

# EP413 3D seismic acquisition survey

## Offsets strategy

Prepared for  
Norwest Energy NL  
by Strategen

July 2014



**STRATEGEN**  
environmental consultants



# **EP413 3D seismic acquisition survey**

## **Offsets strategy**

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July 2014

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## **Client: Norwest Energy NL**

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# 1. Introduction

## 1.1 Background and context

Norwest Energy NL (Norwest), as operator of the EP413 joint venture, is proposing to undertake geophysical exploration of potential shale gas resources in the Midwest region of Western Australia. The 3D seismic acquisition survey (the Survey) will be undertaken over an area comprising approximately 10 600 ha (106 km<sup>2</sup>), subject to Exploration Permit No. 413 (EP413). EP413 is located in the Arrowsmith area, approximately 250 km north of Perth along the Brand Highway between Eneabba and Dongara (Figure 1).

The purpose of this survey is to characterise the prospectivity of shale gas resources within the delineated area of EP413 and to define the location of the Beagle Fault that traverses EP413. Approximately 2% of native vegetation within the 10 600 ha area (Development Envelope) will be disturbed as a result of the Survey.

The Survey requires disturbance (by mulching) of up to 200 ha of native vegetation (Disturbance Footprint) within a defined seismic survey boundary (Development Envelope) (Figure 1).

## 1.2 Purpose of this document

The Survey has been referred to Environmental Protection Authority (EPA) under section 38 of the EP Act and the level of assessment set at Assessment on Proponent Information (API). To support assessment of the Survey, the EPA requested additional information on potential significant residual impacts and offsets.

The Survey has also been referred to Department of the Environment (DotE) under s 68 of the EPBC Act. DotE determined the proposed action to be a 'controlled action – assessment on preliminary documentation'. DotE requested additional information be provided in support of the referral including an outline of the proposed offsets for the disturbance of black cockatoo foraging habitat to compensate for any residual significant impact. DotE requested an outline of how the proposed offsets align with the principles of the EPBC Act *Environmental Offset Policy*.

During subsequent discussions with DotE, it was agreed that offset requirements needed to include consideration of the temporary nature of the Survey.

This offsets package presents the details of potential offsets to mitigate the environmental impacts of the proposal. The package has been prepared to accompany the following environmental approval documents:

- Environmental Review (ER) document prepared for submission to EPA for assessment (API)
- additional information prepared for submission to DotE for assessment.

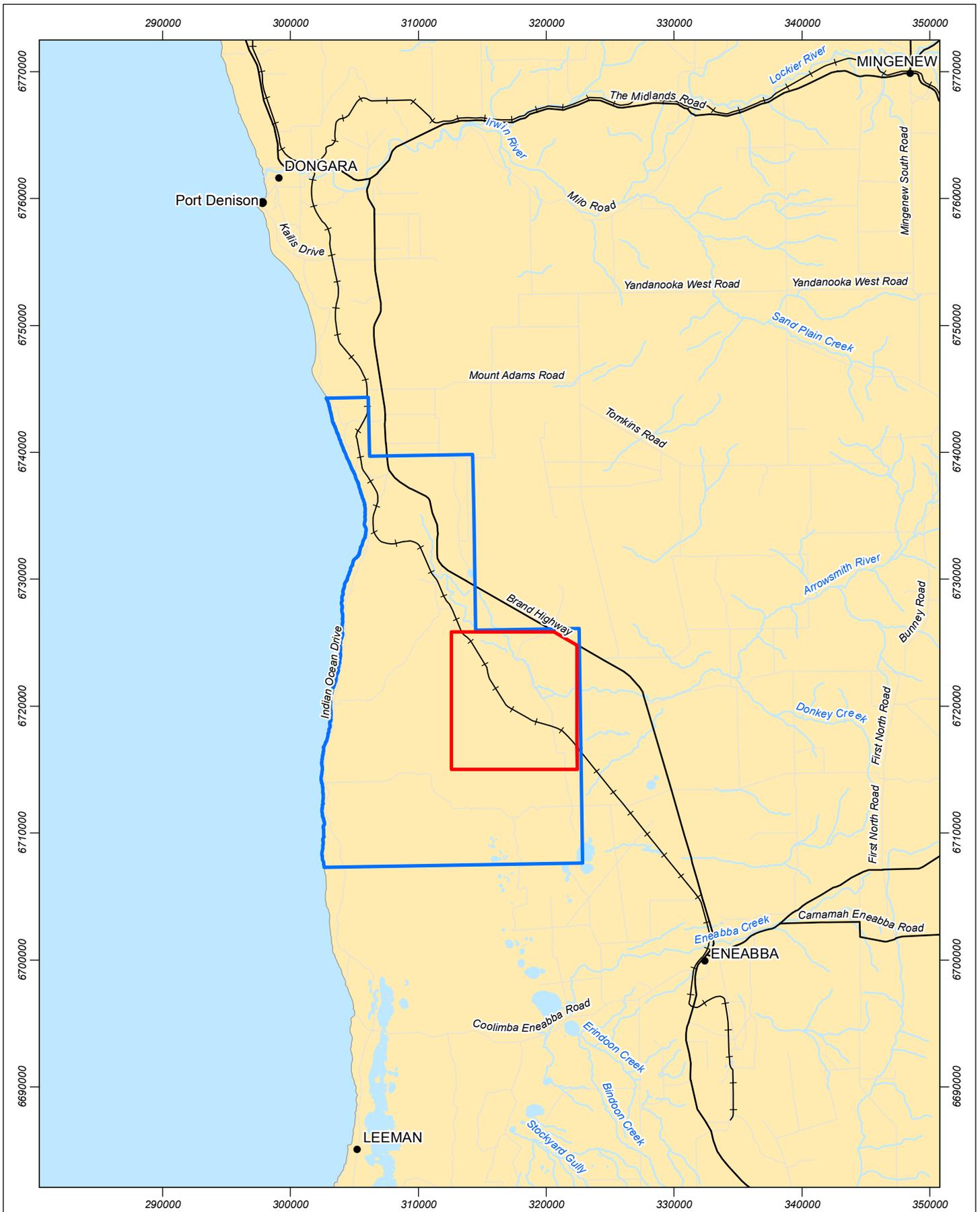
## 1.3 Overview of proposal

The main elements of the Survey involve laying out a grid of receiver cables and detectors and conducting a seismic survey. One of the key objectives of the survey is to define the location and form of the Beagle Fault, which is located near the eastern boundary of Beekeepers Nature Reserve. There is no intention to conduct any drilling within the nature reserve. The survey will assist Norwest in ensuring future wells are drilled in locations that minimise the risk of intersecting this fault system. Disturbance of native vegetation is required to provide survey line access.

The Survey will require temporary disturbance of vegetation in seismic lines up to 4 m wide by cutting all vegetation as close to ground level as possible and mulching greenstock to facilitate vehicle access. Seismic lines will be created at grid intervals of between 350–450 m, in both north-south and east-west directions. The total area of temporary disturbance is up to 200 ha (approximately 2% of the Development Envelope). The seismic lines will facilitate access across the area for vibroseis trucks and light vehicles to carry out the survey. The survey will be undertaken over a period of approximately twelve weeks, during which seismic line preparation is expected to take approximately two weeks, with a potential lay period before the seismic survey is carried out over a period of approximately 4 weeks. Additional time has been incorporated to allow for mobilisation and demobilisation.

Geophone receivers are placed along east-west oriented lines, laid using light vehicles. Geophones are inserted into the ground to approximately 100 mm depth. Vibroseis trucks traverse north-south source lines, creating acoustic vibrations at regular intervals, which are received by the geophones. Data received is interpreted to create subsurface imaging.

Seismic survey lines can be deviated from the nominal mapped alignments by up to approximately 15 m without losing definition in survey results. This allows for deviation of survey lines to avoid rock outcrops, large trees, soaks, creek lines and other environmental values such as populations of conservation significant flora, vegetation or fauna habitat.



**Figure 1 Seismic survey boundary**

Scale 1:400,000 at A4

Coordinate System: GDA 1994 MGA Zone 50  
 Note that positional errors may occur in some areas  
 Date: 22/05/2014  
 Author: JCrute  
 Source: Topography: Geoscience Australia 2012.  
 EP 413; DMP 2012.



**Legend**

- Town
- Major road
- Minor road
- + Railway
- Development envelope
- Exploration Permit EP413



## 1.4 Site description

### 1.4.1 Beekeepers Nature Reserve

The western edge of the Development Envelope partially overlies Beekeepers Nature Reserve (Figure 3–1). Beekeepers Nature Reserve is located within the DPaW management district of Moora and is divided into two sections, northern and southern. Part of the northern section of Beekeepers Nature Reserve is located within the Development Envelope. Beekeepers Nature Reserve (Northern) is located between the towns of Dongara and Jurien, within the vicinity of Yordanogo Nature Reserve to the north and Lake Logue Nature Reserve to the south. The southern portion of Beekeepers Nature Reserve is located further south, between Jurien and Cervantes. There are many other nature reserves between the towns of Dongara and Jurien on the Western Australian coast, including the following nearest Beekeepers Nature Reserve (Northern):

- Watto Nature Reserve (east)
- Tathra Nature Reserve (east)
- South Eneabba Nature Reserve (south-east)
- Lesueur National Park (south)
- Drovers Cave National Park (south)
- Coomaloo Nature Reserve (south).

Beekeepers Nature Reserve is a major regional nature reserve covering an area of about 120 000 ha that was vested with the Conservation Commission of Western Australia (CCWA) as a “C” Class Nature Reserve for the Protection of Flora in 1992. It is listed as a nature reserve under the *Conservation and Land Management Act 1984*.

Beekeepers Nature Reserve is managed by the Department of Parks and Wildlife (DPaW) on behalf of CCWA.

### 1.4.2 Fauna

The survey is proposed in an area of foraging habitat for Carnaby’s Black-Cockatoos (*Calyptorhynchus latirostris*), indicated by the prevalence of different varieties of Banksia species. Carnaby’s Black-Cockatoos are currently listed as:

- ‘Schedule 1 – fauna that is rare or is likely to become extinct’ under the *Wildlife Conservation Act 1950* (WC Act)
- ‘Endangered’ under the EPBC Act.

The Development Envelope may also provide habitat for Malleefowl (*Leipoa ocellata*), indicated by the presence of disused nesting mounds. Malleefowl are currently listed as ‘Schedule 1 – fauna that is rare or is likely to become extinct’ under the WC Act, and ‘Vulnerable’ under the EPBC Act.

The Rainbow bee-eater (*Merops ornatus*) may also occur within the Development Envelope. This species is a listed migratory and marine species under the EPBC Act.

### 1.4.3 Flora

The region is well known for its high level of floral biodiversity, and the Development Envelope hosts a number of specimens of flora species under state-level protection. A portion of the Survey overlays Beekeepers Nature Reserve, recognised for its flora and vegetation values.

Based on a database search, the Development Envelope may provide habitat for six flora species listed as ‘Endangered’ and one species listed as ‘Critically Endangered’ under the EPBC Act. None of these species were identified during the Level 2 survey (Western Botanical 2014).

## 1.5 Proposed management and mitigation

The seismic survey has been designed to minimise impacts to significant environmental values within EP413. An overview of the mitigation hierarchy applied to the Survey is provided in Table 1-1, in accordance with Environmental Offsets Position Statement No. 9 (PA 2006).

Table 1-1: Mitigation options to manage adverse environmental impacts

Avoidance	
1	<p>Avoidance of survey: Existing 2D seismic data is of insufficient quality to reuse for the purpose of this survey for the following reasons:</p> <ul style="list-style-type: none"> <li>• 2D migration is not sufficient to resolve complex subsurface structures associated with poor signal to noise ratios</li> <li>• near-surface limestone results in data distortion</li> <li>• reprocessing of older data resulted in minor improvements in data quality, remaining insufficient for use</li> <li>• line frequency used was too large for interpretation for the purpose of this survey.</li> </ul>
2	<p>Avoidance of survey: The Development Envelope has been located to utilise existing seismic data where possible, rather than re-sampling areas that have been subjected to previous surveys.</p>
3	<p>Avoidance of vegetation disturbance impacts: Heli-portable surveying was considered; however, was determined to be cost-prohibitive.</p>
4	<p>Avoidance of vegetation disturbance impacts: Existing tracks will be used wherever possible but this can only be decided once on the ground, taking avoidance areas into consideration.</p>
5	<p>Avoidance of impacts to Beekeepers Nature Reserve: Data collected from the fringes of a seismic survey is of poorer quality than data collected from the centre. As such, the proposed Development Envelope integrates a buffer to ensure data acquired is of sufficient quality to define the extent of the fault. The survey would ideally have been extended several kilometres further west, further into Beekeepers Nature Reserve. However, it has been restricted to the extent provided as an absolute minimum encroachment on the Reserve.</p>
6	<p>Avoidance of subsurface impacts: No drilling is proposed in association with seismic surveying, avoiding impacts to unmapped subsurface features.</p>
Minimisation (limit magnitude)	
1	<p>Minimisation of vegetation disturbance impacts: Given the limited capability of equipment to mulch mature trees and large shrubs, disturbance to these habitat types will be avoided. Norwest will also implement a policy to avoid any areas of environmental significance (Malleefowl mounds, mapped populations of Priority-listed flora species, rock outcrops, slow-growing species, waterways)—source and receiver lines will be placed where they do not affect these features.</p>
2	<p>Minimisation of vegetation disturbance impacts: Other surveys in the region (Denison 3D seismic acquisition survey 2004) have used a greater line frequency (240 x 480 m) instead of the proposed 350–450 m frequency (average 400 x 400 m used for prediction of impact) – Norwest has broadened the line frequency to minimise environmental footprint as much as possible and still achieve data quality objectives. This will apply across the Development Envelope as a whole, as consistency is required.</p>
3	<p>Seismic line widths:</p> <ol style="list-style-type: none"> <li>1. Maximum seismic line widths have been reduced from 5 m to 3.6 m to minimise the amount of vegetation disturbance required.</li> <li>2. Disturbance Footprint estimated at 200 ha (based on seismic line widths of 2.5–3.6 m) within a total Development Envelope of approximately 10 600 ha.</li> <li>3. Actual impact area is expected to be only 184.13 ha, based on: <ul style="list-style-type: none"> <li>• 3.6 m source line widths to accommodate the seismic vibroseis vehicles</li> <li>• half of the receiver line widths of 2.5 m (to accommodate light vehicles only)</li> <li>• the other half of the receiver line widths of 3.6 m (for vibroseis vehicles to traverse the site).</li> </ul> <p>NB. Impact area calculations are likely to be lower still, as this total does not take into account sections of lines that will not require vegetation disturbance through the use of existing tracks.</p> </li> <li>4. Quantity of Disturbance Footprint estimated in referral documents has been deliberately conservative.</li> </ol>
4	<p>Minimisation of compaction: Vehicle passes will be kept to a minimum to mitigate soil compaction.</p>

Rectification (restore, repair)	
1	Creating conditions appropriate for regeneration: Topsoil and rootstock will be left undisturbed and all cut vegetation mulched and spread over disturbed area, providing ideal conditions for regeneration of native vegetation.
2	Survey line rehabilitation: <ul style="list-style-type: none"> <li>• Vegetation will be cut as near to the ground surface as possible leaving rootstock intact, greenstock will be mulched, and mulch replaced immediately on seismic lines, returning seed stock and biomass to the soil and providing a cover to minimise soil erosion.</li> <li>• Where seismic lines intersect existing access tracks, entrances will be concealed by orientation and the use of vegetative cover to prevent future vehicle access that may introduce weed seeds or dieback-infected soil and inhibit regeneration of native vegetation.</li> <li>• Lines will be woven (zig-zagged) to diminish sight-lines visible from access tracks, to minimise unauthorised public access.</li> </ul>
Reduction (over time)	
1	Temporary duration of survey: No further exploration is proposed at this time.
2	Limiting public access: Public access to seismic lines will be minimised through orientation and concealment of line entrances where they intersect with access tracks.
3	Limiting public access: Fence lines will be left intact, leaving the current number of access points unchanged.

## 1.6 Residual impact

The key residual environmental impacts of the Survey after application of the mitigation hierarchy include:

- temporary disturbance to up to 200 ha of potential medium-value habitat for Carnaby's Black-Cockatoo (63 ha of which is located in Beekeepers Nature Reserve)
- temporary disturbance of 63 ha of vegetation within Beekeepers Nature Reserve, a portion of which is significantly affected by recent fires.

While the above residual impacts have been identified, these impacts must also be placed in the following context:

1. No permanent impacts are anticipated as a result of the Survey. The only residual impact of the Survey is considered to be the temporary reduction in potential foraging habitat across the Development Envelope during the three year period while less mature trees and shrubs recover.
2. Broad-scale disturbance is not proposed. The proposed disturbance is distributed within an overall Development Envelope of 10 600 ha. Less than 2% of vegetation within the Development Envelope will be affected and significant areas of habitat will remain.
3. Mulching equipment is unable to process trees/shrubs with a trunk diameter of greater than 100 mm. This means that mature trees/shrubs will be retained and only less mature specimens and understorey species will be disturbed. The identified 200 ha of disturbance to potential foraging habitat is, therefore, expected to be an over-estimation of actual impact.
4. The method of disturbance (mulching) allows rootstock and topsoil to remain undisturbed, and seed stock to be immediately replaced, significantly improving the likely success of rehabilitation and reducing the timeframe for disturbed vegetation to regenerate.
5. Disturbed vegetation is expected to fully recover within three wet seasons to be undiscernible from surrounding, undisturbed vegetation.

The level of residual impact as described above has been used to determine an appropriate level of offsets for the Survey using relevant State and Commonwealth policy and guidance.

## 2. Offset framework

### 2.1 Regulatory framework

Consideration of environmental offsets is required by both the WA State Government and Australian Government to ensure a proposal results in net environmental benefit. Where a proposal is being assessed in parallel under the *Environmental Protection Act 1986* (EP Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), agencies will endeavour to align offset requirements.

### 2.2 Policy framework

Where a significant residual environmental impact has been identified, both the WA Government and the Australian Government have policies regarding offsets (DSEWPaC 2012, Government of Western Australia 2011, EPA 2008, EPA 2012).

#### 2.2.1 EPA offsets policy

Offsets are actions to address significant residual environmental impacts of a development or activity. Where a significant residual environmental impact has been identified, the WA Government Environmental Offsets Policy 2011 (Offsets Policy) aims to achieve a net environmental benefit, or at a minimum maintain environmental values (Government of Western Australia 2011).

When considering proposed environmental offsets, the EPA is guided by the following principles as outlined in the Offset Policy:

- environmental offsets should only be considered after all other reasonable attempts to mitigate adverse impacts have been exhausted
- an environmental offset package should address both direct offsets and contributing offsets
- environmental offset and impact should ideally be “like for like or better”
- positive environmental offset ratios should apply where risk of failure is apparent
- environmental offsets must entail a robust and consistent assessment process
- environmental offsets must meet all statutory requirements
- environmental offsets must be clearly defined, transparent and enforceable
- environmental offset must ensure a long lasting benefit (Government of Western Australia 2011).

#### 2.2.2 WA Government Environmental Offsets Guidelines (draft)

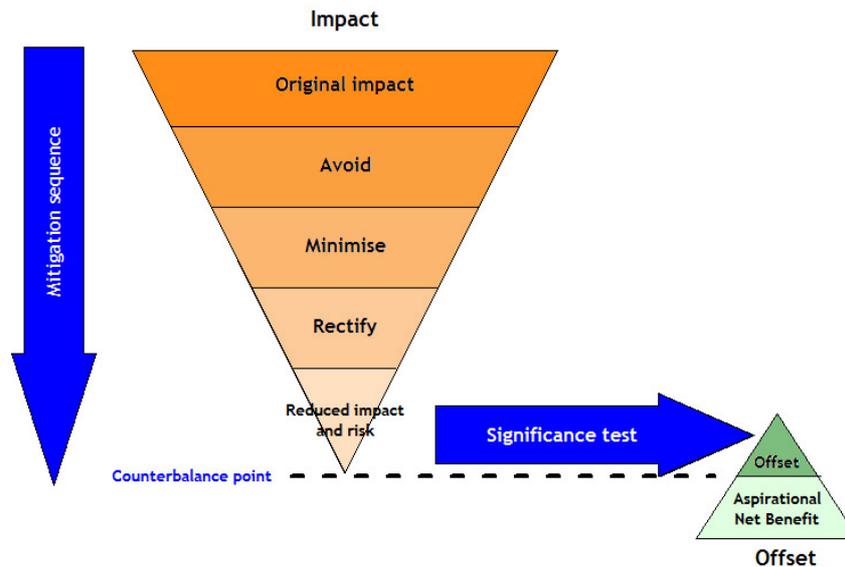
The WA Government has recently released a draft WA Government Environmental Offsets Guideline (Offset Guidelines) that is intended to complement the Offsets Policy by clarifying the determination and application of environmental offsets in Western Australia (Government of Western Australia 2014). The Offset Guidelines outline the methodology for determining an appropriate offset by identifying the key elements that should be considered to ensure that decisions made on environmental offsets are consistent and accountable under the EP Act.

The Offset Guidelines outline the framework for consideration of offsets required under the environmental approvals process, including demonstrated application of the mitigation hierarchy and assessment of the residual impacts in relation to relevant EPA environmental factors (Government of Western Australia 2014).

The mitigation hierarchy as documented within the Offset Guidelines is presented in Figure 2–1, in which the following four scenarios are presented, in decreasing order of environmental impact:

- A) No mitigation measures taken
- B) Mitigation measures employed, but significant residual impact remains
- C) Residual impacts remain significant - Offsets are required
- D) Impacts have been reduced to an acceptable level - Offsets are not required

Figure 2–1: Mitigation hierarchy (EPA Draft Environmental Offsets Guidelines 2012)



The provision of offsets is the final mitigation option available to help manage significant adverse environmental impacts.

### 2.2.3 Australian Government policy

The Environmental Offsets Policy (EPBC Act Policy) (DSEWPaC 2012b) defines two types of offsets

- **direct offsets:** measures that have on-ground, tangible benefits that improve the viability of the protected matter
- **other compensatory measures:** any other measure that contributes to the overall conservation outcome of the protected matter.

Principles guiding the EPBC Act Policy are that offsets:

1. Deliver an overall conservation outcome.
2. Be efficient, effective, transparent, proportionate, scientifically robust and reasonable.
3. Be built around direct offsets but may include indirect (i.e. compensatory) offsets.
4. Be of a size and scale proportionate to the impacts being offset.
5. Be in proportion to the level of statutory protection that applies to the affected species or community.
6. Effectively manage the risks of the offset not succeeding.
7. Be able to be readily measured, monitored, audited and enforced.

### 3. Assessment of impacts requiring offsets

#### 3.1 Flora and vegetation

The EPA objective for vegetation and flora is:

*To maintain representation, diversity, viability and ecological function at the species, population and community level.*

##### 3.1.1 Nature and scale of impact

Impacts to flora and vegetation will be temporary and widely distributed across the Development Envelope. Disturbance to flora and vegetation comprises the mulching of 200 ha of native vegetation in seismic lines up to 3.6 m wide, across a Development Envelope of 10 600 ha. Disturbance of vegetation is expected to occur over a period of approximately two weeks within a total survey duration of twelve weeks (allowing for mobilisation and demobilisation), after which mulched seismic lines will be allowed to regenerate.

The process of rehabilitation will commence immediately on completion of the survey, with the placement of mulch on survey lines as it is created. Vegetation is expected to have regenerated to match pre-disturbance conditions within several years. Monitoring of regrowth is proposed for three years following completion of the survey to validate the proposed rehabilitation strategy.

##### 3.1.2 Impact to rare and protected flora species

No threatened ecological communities (TEC) or priority ecological communities (PEC) have been identified during surveys of the Development Envelope by O2 Ecology (2012) or Western Botanical (2014).

No threatened flora species have been recorded during surveys.

Thirteen Priority flora species were recorded within the Development Envelope during the recent Level 2 survey, distributed amongst the four categories of priority as follows:

- 1 x P1
- 2 x P2
- 7 x P3
- 3 x P4.

The Survey may result in the disturbance of these Priority flora species. Populations of these species have been identified, and known population locations will be demarcated and avoided as far as possible by deviating survey lines up to 15 m.

The Survey will not result in a change in the status of plants of conservation significance and will not significantly affect the regional distribution of flora and vegetation species. Existing management measures are expected to mitigate any significant residual environmental impact to conservation significant flora species within the Development Envelope.

#### 3.2 Fauna

The EPA applies the following objective in its assessment of proposals that may affect terrestrial fauna:

*To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.*

### 3.2.1 Nature and scale of impact

Impacts to rare or protected fauna will consist of temporary removal of potential habitat. As with flora and vegetation, impacts will be temporary and widely distributed across the Development Envelope. Disturbance to fauna habitat comprises the mulching of 200 ha of native vegetation in seismic lines up to 3.6 m wide, across a Development Envelope of 10 600 ha. Disturbance of habitat is expected to occur over a period of approximately two weeks within a total survey duration of twelve weeks (allowing for mobilisation and demobilisation), after which mulched seismic lines will be allowed to generate to re-establish habitat value.

The process of rehabilitation will commence immediately on completion of the survey, with the placement of mulch on survey lines as it is created. Vegetation is expected to have regenerated to match pre-disturbance habitat conditions within several years. In the interim, regenerating vegetation (new, green shoots) is likely to provide good foraging habitat. Monitoring of regrowth is proposed for three years following completion of the survey to validate the proposed rehabilitation strategy.

### 3.2.2 Impact to rare and protected fauna species

A search of the threatened fauna database and EPBC Act Protected Matters database indicated that two Priority 4 species, six specially protected and two threatened species may be present in the Development Envelope (O2 Ecology 2012) (Table 3-1). Of these, three have been recorded within the Development Envelope (Table 3-1).

Table 3-1: Conservation significant fauna recorded within Development Envelope (O2 Ecology 2012)

Species	Status		Assessment
	WC Act / DPaW	EPBC Act	
Carnaby's Black-Cockatoo	T	E	Observed in woodland within Development Envelope
Rainbow Bee-eater	IA	M	Several sightings within Development Envelope
Malleefowl	T	V	Nesting site (disused mound) observed within Development Envelope

T = Threatened under *Wildlife Conservation Act 1950* (WC Act); E = Endangered under *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); M= migratory under EPBC Act; IA = International Agreement (JAMBA (Japan-Australia Migratory Bird Agreement)).

#### *Carnaby's Cockatoo*

Based on an assessment of vegetation, the majority of the Development Envelope (96.3%) contains suitable foraging species for Carnaby's Black-Cockatoo and may, therefore, provide habitat for this species.

An assessment has been undertaken against the DotE Significant Impact Criteria to determine the potential environmental impacts on this species (Table 3-2). An assessment of the habitat value of the Development Envelope for this species is provided in Appendix 1.

Table 3-2: Significant impact criteria for Carnaby's Black-Cockatoo

Significant impact criteria	Comment
Determine whether the proposed action will lead to a long-term decrease in the size of a population of the species	The majority of the Development Envelope (96.3%) has been identified as containing suitable feeding habitat for Carnaby's Black-Cockatoo and there was one visual and aural observation of a Carnaby's Black-Cockatoo during the fauna assessment. Given the maximum disturbance area represents 1.8% of the Development Envelope, mature trees and shrubs will be retained and the vegetation is expected to recover quickly, the proposed action will not result in a long-term decrease in the size of a population of the species. Mulching of vegetation has been adopted as the preferred method of vegetation disturbance as it is temporary with vegetation able to regenerate more quickly than would be the case with broad-scale clearing.

Significant impact criteria	Comment
Determine whether the proposed action will reduce the area of occupancy of the species	No more than 200 ha within a total Development Envelope of 10 600 ha will be disturbed as a result of the proposed action. The disturbance will be in narrow lines in a grid across the Development Envelope. Habitat will be largely intact throughout the Development Envelope and the duration of the survey is short so species would be expected to continue to use the Development Envelope. Given the limited nature and distributed extent of the disturbance, the proposed action will not reduce the occupancy of the species.
Determine whether the proposed action will fragment an existing population into two or more populations	Vegetation will be cut and mulched along seismic lines either 2.5 or 3.6 m wide. Survey grid spacing is at intervals of between 350 m and 450 m. Vegetation is expected to recover quickly and impact to the fauna habitat is not considered significant. Given the limited nature and distributed extent of the disturbance, the proposed action is not anticipated to fragment populations of the species. In addition, Carnaby's Black-Cockatoos are a highly mobile species and the narrow lines of proposed vegetation disturbance will not present a barrier to movement across the region.
Determine whether the proposed action will adversely affect habitat critical to the survival of the species	Whilst kwongan vegetation is known to comprise foraging habitat (Australian Heritage Database 2012), the Development Envelope is identified as non-breeding habitat for Carnaby's Black-Cockatoo (DSEWPaC 2011) and there is a low risk of breeding habitat trees occurring within the Development Envelope. The mulched lines can be deviated to avoid any habitat trees that are encountered. Given the nature and extent of disturbance, the proposed action will not significantly affect habitat critical to survival of the species. In addition, disturbance to potential foraging habitat will be minimised through implementation of mitigation measures, as outlined in Table 11.
Determine whether the proposed action will disrupt the breeding cycle of a population	The Development Envelope is identified as non-breeding habitat for Carnaby's Black-Cockatoo (DSEWPaC 2011) and there is considered to be a low risk of breeding habitat trees within the Development Envelope, which will be avoided if present. The proposed action will not disrupt the breeding cycle of a population.
Determine whether the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No more than 200 ha within a total Development Envelope of 10 600 ha will be disturbed as a result of the proposed action. Given the limited extent of the disturbance, its low density distribution, its temporary nature, and with vegetation expected to recover relatively quickly, the proposed action will not affect the availability or quality of habitat to the extent that the species is likely to decline.
Determine whether the proposed action will result in invasive species that are harmful to the endangered species, becoming established in the endangered species' habitat	The proposed action will not result in introduction or spread of invasive species that are harmful to the species or its habitat. Impact due to invasive species will be minimised through implementation of mitigation measures as outlined in Table 1-1.
Determine whether the proposed action will introduce disease that may cause the species to decline	Disease is not a known threat to Carnaby's Black-Cockatoo. The proposed action will not introduce disease that may cause the species to decline. Whilst foraging species may be susceptible to Dieback, a soil pathogen survey conducted across the seismic Development Envelope did not detect any outbreaks of Dieback. Additionally, impact due to Dieback will be minimised through implementation of mitigation measures as outlined in Table 1-1.
Determine whether the proposed action will interfere with the recovery of the species	The proposed action will not interfere with the recovery of the species. No breeding habitat is understood to be present in the area, and disturbance to potential breeding habitat that may exist will be minimised through implementation of mitigation measures, as outlined in Table 1-1. Given the vegetation is expected to recover relatively quickly; the proposed action will not interfere with the recovery of the species.

### *Malleefowl*

Malleefowl is a large and distinctive ground-dwelling bird that inhabits semi-arid regions of southern Australia, where it occupies shrublands and low woodlands that are dominated by mallee vegetation. In Western Australia, Malleefowl is mostly located to the south and west of a line extending from Cape Farquhar, north of Carnarvon, to the Eyre Bird Observatory in the southeast of the state. Threats to Malleefowl primarily consist of clearance and fragmentation of mallee vegetation habitat for forestry and grazing, predation by European red fox and feral cats, and degradation of existing habitat by tramp ants, feral rabbits and feral goats (DSEWPac 2013).

An assessment has been undertaken against the DotE Significant Impact Criteria to determine the potential environmental impacts on this species (Table 3-3). An assessment of the habitat value of the Development Envelope for this species is provided in Appendix 1.

Table 3-3: Significant impact criteria for Malleefowl

Significant impact criteria	Comment
Determine whether the proposed action will lead to a long-term decrease in the size of a population of the species	A single disused Malleefowl nesting site was observed during the fauna assessment and patches of suitable habitat occur within the Development Envelope. Vegetation is expected to recover relatively quickly and impact to the fauna habitat is not considered to be significant. The proposed action will not result in a long-term decrease in the size of a population of the species. Any nesting sites encountered will be avoided by realignment of the survey lines to avoid impact.
Determine whether the proposed action will reduce the area of occupancy of the species	No more than 200 ha within a total Development Envelope of 10 600 ha will be disturbed as a result of the proposed action. Given the low density of the distributed mulching, and as only patches of the proposed area of disturbance represent suitable habitat for Malleefowl, the proposed action will not reduce the occupancy of the species.
Determine whether the proposed action will fragment an existing population into two or more populations	Vegetation will be mulched in seismic lines between 2.5–3.6 m wide. Survey grid spacing is at intervals of between 350–450 m. Vegetation is expected to recover relatively quickly and impact to the fauna habitat is not considered to be significant. Given the limited extent of the disturbance, its low density distribution, its temporary nature, and with vegetation expected to recover relatively quickly, the proposed action will not fragment populations of the species.
Determine whether the proposed action will adversely affect habitat critical to the survival of the species	Patches of suitable habitat occur within the Development Envelope and potentially exist within proposed survey lines. However, given the limited extent of the disturbance, its low density distribution and its temporary nature, the proposed action will not significantly affect habitat critical to the survival of the species.
Determine whether the proposed action will disrupt the breeding cycle of a population	Malleefowl mounds will be avoided when encountered along survey lines. The proposed action will not disrupt the breeding cycle of a population.
Determine whether the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No more than 200 ha within a total Development Envelope of 10 600 ha will be disturbed as a result of the proposed action. Given that only patches of the proposed area of disturbance represent suitable habitat for Malleefowl and vegetation is expected to recover relatively quickly, the proposed action will not affect the availability or quality of habitat to the extent that the species is likely to decline.
Determine whether the proposed action will result in invasive species that are harmful to the endangered species, becoming established in the endangered species' habitat	Invasive fauna species that may occupy Malleefowl habitat or are harmful to Malleefowl comprise foxes and feral cats. Through appropriate management of onsite waste, the proposed action will not result in the introduction or encourage the spread of these invasive fauna species. In addition, weed management will be implemented through cleaning of vehicles prior to arrival onsite, avoidance of vehicle traffic through weed-infested areas, and ongoing weed monitoring at yearly intervals to gauge impact of the seismic survey on weed species diversity and spread.

Significant impact criteria	Comment
Determine whether the proposed action will introduce disease that may cause the species to decline	The proposed action will not introduce disease that may cause the species to decline through appropriate management of vehicle hygiene and onsite waste. A dieback survey conducted in 2013 identified no incidences of dieback within the Development Envelope.
Determine whether the proposed action will interfere with the recovery of the species	The proposed action will not affect the mortality of the local population and disturbance to potential habitat will be minimised through implementation of management and mitigation. The proposed action will not interfere with the recovery of the species.

Based on survey information, the likelihood of encountering Malleefowl or their nesting sites is considered to be low and avoidable. While the formation of vehicle access seismic lines requires disturbance of native vegetation, impacts to Malleefowl will be mitigated by:

- induction of personnel in documented site management measures
- avoidance of Malleefowl mounds encountered
- avoidance of Malleefowl individuals
- immediate replacement of mulch on seismic lines to retain topsoil and seed stock.

The temporary nature of the survey (six weeks within a twelve week window) is not anticipated to result in significant residual impacts to the species. Existing management measures are expected to mitigate any significant residual environmental impact to Malleefowl.

#### *Rainbow bee-eater*

All fauna habitat types identified within the Development Envelope can be considered potentially appropriate for Rainbow bee-eater. Many observations of Rainbow bee-eater were made during the fauna habitat assessment carried out in 2012, primarily in Eucalyptus woodland, Banksia scrub and amongst Xanthorrhoea, but also within disturbed areas along the rail line.

Offsets of impacts to potential habitat have not been further considered for the Rainbow bee-eater, as whilst the area may provide suitable habitat for this species, it is a migratory species that is attracted to disturbance areas. Sightings of the species indicate that the Development Envelope provides potential habitat; however, there is abundant similar habitat adjacent to the Development Envelope to the north, south and east.

The temporary nature of the survey (six weeks within a twelve week window) is therefore not anticipated to result in significant residual impacts to the species. Existing management measures are expected to mitigate any significant residual environmental impact to potential Rainbow bee-eater habitat.

### 3.3 Beekeepers Nature Reserve

A portion of the Development Envelope is located within Beekeepers Nature Reserve. Approximately one third of the Development Envelope is located within the Reserve (3014 of ~10 600 ha) and up to 63 ha of vegetation will be disturbed within the Reserve as a result of the Survey.

Vegetation and flora within some areas of Beekeepers Nature Reserve is currently in a degraded state, having been burnt during bushfires between 2000 and 2012. As such, vegetation structure and composition within these areas have been affected and are not considered to provide valuable habitat for threatened fauna species.

There are many other nature reserves between the towns of Dongara and Jurien on the Western Australian coast, including the following nearest Beekeepers Nature Reserve (Northern) (Figure 3–1).

- Watto Nature Reserve (east)
- Tathra Nature Reserve (east)
- South Eneabba Nature Reserve (south-east)
- Lesueur National Park (south)

- Drovers Cave National Park (south)
- Coomallo Nature Reserve (south).

Published management plans for these areas appear to be restricted to the following (approximately 5 km south of Beekeepers Nature Reserve (Northern):

- Lesueur National Park and Coomallo Nature Reserve 1995-2005 (CALM 1995).

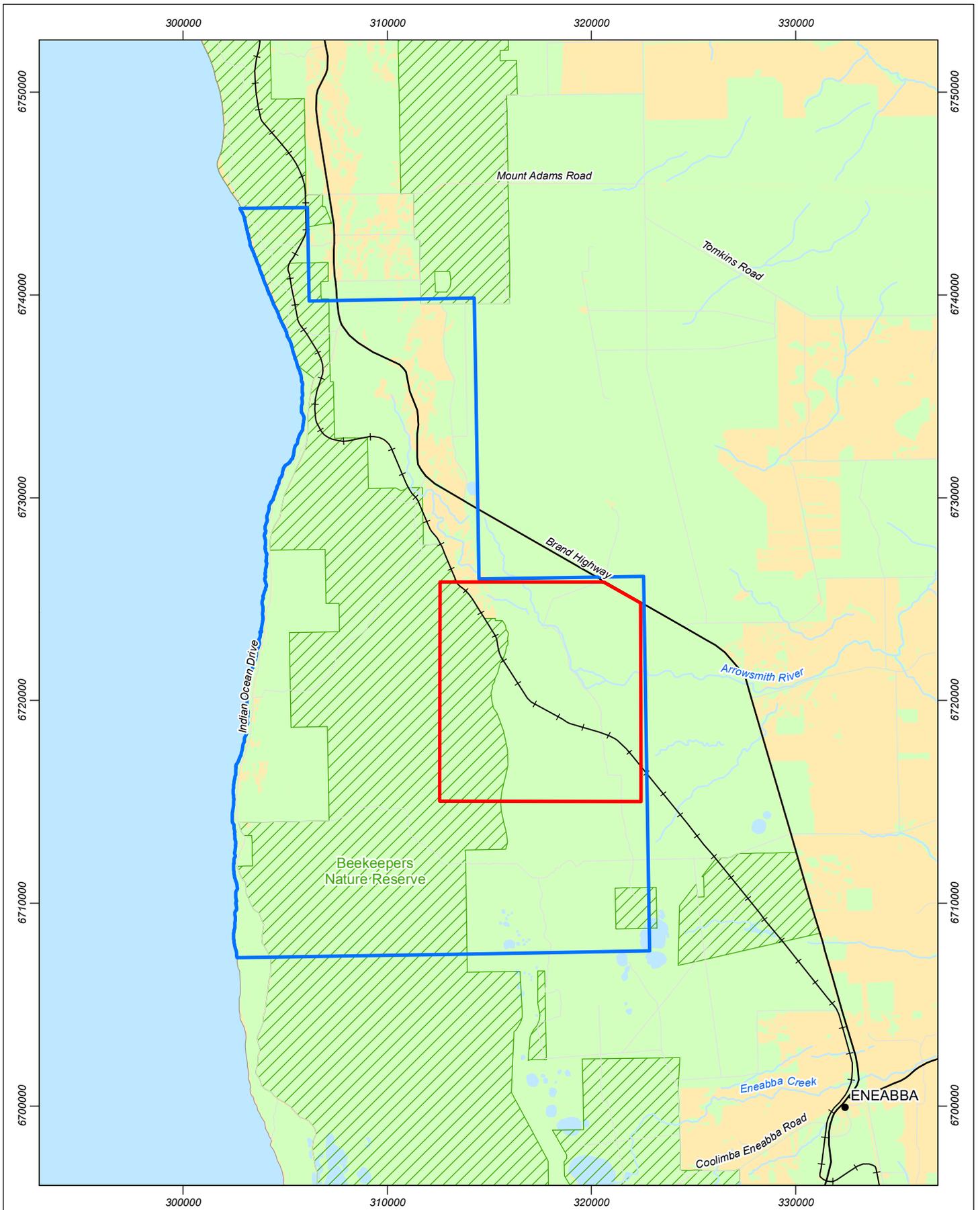
Lesueur National Park was gazetted as a Class 'A' reserve for national park in 1992, and Coomallo Nature Reserve gazette as a Class 'C' reserve vested in the National Parks and Nature Conservation Authority (now DPaW). Beekeepers Nature Reserve is similarly a Class 'C' reserve.

Management of Nambung National Park, located south of Cervantes approximately 25km south of Beekeepers Nature Reserve (Northern), also has a management plan (CALM 1998) that encompasses the following areas:

- Nambung National Park
- Wanagarren Nature Reserve
- Nilgen Nature Reserve
- Southern Beekeepers Nature Reserve.

Based on their proximity, management requirements at Lesueur National Park and Coomallo Nature Reserve are expected to be applicable to management of Beekeepers Nature Reserve (Northern). As such, management recommendations provided in CALM (1995) have been used to derive applicable management actions that may be used in Beekeepers Reserve to contribute to offsets for this Survey. Key issues for future management were identified as (CALM 1995):

- *Phytophthora* dieback
- fire protection
- recreation access.



**Figure 2 Nature reserves and remnant native vegetation near seismic survey area**

Scale 1:250,000 at A4



Coordinate System: GDA 1994 MGA Zone 50  
 Note that positional errors may occur in some areas  
 Date: 22/05/2014  
 Author: JCrute  
 Source: Topography: Geoscience Australia 2012.  
 EP 413: DMP 2012.

**Legend**

- Town
- Major road
- Minor road
- + Railway
- Development envelope
- Exploration Permit EP413
- ▨ Nature Reserve
- Native vegetation



## 4. Proposed offset

There are generally three types of environmental offsets – land acquisition, on ground management and resourcing research.

The type of offset depends on the following:

- impact predicted (e.g. temporary or permanent, broad scale clearing or effect on an individual species)
- options for offsets in the vicinity of the project (such as the availability of land for purchase and protection)
- state of knowledge of the environmental value being affected.

### 4.1 Offset approach

The offset proposed is for \$200 000 to be provided to DPaW for use in either land acquisition or for management within Beekeepers Nature Reserve. This offset is based on an offset ratio of 2:1, where up to 400 ha could be acquired for conservation at the regional land value of \$500/ha. This is less than would be proposed if the disturbance were for conventional clearing. As such, the DotE offset calculator was not considered an appropriate tool for the determination of offsets in this case. The ratio of 2:1 was considered appropriate given the following:

- no permanent impacts are anticipated as a result of the Survey and disturbed areas are expected to fully recover within three years
- broad-scale disturbance is not proposed
- only less-mature specimens and understorey species (with stem diameters of <100 mm) will be disturbed, hence the identified 200 ha of disturbance to potential foraging habitat is expected to be an over-estimation of actual impact
- mulching, root and seed stock will remain, significantly improving the likely success of rehabilitation with vegetation expected to fully recover within three wet seasons
- duration of the project will be short (six weeks within a twelve-week window).

The ratio of 2:1 is comparable to that generally applied by the EPA for proposals resulting in temporary (albeit over longer timeframes) impacts. The effect of implementation of the proposed offsets is displayed in Figure 4–1. The offset assessment is presented in Table 4-1.

The \$200 000 of funding provided to DPaW would be used for one of the following options:

1. Acquisition of land for inclusion into the conservation estate.
2. Active management, rehabilitation or research within Beekeepers Nature Reserve (including weed control, fire protection, dieback mapping and control, feral animal control, access management).
3. A combination of land acquisition and active management/rehabilitation.

Land acquisition would be undertaken following an assessment of potential sites against the offset criteria and negotiation with the relevant landholders. No specific site has been identified at this stage. The potential uses of the funds within Beekeepers Nature Reserve are discussed in Section 4.2.

The proposed offset is expected to result in the protection of additional lands or the enhancement and management of current lands within the conservation estate. The proposed offset is expected to fulfil the principle of 'no net loss', consistent with the WA Environmental Offsets Policy (EPA 2011) and the Australian Government Environmental Offsets Policy (DSEWPac 2012). Protection of habitat is also consistent with the principles of the *Carnaby's Black Cockatoo (Calyptorhynchus latirostris) Recovery Plan* (DEC 2012a).

Figure 4–1: Reduction of significant residual environmental impact to acceptable levels using offsets

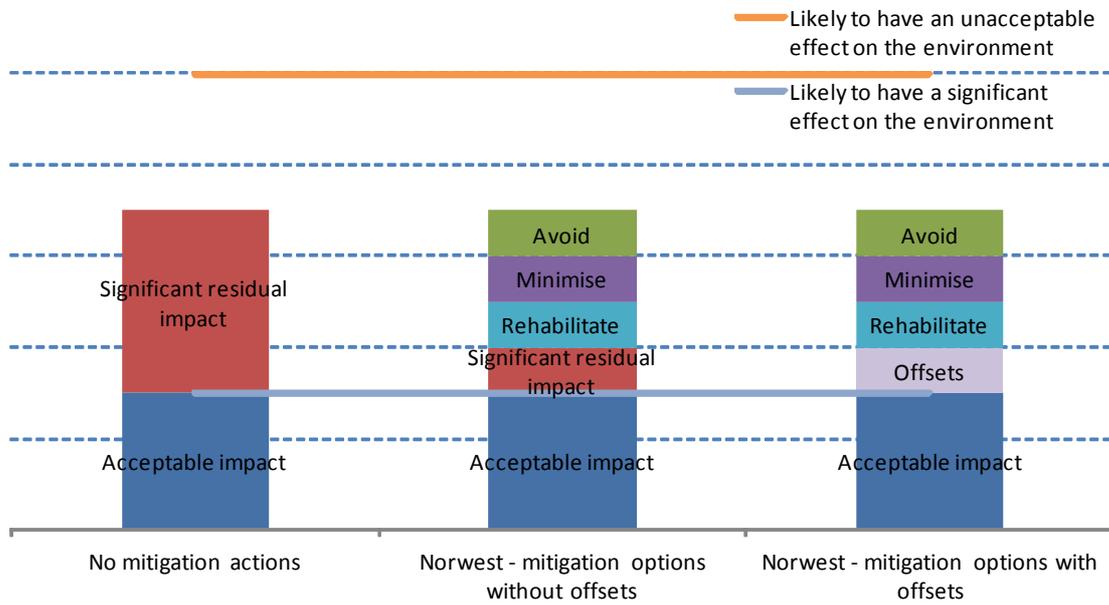


Table 4-1: Offset assessment

Existing environment/impact			Significant residual impact	Offset calculation methodology					
Avoid and Minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification	
Up to 200 ha of vegetation disturbance									
Up to 200 ha of potential foraging habitat for Carnaby's Black-Cockatoo (including 63 ha of which is located in Beekeepers Nature Reserve)	Refer to Table 1 -1.	200 ha of disturbance will be regenerated with the existing foraging habitat for Carnaby's Black-Cockatoo.	Root stock and seed stock will be retained during disturbance significantly enhancing the likely success of rehabilitation. Full ecosystem function expected within three years.	Temporary disturbance to up to 200 ha of foraging habitat for Carnaby's Black-Cockatoo, expected to recover within three years.	Provision of funding to DPaW for: <ul style="list-style-type: none"> <li>acquisition of land to add to the conservation estate OR</li> <li>rehabilitation and management of Beekeepers Nature Reserve.</li> </ul>	Low – funding provided to DPaW	Value to Carnaby's Black-Cockatoo can be defined through either acquisition and protection of additional areas of habitat, or improved habitat value from rehabilitation and management within existing conservation lands. Funding provides an opportunity to facilitate formal management of Beekeepers Nature Reserve. DPaW will manage and determine use of funding to achieve the greatest environmental benefit.	<u>Acquisition of land</u> – no time lag <u>Or:</u> <u>Rehabilitation of land</u> – Rehabilitation of disturbance area within 3 years to achieve no net loss. Additional rehabilitation or management of lands within Beekeepers Nature Reserve will improve the conservation and management of values within the reserve.	The ratio of land acquisition/ funding (2:1) consistent with State offset requirements for temporary impacts
Up to 63 ha (within a total of 200 ha) of vegetation within Beekeepers Nature Reserve.	63 ha (of 200 ha) of disturbance will be rehabilitated.	Root stock and seed stock will be retained during disturbance, significantly enhancing the likely success of rehabilitation. Full ecosystem function expected within three years.	Temporary disturbance of 63 ha (of 200 ha) of vegetation within Beekeepers Nature Reserve, expected to recover within three years. Vegetation <i>condition</i> over a portion of the Development Envelope is affected by fire.						

## 4.2 Improvement to habitat quality in Beekeepers Nature Reserve

The proposed offset is for funding of \$200 000 that would be provided to DPaW for land acquisition or for improved management, rehabilitation or research in Beekeepers Nature Reserve to improve its habitat value for MNES. If the funding was used to improve Beekeepers Nature Reserve, this section discusses the type of measures that may be implemented:

1. Preparation of Beekeepers Nature Reserve (Northern) Management Plan.
2. Weed control.
3. Fire protection.
4. Dieback control.
5. Feral animal control.
6. Access management.

### 4.2.1 Beekeepers Nature Reserve Management Plan

Published management plans for Nature Reserves near the Development Envelope appear to be restricted to the following (approximately 5 km south of Beekeepers Nature Reserve (Northern)):

- Lesueur National Park and Coomallo Nature Reserve 1995-2005 (CALM 1995).

Lesueur National Park was gazetted as a Class 'A' reserve for national park in 1992, and Coomallo Nature Reserve gazette as a Class 'C' reserve vested in the National Parks and Nature Conservation Authority (now DPaW). Beekeepers Nature Reserve is similarly a Class 'C' reserve.

Management of Nambung National Park, located south of Cervantes, also has a management plan (CALM 1998) that encompasses the following areas (approximately 25km south of Beekeepers Nature Reserve (Northern)):

- Nambung National Park
- Wanagarren Nature Reserve
- Nilgen Nature Reserve
- Southern Beekeepers Nature Reserve.

Based on their proximity, management requirements at Lesueur National Park and Coomallo Nature Reserve are expected to be similar to those at Beekeepers Nature Reserve (Northern). As such, management recommendations provided in CALM (1995) have been used to derive applicable management actions that will act to ensure 'no net loss'.

Management goals and strategies applicable to Beekeepers Nature Reserve are considered to mirror those developed for Lesueur National Park and Coomallo Nature Reserve. Key issues for future management were identified as (CALM 1995):

- *Phytophthora* dieback
- fire protection
- recreation access.

### 4.2.2 Weed control

Weed control is most effectively applied prior to, during and following disturbance. Habitat quality of areas of Beekeepers Nature Reserve that have experienced recent disturbance by bushfire but are currently unmanaged would be likely to improve with the application of weed control.

#### **4.2.3 Fire protection**

Fire protection would enhance the habitat quality of Beekeepers Nature Reserve by acting to minimise the frequency and duration of bushfires and speeding the recovery of vegetation. Fire protection can take many forms, consisting of enhancing support for regional personnel to respond to local fire incidents, providing support for training of personnel, provision of funding for fire-fighting infrastructure or contributing towards the maintenance or upgrade of existing infrastructure.

#### **4.2.4 Dieback control**

Control of dieback through use of dieback risk mapping to guide appropriate visitor access would substantially reduce the threat of habitat degradation due to dieback in Beekeepers Nature Reserve. Signage regarding implementation of soil hygiene measures can help with the prevention of the spread of infected material.

#### **4.2.5 Feral animal control**

Feral animals such as cats and foxes are identified risks to Carnaby's Black-Cockatoos, Malleefowl and Rainbow bee-eater, and other feral animals such as wild goats and pigs are recognized risks to native fauna habitat more generally. Control measures such as baiting and trapping would improve the habitat quality of Beekeepers Nature Reserve for these species.

#### **4.2.6 Access management**

Restriction of public access for inappropriate recreational purposes (such as four-wheel driving and trail bikes) would ensure the habitat quality of recently burnt areas of Beekeepers Nature Reserve is maintained and improved. Such access can exacerbate impacts from dieback and weeds, thus restriction of public access will enable native vegetation to regenerate without additional threats posed by these impacts.

## 5. References

- Benshemesh J 2007, *National Recovery Plan for Malleefowl*, Department of Environment and Heritage, South Australia, Government of South Australia, Adelaide, South Australia.
- Department of Conservation and Land Management (CALM) 1995, Management Plan – Lesueur National Park and Coomallo Nature Reserve 1995–2005, prepared by Department of Conservation and Land Management for National Parks and Nature Conservation Authority, Perth, Western Australia.
- Department of Conservation and Land Management (CALM) 1998, *Nambung National Park Management Plan 1998–2008, Management Plan No. 37*, prepared by Department of Conservation and Land Management for National Parks and Nature conservation Authority, Perth, Western Australia.
- Department of Environment and Conservation (DEC) 2012a, *Fauna profiles – Carnaby's Black Cockatoo *Calyptorhynchus latirostris* (Carnaby 1948)*, Department of Environment and Conservation, Perth, Western Australia.
- Department of Environment and Conservation (DEC) 2012b. *Fauna profiles – Malleefowl - *Leipoa ocellata* (Gould, 1840)*, Department of Environment and Conservation, Perth, Western Australia.
- Department of Environment and Conservation (DEC) and Australian Government 2012, *Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan – Western Australian Wildlife Management Program No. 52 October 2012*, Department of Environment and Conservation, Perth, Western Australia.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011, *Modelled distribution of Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)*, Environmental Resources Information Network, Commonwealth of Australia.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012, *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*, Commonwealth of Australia, October 2012.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013, *Leipoa ocellata in Species Profile and Threats Database*, [Online], Department of the Environment, Canberra, available from: <<http://www.environment.gov.au/sprat>>, [9 October 2013].
- Ecologia Environment 2011, *Norwest Energy NL Level 1 Flora and Fauna Assessment – Investigations for Arrowsmith-2 – May 2011*, unpublished report prepared for Norwest Energy NL.
- Environmental Protection Authority (EPA) 2008, *Environmental Offsets – Biodiversity*, Guidance Statement No. 19, Environmental Protection Authority, Perth.
- Environmental Protection Authority (EPA) 2012, *Draft Environmental Assessment Guideline for Environmental offsets*, October 2012, Environmental Protection Authority, Perth.
- Government of Western Australia 2011, *WA Environmental Offsets Policy*, [Online], Government of Western Australia, Available from: <http://www.epa.wa.gov.au/EPADocLib/WAEnvOffsetsPolicy-270911.pdf> [December 2012].
- Groom C 2011, *Plants used by Carnaby's Black Cockatoo*, [Online], Department of Environment and Conservation, Available from: [http://www.dec.wa.gov.au/component/docman/doc\\_download/5310-plants-used-by-carnaby-s-black-cockatoo.html?Itemid=](http://www.dec.wa.gov.au/component/docman/doc_download/5310-plants-used-by-carnaby-s-black-cockatoo.html?Itemid=) [January 2014].
- O2 Ecology 2012, *Arrowsmith Level 1 Botanical survey report and threatened fauna assessment report*, unpublished report prepared for Strategen Environmental Consultants on behalf of Norwest Energy NL.

Western Botanical 2014, *Norwest Arrowsmith Seismic Survey Level 2 Flora and Vegetation Survey – April 2014*, unpublished report prepared for Strategen Environmental Consultants, April 2014.

**Appendix 1**  
**Assessment of habitat value within**  
**Development Envelope**



## Assessment of habitat values within Development Envelope

A process of assessment was conducted to quantify habitat value across the Development Envelope considering the factors of site condition, site context and species stocking rate for both Carnaby's Black-Cockatoo and Malleefowl. The results of this assessment are provided below.

### Fauna habitat value

Habitat quality across the Development Envelope has been informed by the following aspects:

1. Site condition. This is the condition of a site in relation to the ecological requirements of a threatened species or ecological community. This includes considerations such as vegetation condition and structure, the diversity of habitat species present, and the number of relevant habitat features.
2. Site context. This is the relative importance of a site in terms of its position in the landscape, taking into account the connectivity needs of a threatened species or ecological community. This includes considerations such as movement patterns of the species, the proximity of the site in relation to other areas of suitable habitat, and the role of the site in relation to the overall population or extent of a species or community.
3. Species stocking rate. This is the usage and/or density of a species at a particular site. The principle acknowledges that a particular site may have a high value for a particular threatened species, despite appearing to have poor condition and/or context. It includes considerations such as survey data for a site in regards to a particular species population or, in the case of a threatened ecological community this may be a number of different populations. It also includes consideration of the role of the site population in regards to the overall species population viability or community extent.

### Quantification of value

Consideration of habitat value of the Development Envelope from an assessment of vegetation condition, structure and extent of disturbance has been derived from Appendix 1 Table 1.

Appendix 1 Table 1: Vegetation condition within the study area (Kaesehagen 1994; Keighery 1994 in O2 Ecology 2012)

Condition rating	Area (ha)	Description	Interpreted value (proposed habitat quality score)
Pristine	-	Pristine or nearly so; No obvious signs of disturbance	10
Excellent	10 300	>80% native flora composition; Vegetation structure intact or nearly so; Minor signs of disturbance; Non-aggressive weed species (cover <5%)	8–9
Very Good	616	60–80% native flora composition; vegetation structure altered in places; Obvious signs of disturbance; Weed cover/abundance 5–20%.	6–7
Good/Fair	63	40–60% native flora composition; Vegetation structure significantly altered yet retains basic structure or ability to regenerate to it; Very obvious signs of multiple disturbance; Weed cover/ abundance 20–50%.	4–5
Degraded	-	Basic vegetation structure severely impacted by disturbance; Scope for regeneration but not to a state approaching good condition without intensive management.	2–3
Completely Degraded	143	<20% native flora composition; Vegetation structure no longer intact; Extensive disturbance/modification present; Weeds are highly invasive (cover/abundance >80%).	1

## Value as Carnaby's Black-Cockatoo habitat

Condition results from surveys show that vegetation structure across the majority of the Development Envelope was considered to be intact or nearly so (O2 Ecology 2012; Western Botanical 2014), despite being subject to bushfires in 2000, 2002, 2010 and 2012. Across these four fire periods, approximately 70% of the seismic Development Envelope has been recently burnt. As a result, vegetation structure across a large proportion of the Development Envelope may provide optimal foraging conditions for Carnaby's Black-Cockatoo by comparison with unburnt areas of foraging habitat nearby. This understanding of recently burnt areas has been considered in relation to vegetation community mapping (Western Botanical 2014) to identify areas in which fire is likely to have stimulated new growth suitable for foraging. Given that the above assessment indicates the Survey may result in temporary impact to potential foraging habitat for this species, an assessment of the site as potential habitat has also been undertaken (Appendix 1 Table 2).

Appendix 1 Table 2: Site assessment for Carnaby's Black-Cockatoo habitat

Element	Criteria	Assessment	Score
Site condition	Vegetation condition	Vegetation condition was assessed by O2 Ecology in 2012. A range of vegetation conditions from 'Completely Degraded' to 'Excellent' were observed, the majority of the Development Envelope being rated as 'Excellent'.  Vegetation condition was also assessed by Western Botanical in 2013-14. Vegetation condition was rated from 'completely degraded' to 'very good to excellent', the majority of the Development Envelope being rated as 'very good to excellent'.	8
	Vegetation structure	Vegetation structure is a contributing factor to vegetation condition, described above. Vegetation structure across the majority of the Development Envelope was considered to be intact or nearly so (O2 Ecology 2012).  The seismic Development Envelope has been subject to bushfires in 2000, 2002, 2010 and 2012. Across these four fire periods, approximately 70% of the seismic Development Envelope has been burnt. Vegetation structure across a large proportion of the Development Envelope may provide optimal foraging conditions for Carnaby's Black-Cockatoo by comparison with unburnt areas of foraging habitat nearby.	
	Diversity of habitat species	The Development Envelope hosts a range of foraging species suitable for foraging by Carnaby's Black-Cockatoo. Habitat species for Carnaby's Black-Cockatoo are identified in Groom (2011) (Appendix 2).  Of the approximately 140 species identified by Groom (2011), 13 of these species were positively identified during the Level 1 survey. A further 91 species may have been present, in which the Level 1 survey identified only the genus (i.e. <i>Banksia</i> spp.)	
	Relevant habitat features	Plant use by Carnaby's Black-Cockatoo has been categorised into feeding, nesting and roosting. Plant species identified within the Development Envelope are primarily used by Carnaby's Black-Cockatoo for foraging.  <i>Eucalyptus camaldulensis</i> was the only roosting species positively identified in the Development Envelope, considered a low priority for planting to encourage roosting (Groom 2011). <i>Eucalyptus loxophleba</i> was the only nesting species positively identified in the Development Envelope, also considered a low priority for planting to encourage nesting (Groom 2011).	
Site context	Movement patterns	The species is highly mobile and displays a seasonal migratory pattern that is linked to breeding (Saunders 1980, 1990, Berry 2008 in DEC & Australian Government 2012).  Breeding takes places between late July and December and most breeding occurs in the inland parts of its distribution, in areas receiving between 300–750 mm of average rainfall (Saunders 1974 in DEC & Australian Government 2012). During the non-breeding season (January to July), the majority of the birds move to the higher rainfall coastal regions of their range including the Midwest coast, Swan Coastal Plain and south coast (Saunders 1980, 1990; Berry 2008; Saunders et al. 2011; Johnstone et al 2011 in DEC & Australian Government 2012).	7
	Proximity of the site to other areas of suitable habitat	Aerial photography, mapped remnant native vegetation mapping indicates similar remnant native vegetation cover is well-represented in the near vicinity, particularly west of the Brand Highway (see distribution of native vegetation in Figure 3–1).	

Element	Criteria	Assessment	Score
	Regional importance of site to species	<p>The Development Envelope is located in an area designated by DSEWPaC (now DotE) as foraging habitat likely to be utilised by the species for foraging during January–July. Suitable habitat is identified as remnant native eucalypt woodlands and in shrublands and kwongan heathland dominated by <i>Hakea</i>, <i>Banksia</i> and <i>Grevillea</i> species, as well as in native vegetation on land that would otherwise be cleared for agriculture (O2 Ecology 2012). Patches of suitable habitat were noted to occur within the study area, primarily foraging habitat of proteaceous species during autumn and winter (O2 Ecology 2012).</p> <p>Together with an abundance of similar vegetation in the near vicinity, the site may be of regional importance to Carnaby's Black-Cockatoos for part of the year due to presence of proteaceous flora and vegetation species used for foraging. However, the site is not considered of regional importance for nesting or roosting, based on the absence of dead eucalypts suitable for roosting and breeding such as Salmon Gums and Wandoo (DEC 2012).</p>	
Species stocking rate	Site survey data	<p>Botanical surveys carried out during 2011, 2012 and 2013–14 recorded the presence or absence of Carnaby's Black-Cockatoos (Ecologia Environmental 2011; O2 Ecology 2012; Western Botanical 2014).</p> <p>Ecologia Environmental (2011) noted that Carnaby's Black-Cockatoos were not observed during the survey conducted in April 2011; however, noted that Carnaby's Black-Cockatoos were likely to forage throughout the Development Envelope on <i>Banksia</i> and other proteaceous shrubs during the autumn and winter (Ecologia Environment 2011). O2 Ecology (2012) recorded one visual and aural observation of an adult Carnaby's Black-Cockatoo during the spring survey of October 2012.</p> <p>Previous recorded indicate flocks of up to 1500 individuals in the vicinity of Eneabba, south-east of the Development Envelope (Johnstone et al 2007 in Ecologia Environment 2011).</p>	7
	Regional role of the site population in overall species viability or community extent	<p>Rather than hosting a discrete population of Carnaby's Black-Cockatoos, the site is expected to play a role in contributing foraging habitat within the wider Midwest region for visiting groups of the species during the autumn and winter months.</p>	
Score			7

In summary, the site may be used as foraging habitat by Carnaby's Black-Cockatoos for part of the year due to presence of proteaceous flora and vegetation species used for foraging. However, the site is not considered of regional importance for nesting or roosting, based on the absence of dead eucalypts suitable for roosting and breeding such as Salmon Gums and Wandoo (DEC 2012). An abundance of similar vegetation occurs in close proximity to the Development Envelope.

Rather than hosting a discrete population of Carnaby's Black-Cockatoos, the site is expected to play a role in contributing foraging habitat within the wider Midwest region for visiting groups of the species during the autumn and winter months.

Habitat quality of the seismic Development Envelope for Carnaby's Black-Cockatoos has been rated as medium-high (i.e. habitat quality score of 7).

## Value as Malleefowl habitat

Vegetation structure across a large proportion of the Development Envelope may not provide ideal habitat conditions for Malleefowl by comparison with unburnt areas nearby, due to the reduction in leaf litter used by Malleefowl for nesting. Given that the above assessment indicates the Survey may result in temporary impact to potential habitat for this species, an assessment of the site as potential habitat has also been undertaken (Appendix 1 Table 3).

Appendix 1 Table 3 Site assessment for Malleefowl habitat

Element	Criteria	Assessment	Score
Site condition	Vegetation condition	Vegetation condition was assessed by O2 Ecology in 2012. A range of vegetation conditions from 'Completely Degraded' to 'Excellent' were observed, the majority of the Development Envelope being rated as 'Excellent' (10 300 ha).	7
	Vegetation structure	Vegetation structure is a contributing factor to vegetation condition, described above. Condition results from the Level 1 survey show that vegetation structure across the majority of the Development Envelope was considered to be intact or nearly so (O2 Ecology 2012).  Due to recent bushfires, the Development Envelope may not provide optimal habitat for Malleefowl due to the removal of leaf litter required for cover and construction of mounds.	
	Diversity of habitat species	Malleefowl habitat can occur in a range of vegetation types, thus the Development Envelope may provide a range of species that would be considered suitable habitat for Malleefowl.	
	Relevant habitat features	Malleefowl habitat generally occurs in areas of arid and semi-arid woodland dominated by mallee eucalypts on sandy soils, with less than 430 mm rain annually, but can also occur in coastal heath where shrubs produce sufficient leaf litter for use in nest mounds (DEC 2012b). Patches of suitable habitat were noted to occur within the study area, primarily shrubland and low woodland dominated by mallee vegetation with a dense understorey of shrubs or grass and herbs with an abundance of leaf litter (O2 Ecology 2012).  Ecologia Environmental (2011) noted the likelihood of Malleefowl occurring in the area as 'Low', based on little suitable habitat and no recent records.	
Site context	Movement patterns	Malleefowl may inhabit an area ranging from one to several square kilometres (DEC 2012b). As such, any Malleefowl that might inhabit the seismic Development Envelope are also likely to range outside of it.	7
	Proximity of the site to other areas of suitable habitat	As Malleefowl can inhabit a range of different styles of habitat, suitable habitat covers a wide area across the whole continent. As such, alternative suitable habitat is present in close proximity to the site.	
	Regional importance of site to species	The vegetation types and structure are common in remnant native bushland within the regional area, thus the regional importance of the site to Malleefowl is considered low.	
Species stocking rate	Site survey data	The site has not been subject to a targeted survey to record observations of birds or nesting mounds. However, the botanical survey carried out during 2012 recorded the historical presence of Malleefowl s indicated by a disused mound (O2 Ecology 2012).  O2 Ecology recorded one disused mound along a traverse within <i>Eucalyptus erythrocorys</i> mallee woodland with <i>Acacia</i> spp., <i>Hibbertia</i> and <i>Banksia</i> shrubland. Eight of twelve botanical traverses were considered potentially suitable habitat for Malleefowl (1,7,9 full traverses,13, 19 part traverses,15,17,23 half traverses), consisting of open woodland typically over open to closed shrubland, with cover provided by shrubs, the presence of fallen woody debris and leaf litter and hosting tree hollows and log hollows (O2 Ecology 2012; Table 9, Figure 2). These habitat elements were considered to provide good cover for fauna with plentiful nesting materials and locations, supporting a range of birds, mammals and reptiles and likely to support the vulnerable Malleefowl (O2 Ecology 2012).	7

Element	Criteria	Assessment	Score
	Regional role of the site population in overall species viability or community extent	Malleefowl range across a wide area and current survey data has not recorded an onsite population. Due to the abundance of suitable habitat nearby, any Malleefowl ranging across the Development Envelope are not expected to play an important role in overall species viability.	
Score			7



**Appendix 2**  
**Groom (2011)**







