting tracks, facilitate avoidance of environmental constraints and allow for exceptional circumstances (e.g. tyre repairs)
Number of data acquisition holes (up-holes) required	Not needed on this survey
Plant and equipment details for survey	Trailer camp (including office, mess and accommodation) Three truck-mounted source vehicles Up to 12 vehicles operating at any one time
Camp(s) area	50 m x 50 m
Approximate number of persons involved	~37 personnel including any sub-contractors
Operation hours	Daylight hours only, 7 days/week

2. LOCATION

The seismic survey will take place on: Annitowa, Argadargada, Georgina Downs, Lake Nash, Lucy Creek, Manners Creek, Marqua and Tarlton Downs Pastoral properties. The area is accessible via the Plenty and Sandover Highways and there are a number of station tracks that allow access to the proposed seismic lines.

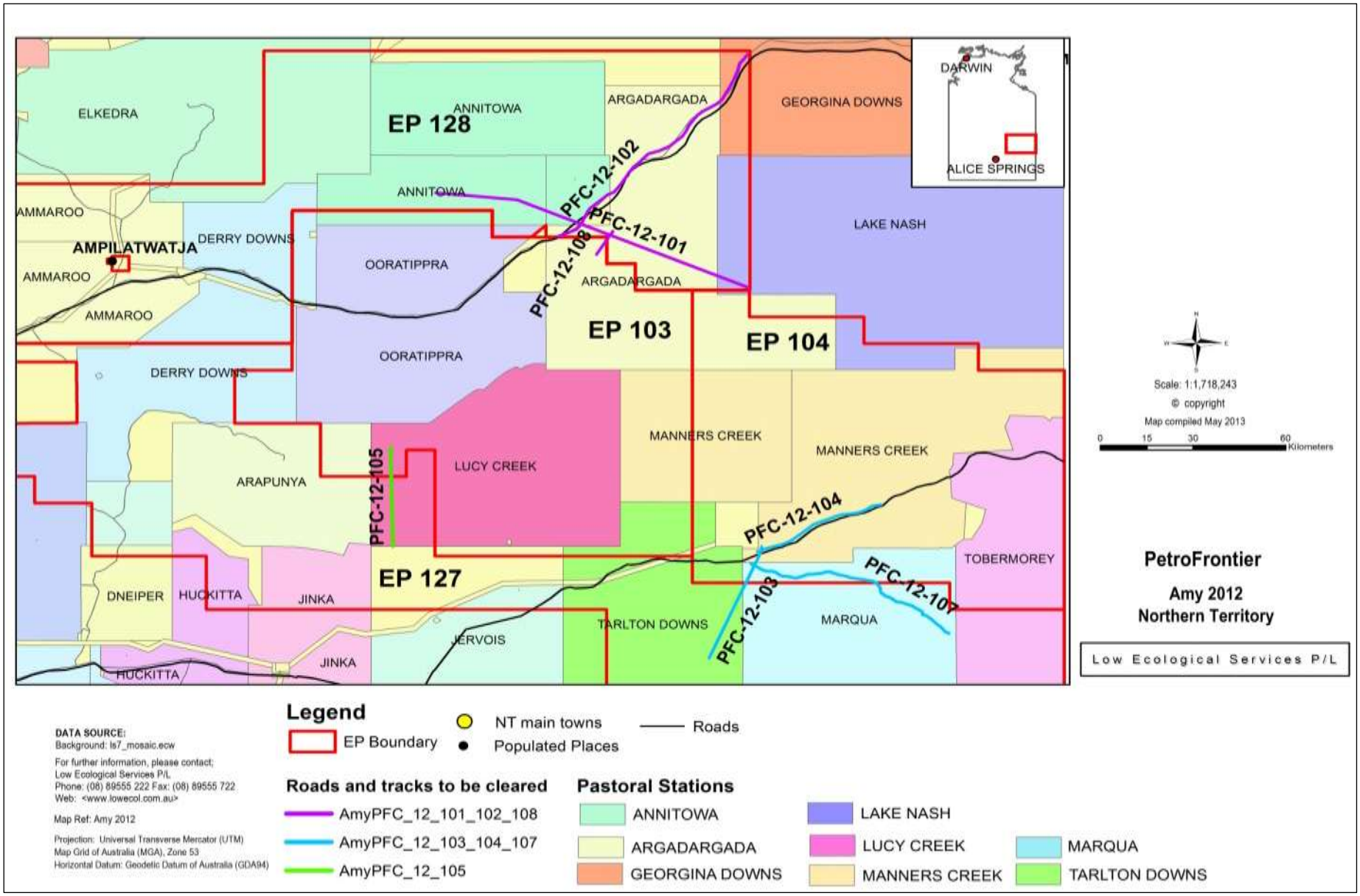

Figure 1 – Pastoral stations and planned seismic lines

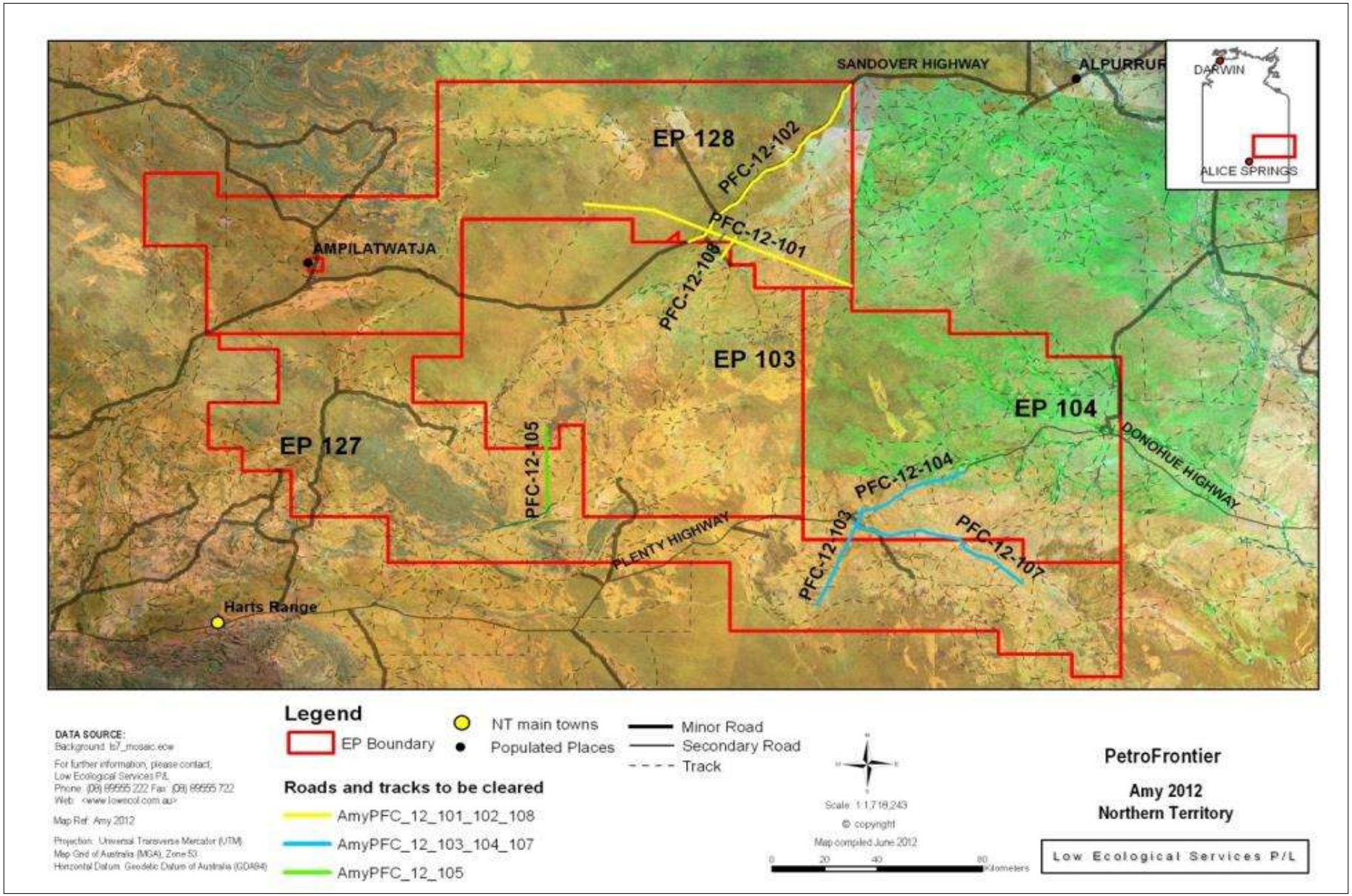

Figure 2 - Location of seismic lines which will mainly run along roads, tracks and cleared lines where available or permitted

Table 2: Seismic line length within each EP

EP	line ID	total length (km) of seismic line in EP
EP103:	12-105	8.45
EP103:	12-108	5.88
Total EP 103		14.33
EP104:	12-104	41.22
EP104:	12-103	13.50
EP104:	12-107	39.85
Total EP 104		94.57
EP127:	12-103	28.35
EP127:	12-107	29.42
EP127:	12-105	25.49
Total EP 127		83.26
EP128:	12-102	89.23
EP128:	12-108	3.33
EP128:	12-101	100.94
Total EP 128		193.51
Total		385.66

3. ACTIVITY

The EMP includes all operational activities for the seismic survey. The key activities include:

- Establishing a minimal environmental impact camp using temporary trailer camp(s).
- Preparing survey lines (access track, line surveying and line preparation). Access on Argadargada Station will be on seismic lines and not via station tracks. Access on other properties will be station tracks, seismic lines or highway.
- Acquiring data (surface seismic acquisition); and,
- Demobilising, rehabilitating seismic lines and ongoing monitoring to ensure successful rehabilitation.

4. ENVIRONMENT DESCRIPTION

Bioregion description

The seismic lines lie within the Channel Country, the Mitchell Grass Downs and the Tanami bioregions.

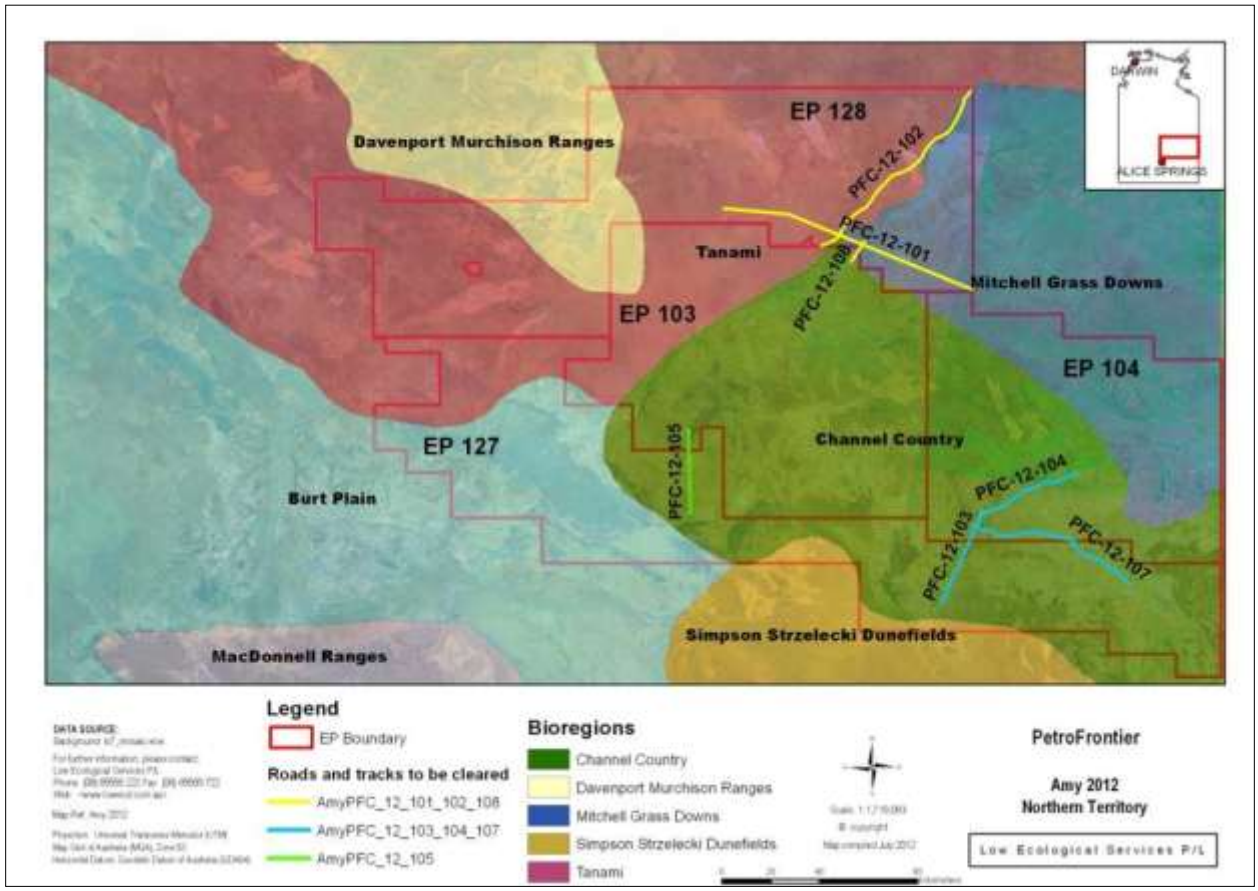

Figure 3: Bioregions

Channel Country is described as "extensive gidgee (*Acacia georginae*) plains and rolling hills (which) characterise the NT part of this bioregion. Elevation is between 180 m and 400 m, with minor relief provided by the Tarlton and Toko Ranges. Vegetation is predominantly spinifex grassland and acacia tall open-shrubland, with occasional large bluebush (*Chenopodium auricomum*) swamps" (Baker et al. 2005).

The Tanami bioregion comprises mainly red Quaternary sandplains overlying Permian and Proterozoic strata which are exposed locally as hills and ranges. The sandplains support mixed shrub steppes of *Hakea suburea*, desert bloodwoods, acacias and grevilleas over *Triodia pungens* hummock grasslands. Acacia shrublands over hummock grass communities occur on the ranges. Alluvail and lacustrine calcareous deposits occur throughout. In the north they are associated with Sturt Creek drainage and support *Chrysopogon* and *Iseilema* short-grasslands often as savannas with River Gum. In the south, the saline alluvia of Lake Mackay support Samphire low shrubland and *Melaleuca lasiandra* - M. glomerata shrublands. Arid tropical with summer rain.

A fraction of the lines lie within the Mitchell Grass Downs bioregion. The bioregion is described as "Georgina and Dunmurra Basins containing sedimentary rocks of Cretaceous, Tertiary and Cambrian ages and soils are predominantly cracking clays. The vegetation is predominantly *Eucalyptus microtheca* low open-woodland with bluebush (*Chenopodium auricomum*) sparse shrubland understorey, and

Mitchell grass (*Astrebla*) grassland on the Barkly Tableland. The southern section contains gidgee (*Acacia georginae*) low open woodland with *Astrebla* open grassland understorey. Drainage in the tableland is complex, with a number of short creeks and rivers flowing toward several large seasonal lakes, while the Rankin and Georgina Rivers flow southeast of the bioregion" (Baker et al. 2005). No lakes occur in the region of the proposed seismic line although the line does cross over numerous small areas of cracking clay flats which can remain flooded for extended periods after rain. In the current year, 2013, minimal rain has fallen during the wet season and the cracking clay plains are in a state of drought.

There are no Sites of Botanical Significance (SOBS) along the lines. SOBS are determined by the NT Government Department of Land Resource Management (DLRM) Parks and Conservation Masterplan.

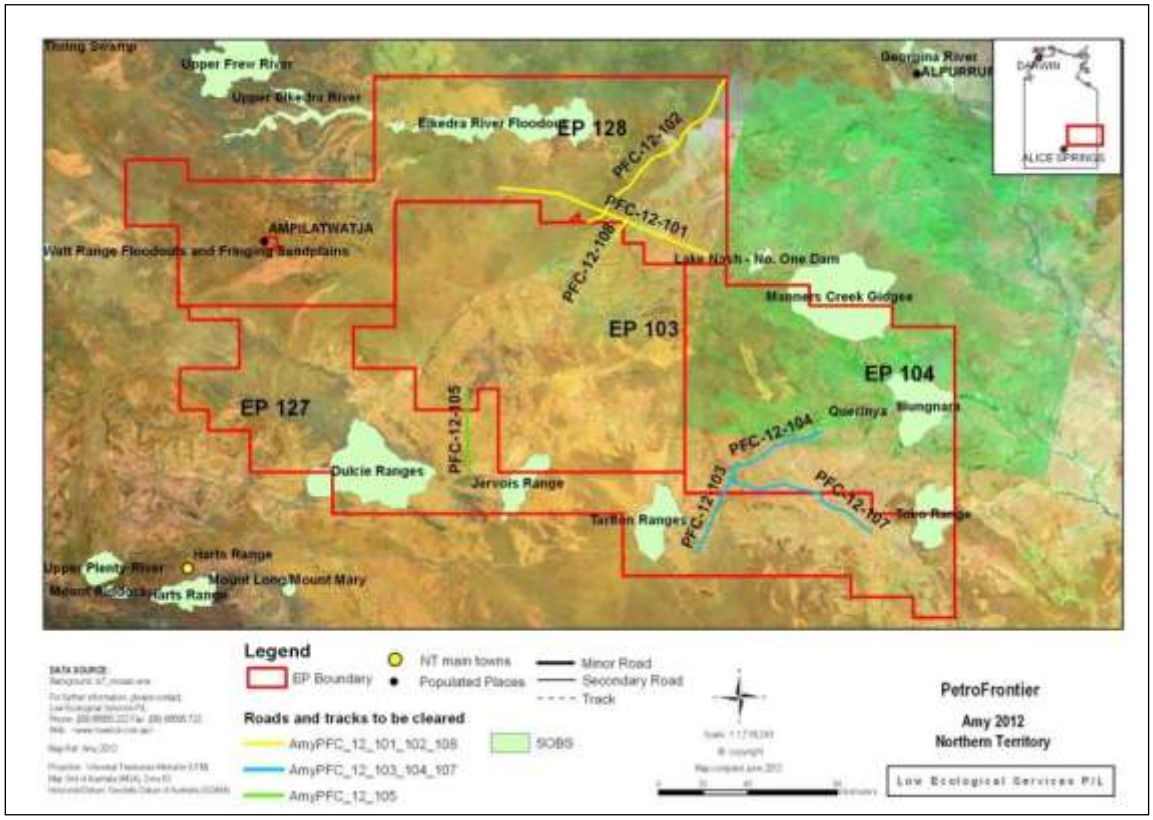

Figure 4: SOBS

Hydrology

The line PFC-12-101 crosses the floodout of the Sandover River. Minor drainage channels and drainage depressions are within the vicinity of the proposed seismic lines. These are non-permanent and rely on above average local rain events or floods from the Sandover catchment for surface water to be present.

The drainage lines appearing on the map below are based on the background map and they are derived from NT Government's shape files. Shallow drainage depressions are shown by vegetation patterns in the Sandover floodout. All water courses in the area are ephemeral. The crossing of the Sandover river bed, normally dry, may require special attention. The lines must be positioned at least 50 – 100 m distant from any important ephemeral water courses. Crossing points should be positioned away from surface water holes that might be present.

Rainfall conditions during 2012-2013 were very dry and the Sandover floodout will therefore be dry during the June-July survey.

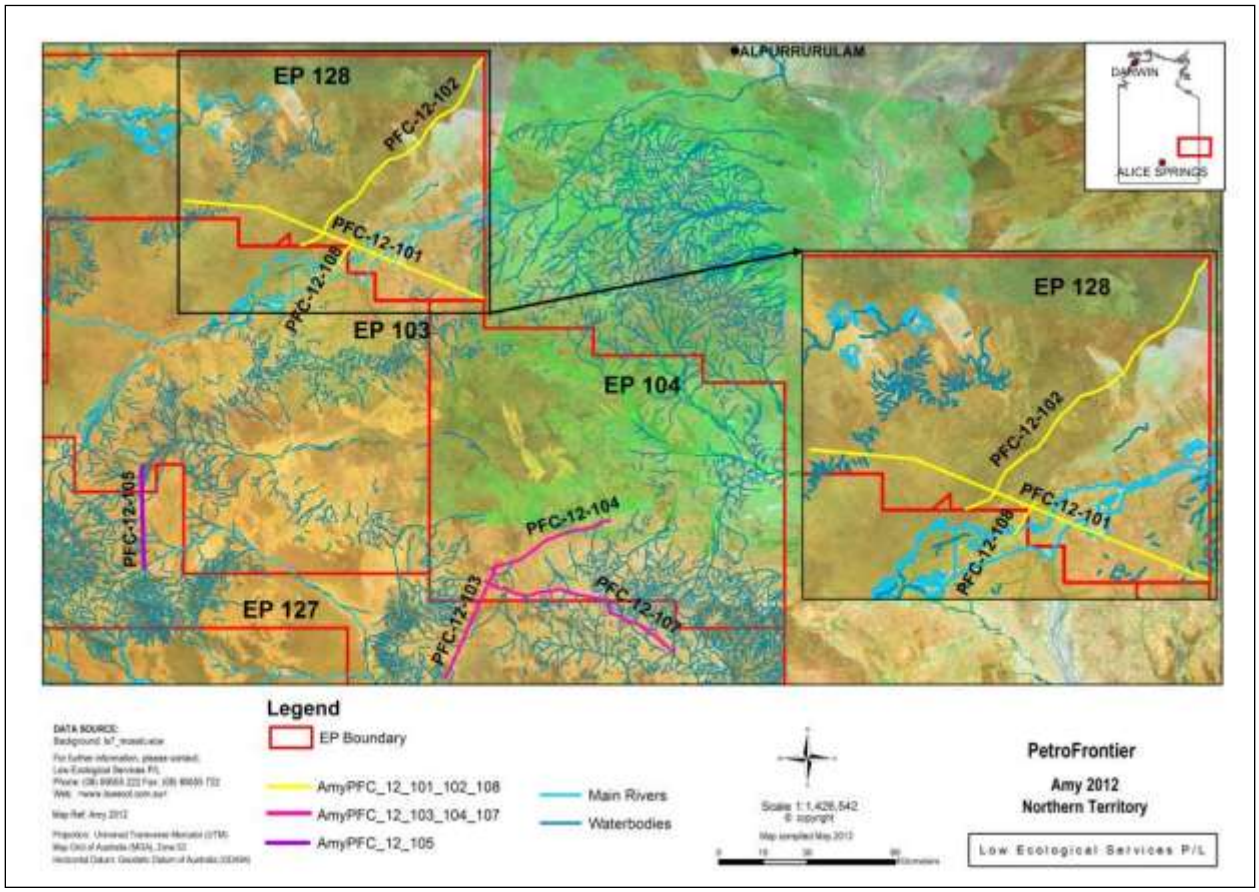

Figure 5: Hydrology for PFC-12-101-102-108, PFC-12-105, PFC-12-103-104-107.

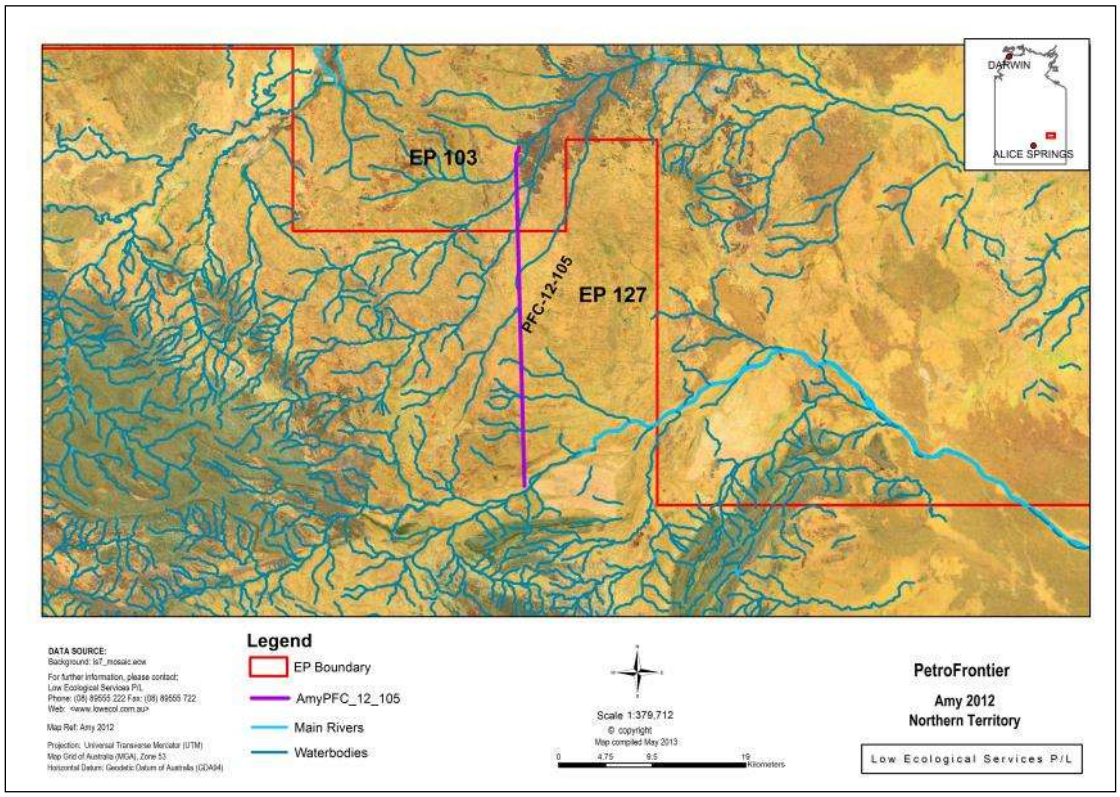

Figure 6: Hydrology for PFC-12-105.

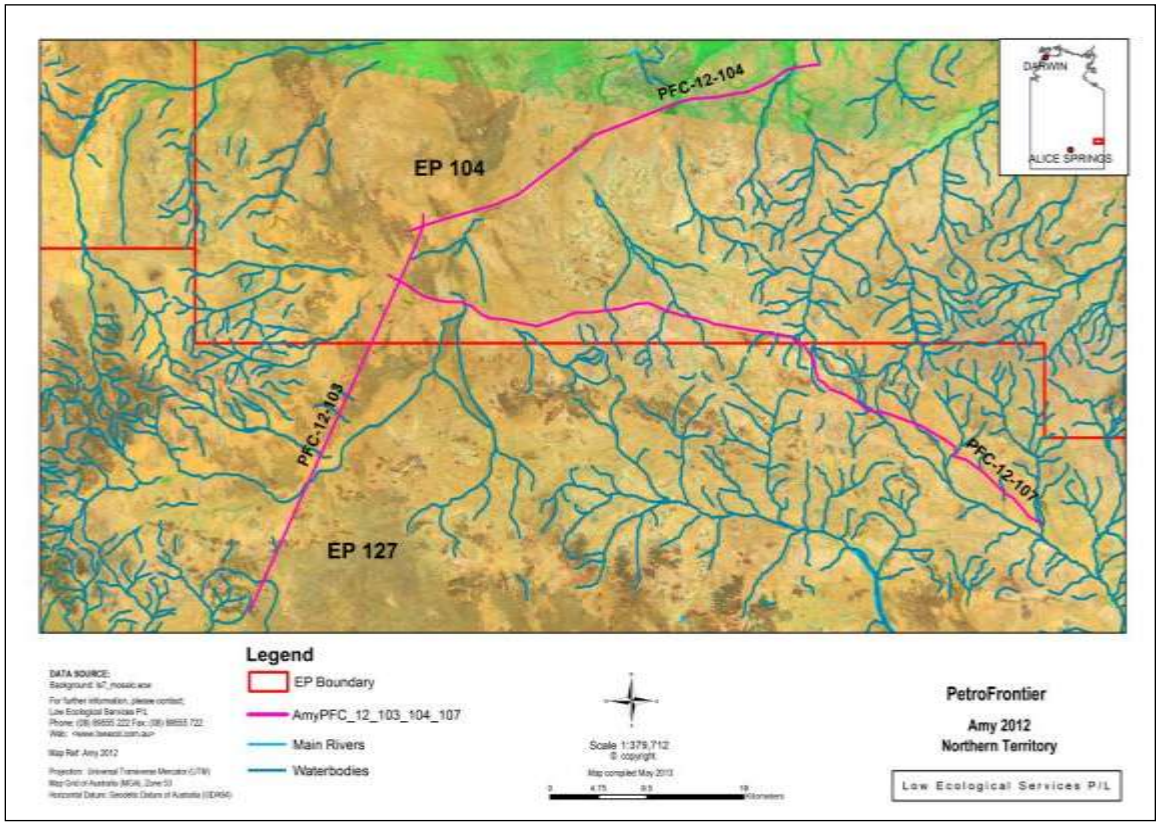

Figure 7: Hydrology for PFC-12-103-104-107.

Soils

The Digital Atlas of Australian Soils (Australian Soil Resource Information System 1991) shows the soil types intersected by the proposed lines.

The PFC-12-101-102-108 roads intersect soil types:

- AB31 Flat to gently undulating sand plains with some low broad sand rises and intervening swales; some small alluvial flats; some clay pans; and some stone-covered ridges: chief soils are red earthy sands on the plains and swales. Associated are red siliceous sands on the sand rises. Small areas of sandy red earths occur on the plains, in the swales, and on the alluvial flats. Other soils include shallow (< 12 in.) stony red loose siliceous sands on the stone-covered ridges.
- BA42 Rugged mountain ridges, plateaux, and low hilly areas on limestone, dolomite, calcareous sandstones, siltstones, and sandstones; narrow valleys; some small plains; extensive rock outcrop: chief soils are shallow stony siliceous and calcareous sands and earthy loams. Small areas of other soils, notably red sands with coherent earthy subsoils and calcareous soils, may occur in areas of gentler relief. Small areas of unit My128 are included in eastern portions of this unit.
- CC60 Flat to gently undulating plains with widely spaced narrow drainage-ways, low gravelly (chert) rises with variable gilgai development, some shallow depressions, some stony rises, the proportion of which varies locally: chief soils are deep grey clays such as (Ug5.24, Ug5.25). Other soils include (Uf6.33) on gravel covered calcareous rises and possibly small areas of (Ug5.3) soils along the southern margins of the unit. Small areas of units My80 and II6 of Sheet 8 and II9 may be included locally.
- CC76 Plains with broad shallow depressions, some drainage-ways with narrow levees: chief soils are deep grey and brown clays (Ug5.24, Ug5.25) and (Ug5.34), often in gilgai complex with (Dy2.13, Dy2.12) soils. Other soils may occur. As mapped, small residual islands of unit My128 are included.
- My125 Flood-out plains, levees, and sand banks: chief soils are probably neutral red earths and red earthy sands. Associated are a variety of soils including red a brown duplex and mottled soils on flood-plain areas; grey and brown cracking clays in depressions; and sandy soils on levees and sand banks.
- My126 Gently undulating sandy plain with some limestone ridges: dominant soils are sandy neutral red earths. Other soils include grey, brown and red cracking clays in depressions; and firm calcareous sands, powdery calcareous loams, and calcareous earths on the ridges. Small areas of units II13 and Lh2 are included
- My127 Gently undulating sandy plains: chief soils are neutral red earths and red earthy sands. Other soils are likely also.
- Mx30 Plains on dolomite, limestone, and shale: chief soils are alkaline and neutral red earths (Gn2.13, Gn2.12). Associated locally are (Uc1.3), (Um5.11), and (Gc1.22) soils.

The PFC-12-103-104-107 lines intersect soil types:

- BA42 Rugged mountain ridges, plateaux, and low hilly areas on limestone, dolomite, calcareous sandstones, siltstones, and sandstones; narrow valleys; some small plains; extensive rock outcrop: chief soils are shallow stony siliceous and calcareous sands and earthy loams. Small areas of other soils, notably red sands with coherent earthy subsoils and calcareous soils, may occur in areas of gentler relief. Small areas of unit My128 are included in eastern portions of this unit.
- Fd1 Undulating limestone ridges, usually with broad crests and long gentle slopes; in some areas low benched scarps occur; outcrop is common: dominant soils are shallow gravelly calcareous loams, with other similar but looser, more powdery or friable shallow gravelly calcareous loams associated. In lower sites shallow to moderately deep loamy calcareous earths are common.
- My128 Sandy plains: chief soils are neutral and alkaline red earths with areas of red sands with coherent earthy subsoils. There are scattered limestone ridges of unit BA42 in the western portion and unit Fd1 in the eastern portion.
- My131 Plains with some mesas and buttes: chief soils are neutral red earths (Gn2.12) and red earthy sands (Uc5.21). Associated are mesas and buttes of unit Fc2 and small hilly areas similar to unit BA43. Other soils include (Dr) soils on pediments of the mesas and (Uc1.23) on dunes .
- Oc78 Undulating very low dissected plateaux or broadly undulating ridges; surface soil is usually strewn with chert gravel: dominant are thin-surfaced loamy red duplex soils. Adjacent to more calcareous outcrops are shallow calcareous loams , both powdery and firm. On some slopes there are small areas of red calcareous earths, and in broad valley floors are loamy red earths or occasionally deep red sands. Data are fairly limited.
- Ld2 Undulating or occasionally level low limestone plateaux, the margins of the unit are usually scarped and have much silicified limestone outcrop; the soil surface throughout the unit is usually strewn with chalcedony and silicified limestone gravel: dominant soils are shallow to moderately deep gravelly brown calcareous earths (Gc1.22), with lesser (Gc2.22) and (Gc1.12). In parts of the unit, moderately deep to deep loamy red earths (Gn2.13) occur. Adjacent to limestone outcrop, shallow gravelly calcareous loams (Um1.3), (Um5.11), and (Um5.61) are common.

The PFC-12-105 line intersects soil class

- BA44 Broken terrain on dolomite, limestone, shale, and sandstone; rock outcrop is common: chief soils are loose and firm shallow stony sands, with some deeper firm siliceous sands. Associated are red non-calcareous earths, red sands with coherent earthy substrates and calcerous earth soils in valley areas. Inclusions of unit BA45 are likely.

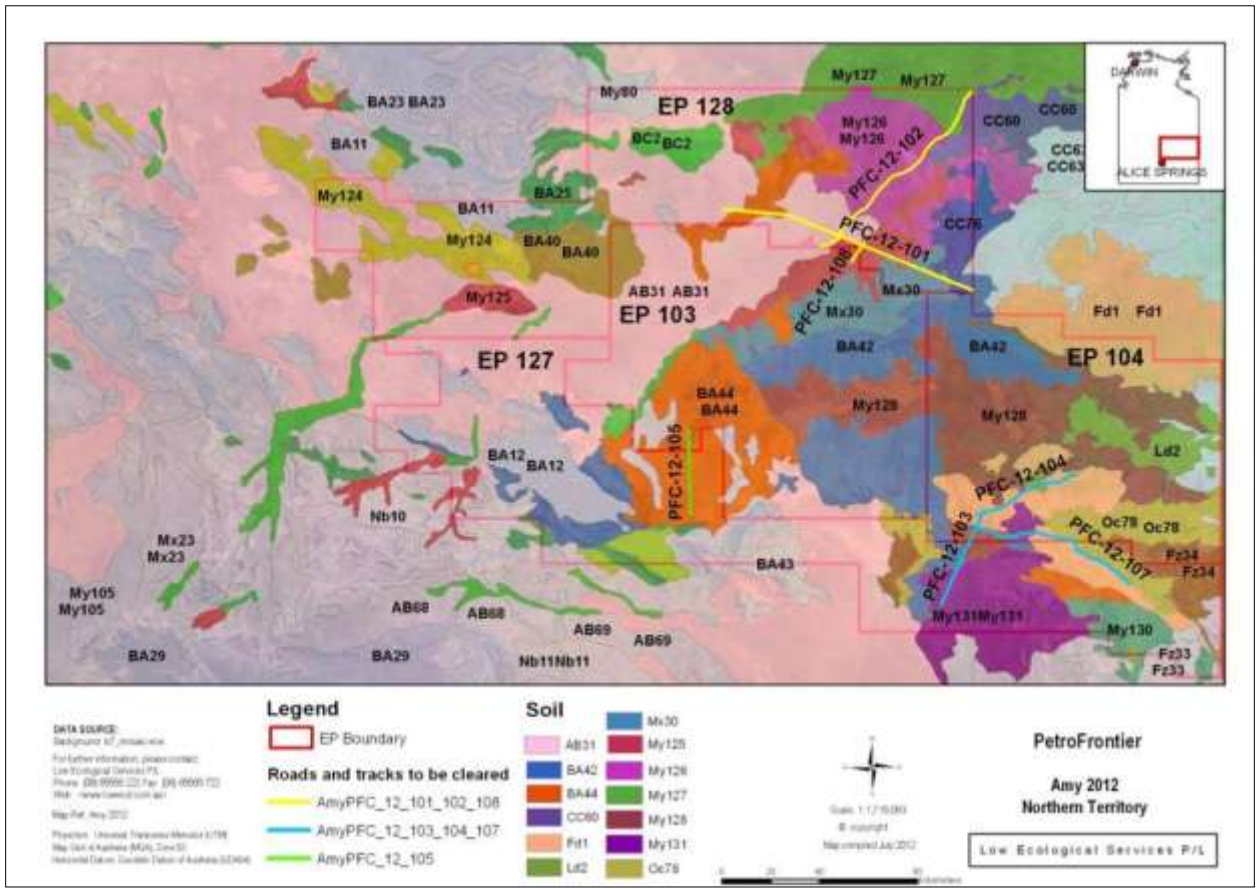

Figure 8: Layout of the seismic survey in relation to The Digital Atlas of Australian Soils (Australia Soil Resource Information System 1991).

Flora and Vegetation

Northern Territory vegetation classes have been mapped and described by at a scale of 1:1,000,000 by Wilson (1991).

The PFC-12-101-102-108 lines intersect vegetation classes:

- Class 62 *Acacia georginae* (Giddier) low open-woodland with *Astrebla pectinata* (Bull Mitchell Grass) open-grassland understorey.
- Class 71 *A. aneura* (Mulga) tall sparse-shrubland with grassland understorey.
- Class 76 *Triodia pungens* (Soft Spinifex), *Triodia schinzii* (Curly Spinifex) hummock grassland with *Acacia* tall sparse-shrubland overstorey.
- Class 84 *Triodia basedowii* (Hard Spinifex) hummock grassland with *Eucalyptus gamophylla* (Blue Mallee) tall sparse-shrubland overstorey.
- Class 96 *Astrebla pectinata* (Barley Mitchell grass) grassland.

The PFC-105 line intersects vegetation classes:

- Class 63 *A. georginae* (Gidyea) low open-woodland with open-grassland understorey.

- Class 68 *Acacia kempeana* (Witchetty Bush) *Acacia* tall open-shrubland with Cassia, *Eremophila* (Fuchsia) open-shrubland understorey.
- Class 71 *A. aneura* (Mulga) tall sparse-shrubland with grassland understorey.

The PFC-12-103_104_107 lines intersect vegetation classes:

- Class 63 *A. georginae* (Gidyea) low open-woodland with open-grassland understorey.
- Class 70 *A. aneura* (Mulga) tall sparse-shrubland with Cassia*, Eremophila* (Fuchsia) low sparse-shrubland understorey.
- Class 84 *Triodia basedowii* (Hard Spinifex) hummock grassland with *Eucalyptus gamophylla* (Blue Mallee) tall sparse-shrubland overstorey.

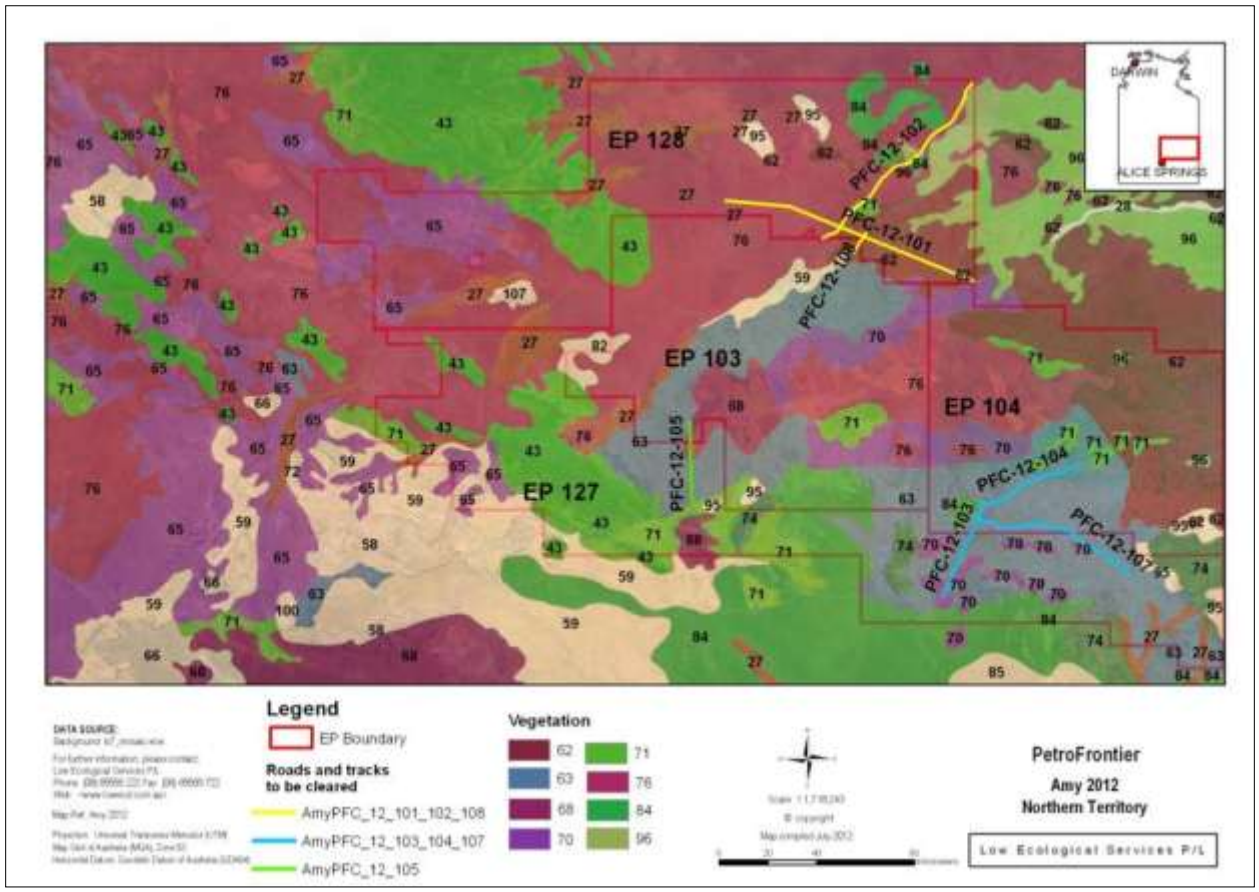

Figure 9: Layout of the seismic survey in relation to NT vegetation map (B. A. Wilson et al. 1991).

Flora – database searches

A protected matters search from Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) was performed on the 24th[th] May 2013. No flora species of conservation significance were identified in the Protected Matters search.

Searches of the NT Parks and Wildlife Flora Atlas, have been performed 20km either side of the seismic lines with flora of conservation significance. There are:

- 4 species are listed as endemic (*Alternanthera angustifolia var. lanata, Stemodia sp. Manners Creek, Sida sp. Hale River, Eremophila christophori)* and 14 species (*Cynodon dactylon var. dactylon, Malvastrum americanum, Portulaca pilosa subsp. Indeterminate, Salsola tragus subsp. Indeterminate,Tribulus terrestris, Chloris virgata, Datura ferox, Sida cordifolia, Cenchrus pennisetiformis, Cucumis myriocarpus, Digitaria ciliaris, Malva parviflora, Melia azedarach var. australasica, Salsola tragus subsp. grandiflora)* as exotic.

- 1 flora species within the roads and tracks identified as PFC-12-101-102-108 are listed as Near Threatened, 6 are listed as Data Deficient and 1 as Not Evaluated.

- 1 Near-Threatened flora species is listed within 20km from the road identified as PFC-12-105-106; 1 is listed as Data Deficient and 1 as Not Evaluated.

- 7 flora species within 20km from the road identified as PFC-12-103-104-107 are listed as Near Threatened, 3 are listed as Data Deficient and 3 as Not Evaluated.

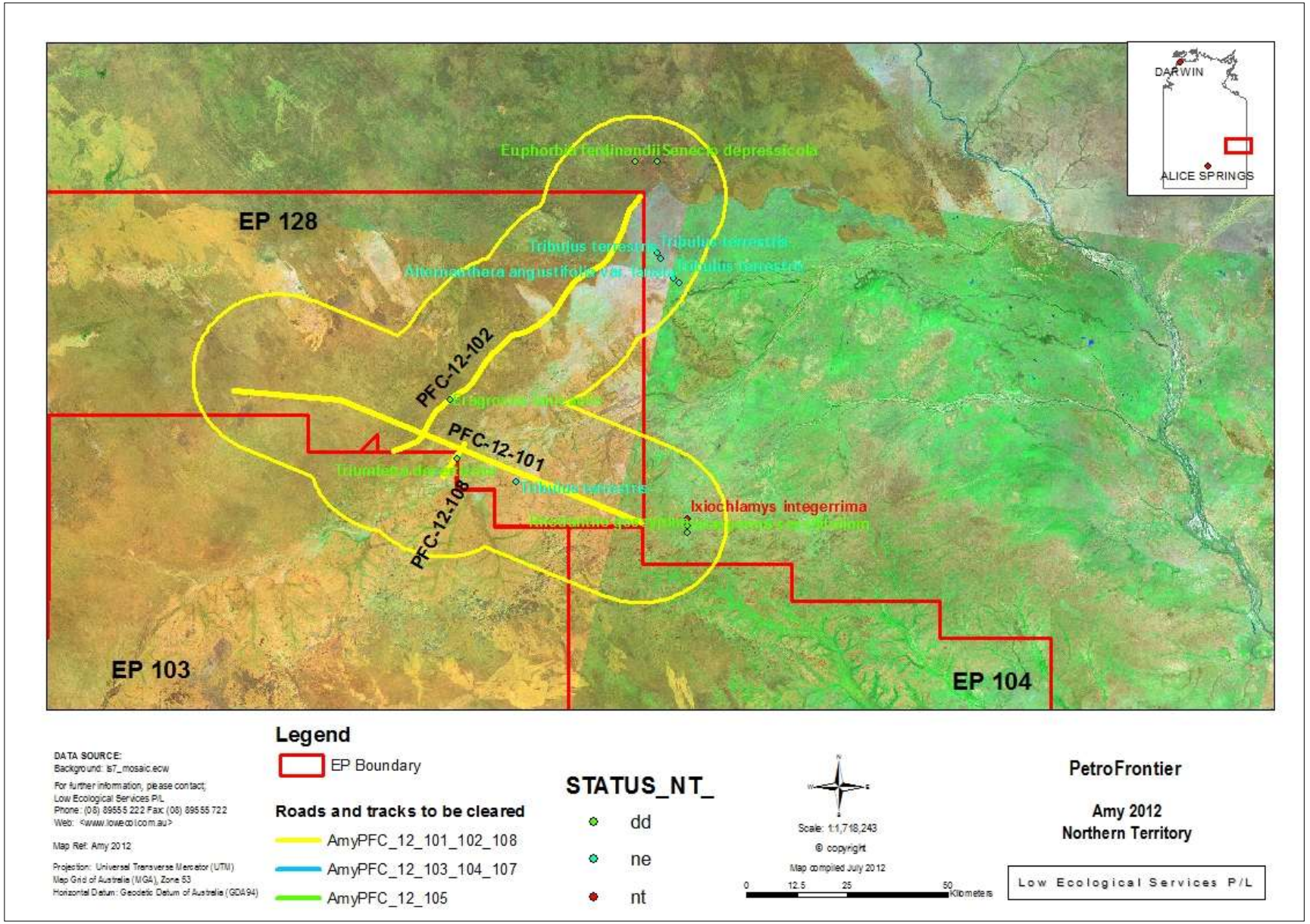

Figure 10: PFC-12-101-102-108 Flora of conservation significance from NT Parks and Wildlife Flora Atlas

DATE_	NAMEINFRA	FAMILY	STATUS_NT_	STATUS_COM	EXOTIC	ENDEMIC
1/05/1996	*Alternanthera angustifolia var. lanata*	AMARANTHACEAE	ne			2
21/09/1992	*Cynodon dactylon var. dactylon*	POACEAE			N	
28/03/1995	*Eragrostis lanicaulis*	POACEAE	dd			
23/09/1992	*Euphorbia ferdinandii*	EUPHORBIACEAE	dd			
30/08/1984	*Iotasperma sessilifolium*	ASTERACEAE	dd			
30/08/1984	*Ixiochlamys integerrima*	ASTERACEAE	nt			
	Malvastrum americanum	MALVACEAE			N	
1/05/1996	*Portulaca pilosa subsp. indeterminate*	PORTULACACEAE			N	
30/08/1984	*Rhodanthe gossypina*	ASTERACEAE	dd			
	Salsola tragus subsp. indeterminate	AMARANTHACEAE			N	
28/08/1984	*Senecio depressicola*	ASTERACEAE	dd			
1/09/1984	*Stemodia sp. Manners Creek (T.S.Henshall 1779)*	PLANTAGINACEAE	lc			1
24/10/1956	*Tribulus terrestris*	ZYGOPHYLLACEAE	ne		B	
9/08/1979	*Triumfetta deserticola*	MALVACEAE	dd			

Table 3: PFC-12-101-102-108 Flora of conservation significance from NT Parks and Wildlife Flora Atlas

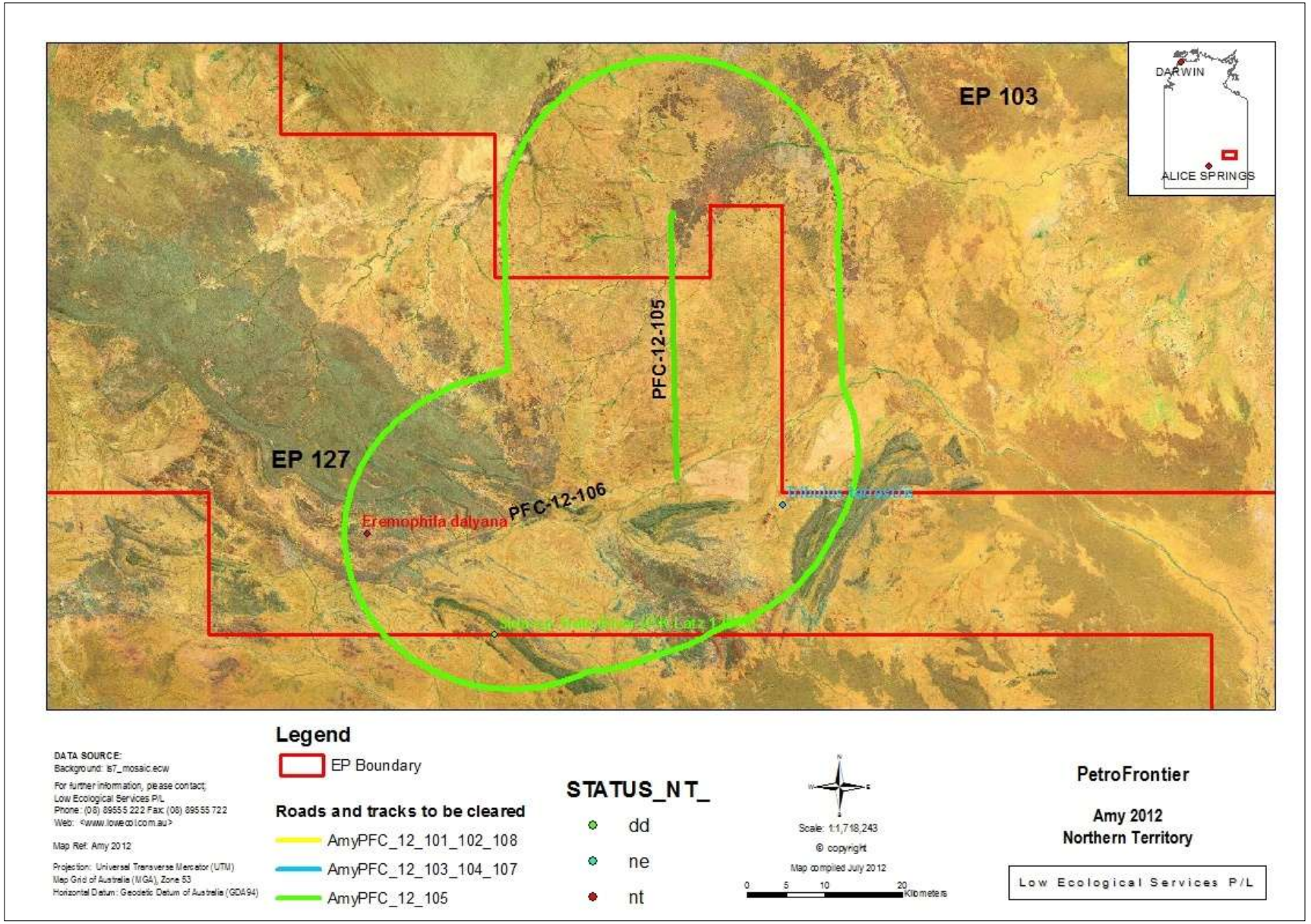

Figure 11: PFC-12-105 Flora of conservation significance from NT Parks and Wildlife Flora Atlas

DATE_	NAMEINFRA	FAMILY	STATUS_NT_	STATUS_COM	EXOTIC	ENDEMIC
6/06/1985	*Chloris virgata*	POACEAE			N	
26/08/2001	*Datura ferox*	SOLANACEAE			A	
6/09/1987	*Eremophila dalyana*	SCROPHULARIACEAE	nt			
6/06/1985	*Malvastrum americanum*	MALVACEAE			N	
6/06/1985	*Sida cordifolia*	MALVACEAE			B	
25/08/1999	*Sida sp. Hale River (P.K.Latz 12036)*	MALVACEAE	dd			1
6/06/1985	*Tribulus terrestris*	ZYGOPHYLLACEAE	ne		B	

Table 4: PFC-12-105 Flora of conservation significance from NT Parks and Wildlife Flora Atlas

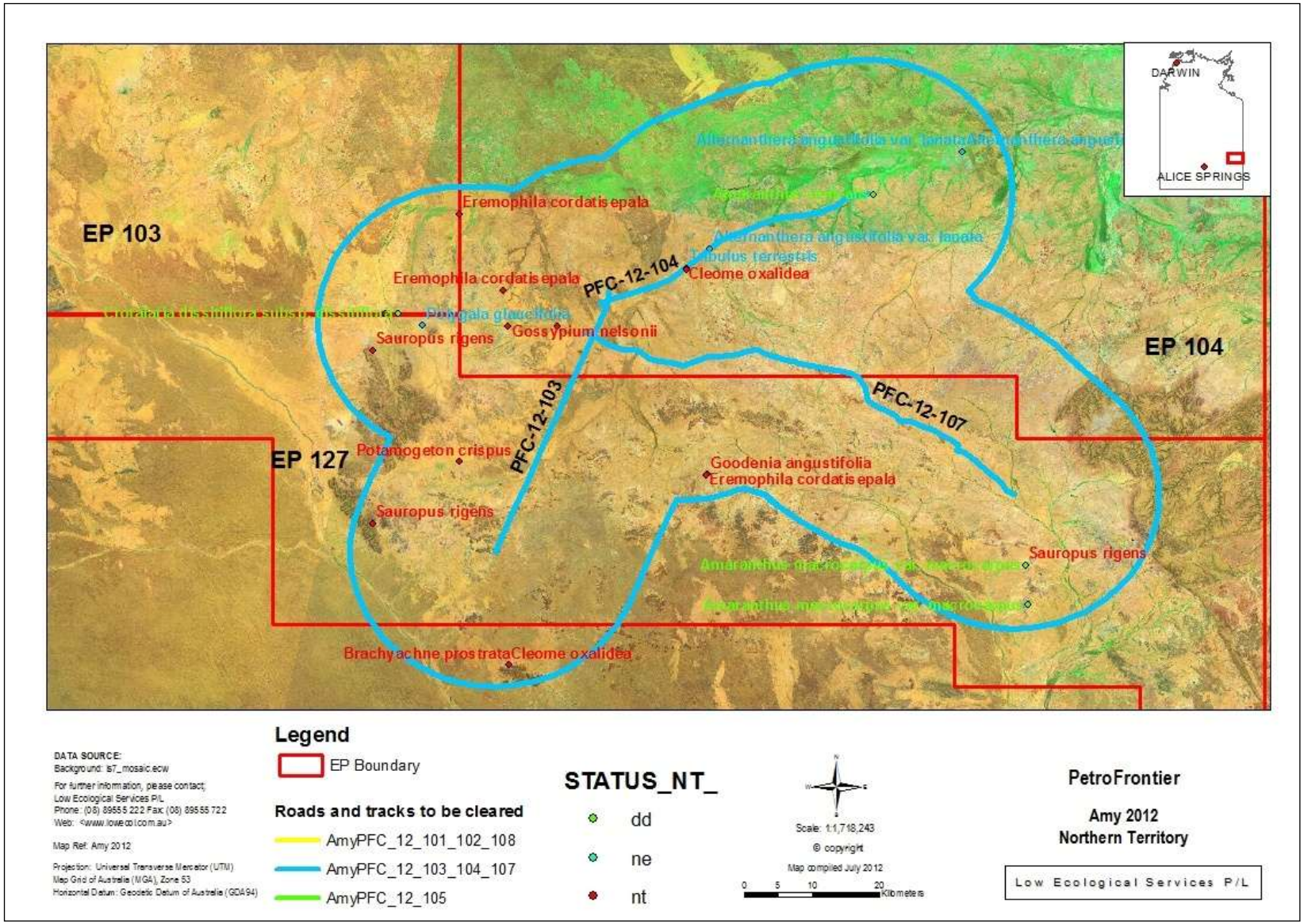

Figure 12: PFC-12-103-104-107 Flora of conservation significance from NT Parks and Wildlife Flora Atlas

DATE_	NAMEINFRA	FAMILY	STATUS_NT_	STATUS_COM	EXOTIC	ENDEMIC
25/08/2001	*Alternanthera angustifolia var. lanata*	AMARANTHACEAE	ne			2
24/04/2006	*Amaranthus centralis*	AMARANTHACEAE	dd			
17/04/2006	*Amaranthus macrocarpus var. macrocarpus*	AMARANTHACEAE	dd			
12/07/2007	*Brachyachne prostrata*	POACEAE	nt			
9/05/1955	*Cenchrus pennisetiformis*	POACEAE			N	
16/04/2006	*Chloris virgata*	POACEAE			N	
20/03/2010	*Cleome oxalidea*	CLEOMACEAE	nt			
11/02/1968	*Crotalaria dissitiflora subsp. dissitiflora*	FABACEAE	dd			
25/05/1972	*Cucumis myriocarpus*	CUCURBITACEAE			N	
22/08/2001	*Cynodon dactylon var. dactylon*	POACEAE			N	
16/04/2006	*Digitaria ciliaris*	POACEAE			N	
24/04/2006	*Eragrostis minor*	POACEAE			N	
9/05/1955	*Eremophila christophori*	SCROPHULARIACEAE	lc			1
25/05/1972	*Eremophila cordatisepala*	SCROPHULARIACEAE	nt			
25/05/1972	*Goodenia angustifolia*	GOODENIACEAE	nt			
6/06/1997	*Gossypium nelsonii*	MALVACEAE	nt			
	Malva parviflora	MALVACEAE			N	
22/08/2001	*Malvastrum americanum*	MALVACEAE			N	
16/10/1995	*Melia azedarach var. australasica*	MELIACEAE			N	
25/05/1972	*Polygala glaucifolia*	POLYGALACEAE	ne			
17/08/1982	*Potamogeton crispus*	POTAMOGETONACEAE	nt			
11/10/1961	*Salsola tragus subsp. grandiflora*	AMARANTHACEAE	lc		N	
	Salsola tragus subsp. indeterminate	AMARANTHACEAE			N	
17/04/2006	*Sauropus rigens*	PHYLLANTHACEAE	nt			
25/08/2001	*Stemodia sp. Manners Creek (T.S.Henshall 1779)*	PLANTAGINACEAE	lc			1
	Tribulus terrestris	ZYGOPHYLLACEAE	ne		B	

Table 5: PFC-12-103-104-107 Flora of conservation significance from NT Parks and Wildlife Flora Atlas

Noxious species and weeds

Acacia georginae

Acacia georginae (Georgina Gidgee) is a stocky spreading tree to 6 or 7m high. The leaves, seeds and pods contain sodium monofluoroacetate (1080) which can cause death in cattle. It occurs in Vegetation Class 62, *Acacia georginae* (Giddier) low open-woodland with *Astrebla pectinata* (Bull Mitchell Grass) open-grassland understorey and Class 63, *A. georginae* (Gidyea) low open-woodland with open-grassland understorey.

Gidgee, *A. georginae,* shrublands cover large areas of central Australia east and north-east of Alice Springs and into Queensland on calcareous soils. The understory usually consists of open tussock grassland, including Mitchell Grass (*Astrebla spp*.) and occasionally herbland. Gidgee patches also occur in inter-dune flats in the southern Simpson Desert, increasing towards Queensland. A small area of scattered Gidgee occurs near the SA border on New Crown Station. Although Gidgee may make good "top feed" for cattle, over much of its range it contains the poison 1080, especially in the seeds. Gidgee may exude an unpleasant rotten egg smell, especially during wet weather (DLRM).

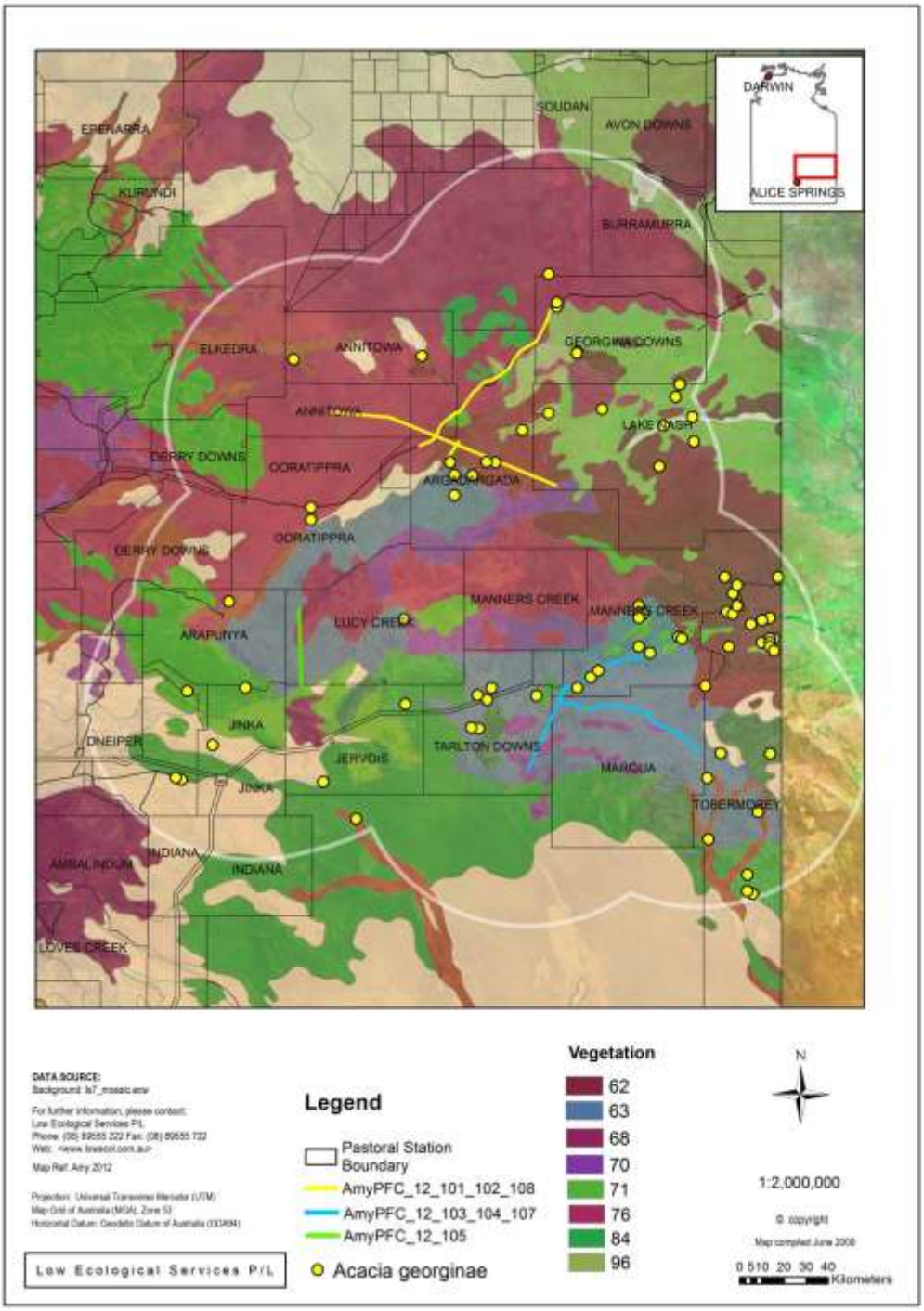

Figure 13: Vegetation map (B. A. Wilson et al. 1991) and *Acacia georginae* distribution (particularly Veg types 62, 63) from Northern Territory Parks and Wildlife Herbarium data base within 70 km buffer around seismic lines.

Acacia georginae is present on all of the properties in which seismic program Amy is being conducted, Argadargada, Lake Nash, Annitowa, Georgina Downs, Lucy Creek, Tarlton Downs, Manners Creek and Marqua Pastoral stations. Although this species is found on all of the pastoral stations, it is not present on all seismic lines areas and pastoralists in some areas have made extensive efforts to remove the species. Therefore, in order to avoid dispersion of seeds when traveling from one project area to the others, ensure vehicles and equipment are washed or cleaned with compressed air in a dedicated area, inspected and free of weeds and soil prior to mobilization.

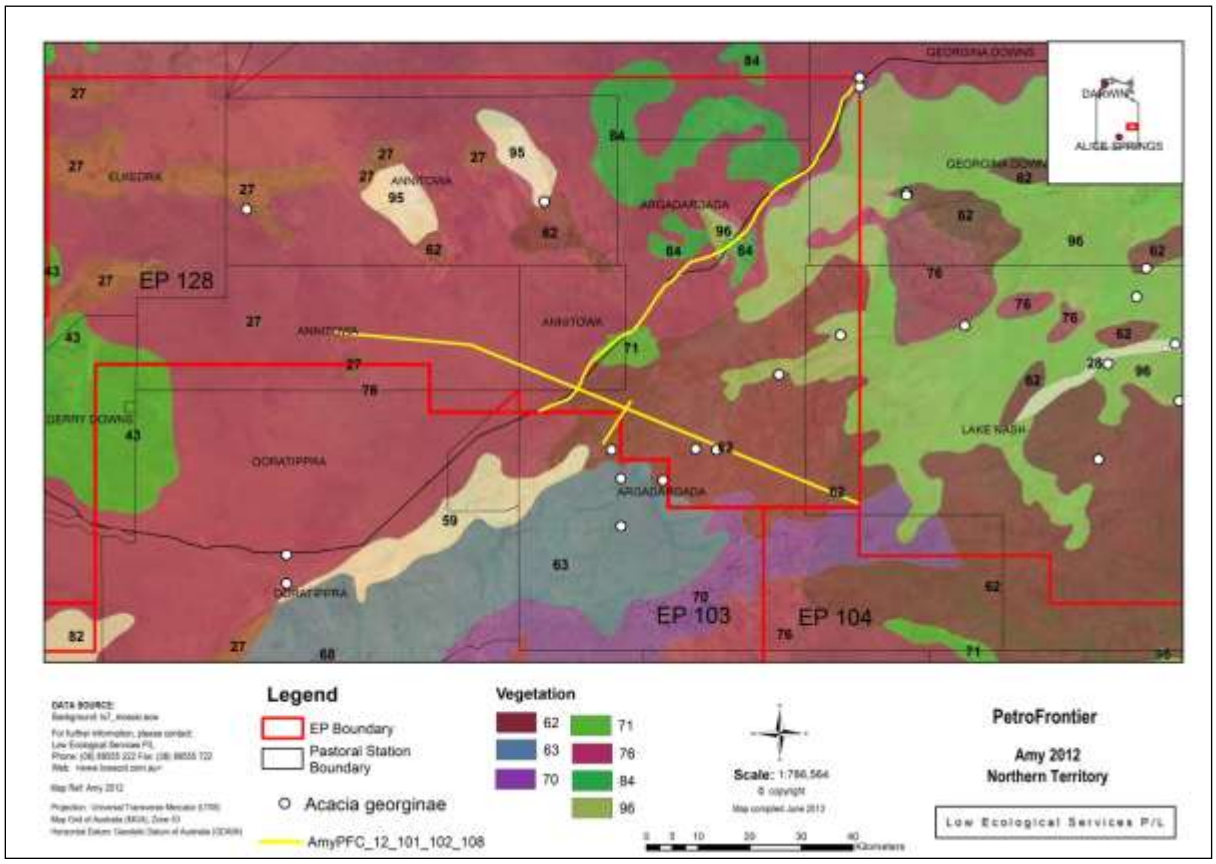

Figure 14: The Vegetation map (B. A. Wilson et al. 1991) showing the distribution of vegetation classes 62 and 63 which are dominated by Acacia georginae. Identified samples have been collated in the Northern Territory Parks and Wildlife Herbarium data base and specimens (white spots) within a 70 km buffer around the seismic lines identified as PFC-12-101-102-108 are shown on the map.

Calotropis procera

Rubber bush (*Calotropis procera*) is a widespread weed in the Northern Territory.
Rubber bush successfully competes with desirable pasture species on disturbed land and is capable of forming dense thickets that interfere with stock management, particularly mustering activities. The plant thrives on nitrogen deficient soil and is often found on previously used crop-land. It also invades roadsides, alluvial river flats and other disturbed areas.

Rubber bush is also reported to contain a bitter principle called calotropin which is a cardiac poison. In western Africa the plant has been suspected of causing ill-thrift and sometimes death in sheep and goats. In the Northern Territory, however, the plant is only palatable to cattle in the semi-arid and tropical areas where no ill-effect has been detected. In the more arid regions of the Territory, cattle seldom, if ever, consume plant parts, even during severe drought. This has led some scientists to believe that environmental conditions may influence whether or not the toxin is present in the plant.
Surveys have confirmed that rubber bush is becoming more invasive in the southern part of the Territory, and accordingly, the species is declared a Class B weed south of latitude 16°30" where it has no nutritive value to stock.

Rubbers bush is a Class B (growth and spread to be controlled) and Class C (not to be introduced into the Northern Territory) weed in accordance with the Weeds Management Act 2001. All personnel are advised not to spread any part of the plant. Weed Management Officers from the Weed Management Branch of the Department of Natural Resources, Environment, the Arts and Sport (NRETAS) advised that the best method of eradication was to cut the plant as close to the ground as possible and apply a 60:1 dilution of Grazon DS to the cut stem

within ten seconds. Any seeds and flowers should be burnt. The rest of the plant should then be placed high in a tree where it cannot access soil to dry out and die, or could be burnt (Low Ecological Services, (2012) MacIntyre-2H Completion & Testing Operations Environmental Audit Report prepared for Petro Frontier Pty Ltd, September 2012).

A search of the DSEWPAC EPBC Act Protected Matters Search was performed and *Calotropis procera* weed species was not identified from the search area.

DLRM records do not show any Rubber bush in the region, however populations are known at Lucy Creek and Ammaroo. Therefore seismic crew will use appropriate wash down procedures to prevent seed transfer from identified populations.

Fauna

Several species are endemic to the region, but as with other central Australian bioregions, mammalian fauna has suffered substantial losses. Several mammal species have become extinct from the bioregion, including burrowing bettong (*Bettongia lesueur*), (Australian Natural Resources Atlas 2007a; Baker et al. 2005).

Searches of the NT Parks and Wildlife Flora Atlas, have been performed 20km either side of the seismic lines with fauna of conservation significance.

Within the lines identified as PFC-12-101-102-108, 1 mammal is listed as Endangered and 1 mammal as Vulnerable under the EPBCA 2007 Act. Under the TPWC Act (2007), 1 mammal and 1 bird are listed as vulnerable and 3 birds and 2 mammals are listed as Near Threatened.

Within the lines identified as PFC-12-105-106, 3 species are listed as Vulnerable under the EPBCA 2007 Act. Under the TPWC Act (2007), 2 mammals species are listed as Endangered, 2 birds and 1 mammal are listed as Vulnerable and 1 bird and 5 mammals are listed as Near Threatened.

Within the lines identified as PFC-12-103-104-107, 1 mammals is identified as Endangered and 1 mammal is identified as Vulnerable under the EPBCA Act (2007). Under the TPWC Act (2007), 2 mammals and 2 birds are identified as Vulnerable and 2 mammals and 2 birds are identified as Near Threatened.

EPBC	EPBC Act protected matters search
TPWFA	Territory Parks and Wildlife Fauna Atlas

Classification

EX	Extinct	ER	Extinct Regionally
EN	Endangered	VU	Vulnerable
NT	Near Threatened	DD	Data Deficient
NE	Not Evaluated	M	Migratory
Ma	Marine	Int	Introduced
INV	Invasive		

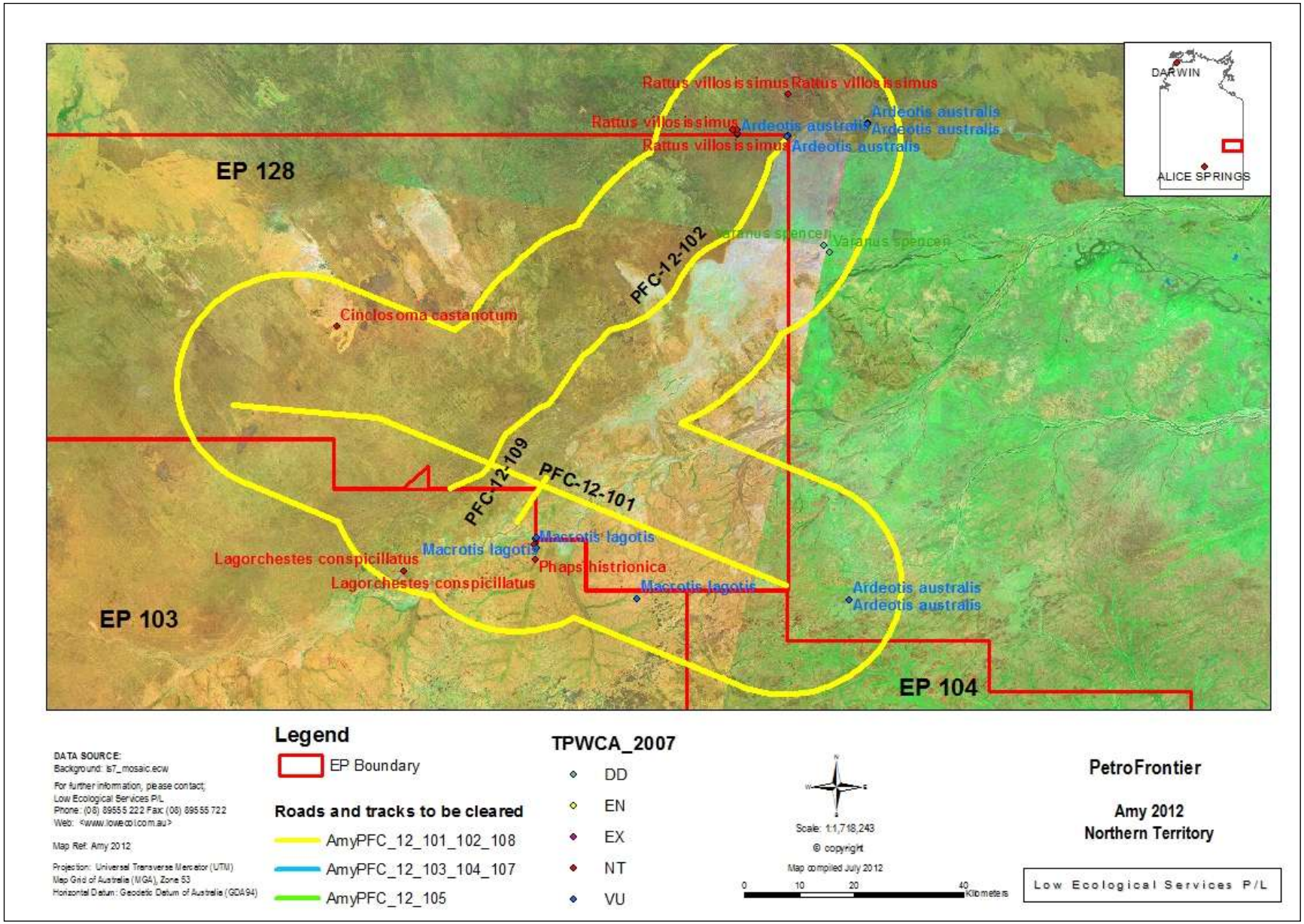

Figure 15: PFC-12-101-102-108 Fauna of conservation significance from Northern Territory Parks and Wildlife Fauna Atlas with a 20 km buffer around the lines identified as PFC-12-101-102-108

FULLNAME	COMMON_NAME	DATE_	TPWCA_2007	EPBCA_2007
Ardeotis australis	Australian Bustard	20010525	VU	
Bettongia lesueur	Burrowing Bettong	19690000	EX	EX
Calyptorhynchus banksii samueli	Red-tailed Black-cockatoo (Central Australia)	20010622	NT	
Cinclosoma castanotum	Chestnut Quail-thrush	0	NT	
Demansia rimicola		19960501	(NL)	
Felis catus	Cat	19921016	(Int)	
Lagorchestes conspicillatus	Spectacled Hare-wallaby	19921016	NT	
Macrotis lagotis	Bilby	19690000	VU	VU
Notomys cervinus	Fawn Hopping-mouse	0	EN	
Oryctolagus cuniculus	Rabbit	19921016	(Int)	
Phaps histrionica	Flock Bronzewing	19620404	NT	
Rattus villosissimus	Long-haired Rat	19920924	NT	
Varanus spenceri	Spencer's Monitor	19961001	DD	

Table 6: PFC-12-101-102-108: Fauna of conservation significance from Northern Territory Parks and Wildlife Fauna Atlas search

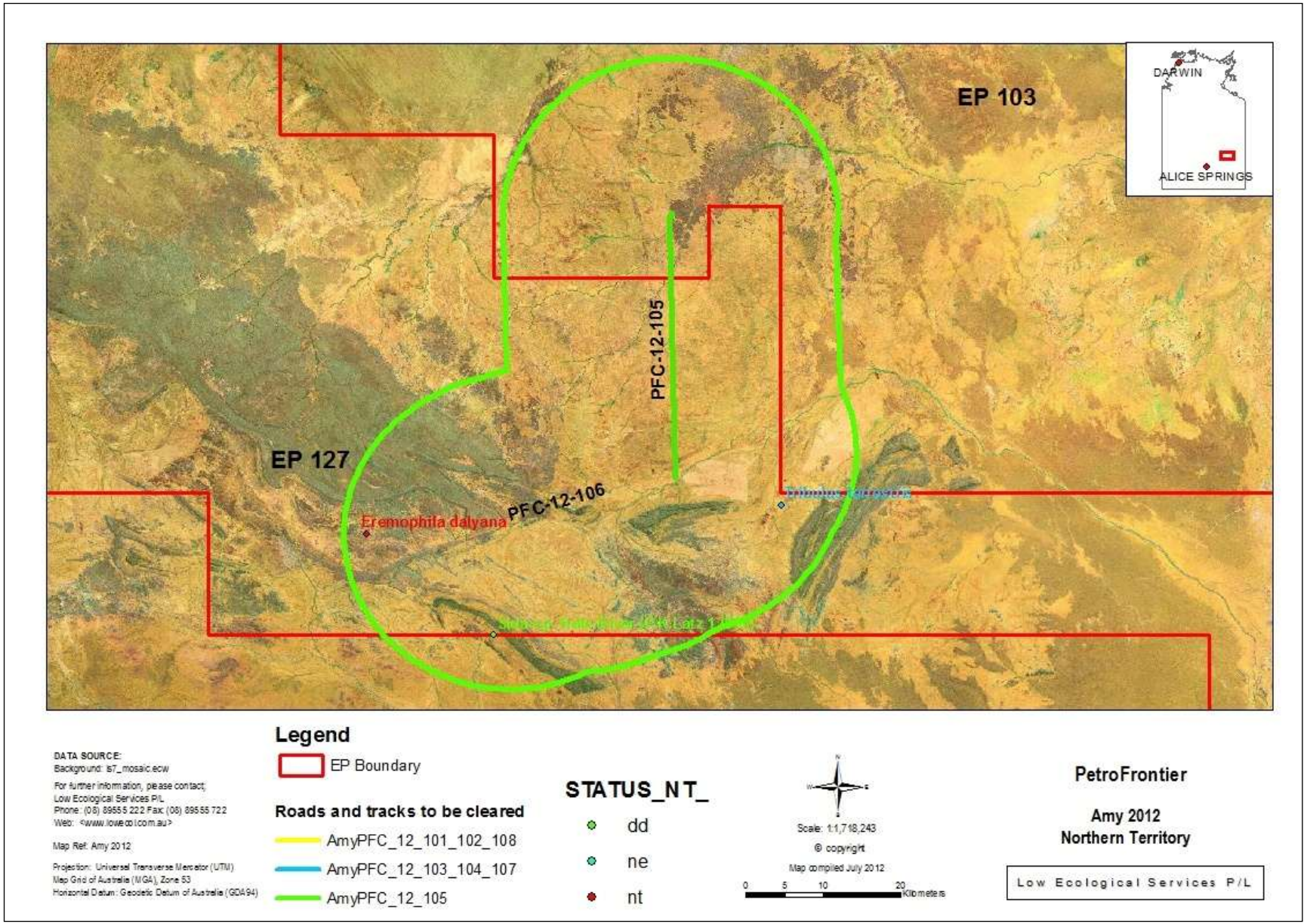

Figure 16: PFC-12-105 Fauna of conservation significance from Northern Territory Parks and Wildlife Fauna Atlas search with a 20 km buffer around the lines identified as PFC-12-105-106

FULLNAME	COMMON_NAM	DATE_	TPWCA_2007	EPBCA_2007
Anas castanea	Chestnut Teal	20011028	NE	
Antechinomys laniger	Kultarr	0	NT	
Ardeotis australis	Australian Bustard	19791101	VU	
Bettongia lesueur	Burrowing Bettong	19690000	EX	EX
Bos taurus	Cattle	20050824	(Int)	
Camelus dromedarius	Camel	20050825	(Int)	
Ctenotus olympicus		19751015	(NL)	
Dromaius novaehollandiae	Emu	20050826	VU	
Equus asinus	Donkey	19930730	(Int)	
Equus caballus	Horse	20060907	(Int)	
Felis catus	Cat	19850606	(Int)	
Isoodon auratus	Golden Bandicoot	19690000	EN	VU
Lagorchestes conspicillatus	Spectacled Hare-wallaby	19880000	NT	
Macroderma gigas	Ghost Bat	19871026	NT	
Macrotis lagotis	Bilby	19301010	VU	VU
Mus musculus	House Mouse	19680909	(Int)	
Oryctolagus cuniculus	Rabbit	20060907	(Int)	
Petrogale lateralis	Black-footed Rock-wallaby	19871025	NT	VU
Phaps histrionica	Flock Bronzewing	19860923	NT	
Rattus villosissimus	Long-haired Rat	19790800	NT	
Trichosurus vulpecula vulpecula	Common Brushtail Possum (Southern N.T.)	19690000	EN	

Table 7: PFC-12-105-106 Fauna of conservation significance from Northern Territory Parks and Wildlife Fauna Atlas

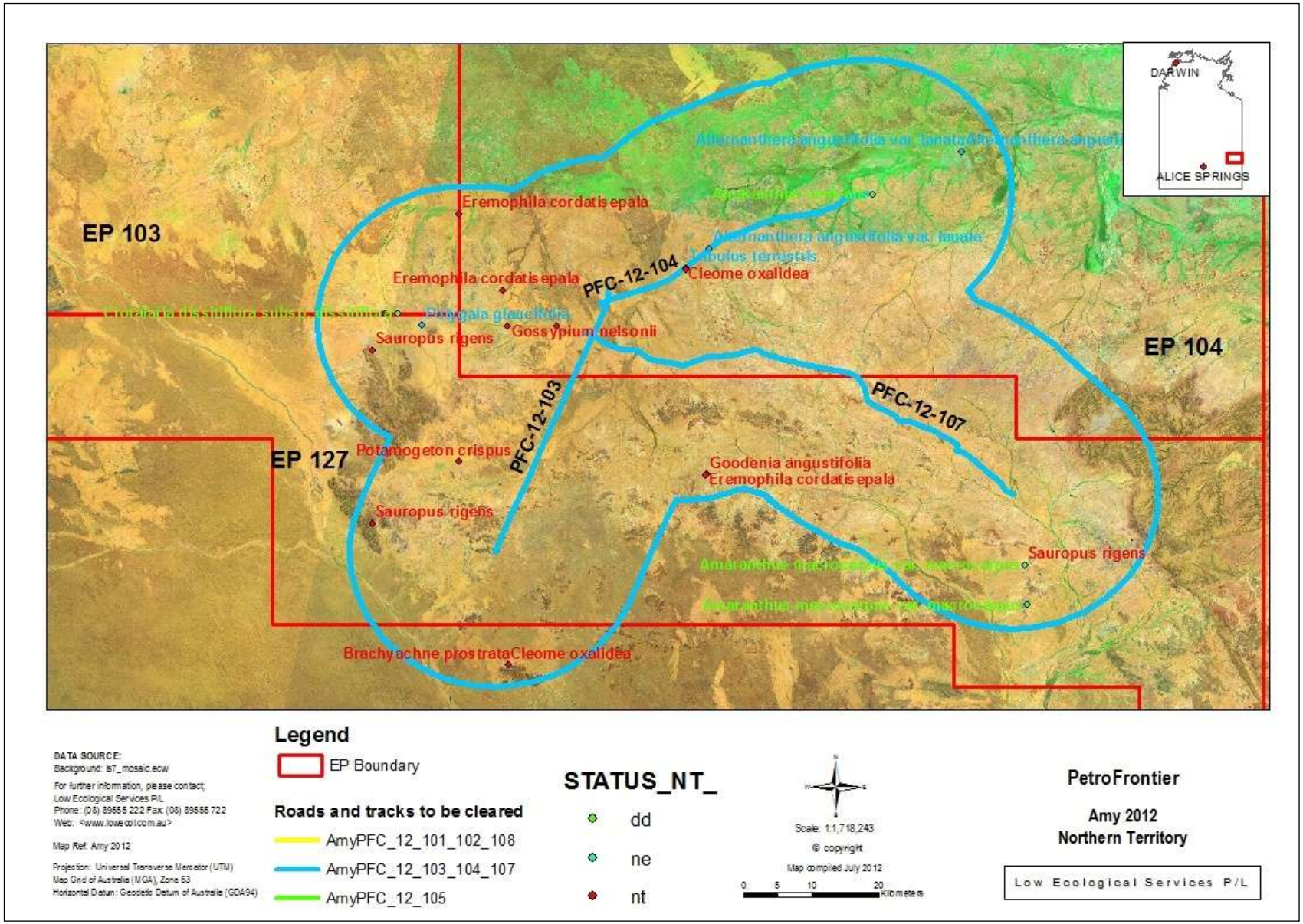

Figure 17: PFC-12-103-104-107 Fauna of conservation significance from Northern Territory Parks and Wildlife Fauna Atlas search with a 20 km buffer around the lines identified as PFC-12-103-104-107 106.

FULLNAME	COMMON NAME	DATE	TPWCA_2007	EPBCA_2007
Antechinomys laniger	Kultarr	0	NT	
Ardeotis australis	Australian Bustard	20010803	VU	
Calyptorhynchus banksii samueli	Red-tailed Black-cockatoo (Central Australia)	20010723	NT	
Dasycercus blythi	Brush-tailed Mulgara	19560703	VU	VU
Dasycercus cristicauda	Crest-tailed Mulgara	19560703	VU	EN
Dromaius novaehollandiae	Emu	20010803	VU	
Planigale tenuirostris	Narrow-nosed Planigale	19951015	DD	
Rattus villosissimus	Long-haired Rat	19820513	NT	
Stictonetta naevosa	Freckled Duck	20010420	NT	

Table 8: PFC-12-103-104-107 106 Fauna of conservation significance from Northern Territory Parks and Wildlife Fauna Atlas search

Potential Impacts of the Operation

In order to determine whether the operation will affect the environment at a national level, criteria from the EPBC Act 1999 have been reviewed; for possible effects at a bioregional level, criteria for identifying important habitats (based on criteria from Neave et al. 2006) are reviewed; for effects at a local level, data provided herein are reviewed.

Potential Impacts of the Proposed Operation: National Level

The *EPBC* Act 1999 (amended 2010) came into force in July 2000. Since the inception of the Act, any proposed project that will have a significant impact on a matter of national environmental significance must be referred for approval to the federal Minister for the Environment. There are eight areas in which a project may have an impact of national environmental significance. These include:

- Impact on World Heritage Properties;
- Impact on National Heritage Places;
- Impact on Wetlands of International Importance;
- Impact on Great Barrier Reef Marine Park;
- Impacts on the Commonwealth Marine areas;
- Impact on Listed Threatened Ecological Communities;
- Impact on Listed Threatened Species, and
- Impact on Listed Migratory Species.

Of these eight areas only three—protected migratory species, and threatened species and communities—were potentially of relevance to the current project. Only one protected migratory species—*Rostratula benghalensis*—has been identified within the project area (PFC-12-101/102/108, PFC-12-105 and PFC-12-103-104-107), although seven species are

listed by DEWHA in the *EPBC* Act 1999 as potentially occurring in the area. Several minor drainage channels and drainage basins are within the vicinity of the proposed seismic lines. These are non-permanent and rely on above average rain events and are only likely to be important for protected migratory species in wet seasons. Whilst there has been above average rainfall in 2010-2011, land clearing guidelines of the NT restrict vegetation clearing around drainage lines, watercourses, wetlands and seepage zones and watercourses should not be diverted from their natural path. Hence, in accordance with best practice guidelines, no modifications should be made to the habitat of protected migratory species and protected migratory species are not likely to be affected on a national level.

No threatened ecological communities or flora listed under the *EPBC* Act 1999, have been identified within the project area although threatened fauna species have been recorded within a 2 km radius of the 2012 proposed seismic lines. The proposed operations are not likely to affect the status of these species at a national level however, due to the scale of the operation, the environmental impact is spread over a significant area and particular attention to management recommendations is necessary to ensure that the potential impact of the operations is minimised.

Table 9: Threatened species listed in the EPBC Act Protected Matter Search.

PFC-12 LINE	Species Name	Status
101-102-108	*Rostratula australis* (Australian Painted Snipe) *Macrotis lagotis* (Greater Bilby) *Notoryctes typhlops* (Southern Marsupial Mole) *Petrogale lateralis MacDonnell Ranges race* (Black-footed Rock-wallaby) *Acanthophis hawkei* (Plains Death Adder)	Vulnerable Vulnerable Endangered Vulnerable Vulnerable
105	*Rostratula australis* (Australian Painted Snipe) *Macrotis lagotis* (Greater Bilby) *Notoryctes typhlops* (Southern Marsupial Mole) *Petrogale lateralis MacDonnell Ranges race* (Black-footed Rock-wallaby)	Vulnerable Vulnerable Endangered Vulnerable
103- 104- 107	*Rostratula australis* (Australian Painted Snipe) *Macrotis lagotis* (Greater Bilby) *Notoryctes typhlops* (Southern Marsupial Mole) *Dasycercus cristicauda* (Crest-tailed Mulgara)	Vulnerable Vulnerable Endangered Vulnerable

Potential Impacts of the Proposed Operation: Bioregional Level

Neave *et al.* (2006) identify a number of criteria for identifying important habitats in Central Australia, which have been adopted for this EMP. Each of these is discussed with reference to current and previous surveys conducted within the project area and surrounding region.

Criteria for identifying important habitats include:

1. *Habitat with high species richness that supports a high abundance of native species, and/or is structurally complex.*

These attributes may relate to:

- the number of vegetation types and the degree of contrast between them;

- availability of shelter sites (e.g. nesting sites, ground litter and logs, rock crevices) and water and food resources (e.g. presence of nectar producing shrubs);
- topographic/geological complexity creating a range of micro-habitats

Assessment: The seismic acquisition areas do not fully meet the characteristics of this criterion. With the exception of the Illungara Site of Botanical Significance, the main vegetation communities of the seismic acquisition area are relatively common and cover hundreds of square kilometres in the Northern Territory (B. A. Wilson et al. 1991). Further, the majority of the vegetation and landscape of the seismic acquisition areas is not considered threatened or significant. This is highlighted in existing data sets by the relatively low number of flora and fauna species listed at or above a vulnerable level (TPWC Act) within a 50 km radius of the seismic acquisition area.

2. Habitat *supporting* species of high conservation value (e.g. threatened species, endemic species, poorly reserved species and/or rare species).

Assessment: The project area and surrounding region do not fully meet the characteristics of this criterion. No legislated protected areas have been identified within the Channel Country, Mitchell Grass Downs, or Tanami bioregions. Two percent of the Davenport Murchinson Ranges bioregion is protected, however, only the most northern end of one seismic line is proposed in this area (Baker et al. 2005). The two endangered species (TPWC Act)—brush tail possum (*Trichosurus vulpecula vulpecula*), golden bandicoot (*Isoodon auratus*)—recorded within a 50 km radius of the proposed seismic lines have not been recorded since 1969. Likewise, none of the five vulnerable species listed under the EPBC Act 1999 have been recorded since 1987. Nonetheless, habitat in the project area and surrounding region supports a small number of flora and fauna species of lower level conservation significance, and there is potential for these species to occur.

3. Habitat that is of good quality (i.e. its compositional and structural integrity and ecological processes have not been undermined).

The level of habitat integrity is influenced by:

- the presence/absence (or low cover abundance) of environmental weeds, especially Buffel Grass and Couch Grass, both of which are known to outcompete native plant taxa and alter habitat parameters for native fauna;
- the presence/absence (or low abundance) of introduced animal species;
- the presence/absence of an appropriate fire regime (inappropriate regimes are known to impact on species composition and canopy condition);
- degree of isolation from infrastructure such as roads and waterpoints (reduced risk of weed invasion and over-grazing); and,
- the state of the hydrological regime (altered regimes may lead to changes in site species composition).

Assessment: The project area and surrounding region do not fully meet the characteristics of this criterion. Several introduced species (flora and fauna) are known to occur in the area. The project area is also in close proximity to infrastructure (highways, station tracks

and water points) and the area has been subject to extensive localised grazing pressure for many years.

4. Habitat that is poorly reserved elsewhere.

Assessment: The project area and surrounding region do not fully meet the characteristics of this criterion. Although there are no national parks or protected areas, habitat found within the seismic acquisition area is characteristic of typical habitat found within the surrounding bioregion and flora and fauna in the area are generally common and widespread.

Potential Impacts of the Proposed Operation: Local Level

Vegetation communities in the vicinity of the seismic acquisition area are dominated by common species such as Mulga (*Acacia aneura*), Ghost Gum (*Corymbia aparrerinja*), Coolabah (*Eucalyptus coolabah subsp. arida*), Georgina Gidgee (*Acacia georginae*) over sparse annual grasses, tussock grasses and spinifex (*Triodia spp*). If best practice techniques are followed, the proposed operations should have little impact on the larger flora species (>2 m tall) as the path of the seismic line can follow a route causing minimal vegetation loss. There will be localised loss of flora and habitat for fauna, where line establishment requires removal of small shrubs to allow for access of vehicles. Line establishment can also result in the removal of topsoil and the formation of windrows, which can channel water and create erosion. Top soil is also lost in areas where vegetation is removed and bulldust is created due to traffic use. In areas where soils are prone to erosion, where existing erosion is present, or where seismic lines are established up and down slopes, soils can become eroded if best practice techniques are not followed. Mining exploration can indirect impact on local fauna through increased noise, vibration, dust, lights, roads, and increased human activity. A number of management strategies (outlined in following sections) can be adopted to minimise this disturbance.

The NT Parks and Wildlife Flora Atlas identify several flora species with lower conservation listings, which have been identified within a 20 km radius of the proposed seismic lines. However, if best practice techniques are followed and management recommendations outlined in sections to follow are adhered to, impacts on these species by the proposed operations will be minimal.

A number fauna species listed under the TPWC Act and/or EPBC Act 1999 for conservation significance have been identified within the vicinity of the proposed seismic lines and/or surrounding region. Species with a conservation status at or above vulnerable are discussed below. Species that are extinct or regionally extinct are not discussed.

The Crest-tailed Mulgara, or Ampurta, (*Dasycercus cristicauda*) is listed as vulnerable under the TPWC Act and Endangered under the EPBC Act. Previously the Ampurta was known as *D. hillieri* (as listed in the EPBC Act status). The Ampurta is a mid-sized, robust carnivorous marsupial. There has been considerable taxonomic confusion between the Ampurta and Brush-tailed Mulgara, and most records did not distinguish between the two species, so the Ampurta's distribution is ambiguous. Due to this confusion, while there are no records in the TPW Fauna Atlas, it may be present in the survey area. Most records are from the Simpson Desert and northern South Australia, but it may occur much more widely across arid Australia, with records from the Canning Stock Route in WA and the Nullabor Plain. Environmental degradation and habitat homogenisation are likely contributors to its decline (NT Parks and Wildlife Commission 2006c)

The Greater Bilby (*Macrotis lagotis*) is listed as vulnerable under the TPWC Act and EPBC Act 1999. There are only a few recordings of this species in the eastern desert country of the NT, with populations more prominent in the west. Woinarski et al. (2007) describe the suitable habitat as sandy soils dominated by hummock grasslands covered predominantly by spinifex and an overstorey of low shrub cover dominated by Acacia and Melaleuca. The sandy landscape also often comprises rocky outcrops, lateritic rises and low-lying drainage

depressions. Whilst we cannot rule out the possibility of this species occurring in the vicinity of the proposed seismic lines and/or surrounding region it is unlikely that small, localised disturbance will affect the status of this species on a local scale.

Black-footed Rock Wallabies (*Petrogale lateralis*) are listed as vulnerable under the EPBC Act 1999. The distribution of the rock wallaby is centred on the MacDonnell Ranges, although there are records within the Dulcie Ranges National Park and in the Jervois Range. These are well south of the proposed seismic lines, and there are no rocky outcrops or steep rocky slopes within the vicinity of the proposed seismic lines. Mesas and stony lowlands exist although rock wallaby populations in these areas are unlikely.

The Australian Painted Snipe has been listed as a vulnerable species under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). It is also listed as a migratory species under the EPBC Act, as it is listed in the China–Australia Migratory Bird Agreement (CAMBA). The Australian Painted Snipe has also been referred to as the Painted Snipe or Greater Painted Snipe, Rostratula benghalensis or Rostralula benghalensis australis, as it was previously considered to be part of the Greater Painted Snipe species that occurs also in Africa and Asia. Recent research indicates that the Australian Painted Snipe is a separate species. This taxonomic history is reflected in the names that have been used to list the species under State and Territory threatened species legislation, under CAMBA and under the migratory provisions of the EPBC Act.

The southern marsupial mole or Itjari-itjari lives a secret, solitary life below the spiky spinifex and burning sands of Central Australia. Even its tracks are seen only rarely, usually after rain. Europeans first collected the mole from a pastoral station on the Northern Territory's Finke River in 1888. It lives in the central sandy desert regions of Western Australia, northern South Australia (apart from records from the Fowlers Bay area near the SA coast) and the Northern Territory. The mole is listed as endangered under the Commonwealth's Endangered Species Protection Act 1992. Some researchers think that comparisons of past and present records are biased by the large numbers of specimens collected during early scientific expeditions. Overall, the number of specimens added to museum collections has not varied much this century.

Between 1900 and 1920, it is estimated that several thousand marsupial mole pelts were traded by Aboriginal people to Europeans and Afghan cameleers. The mole was prized for its luxuriant cream-yellow fur. So little is known about the marsupial mole's current conservation status that it is highly speculative to describe current threats for the species. Predation by feral cats, foxes and dingos of moles when they are above ground, and soil compaction by stock movements or by vehicles, may be potential threats to the long-term survival of the species. Other threats that may change the abundance of ants, insect larvae and termites, such as altered fire regimes and grazing, may also be included.
The most pressing needs are to find out more about the mole's past and present distribution, and to find a living population that can be studied. This will provide the facts needed to prepare a recovery plan for the species.

Scientists are now working with Anangu people in Anangu-Pitjantjatjara lands in South Australia and the Northern Territory to gather information about the southern marsupial mole in that region. Anangu people are teaching western scientists their tracking skills and giving them an insight into their traditional ecological knowledge to find populations of the mole and to study their movements.
The habitat in the region of seismic lines 101 and 108 are dominated by cracking clay and limestone soils and are not appropriate to Desert Moles.

Acanthophis hawkei (plains death adder) was nominated for inclusion in the list of threatened species referred to in section 178 of the EPBC Act. The nominator suggested listing in the vulnerable category of the list.

The geographic distribution of the plains death adder is precarious and the species is likely to decline as a result of the introduction of cane toads to Northern Australia. Given that the cane

toad is expected to encompass almost all of the species' range in the future, it is considered that the plains death adder is likely to undergo a substantial reduction in numbers. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as vulnerable. The exact distribution of the species is unclear. Suitable habitat for the plains death adder consists of flat, treeless, cracking-soil riverine floodplains (Cogger, 2000). Based on the presence of suitable habitat, the potential geographic range of the plains death adder extends from Western Queensland, across the north of the Northern Territory to north-east Western Australia. Fragmented populations of the plains death adder are known to occur in the Mitchell Grass Downs of western Queensland, the Barkly Tableland on the Northern Territory / Queensland border and east of Darwin in the Northern Territory. The species' extent of occurrence is estimated to be approximately 720,000 km2 and its area of occupancy is estimated to be approximately 233,480 km2 (Phillips, pers. comm., 2009). Based upon field experience, and encounter rates across its range, the species can be locally common (in the absence of cane toads (*Rhinella marinus*)) on the highly productive floodplains of northern Australian rivers. On the Barkly Tableland and Mitchell Grass Downs, however, the species is less-commonly encountered, so can probably be considered scarce in this habitat. However, the total population size of the plains death adder is unknown.

Climate

The Channel Country IBRA region has an arid climate with very hot, dry summers and short, dry winters (Department of Sustainability, Environment, Water, Population and Communities, 2013). Rainfall is unpredictable in both timing and quantity, with most of the 300-400 mm of rain occurring in the summer months (Baker, et al., 2005; Department of Sustainability, Environment, Water, Population and Communities, 2012a).

The long-term temperature data for Jervois weather station. (Bureau of Meteorology, 2013) are shown in Figure 6.12.1. The mean maximum temperature at Jervois ranges between 21.9°C in July and 38.4°C in January. The mean minimum temperature ranges between 5.2°C in July and 22.7°C in January.

The rainfall data were recorded at Argadargada, (Bureau of Meteorology, 2013). Mean monthly rainfall at Argadargada ranges from 1.9 mm in August to 79.7 mm in January. Mean annual rainfall at Argadargada is 322.5 mm. Annual rainfall in 2010 and 2011 was well above the mean annual, with 826.8 mm in 2010 and 727 mm in 2011 (Bureau of Meteorology, 2013). Annual rainfall in 2012, however, was below average at 281.8 mm. November and December 2012 had above the monthly average rainfall (Bureau of Meteorology, 2013). This data shows that the majority of the rainfall in these areas falls in the summer months. This is consistent with the bioregional description given by Baker *et al*, (2005).

January and February 2013 were much drier than the monthly average, with 9 mm and 16.4 mm rainfall respectively (Bureau of Meteorology, 2013). Monthly temperature averages at Jervios over January and February 2013 were 41.1 ^{o}C and 37.9 ^{o}C respectively. In January there were sixteen consecutive days over 40 ^{o}C (Bureau of Meteorology, 2013).

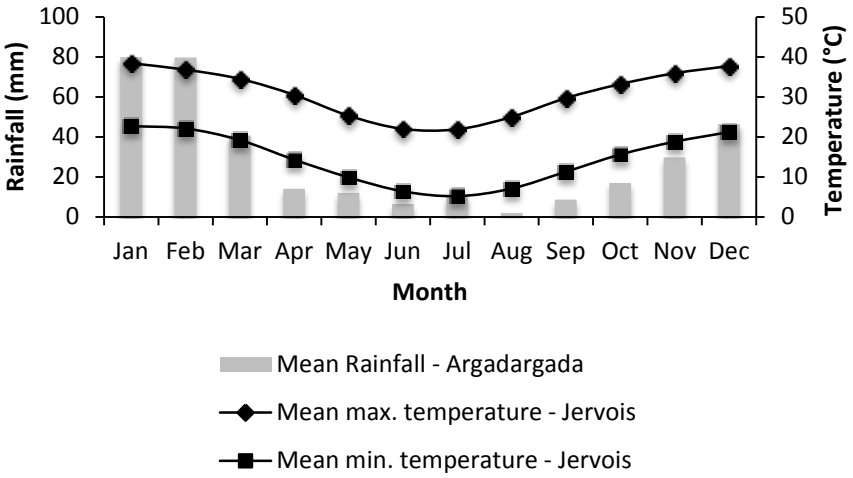

Figure 18: Mean monthly rainfall at Argadargada between November 1968 and February 2013, and mean minimum and mean maximum temperature at Jervois between January 1967 and August 2012 (Bureau of Meteorology, 2013)

Cultural and Socio-Economic Environment

The primary land use in the region is pastoral (commercial). The area is occasionally visited by four-wheel drive campers however other recreational or tourism related activities are uncommon. The Irraman (Ermarne) Indigenous community area boarders Argadargada station and the Anatye Aboriginal Land Trust area shares boundaries with Manners Creek, Tarlton Downs and Marqua stations. Line clearing and recording crews may be observed from these areas, however operations will only be conducted during daylight hours and are of a temporary nature. It is unlikely there will be any impact on the community.

5. ENVIRONMENTAL MANAGEMENT

During the planning and scouting phase the seismic lines will be deviated, where possible, without compromising the technical requirements of the seismic data to:

- Make the maximum use of existing roads, tracks and old seismic lines.
- Avoid significant watercourse and riparian vegetation.
- Avoid erosion sensitive soils and large trees.
- Avoid areas of cultural significance.
- Minimise disturbance to dunes; and
- Conserve biodiversity.

Several assessments of environmental sensitivities have been undertaken which are applicable to this project and these are detailed in Section 6. The seismic survey area avoids all known environmental sensitivities and PFC considers these assessments to be sufficient for line planning, given the following:

- LES has conducted desktop, aerial and ground surveys, the results of which are incorporated into this EMP.
- The survey area consists primarily of open Gidgee sand plain habitat with minor hills and black soil plains. These habitat types are widespread in the region.
- River, Wetland and Dune Management Plans in force.
- Seismic lines will avoid erodible soils wherever possible and erosion control measures utilised on sloping terrain.
- The area impacted by the proposal relative to the extent of the vegetation associations is relatively small.
- PFC has a commitment to follow on from rehabilitation programs conducted in the area.
- The risk to biodiversity is minimal. At induction, line pointers/clearers will be alerted to identify and avoid areas indicating native fauna habitation.
- Heritage surveys have been conducted within the seismic survey area and an assessment report submitted and approved in September 2012. Sacred Site Clearance Certificates have been granted by the Central Land Council covering all lines.
- The seismic lines will be accessed from existing tracks where possible; and,
- Weed hygiene management measures (i.e., use of hygiene stations) are essential for this project to prevent the spread of weeds. Vehicles will be cleaned of mud and plant material prior to entry into the site. Hand tools, personnel boots and clothing and any item that is used in contact with soils or organic matter will also be cleaned prior to entry into the site. Weed identification will be included as part of the site induction.

Mobilisation and Camp Construction

The seismic crew will be housed in purpose built trailer camp(s) located on or close to the survey area. The camp(s) will occupy an area of approximately 50 m x 50 m. The campsite will be located in existing cleared areas or areas of sparse vegetation with clearing kept to a minimum.

Sewage will be treated and then disposed of in a fenced pit. Grey-water will be disposed of via absorption trench and/or sprinkler. This pit will be backfilled when no longer required.

All waste produced by the workforce operating in the field will be brought back to the camp each day for correct disposal. The nature of these operational wastes and information on their disposal management are detailed in Table 10.

All personnel involved in field activities will undergo a site-specific induction prior to commencing work. The site-specific environmental component of the pre-survey induction will educate the workforce of the issues presented in this EMP including:

- Native flora and fauna (including scat and burrow identification).
- Soil instability and degradation issues.
- Watercourse and surface water flow management.
- Bushfire prevention and management.
- Weed management including weed identification; and,
- Training in identification of archaeological indicators.

Personnel will be advised of the provisions in the Northern Territory Sacred Site Act and Heritage Conservation Act where a person constitutes an offence if they knowingly interfere with Aboriginal or Heritage sites.

In the event that any archaeological material, including human skeletal material, is uncovered as a result of line preparation, the discovery will be immediately reported to the PFC Authorised Representative who will then report to relevant authorities. All work within the affected area will stop immediately and the area will be isolated.

Table 10: Waste Management

Waste Item	Source	Handling Method	Disposal Route
Domestic wastes (food, scraps, light paper, cardboard, putrescibles and plastic waste)	Workforce when in the field	All domestic wastes will be collected and stored in pest proof bins.	Waste removed from the area and disposed of at an appropriate facility
Industrial waste: (wood, scrap steel and other metals, scrap tyres, rubber and synthetic materials, and other inert mixed industrial waste) and waste oils, etc.	Hazardous wastes produced from operating, maintaining and repairing machinery as part of survey activities.	Hazardous waste materials will be stored separately and handling of these materials will be done in accordance with contractor dangerous goods procedures.	Waste removed from the area and disposed of at an appropriate facility
Sewage and grey water	Workforce camp	Treated domestic sewage will be deposited into a fenced pit in a benign area away from water courses or areas of potential run-off.	The fenced pit will be backfilled when the survey is completed. Greywater generated from camp(s) will be disposed of via absorption trench and/or sprinkler.

All hazardous materials and wastes associated with the seismic survey will be stored separately at the camp and clearly labelled. Hazardous inventory items such as hydraulic fluid, solvents and battery acid will be stored in accordance with Australian Standard AS 1940 - 1993. The primary hazardous material stored will be diesel fuel. The seismic source vehicles will be the largest consumers of diesel, requiring daily refuelling.

Vehicles will be re-fuelled either:

- At the base camp from an on-site fuel trailer (generally the case for all light vehicles).
- In the field with a stationary fuel trailer of up to 20,000 L capacity; or
- In the field with a 2,000 L capacity seismic service unit; (e.g. to refuel the vibrators and recorders in the field).

Refuelling vehicles will, at all times, carry a spill kit and a drip tray, which is to be placed beneath the nozzle while refuelling. Additionally, refuelling vehicles will carry a shovel and thick plastic bags for the collection of any soil contaminated by a fuel spill.

Spill kits, bio-remedial products, drip trays and shovels will be available in the case of a spill of hazardous materials or wastes. For every hazardous substance brought onto the seismic survey area, a materials safety data sheet (MSDS) that conforms with the Work Safe Australia Code of Practice will be made easily available to all personnel. A Hazardous Materials Registry will be maintained by Terrex.

Table presents the hazardous materials which will be used during the seismic survey, including how each substance is used and the estimated mean volumes maintained as inventory.

Purchasing and transport will be undertaken in accordance with provisions of explosives and dangerous goods legislation, Work Health and Safety (National Uniform Legislation) Act 2011, codes of practice and Australian Standards.

Table 11: Hazardous materials inventory

Substance	Purpose	Estimated or Indicative Maximum Inventory
Hydraulic fluids	Equipment servicing, line clearing equipment, seismic vibrators	~ 1,000 L
Gas	Kitchen activities	360 kg (~ 8 cylinders)
Diesel (at base camp)	Vehicle refuelling On-site refrigeration	Up to 20,000 L ~ 200 L
Diesel (in field)	Workforce camp	2,000 L
Batteries, Battery acid	Workforce camp	~ 20 L
Engine oils/Greases	Workforce camp	~ 1,000 L

Line Establishment

Seismic survey lines are linear developments that require a fairly narrow corridor (~4.5 m wide), only partial clearing of vegetation and may not require any formal drainage or rehabilitation works. Despite this, ongoing monitoring and maintenance to prevent erosion is important, particularly in floodout fine silt and bulldust prone area.

PFC is committed to only disturbing the minimum amount of vegetation and area required to allow for the passage and operation of the Vibroseis trucks and crew. In the field, surveyors peg out the location of each seismic line by placing markers at 20 m intervals along the seismic lines. Lines will follow the agreed swath map path but will be modified by surveyors as needed to avoid areas of cultural exclusion, large trees, slow growing flora and areas with high erosion potential. Fencing crews construct temporary gates and fence crossings where lines cross fences, although there are few fences within the survey area. These gates will be kept closed when not in use to ensure stock do not move between paddocks.

Line clearing will be carried out by a bulldozer or grader equipped with a large screen global positioning system (GPS) that illustrates the seismic lines to be cleared and the position of the machine in relation to the line. Unlike former traditional line clearing, the GPS enables the operator to avoid large trees (over 2 m high) and obstacles while staying on course (approximately +/- 20 m). The operator is also able to cross landscape features such as dunes and gullies obliquely, reducing potential for erosion and creating a minimal line of sight. PFC will follow the recommendations included in the September 2012 approved Archaeological Assessment Report by Tim Hill Heritage Management and Planning to avoid heritage sites.

The method used on sections of each line will depend on the vegetation that requires clearing but the following best practice guidelines will be followed at all times.

To minimise the potential for bushfires, no petrol vehicles will be used for the seismic survey. Personnel will remove vegetation built-up around the belly plates and exhaust systems of vehicles as part of the daily vehicle pre-start inspection. Every vehicle involved in the seismic survey will carry:

- A rake or shovel for each work team to assist in suppressing a small fire if it occurs.
- A 9 kg pressurised water fire extinguisher applicable to scrub fires; and
- The all-terrain trucks used in seismic acquisition will carry two 2 kg multi-purpose fire extinguishers

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. Appropriate Terrex personnel will be trained in fire-fighting techniques and equipment/vehicle use and the Terrex OHS Advisor will conduct inspections at mobilisation and monthly intervals thereafter to ensure compliance with fire regulations, including inspections of all vehicles and equipment for possible sources of ignition.

For small fires that can be contained or extinguished immediately without further risk to personnel, the fire-fighting equipment provided to the seismic crews will be used to control the fire. If the fire cannot be contained without risk to the seismic crew, seismic personnel will remove themselves from danger and call for help. 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. This system will also be used to notify outside authorities and requests for additional resources from Bushfires NT.

The short and long term activities to be implemented after the impact of a fire include:

- Debriefing all stakeholders.
- Compiling records relating to the fire for future reference.
- Investigating the cause of the fire.
- Assessing public facilities for re-ignition and safety hazards created by the fire; and,
- 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 only to reduce:
    - The damage to regrowth; and,
    - The potential to increase erosion.

Seismic Line Layout

- Seismic survey lines will avoid lower areas of the landscape (e.g. floodplains, broad drainage lines).
    - These areas are subject to inundation and lines in these areas can drastically increase the likelihood of erosion as a result of the disruption to natural water flows. Access to higher areas requires the placement of seismic survey lines up and down steeper slopes. This can cause accelerated erosion and consequently sediment loads. Ideal alignments follow the contour of the landscape, avoiding (where possible) major watercourses, significant or dense stands of vegetation, steep slopes and soils with high erosion risk.

- All associated seismic survey works will remain within the designated corridor (including, wherever possible, construction camps, turn-around points, watering points and stockpiles).
    - This reduces the impact on the surrounding environment and reduces the likelihood of initiating erosion, making maintenance easier.
- Seismic survey lines will make use of existing tracks and fence lines where possible.
    - The only seismic survey lines that will remain open after the completion of the survey are those required by the landholder or those required for future exploration. Seismic survey lines not required after the completion of the survey will be rehabilitated and re-vegetated back to their natural state.
- Seismic lines that cross dunes will require specific planning and rehabilitation. Seismic lines that cross dunes will be planned according to the Dune Management Plan.
- Seismic survey lines will not require any major constructed drainage or formalised drainage such as table and mitre drains because to the survey will seek to avoid impact to natural waterways (e.g. drainage lines, creeks and rivers). However, whoa-boys may be required in some areas). PFC will also ensure that:
    - Receiving waterways and habitats are protected from the impacts of runoff (e.g. using buffer zones or sediment filter strips).
    - Crossfall drainage is incorporated on seismic survey lines. It is important that water can move across the lines unimpeded by windrows. Allowing natural cross flow will reduce the likelihood of erosion, sedimentation, ponding and water starvation of down slope vegetation.
    - The surface of the lines will not be below natural ground level. Lines constructed below ground level intercept natural sheet flows and watercourses, concentrating and directing them away from their natural paths, and therefore will be avoided.
    - Windrows are not created. Windrows concentrate and divert natural overland water flows causing erosion and sedimentation.
- No works will be undertaken during or shortly after a significant rainfall event.
    - The use of machinery on wet soils causes compaction and rutting, ultimately leading to an increased possibility of initiating erosion or destroying soil structure. Hence, all works will be suspended until the work area has sufficiently dried out.

Conservation of fauna

To reduce any impact on the possible (but not yet identified) presence of significant burrowing mammal species (Bilby, Mulgara and Kultarr) discussed later, line clearance crews will be instructed at induction on the detection of these species scats and signs. If these species are detected, then no ground disturbance will take place within 100 m of these areas. Indications of the presence of these species will be reported. Safe speed limits and minimising travel at dusk and dawn will be applied to roads and cleared lines to avoid wildlife collisions.

Vegetation Clearing

The construction of seismic survey lines does not require complete removal of vegetation and grading down to bare earth is not necessary. There are a number of ways in which this can be done with similar results. In the case of seismic survey lines, the removal of vegetation may not be necessary at all.

- Vegetation clearing will be kept to a minimum to retain or preserve as much native vegetation as possible.
    - Retained vegetation is very effective in reducing runoff and filtering sediments and can be utilised throughout the construction phase. Retained native vegetation can also greatly assist in the rehabilitation of disturbed areas. Areas not to be cleared will be clearly identified as NO-GO areas and flagged to ensure the area is not affected by the clearing of surrounding vegetation.
- Riparian vegetation associated with seasonal, permanent or intermittent watercourses will be avoided wherever possible, as these vegetation types play an important role in protecting watercourses and water quality.
    - Riparian vegetation is the vegetation occurring adjacent to permanent or intermittent waterways (e.g. rivers, creeks, lagoons and broad drainage lines). This area is commonly referred to as the 'riparian zone'. Riparian zones provide a buffer between the land and water environments, assist in maintaining water quality by filtering nutrients and sediment from overland water flows, and reduce erosion on embankments. These zones provide habitat, shade, food and corridors for the movement of wildlife. The health of vegetation and animals along and within any watercourses depends on the health of its riparian vegetation.
    - Riparian vegetation areas are to be protected. The recommended width of such zones depends on the size and character of the waterway. Such areas can vary from well-defined creeks or rivers, to less defined drainage lines, seepage areas and wetlands. Drainage lines collect and safely channel runoff into more significant waterways or water bodies. Disturbance of drainage lines can have serious consequences in terms of flooding and erosion. Drainage lines often have no obvious channels and can be difficult to define, especially during the drier months of the year. Certain types of vegetation indicate wet or seasonally inundated areas and seepage zones. Such areas are largely unsuitable for development and importantly can extend above the 1% annual exceedence probability (AEP) flood line.

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 will 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 (5 Hz to 80 Hz). Geophones, which detect the seismic signal, are placed 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. Once a section of the line is completed, the geophones and cables are picked up and moved to the next section of the line. Daily toolbox meetings will be used to highlight sensitive areas requiring conservation and rehabilitation management within each day's working area.
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 reinstated.

The survey, including preparatory works, will be conducted only during daylight hours to avoid impacts to nocturnal species and noise impacts on landowners in the area. The survey will conform to the Australian Standard on vibration (AS/NZS 1170.0:2002) to ensure that vibration does not adversely impact structures. Since the survey area is far removed from any habitations or communities, this aspect will be of minor importance. Any damage to infrastructure will be recorded as an environmental incident and managed according to the incident management procedures. The noise generated during the seismic survey will be primarily associated with vehicle movement and running diesel engines, and will be similar to that from running agricultural machinery. The seismic survey will be compliant with statutory noise level requirements and landowners will be informed of PFC's progress and areas of operations throughout the survey. Records of landowner consultation will be maintained. Any complaints from affected landowners will be recorded as an environmental incident and handled according to the incident management procedures. Noise is not expected to impact fauna significantly, given that the survey will be undertaken over a short duration (~ 6 weeks) during the dry season and will be conducted during daylight hours only.

For safety and to limit the potential for road kill of both native and domestic fauna, vehicle speed will be limited to 40 km/h on seismic tracks, except in case of an emergency. Fauna injuries or fatalities will be reported through the internal incident reporting system. All practicable measures to rehabilitate any injured animal found within the operations boundaries will be implemented.

Rehabilitation

Rehabilitation of seismic lines will ensure that the seismic survey will avoid land degradation within the seismic survey area. The type and extent of rehabilitation will vary depending on the extent of disturbance, location, soil type and slope. The rehabilitation of an area is required for maintaining ongoing soil stability, soil health, dust suppression, natural water flow as well as vegetation productivity, biodiversity and aesthetic values. Rehabilitation may be in the form of diversion banks, earth shaping or ripping on the contour to slow runoff and allow for natural regeneration from the seed bank located in the soil. It can also be a combination of earthworks and revegetation to reduce the velocity of runoff and to provide short and long term soil protection. In the case of seismic survey lines, any cleared vegetation should be stockpiled for later use during rehabilitation. An inspection of the site will be undertaken to identify areas of active erosion and the level of works required.

Disturbance of native vegetation will be minimised through forward planning and using seismic survey methods that have the least environmental impact (e.g. raised blade clearing of seismic lines) (see Section 5.2.4). This will also improve the likelihood of successful rehabilitation.

To promote successful rehabilitation of the seismic lines the Terrex Crew Manager will ensure that the following are carried out on completion of the survey:

- All temporary fencing is removed and any permanent fencing, which may have been removed to allow access for the seismic crew, is reinstated.

- All unnecessary seismic lines are closed within four weeks of the completion of the seismic data acquisition to prevent third party access.
- All permanent markers, steel pegs and other materials are removed from the seismic lines and camp site, except for permanent markers required under legislation.
- Sump and adsorption trenches used for greywater disposal backfilled and;
- All intersections of seismic lines with public roads are disguised with “dog legs” 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 closure will be determined on a case-by-case basis. Site rehabilitation will ideally be completed immediately after data acquisition is completed and certainly within 3-6 months of seismic line closure, depending on weather conditions. Should rehabilitation be delayed due to the onset of the wet season, rehabilitation will be completed in the next dry season. The following is a list of active measures to improve rehabilitation performance that may be carried out, if required, immediately following completion of the seismic survey:

- Compacted or rutted soils may be lightly scarified using a three cut snake pattern to decompress soils and improve aeration and prevent channelling of surface water flows.
- Substantial vegetation pushed to one side of the seismic lines during operations will be pulled and spread back over the lines.

Once the seismic survey is complete all equipment and any waste will also be removed from the camp. On completion of field activities each pastoral leaseholder will be notified of completion of line rehabilitation.

Monitoring and assessment of the seismic survey will be implemented to determine if rehabilitation has been successful or if additional measures are necessary to achieve the rehabilitation criteria listed below:

- No evidence of infestations of new weed species on seismic lines due to seismic survey activities.
- Total vegetation percentage cover on the seismic lines should be at least 50% of the surrounding undisturbed vegetation after 3 years.
- No obvious areas of soil erosion or compaction after 3 years due to the seismic survey activities.
- Percentage of keystone species on the seismic lines within each vegetation type should be 50% of the surrounding vegetation within 3 years.
- The above rehabilitation criteria will also apply to any watercourse or wetland damaged during crossing;

If monitoring identifies poor rehabilitation of seismic lines, appropriate contingency actions will be implemented in consultation with the DME.

Table 12: Contingencies for closure of seismic lines due to poor rehabilitation.

Cause	Contingency
Unauthorised third party access.	Alternative means of line closure will be assessed and implemented.
Presence of infestations of new weed species on seismic lines due to seismic survey activities.	Weed control measures will be assessed and implemented.
Erosion evident on seismic lines.	Erosion control measures will be implemented as required in accessible areas based on monitoring. Whoa boys, check banks or mitre drains will be installed where required.
Soil compaction linked to seismic lines.	Compaction reduction measures will be implemented as required based on monitoring.
Poor germination linked to seismic lines.	Follow up surveys will be conducted to determine if poor germination has resulted from poor climatic conditions or from poor closure of seismic lines. If necessary the lines will be ripped and/or re-seeded with approved species to encourage seed germination.

6. DESCRIPTION AND ASSESSMENT OF ENVIRONMENTAL RISKS AND IMPACTS

Scope

The scope of the environmental risk assessment covers all aspects of seismic survey activity. The web site guidelines (Department of Mines and Energy, Northern Territory Government, August 2012) have been followed in establishing the environmental risk table (Table 7.7.1 and 7.7.2).

Key Definitions

Incident Event: An event capable of causing critical, major, moderate, minor damage to the environment or negligible damage with no significant environmental effect.

Hazard: A physical situation with the potential for damage to the environment, human injury, damage to property or some combination of these.

Risk: The likelihood of a specified undesired event occurring within a specified period or in specified circumstances. It may be either a frequency (the number of specified events occurring in a time unit) or a probability (the probability of specified event following a prior event), depending upon circumstances.

Risk Assessment Methodology

This section describes the environmental risk assessment for potential events that may impact the environment during operational activities. The purpose of this assessment is to identify hazards and develop risk-reducing measures to prevent and mitigate impacts from operational activities. An environmental hazard-type assessment was undertaken to identify, analyse and evaluate the environmental risks associated with operation and to recommend management actions to reduce the risk to ALARP. Environmental risk assessment consists of four basic steps:

1. Hazard identification.
2. Hazard analysis.
3. Risk evaluation.
4. Risk treatment.

These steps are described briefly below.

Hazard Identification

Hazard identification involves identifying the sources of risk i.e. those activities or incidents that could result in an environmental impact. Hazards are categorised into those arising from routine operations, and those arising from incidents.

Hazard Analysis

Hazard analysis determines the likelihood of an activity or event occurring, and the consequences of that activity or event on the environment. The PFC risk ranking matrix was used to assess the consequence and likelihood of all identified events. The matrix is based on six classifications of severity and six for the likelihood of a hazard.

Risk Evaluation

Risk evaluation prioritises the risks i.e. determining if the risk of an activity or incident is acceptably low, or if management actions are required to reduce the risk to as low as reasonably practicable (ALARP). The risk evaluation presented in Table takes existing safeguards/management measures into consideration i.e. represents the residual risk with existing or planned safeguards in place.

Risk Management

The following Tables present the detailed assessment of risks, impacts and their management for the proposed Seismic Survey. The Implementation Strategy in Sections 7 and 8 focuses on the significant issues identified to ensure the ongoing management of environmental risks to ALARP.

LIKELIHOOD		CONSEQUENCES	
5 Almost Certain	**Expected to occur in most circumstances**	5 Catastrophic	**Environmental disaster**
4 Likely	**Will probably occur in most circumstances**	4 Major	**Severe environmental damage**
3 Possible	**Might possibly occur at some time**	3 Moderate	**Contained environmental impact**
2 Unlikely	**Could occur at some time**	2 Minor	**Some environmental impact**
1 Rare	**May occur only in exceptional circumstances**	1 Insignificant	**Low environmental impact**

Risk Score	Risk Rating	Action Required
9 - 10	**Extreme**	**Immediate**
7 - 8	**High**	**Action plan required. Senior management attention**
5 - 6	**Medium**	**Specific monitoring or procedures required**
2 - 4	**Low**	**Management through routine procedures**

Likelihood	Consequences/Severity				
	5 Catastrophic	4 Major	3 Moderate	2 Minor	1 Insignificant
5 Almost certain	Extreme	Extreme	High	High	Medium
4 Likely	Extreme	High	High	Medium	Medium
3 Possible	High	High	Medium	Medium	Low
2 Unlikely	High	Medium	Medium	Low	Low
1 Rare	Medium	Medium	Low	Low	Low

Table 14: Risk assessment matrix and interpretation (adapted from Griffith University)

Table 15: Detailed assessment of environmental risks, impacts and their management

RISK IDENTIFICATION				RISK ANALYSIS		RISK EVALUATION	RISK TREATMENT
Activity	**Event/ Incident**	**Potential Impact**	**Causes**	**Severity**	**Likelihood**	**Risk Ranking**	**Safeguards / Management Methods**
CLEARING OF CAMPSITE							
Preparation of a cleared area for Seismic Camp and access route	Clearing or removal of native vegetation and potential fauna habitat.	Loss of native vegetation, declared rare flora or priority species. Destruction of fauna habitat.	Onsite flora not previously determined during botanical assessment.	3	2	Medium	Desktop assessment indicates that threatened flora is unlikely to occur in proposed survey area. No threatened flora identified during on ground flora surveys Clear area chosen for Camp site(s) to eliminate or minimise need for clearing. No clearing of trees. Camp site(s) rehabilitated to former condition when no longer required.
	Dispersal or death of priority fauna.	Loss of declared rare fauna locally. Loss of local biodiversity.	Onsite fauna not determined during ecological assessments. Improper training. Uncontrolled vehicle access.	3	1	Low	Select a clear area with sparse vegetative cover. Effective, site-specific environmental inductions for PFC employees and contractors. Personnel trained to identify and avoid sensitive areas and potential fauna habitat. Use existing access tracks and infrastructure where possible. Vegetation clearing kept to a minimum. Access tracks and camp site avoid native fauna burrows and habitat. Implement a no off-road policy for all workers and create designated turn around points to minimise unnecessary disturbance to potential habitat.
	Soil disturbance.	Erosion and sedimentation. Compaction. Subsidence. Dust emissions.	Vegetation clearing causing erosion Traffic causing soil compaction	3	3	Medium	Select Camp site(s) on a level stable soil area to avoid any erosion potential. Following the first wet season after decommissioning, camp site will be inspected to determine whether any soil disturbance issues persist. Remediation actions initiated if needed.
	Disturbance of indigenous heritage site.	Damage to indigenous heritage sites.	Onsite indigenous heritage sites not previously determined during ethnographic study.	4	1	Low	Ethnographic and archaeological studies to be completed before activities begin. Personnel trained in local environmental and heritage sensitivities during induction. Conform to conditions set out in the SSSCC's.
	Noise.	Disturbance to local residents, wildlife or adjacent activities.	Noise generated during routine camp operation, e.g. generator.	4	1	Low	General area has low population density and is remote from high-density populations. Well maintained and muffled generator(s).
MOBILISATION							
Mobilisation to survey area for	Introduction of noxious weeds and vermin, exotic species, flora and animal diseases.	Infection of soil with diseases and pathogens Infestation of weeds in cleared areas. Increased vermin	Weeds and contaminated soil on vehicles.	4	1	Low	All Vehicles and equipment cleaned by washdown and inspected for soil, plant material and pest animal contamination prior to arriving at site , moving between areas/properties, and at demobilisation, to minimise the risk of introducing exotic species. All washdown sites geo-referenced for future

RISK IDENTIFICATION				RISK ANALYSIS		RISK EVALUATION	RISK TREATMENT
Activity	**Event/ Incident**	**Potential Impact**	**Causes**	**Severity**	**Likelihood**	**Risk Ranking**	**Safeguards / Management Methods**
preparatory works		numbers.					monitoring. All personnel provided with weed identification training at induction. Personnel trained/refreshed in need for hygiene management during induction. Food scraps collected and disposed in animal pest proof bins. Vehicles cleaned when leaving areas with weed infestations.
	Removal of native vegetation and potential fauna habitat.	Loss of native vegetation. Loss of declared rare flora or priority species. Destruction of fauna habitat.	Uncontrolled vehicle access. Off-road driving to access sites.	2	2	Low	Use access tracks to avoid native fauna burrows and habitat. Minimise disturbance to native vegetation when driving off-road.
	Vehicle collision with fauna.	Fauna death or injury.	Unpredictable movement of animals. Vehicles travelling at high speeds. Vehicles travelling at dawn or dusk or in times of poor visibility.	2	2	Low	Drivers to take extra care in times of poor visibility or when driving at dawn or dusk. Drivers to adhere to speed limits at all times.
CLEARING OF SEISMIC SURVEY LINES							
Preparation of seismic survey sites	Raised blade clearing or removal of native vegetation and potential fauna habitat.	Loss of native vegetation, declared rare flora or priority species. Destruction of fauna habitat.	Onsite flora and habitat not previously determined during botanical assessment.	4	3	Medium	Personnel to be trained in the identification of threatened flora present in the area. Detailed planning of seismic lines to avoid environmental sensitivities. Planning of seismic lines in accordance with Dune Management Plan Seismic survey lines and access route rehabilitated within 3 months of the completion of the survey if no longer required where possible. If initial rehabilitation fails, follow up work will occur until area satisfactorily rehabilitated.
	Dispersal or death of priority fauna.	Loss of declared rare fauna locally. Loss of local biodiversity.	Onsite fauna not determined during ecological assessments. Improper training. Uncontrolled vehicle access.	3	1	Low	Effective, site-specific environmental inductions for all personnel. Personnel trained to identify and avoid sensitive areas and potential fauna habitat. Use existing access tracks and infrastructure where possible. Vegetation clearing kept to a minimum. Access seismic lines avoid native fauna burrows and habitat. Implement a no off-road policy for all workers and create designated turn around points to minimise unnecessary disturbance to potential habitat.
	Soil disturbance	Erosion. Sedimentation. Compaction. Subsidence.	Vegetation clearing causing erosion. Light compaction required for rig stability.	2	2	Low	Lines planned and implemented to avoid areas with high erosion potential. Line preparation, survey and rehabilitation of dune crossings conducted in accordance with the Dune Management Plan.

RISK IDENTIFICATION				RISK ANALYSIS		RISK EVALUATION	RISK TREATMENT
Activity	**Event/ Incident**	**Potential Impact**	**Causes**	**Severity**	**Likelihood**	**Risk Ranking**	**Safeguards / Management Methods**
		Dust emissions.					Lines follow swales or run perpendicular to dunes to minimise impact. PFC representative on-site to oversee program. Use recognised and experienced seismic contractor (Terrex). Seismic contractor informed of risks and trained to avoid areas of high erosion potential. During line closure, areas with severe compaction and/or rutting will be identified and will be ripped and/or levelled. Survey area will be inspected to determine whether any soil disturbance issues persist following the first wet season after decommissioning. Active remediation actions initiated if needed.
	Disturbance of indigenous heritage site.	Damage to indigenous heritage sites.	Onsite indigenous heritage sites not previously determined during ethnographic study.	4	2	Medium	Heritage assessment completed prior to works commencing. Personnel trained in local environmental and heritage sensitivities during induction. Survey lines situated to avoid known indigenous cultural areas.
SEISMIC SURVEY							
Seismic survey equipment, personnel and supplies to site.	Introduction of noxious weeds and vermin, exotic species, flora and animal disease.	Infection of soil with diseases and pathogens Infestation of weeds in cleared areas. Local increase in pest fauna.	Weeds and contaminated soil on vehicles.	4	1	Low	Line clearing crew to be provided with weed identification training. Any known weed locations included on swath maps and highlighted at toolbox meetings. Significant weed locations identified during field activities included on seismic line maps and highlighted at toolbox meetings. Food waste properly disposed of in animal proof bins. Following the first wet season after decommissioning, the project area will be inspected to determine whether any weed species have established during auditing and inspection program and remediation actions initiated if needed.
	Disruption of local traffic.	Inconvenience to local landholders, residents and other road users.	Movement of heavy machinery on public roads.	1	2	Low	Due to remote location a significant distance from public access roads, traffic volume will be minimal - Operations along Sandover and plenty highways will be conducted on road verges, not on roadway.
	Ignition sources e.g. vehicle exhaust, smokers.	Loss of vegetation and native fauna	Grass fires and bush fires in uncleared areas from sources of ignition.	3	1	Low	Diesel used in all vehicles. Adequate fire equipment located on-site and in vehicles. Personnel trained in its use. Spark arresters fitted to vehicles. EPR vehicles on site during seismic activities.
	Soil compaction.	Physical or chemical impacts on flora, fauna, soil, surface water or groundwater from soil compaction.	Movement of heavy vehicles.	2	1	Low	All personnel to be inducted into this EMP. Use recognised seismic contractor. Seismic contractor informed of potential risks and trained to minimise soil disturbance where possible Lines planned and implemented to avoid highly sensitive areas. Dune management plan in place During line closure, areas identified with severe compaction

RISK IDENTIFICATION				RISK ANALYSIS		RISK EVALUATION	RISK TREATMENT
Activity	**Event/ Incident**	**Potential Impact**	**Causes**	**Severity**	**Likelihood**	**Risk Ranking**	**Safeguards / Management Methods**
							and/or rutting will be ripped and/or levelled. Following first wet season after decommissioning, proposed survey area will be inspected to determine whether soil disturbance issues persist. Remediation actions initiated if needed (including tilling of compacted soil to aid rehabilitation if required)
During survey	Noise.	Disturbance to local residents, wildlife or adjacent activities.	Noise generated during routine seismic operations.	1	1	Low	Area remote, so negligible, if any, disturbance to residents. Operate only during daylight hours, minimise disturbance to most fauna.
	Visual amenity.	Disturbance to local residents	Presence of seismic vehicles	1	1	Low	General area has low population density and is remote from high density populations e.g. Alice Springs.
	Disturbance or damage to infrastructure and services.	Disruption of services to local residents e.g. power, telecommunications. Damage to fence lines and farm gates	Unknown infrastructure located in the planned survey location. Human error.	2	2	Low	Consultation with relevant utility authorities for the early identification of the locations of existing overhead and buried cables, lines, pipes, water mains or other potentially affected infrastructure. General area has low population density and is remote from high density populations e.g. Alice Springs so will have little in the way of infrastructure and services. Re-instatement of all fences and affected infrastructure to pre-survey conditions as agreed with the relevant landowners.
	Fuel, oil, chemical or waste spills.	Contamination of soil, surface water or groundwater. Mortality of flora and fauna arising from soil, surface and groundwater contamination. Visual pollution from rubbish.	Lack of appropriate bunding around storage and refuelling areas. Inappropriate storage of fuel, oil or chemical drums. Inappropriate handling of fuel, oil or chemicals during use. Improper disposal of wastes.	2	1	Low	Induction to cover refuelling procedures. Use of experienced and reputable contractor (i.e. Terrex Seismic). Fuel, oil and chemical storage areas appropriately segregated, labelled and bunded. Refuelling only at designated areas/no refuelling within 50 m of wetlands or watercourses Drip trays used while refuelling. Clean-up materials available in all relevant areas. Waste oils and chemicals labelled and stored appropriately for offsite disposal by waste management contractor. Maintenance of mandatory waste records including type and volume. Site inspected at conclusion of survey.
Waste Disposal	Visual amenity.	Disturbance to local residents.	Presence of seismic vehicles.	1	1	Low	Area of seismic survey is extremely remote. Line start and end points offset from roads.
	Disturbance or damage to infrastructure and services.	Disruption of services to local residents e.g. power, telecommunications.	Unknown infrastructure located in the planned survey location Human error.	2	2	Low	Consultation with relevant utility authorities for the early identification of the locations of existing overhead and buried cables, lines, pipes, water mains or other potentially affected infrastructure. Area of seismic survey is extremely remote and so will have little in the way of infrastructure and services.
	Release of waste oils or chemicals into the environment. Accidental rubbish	Soil, surface water and groundwater contamination. Mortality of flora and fauna arising from soil,	Site wastes and chemicals not removed at end of seismic program Improper disposal of	3	2	Medium	Spill Kit readily available, crew trained in use. Maintenance of mandatory waste records including type and volumes. Program in place to minimise the volume of wastes generated and to encourage recycling.

RISK IDENTIFICATION				RISK ANALYSIS		RISK EVALUATION	RISK TREATMENT
Activity	**Event/ Incident**	**Potential Impact**	**Causes**	**Severity**	**Likelihood**	**Risk Ranking**	**Safeguards / Management Methods**
	pollution.	surface and groundwater contamination. Visual pollution from rubbish.	wastes.				Landfill not established within 100 m of surface water or within 3 m of ground water. The open face of the landfill will be covered / screened to prevent material escaping from the landfill. The area of the landfill will be fenced to prevent cattle and other animals entering the landfill. Landfill area checked regularly to ensure that no material has been blown or washed out of the landfill. Material found to have escaped will be returned to landfill and corrective actions implemented to prevent reoccurrence. Solid wastes such as scrap wood, metal, packaging and litter segregated and stored in covered rubbish skips for offsite recycling or disposal by waste management contractor. Pallets and oily waste not to be disposed of in landfill. Waste oils and chemicals labelled and stored appropriately for offsite disposal by waste management contractor Site inspected at conclusion of the seismic survey. All top soil will be stockpiled separately from the subsoil removed from the landfill.
	Water or food scraps available for consumption by pests	Increased numbers of pest species displacing non-pest species	Failure to disposed of wastes properly	1	2	Low	Food wastes disposed of in pest proof bins. Any free standing surface water is fenced to prevent access by pest species
DEMOBILISATION AND SITE RESTORATION							
Site restoration and rehabilitation	Disturbed sites abandoned without required rehabilitation as per DOR Schedule of Onshore Petroleum Exploration and Production Requirements - 2012 and this EMP	Erosion by wind or water. Failure of revegetated areas to return to pre-survey conditions. Loss of native vegetation (% cover and diversity) Threat to conservation values in the area. Survey footprint increasing in area, particularly through erosion or sedimentation. Impact on local aesthetics Inappropriate third party access.	Sites not progressively rehabilitated Sites not monitored and assessed for rehabilitation success Access tracks and survey lines not adequately blocked or disguised	4	2	Medium	Rehabilitation in accordance with criteria defined in this EMP and Dune Management Plan. Decommission site inspection conclusion of survey. Continued monitoring and assessment of rehabilitation success and remediation works undertaken until completion criteria have been achieved. Rehabilitation of survey lines and access track to pre survey condition. In compliance with clause 638 of the Schedule of Onshore Petroleum Exploration and Production Requirements – 2012. Rehabilitation of cleared vegetation includes reinstatement of landform, respreading of topsoil and scattering of endemic seed mix prior to wet season. Seismic line and access road intersections blocked within 3 months of the completion of the survey to deter third party access.

7. CONSULTATION

PFC will consult with relevant government authorities, interested persons and organisations on all operations as required. Consultation has been or will be undertaken with the following stakeholders regarding the seismic survey (see Table) and will continue during surveying activities:

- Traditional Owners through the CLC.
- Pastoral leaseholders.
- Department of Mines and Energy

Table 16: Stakeholder consultation

Stakeholder	Status	PFC Consultation
Central Land Council	Representative of Traditional Owners	Sacred Site Clearance Certificate (SSCC) issued.
Georgina Downs	Pastoral Lease holder	Recording only on public road, no notification required
Lake Nash	Pastoral Lease holder	Letter advising of activities sent 7 June 2013
Argadargada	Pastoral Lease holder	Letter advising of activities sent 24 April 2013
Annitowa	Pastoral Lease holder	Letter advising of activities sent 7 June 2013
Lucy Creek	Pastoral Lease holder	Letter advising of activities sent 7 June 2013
Tarlton Downs	Pastoral Lease holder	Letter advising of activities sent 7 June 2013
Manners Creek	Pastoral Lease holder	Letter advising of activities sent 7 June 2013
Marqua	Pastoral Lease holder	Letter advising of activities sent 7 June 2013

8. CONTACT DETAILS

Griff Weste
Operations Geologist
PetroFrontier (Australia) Pty Ltd
Level 1, 262 Franklin Street
Adelaide SA 5000

Telephone: 08 8104 3202
Facsimile: 08 8231 8532
Email: gweste@petrofrontier.com

Erik Vik
Manager, Engineering & Operations
PetroFrontier (Australia) Pty Ltd
Level 1, 262 Franklin Street
Adelaide SA 5000

Telephone: 08 8104 3252
Facsimile: 08 8231 8532
Email: evik@petrofrontier.com
