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Wedge-tailed eagle nest relocation plan

FINAL (Revision 3)
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KS8 Pty Ltd

ecology / vegetation / wildlife / aquatic ecology / GIS

Acronyms and abbreviations

Council	Council of the City of Gold Coast
DES	Department of Environment and Science (Queensland)
NC Act	*Nature Conservation Act 1992* (Queensland)
NRP	Nest relocation plan
RE	Regional ecosystem
WBSE	White-bellied sea eagle
WTE	Wedge-tailed eagle

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1 Introduction

1.1 Scope

The Council of the City of Gold Coast (Council) requires a nest relocation plan (NRP) to guide relocation of a wedge-tailed eagle (WTE) *Aquila audax* nest from a proposed development site to a suitable nearby site in the non-breeding season. Gassman Development Perspectives (Gassman) on behalf of KS8 Pty Ltd engaged Ecosure to develop an NRP, including:

- project details
- review of ecology relevant to nest relocation
- assessment of potential relocation sites
- assessment of relocation methods (removal and installation)
- action plan to guide relocation works
- monitoring and maintenance of relocated nest
- further investigations to refine the NRP.

1.2 Proposed development

The proposed development is an industrial subdivision on Lot 501 on SP295994 and Lot 500 on SP295994, Stapylton (herein referred to as the subject site). Note that Lot 501 on SP295994 and Lot 500 on SP295994 were previously identified as Lot 1 on RP6882 and Lot 240 on W31320.

The subject site is located within the Gold Coast City and is 77.2 ha in area. It is bordered by Stapylton Jacobs Well Rd to the north-west, Christenson Rd to the south-west and freehold properties along other boundaries. It adjoins the Stapylton Landfill Facility to the east.

The subject site is proposed to be developed in two stages:

- Stage 1 (27.5 hectares) requires clearing of remnant regional ecosystem (RE) 12.11.5/12.11.24
- Stage 2 (49.7 ha) requires clearing of remnant RE 12.11.5/12.11.24 and RE 12.11.25, which includes a large broad-leaved ironbark (*Eucalyptus fibrosa*) containing an active WTE nest.

Gassman prepared an ecological assessment for the subject site in 2011 (Gassman 2011) and a Vegetation Management Plan for Stage 2 works in 2018 (Gassman 2018). Ecosure prepared Fauna Management Plans (FMPs) for Stage 1 and Stage 2 works in 2018 (Ecosure 2018a, 2018b) and monitored the active WTE nest from July to September 2018 (until chicks were fledged).

1.3 Existing nest site

On 12 July 2018 an active WTE nest with two chicks was identified in a mature broad-leaved ironbark 26 m in height, within the Stage 2 works area. Ecosure prepared an FMP for the Stage 2 area (Ecosure 2018b) and monitored the nest site from July to September 2018. Over this period, the WTE pair successfully fledged two chicks. It is uncertain whether this nest has been used during previous seasons or when it will be used in the future as WTE can have multiple nesting/breeding sites within a territory (Mooney and Holdsworth 1991).

The nest is approximately 19 m from the ground, 1.6 m wide and 1.1 m deep. A more detailed assessment of the structure and dimensions of the nest will be undertaken before translocation to assist with planning removal and relocation works.

1.4 Surrounding habitats

The region surrounding the nest site contains a mosaic of remnant vegetation and cleared land, primarily used for industry and agriculture. Remnant vegetation within 2.5 km of the existing nest site includes the following mapped REs:

- RE 12.3.6 – *Melaleuca quinquenervia +/- Eucalyptus tereticornis, Lophostemon suaveolens, Corymbia intermedia* open forest on coastal alluvial plains
- RE 12.11.3 – *Eucalyptus siderophloia, E. propinqua +/- E. microcorys, Lophostemon confertus, Corymbia intermedia, E. acmenoides* open forest on metamorphics +/- interbedded volcanics
- RE 12.11.5 - *Corymbia citriodora subsp. variegata* woodland to open forest +/- *Eucalyptus siderophloia/E. crebra, E. carnea, E. acmenoides, E. propinqua* on metamorphics +/- interbedded volcanics
- RE 12.11.18 - *Eucalyptus moluccana* woodland on metamorphics +/- interbedded volcanics
- RE 12.11.24 - *Eucalyptus carnea, E. tindaliae, Corymbia intermedia +/- E. siderophloia* or *E. crebra* woodland on metamorphics +/- interbedded volcanics
- RE 12.11.25 - *Corymbia henryi* and/or *Eucalyptus fibrosa subsp. fibrosa +/- E. crebra, E. carnea, E. tindaliae* woodland on metamorphics +/- interbedded volcanics.

The nest site lies in remnant vegetation mapped as RE 12.11.5/12.11.24. These REs are dominated by lemon-scented gum (*Corymbia citriodora* subsp. *variegata*), grey ironbark (*Eucalyptus siderophloia*), narrow-leaved ironbark (*E. crebra*), white stringybark (*E. carnea*), white mahogany (*E. acmenoides*), grey gum (*E. propinqua*), Tindale's stringybark (*E. tindaliae*) and pink bloodwood (*Corymbia intermedia*).

2 Review of available information

2.1 Wedge-tailed eagle ecology

The WTE, *Aquila audax*, is Australia's largest raptor (Cherriman 2007) and is found over the mainland of Australia, Tasmania (as a separate sub-species), and in the southern portion of New Guinea (Olsen et al. 2010). Mainland Australian adult eagles have a weight range of 3.9 to 5.8 kg (Debus 2017).

A study conducted by Debus et al. (2007) monitored a group of WTE nests in the northern inland NSW towns of Tamworth and Armidale. Their results showed that WTE nests were commonly found in eucalypt species of woodland landscapes. Nest positions tended to be midslope on the side of ravines and did not show any signs of preferred orientation. Nests were commonly located in the top one-third of large old trees and typically under or within a vegetated canopy. The mean height of trees that contain nests was 21.7 m, and the mean height of nests from the ground was 14.3 m (Debus et al. 2007).

Nests are constructed of sticks and green vegetation in the fork of trees (Debus 2017). Cherriman (2013) recorded an average nest width of 1.3 m and nest depth of 1.1 m. Silva and Croft (2007) found WTE to actively nest only in live trees, and old nests were found clustered around active nests, which were likely disused nests of monitored breeding pairs (Silva and Croft 2007).

Nest sites can potentially be occupied for as long as 40 years, likely by preceding cohorts of eagles, and occasionally will alternate with white-bellied sea-eagles (WBSE *Haliaeetus leucogaster*) over this period (Debus 2017).

WTE breed monogamously, and pairs form close bonds over a minimum of several consecutive years (Debus et al. 2007). The breeding season of the WTE in south east Queensland and northern New South Wales is reported to vary between locations, ranging from April to September (Australian Museum 2018). Clutch sizes range from 1 to 3 eggs, with the typical size of 2 eggs (Olsen and Marples 1993). Egg incubation periods are approximately 41 to 45 days and the nestlings fledge after approximately 79 to 90 days (Allott et al. 2006, Debus et al. 2007, Debus 2017). Both sexes are responsible for incubation and brooding and shading of the nestlings, but females tend to take on this role more often, while males tend to supply most of the food to the nest in the early weeks (Debus et al. 2007).

Fledglings are dependent on their parents for food up to 3 to 4 months and will start to disperse at 4 to 5 months (Debus 2017). Debus et al. (2007) recorded a fledgling success rate per pair year of 0.8 in northern inland NSW.

Nests are defended against other encroaching WTE, WBSE and other predatory birds. However, WTE rarely swoop humans that come within range of their nests. Adults will guard fledglings by use of alarm calls and will coax fledglings to fly away from human interaction (Debus et al. 2007).

The territory size of a pair of WTE depends on the availability of sustained food sources and the number of appropriate nest sites in a breeding region. A study in south-west WA, near Perth, found the mean WTE home range to be about 36 km^2 (Cherriman 2007).

Mooney and Holdsworth (1991) found that the Tasmanian subspecies of WTE (*Aquila audax fleayi*) may have up to five alternate nests in their breeding zone. They recommend that old inactive nests should be left undisturbed, in case the eagle pair decides to reoccupy a nest from preceding breeding seasons. WTE are very reluctant nesters and may abandon nesting efforts if affected by medium to high human disturbance. Heavy disturbances should be avoided within 500 m of active nests during the breeding season (Mooney and Holdsworth 1991). Studies have shown that even the removal of a focal perch near a nest tree, may render a nesting site less desirable and lead to desertion (Cherriman *et al.* 2009).

Many studies have focused on the diets of WTE. Every study concludes that their diet reflects the availability of prey for their habitat, but overall, their main food sources are mammals, followed by birds, reptiles and carrion (Debus 2017).

The WTE nesting in the subject site are known to forage at the Stapylton landfill site just to the east. The proximity to the landfill provides a sufficient ongoing food source to the pair of eagles and their young. Landfills attract many scavenger species, including small mammals and Australian white ibis (*Threskornis molluca*), which is likely to be a major food source for the resident WTE. We recommend that the nest be relocated as close as possible to the landfill to maximise the probability of translocation success.

2.2 Nest relocation works

The literature review did not find any published information on WTE nest relocation. In lieu of relevant WTE material, this review focuses on two similar species, the WBSE and the North American bald eagle (*Haliaeetus leucocephalus*). WBSE was chosen as a model because it shares a similar size and nest dimensions with WTE. Also, both WBSE and WTE are Australian species that nest primarily in living trees and are sensitive to disturbance during breeding periods (Department of the Environment and Energy 2018).

Two reports are available on the relocation efforts of WBSE; one was successful in the six years following relocation (Debus et al. 2014), while the second was relocated without a successful re-nest (Wildlife Preservation Society of Queensland 2015).

The first relocation took place in Townsville, north Qld between the 2002 and 2003 breeding seasons. A long-established WBSE nest in a large eucalypt was inside an area zoned for clearing. Efforts were made to relocate this nest intact, 100 m away. The nest was placed in a cradle structure which was mounted to a 15 m pole adjacent to a large eucalypt patch on the edge of a carpark. The nest was protected by the overhanging canopy of a nearby tree crown. A pair of WBSE successfully reared 1 to 2 young every year from 2003 to 2008, even with the constant flow of traffic, pedestrians, and the use of an adjacent loading-bay storage area. The nest was inactive during the 2009 and 2010 breeding seasons, and in 2011 a pair of black kites (*Milvus migrans*) started using the nest, defending their territory from other encroaching raptors (Debus et al. 2014).

Three factors could have deterred the WBSE from re-nesting after six years: 1) the overhanging branches were overgrowing the nest structure, 2) the constant noise and traffic of humans and 3) a new nesting mate that was being potentially less tolerant to the known disturbances (Debus et al. 2014).

In 2015, a WBSE nest was relocated from the new parallel runway at the Brisbane Airport to a site 2 km away in the Boondall Wetlands in 2015. The nest was located in an old stand of eucalypts that was destined to be removed for the runway. Measures were taken in recording the aspect, orientation and height of the existing nest was measured so these parameters could be replicated in the chosen location. The tree was cut below the nest to keep the nest and its associated branches intact. A crane was used to successfully lower the nest with minimal disruption. The tree/nest structure was carefully moved to its new location within the Boondall Wetlands, away from any trails frequented by humans. The natural structure was attached firmly to a pole with a stainless-steel collar (Wildlife Preservation Society of Queensland 2015).

However, the nest was not used after the relocation process (Brisbane Airport environment officer, pers. comm. 2018). During annual monitoring events, juvenile WBSE were recorded perching near the nest, but no adults or nestlings were observed in the nest. The WBSE pair have likely re-nested in an alternative area that encompasses Brisbane Airport, Boondall Wetlands and the Port of Brisbane, as a pair of WBSE accompanied by juveniles have been sighted on multiple occasions.

Airport personnel believe that the runway construction removed a significant portion of their food source, so the pair may have decided to re-nest closer to a more suitable food source. The substantial relocation distance (2 km) may also have contributed to the failure of the relocation. These hypotheses have not been studied to date.

In North America, many bald eagle nests have been successfully relocated. This species is also a suitable candidate to base relocation works on, as they show similarity in weight, size, nest dimensions, and are sensitive to human disturbances during breeding periods similar to the WTE and WBSE (Mooney and Holdsworth 1991, US Fish and Wildlife Service 2018).

One such case involved the relocation of a 91 kg nest in a power line structure near Dallas, Texas in 2014 (Lee 2014, Mosier 2016). Fifty personnel from multiple agencies were involved in this process. The nest was secured in multiple layers of bubble wrap before works commenced. The entire arm of the powerline structure, which included the nest, was detached using a crane and reattached to a replica of the powerline structure in a nearby wetland 400 m away. Since the relocation, this bald eagle pair have reared two successful rounds of eaglets. Video footage of the relocation process can be found here: https://www.youtube.com/watch?v=obt4A5pQjfU (Oncor 2014).

2.3 Legislative requirements

The *Nature Conservation Act 1992* (NC Act) lists the WTE as Least Concern (LC). The *Environment Protection and Biodiversity Conservation Act 1999* lists the Tasmanian WTE subspecies as critically endangered but does not list the mainland subspecies as threatened.

Section 332 of the Nature Conservation (Wildlife Management) Regulation 2006 requires a Species Management Program (SMP) for interfering with a breeding place (e.g. a nest) of protected animals that are classified as extinct in the wild, endangered, vulnerable, near threatened, special least concern, colonial breeder or least concern. As the WTE is a least concern species, the nest relocation will need to be undertaken under a “low risk of impact SMP” approved by the Department of Environment and Science (DES).

The works described in this plan should be completed in accordance with all associated management plans approved by the City of Gold Coast for the proposed development (e.g. Fauna Management Plan and Vegetation Management Plan).

3 Assessment of suitable relocation sites

3.1 Methods

Ten potential relocation sites were identified through a desktop assessment, using the review of available information above. The sites were assessed using six criteria, four ecological and two non-ecological criteria, that were deemed to be the most important factors to consider when relocating a WTE nest. The weightings of each criteria varied and were determined by the importance of the criteria for nest success, as informed by the literature review. The potential relocation sites have not been subject to field survey or verification. The six criteria are discussed in this section. See Appendix 1 for site specific information.

Ecological criteria

Distance from original nest: The success of eagle nest translocation is strongly influenced by distance from the original nest location. WBSE relocation was successful when relocated within 100 m of the original location (Debus et al. 2014) but was unsuccessful when relocated 2 km away (Wildlife Preservation Society of Queensland 2015). Very limited vegetation will be retained within 100 m of the existing nest due to existing and proposed clearing works. The current assessment adopted a suitability rating ranging from a maximum of “6” for sites less than 500 m away to “0” for sites greater than 2.5 km away from the original nest location (Table 1). Figure 1 shows distances from the existing nest to potential translocation sites.

Table 1 Suitability rating of relocation site based on distance from the original nest.

Distance from original nest	Suitability rating
< 500 m	6
500 m – 1 km	4
1 km – 2.5 km	2
>2.5 km	0

Distance from food source: The nest is currently 420 m from the Stayplton landfill facility, which is most likely the WTE primary food source. The ideal nest relocation site will be close to the landfill facility. The current assessment adopted a suitability rating ranging from a maximum of “6” for sites less than 500 m away to “0” for sites greater than 2.5 km away from the landfill facility (Table 2). Figure 2 shows distances from Stayplton landfill facility to potential translocation sites.

Table 2 Suitability rating of relocation site based on distance from the Stapylton landfill facility.

Distance from landfill	Suitability rating
0 – 500 m	6
500 m – 1 km	4
1 km – 2.5 km	2
> 2.5 km	0

RE: The WTE nest is currently in an ironbark tree in RE 12.11.5/12.11.24. These REs are dominated by *Corymbia citriodora subsp. variegata, Eucalyptus siderophloia, E. crebra, E. carnea, E. acmenoides, E. propinqua, E. tindaliae and Corymbia intermedia*. The nest relocation site should be within a RE that has similar species to the RE where it is currently situated. The current assessment adopted a suitability rating ranging from a maximum of "3" for sites containing the same RE to "0" for sites with no suitable nesting trees (Table 3).

Table 3 Suitability rating of relocation site based on mapped RE.

Regional ecosystem	Suitability rating
Same RE	3
Different RE but with ironbark species (*Eucalyptus crebra, E. siderophloia* or *E. fibrosa*)	2
Different RE (no ironbark species) with other suitable nesting trees	1
RE with no suitable nesting trees	0

Buffer around nest: It is important that the relocation site has an appropriate vegetation buffer around it to minimise the impacts of people, traffic and development. The ideal relocation site should have a recommended buffer distance of approximately 100 m to limit the amount of disturbance at the nest. The current assessment adopted a suitability rating ranging from a maximum of "4" for sites with a buffer greater than 100 m to "0" for sites with less than a 50 m buffer around the relocation site (Table 4).

Table 4 Suitability rating of relocation site based on the likelihood of future disturbance.

Likelihood of future disturbance	Suitability rating
>100 m	4
50 m – 100 m	2
<50 m	0

Non-ecological criteria

Security (tenure) The nest should be relocated to a site where it is unlikely to be disturbed or moved again. The ideal land tenure for the relocation site is a Conservation Reserve or other secure tenure where it will be unlikely to be disturbed in the future. The current assessment adopted a suitability rating ranging from a maximum of "6" for sites within a conservation reserve to "0" for sites within an industrial area (Table 5).

Table 5 Suitability rating of relocation site based on future security of the relocation site.

Security (tenure)	Suitability rating
Conservation reserve	6
Open space / Reserve	4
Freehold / Special purpose	2
Industrial	0

Ease of access to the site: The nest relocation site should be accessible for a truck, EWP and crane, which are likely to be required for the nest translocation. The current assessment adopted a suitability rating ranging from a maximum of "2" for sites with good access to "0" for sites with poor access to the relocation site (Table 6).

Table 6 Suitability rating of relocation site based on ease of vehicular access to the site.

Ease of access to the site	Suitability rating
Good (potential access within 10 m)	2
Average (potential access within 25 m)	1
Poor (no adjacent access)	0

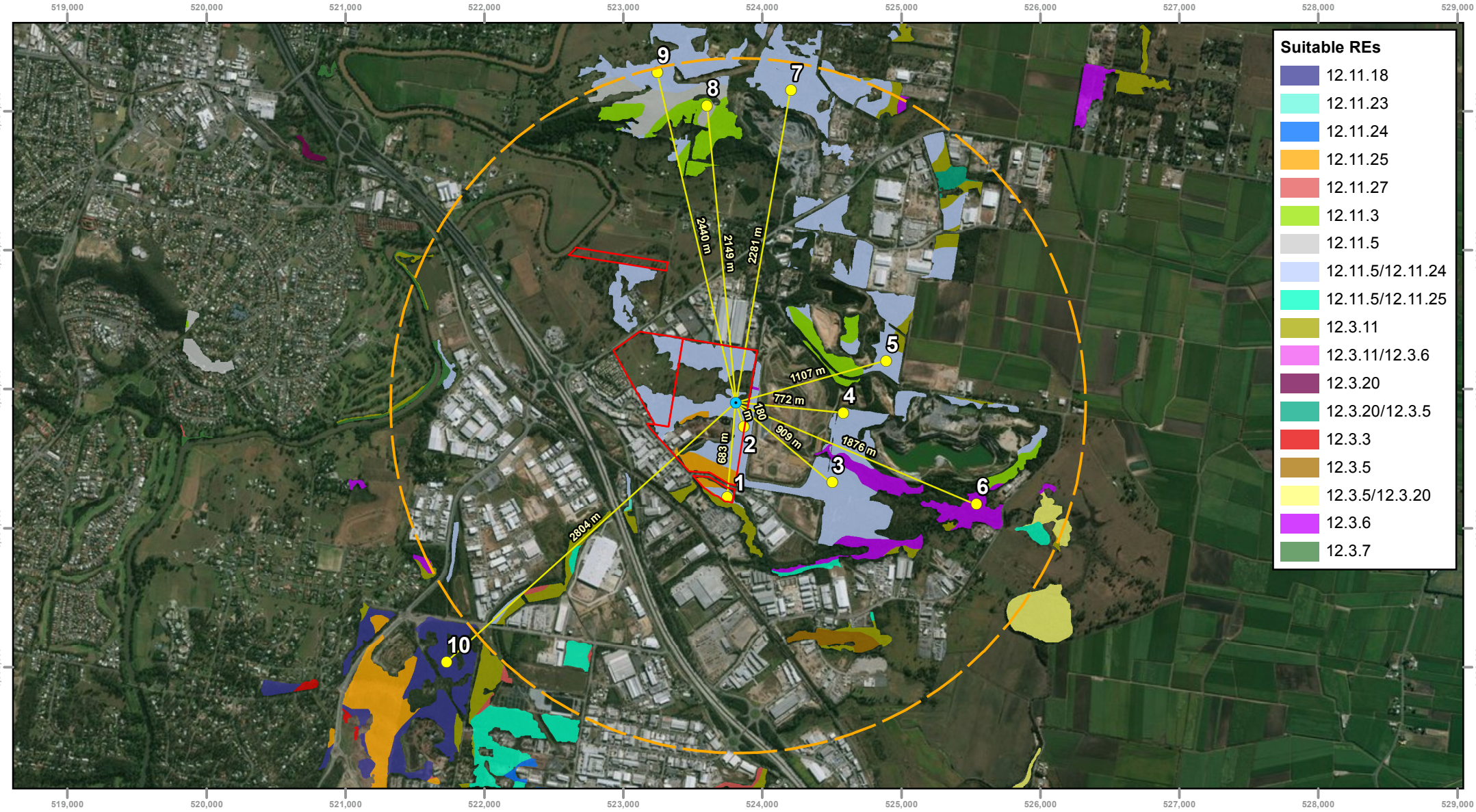

Figure 1: Distance from existing nest to potential relocation sites

Gassman Development Perspectives

Nest Relocation Plan

Current nest location

Potential nest relocation sites

Site boundary

2.5 km buffer

ecosure

Job number: PR3990
Revision: 1
Author: KF
Date: 14/12/2018

0 250 500 1,000
Metres

GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

Figure 2: Distance from Stayplton landfill facility to potential relocation sites

Gassman Development Perspectives

Nest Relocation Plan

- Current nest location
- Potential nest relocation sites
- Landfill
- 100 m buffer
- Site boundary
- 2.5 km buffer

ecosure

Job number: PR3990
Revision: 1
Author: KF
Date: 14/12/2018

0 250 500 1,000
Metres

GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

3.2 Site suitability assessment

The assessment of the ten potential relocation sites against the six criteria is provided in Table 7.

Table 7 Site suitability assessment of potential relocation sites

	Ecological criteria				*Non-ecological criteria*		
Site	**Distance from original nest**	**Distance from food source**	**Regional ecosystem**	**Buffer around nest**	**Security (tenure)**	**Ease of access**	**Score**
1	4	6	3	2	4	1	20
2	6	6	3	0	0	1	16
3	4	6	3	4	2	0	19
4	4	6	3	4	0	1	18
5	2	6	3	4	2	0	17
6	2	2	1	4	4	2	15
7	2	2	3	4	2	0	13
8	2	2	3	4	6	0	17
9	2	2	3	4	2	0	13
10	0	0	2	4	6	1	13

3.3 Conclusions

The site suitability assessment found that Site 1 overall is the most suitable site for the relocation of the WTE nest followed closely by Site 3 and Site 4, which scored highly in the ecological criteria, but are limited by security and ease of access.

Site 1 is approximately 683 m from the original nest location, 183 m from the food source, is within the same RE as the original nest and has the potential to have approximately a 60 m buffer (depending on placement within the site). Access to this site is via Christensen Road South.

Site 3 is slightly further from the original nest site and food source than Site 1 (approximately 909 m from the original nest location and 186 m from the food source). This site is within the same RE as the original nest and has the potential to have a 100 m buffer (depending on placement within the site). The site appears to have access via the southern end of the site, however there is uncertainty on the proposed future use of this site and the ability to maintain security for the nest at this site.

Site 4 is approximately 772 m from the original nest location, 360 m from the food source, is within the same RE as the original nest and has the potential to have a 100 m buffer

(depending on placement within the site). However, this site is on industrial land and therefore is not considered as secure as Site 1 and Site 3 and would potentially be prone to future disturbance. The site appears to have access via the northern end of the property.

Although the desktop site suitability assessment identified Site 1 as the most suitable location to relocate the WTE nest, field verification is required for any relocation site prior to final site selection. Site 1 is to be an open space corridor adjoining Sandy Creek that will be dedicated to Council as part of the industrial development. Prior to disturbance of the existing WTE nest location, a fauna ecologist will confirm the site suitability and determine the exact final placement of the relocated nest, by identifying suitable trees and/or pole sites for the nest relocation.

4 Assessment of relocation methods

4.1 Timing

It is recommended to undertake the nest relocation between October and March, as this period is outside the known WTE breeding season (April to September). If nest relocation is to be undertaken near the start of the breeding season, it should be confirmed prior to removal that nesting has not begun by WTE and that eggs have not been laid in the nest.

4.2 Nest removal

Nest removal will require specialised equipment, which is likely to include:

- a crane of sufficient capacity to lift the nest and associated tree branches
- elevated work platform (EWP)
- slings and straps for securing items
- chain saw
- temporary nest protection to protect nest during translocation works (e.g. bubble wrap, wire, wooden supports)
- cradle to support the nest during and after translocation.

Personnel required to conduct the works are likely to include:

- Ecologist suitably qualified in fauna management.
- Arborist suitably qualified for tree lopping at height.
- Machinery operators suitably qualified for use of required equipment (e.g. crane, EWP, truck).

A suitable access track will be required to allow equipment and personnel to undertake removal works.

Two options for nest removal have been identified, based on previous relocation efforts:

1. Remove the nest only.
2. Remove the section of tree containing the nest.

Table 8 summarises the relative values and risks of both options.

Table 8 Assessment of nest removal options.

Task	Option 1: Remove nest only	Option 2: Remove section of tree and nest
Preparation	Place slings or other lifting equipment under nest. Slings may be difficult to insert and may damage nest integrity.	Remove branches above nest, and attach branch ends to lifting equipment. Branch cutting and felling may damage nest.
Raising and lowering	Raise nest from tree and lower to ground using suitable crane. Upper branches may obstruct crane or damage nest.	Cut trunk below nest. Raise and lower section of tree containing nest using suitable crane. Trunk cutting may damage nest. Extra weight of tree section will require larger capacity crane.
Preparation for transport	Place nest into suitable cradle. Poorly fitting cradle may damage nest.	Place nest into suitable cradle. Cradle must support weight of tree and nest.
Implications for installation into recipient tree or onto a structural pole	Recipient tree must have spreading branches to support cradle at suitable height. Pole that is an approved structure to ensure the nest is secured to ensure safety and security of the nest.	Recipient tree must have trunk and/or branches to support section of tree with nest (or associated cradle) at suitable height. Pole must be designed to ensure it can support the section of tree with nest (or associated cradle) at suitable height.

The preferred method will be identified following more detailed examination of the structure of the nest and supporting tree branches by an arborist.

4.3 Nest transport

Transport equipment will be dependent on the dimensions and weight of the nest and cradle, which depends on the removal method. Transport is likely to require a truck of sufficient capacity to carry the nest and cradle. A suitable access track will be required to allow transport from the removal site to the translocation site.

4.4 Nest installation

Nest installation will require specialised equipment, which is likely to include:

- a crane of sufficient capacity to lift the nest and cradle
- EWP
- slings and straps for securing items
- chain saw
- temporary and permanent attachment straps to secure the nest to the supporting structure
- a pole (if used as supporting structure for nest).

Personnel required to conduct the works are likely to include:

- Ecologist suitably qualified in fauna management.
- Arborist suitably qualified for tree lopping at height.
- Machinery operators suitably qualified for use of required equipment (e.g. crane, EWP, truck).

- Structural engineer suitably qualified to design required installation equipment (e.g. cradle, pole, attachment straps).

A suitable access track will be required to allow equipment and personnel to undertake installation works.

Two options for nest attachment have been identified:

1. Attach the nest to a suitable living tree.
2. Attach the nest to a suitable pole.

Table 9 summarises the relative values and risks of both options.

Table 9 Assessment of nest installation options.

Task	Option 1: Living tree	Option 2: Pole
Preparation	Identify suitable tree and location within tree for installing nest and cradle. May be difficult to find suitable attachment point.	Install suitable pole with customised attachment points into ground. Artificial pole may not be preferred by WTE. Lack of shade could be mitigated by artificial shadecover or by placing the pole under an existing tree. Pole installation more expensive. Can design and construct attachment point in advance, simplifying installation.
Raise nest into position	Raise nest into tree using suitable crane. Upper branches may obstruct crane or damage nest.	Raise nest onto pole using suitable crane.
Attach nest	Strap cradle and nest to tree using metal straps or clamps. Tree growth or damage may affect integrity of nest attachment.	Strap cradle and nest to pole using metal straps or clamps.

The preferred installation method will be identified following the determination of the preferred nest removal method and liaison with relevant stakeholders (e.g. fauna ecologist, arborists and machinery operators).

4.5 Preliminary approach

The preliminary recommended approach is to remove the entire tree section containing the nest and install it onto a pole under the canopy of an existing tree at the relocation site. This approach is preferable as:

- it minimises potential nest damage through extraction from the existing tree
- the existing tree section provides a natural cradle
- the pole can be easily engineered to match the existing tree section and therefore simplifies installation
- the tree at the relocation site would provide natural shading and protection of the nest.

4.6 Safety considerations

Relocation of a large raptor nest is a complex task with significant health and safety risks. Table 10 provides a preliminary safety analysis, which should be refined in liaison with machinery operators, qualified personnel, health and safety professionals, and the project team before works commence.

Table 10 Preliminary safety analysis.

Task	Hazard	Likelihood	Proposed mitigation
Working at height Use of Elevated platform	Falling Dropping equipment	High	Ensure personnel have appropriate qualifications and certificates for working at height and operating equipment Follow appropriate safe work methods for working at height Use appropriate PPE Secure all equipment Maintain clear zone below elevated worksite
Chainsaw operation	Cuts Falling timber	High	Ensure personnel have appropriate qualifications and certificates for operating equipment Use appropriate PPE Secure tree limbs before lopping Maintain clear zone around worksite
Working around crane	Crush injuries Falling Falling timber	High	Ensure personnel have appropriate qualifications and certificates for operating around crane Use appropriate PPE Follow all crane operators' instructions
Working around WTE nest	Attack by WTE	Low	Use appropriate PPE Utilise fauna spotter-catcher to advise workers of any approaching WTE Consider use of scaring device if WTE are present
Installing nest	Crush injuries Falling timber Falling nest	High	Ensure personnel have appropriate qualifications and certificates for operating equipment Use appropriate PPE Plan and familiarise workers with appropriate attachment system before starting installation Apply temporary strapping before installing permanent attachment All poles and cradle designs should be approved structures capable of holding the weight of the nest
Working around wildlife	Bite / sting Injury to other wildlife	Moderate	Utilise fauna spotter/catcher to capture and relocate any fauna that may be inhabiting nest or adjacent translocation site (and transport to wildlife care facility if injured) First aid kit to treat bites and stings

5 Management of relocated nest

5.1 Landholder agreement

If the nest is relocated to a site that is not to be to be transferred to City of Gold Coast or Queensland Government for conservation purposes, then the translocation site should be secured to ensure the protection of the WTE nest. This could include:

- translocating the nest into land protected under the NC Act or Council regulations
- a conservation agreement under the NC Act
- voluntary declaration of an area of high nature conservation value under the *Vegetation Management Act 1999*
- use of a covenant under the *Land Act 1994* or *Land Title Act 1994*
- other written agreement with the landholder to protect the translocation site and an appropriate buffer.

5.2 Exclusion zone

An exclusion zone is required to:

- minimise nest disturbance
- protect people from WTE aggression and falling debris.

WBSE and WTE are adversely affected by human disturbances, predominantly around nesting sites and breeding habitat during their breeding season (Debus 2012; Mooney and Holdsworth, 1991). Protecting the health and safety of people from the injury associated with falling nest debris, organic and decaying material is also important.

The following buffer zones are recommended:

- Debus et al. (2014) recommends buffer zones of at least 130 m around an active nest.
- Mooney and Holdsworth (1991) recommends heavy disturbances should be avoided within 500 m of active nests during the breeding season, April to September.
- A 25 m buffer zone from a nest is recommended at all times of year to prevent any injury associated with falling nest debris, and other organic and decaying material.

It is recommended to maintain a buffer zone of approximately 100 m around the relocated nest to minimise disturbance to an active nest. This is the buffer area incorporated in the site assessment in Section 3 above.

The physical safety needs of personnel involved in the relocation process are considered in Section 4.6.

6 Monitoring

6.1 Nest use

The relocated nest will be monitored to:

- determine if WTE accept the nest relocation
- learn if WTE use alternate nests.

The relocated nest will be monitored for 5 breeding seasons or until nesting by WTE has been observed in that nest following the relocation. One monitoring event is recommended each year approximately in the middle of the breeding season (June to July).

6.2 Structural integrity

The integrity of the translocated nest could be compromised by:

- death of the supporting tree
- breakage of the supporting tree limbs
- damage to the supporting cradle
- breakage of attachment straps or clamps (e.g. due to tree growth or corrosion)
- slippage of attachment straps or clamps (e.g. due to wind movement or abrasion of tree limbs).

To ensure that the nest remains secure and allow for potential breeding use, attachments should be assessed for integrity:

- one month and six months after installation
- outside of the breeding and nesting season to minimise disturbance to WTE.

7 Further investigations

The following further investigations are recommended to refine the NRP and identify appropriate removal and installation options.

Conduct a detailed visual inspection of the existing nest, using binoculars and camera (and potentially a drone). This information will be used to:

- assess the structure of the nest and associated tree branches to determine the best removal and installation options
- estimate the weight of the nest (and section of supporting tree if using option 2) to determine the required capacity of lifting equipment
- assist in the design and construction of temporary nest protection (used during removal, transport and installation) and a suitable nest cradle.

Identify and map suitable access routes for removal, transport and installation works.

Survey the preferred relocation sites for suitable trees, including perch sites surrounding the nest relocation site. Conduct a detailed visual inspection of the selected tree(s), using binoculars and camera (and potentially a drone). This information will be used to:

- locate suitable installation points within or adjacent to the tree
- assist in the design and construction of a suitable attachment system
- assist in the design and construction of a suitable nest cradle.

Liaise with an arborist, machinery operators, engineers (pole/cradle), fauna ecologists, Gassman and the Development Project Manager to discuss:

- removal and installation options
- final selection and approval of the translocation site
- development of an appropriate security agreement for the translocation site.

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Appendix 1 – Suitability assessment table

	Ecological criteria				*Non-ecological criteria*	
Site	**Distance from nest (m)**	**Distance from food source (m)**	**RE**	**Buffer (m)**	**Security (tenure)**	**Ease of access**
1	683	183	12.11.5/12.11.24	50-100	Open Space Zone	Average
2	180	61	12.11.5/12.11.24	<50	Industrial Zone	Average
3	909	186	12.11.5/12.11.24	>100	Special Purpose Zone	Poor
4	772	74	12.11.5/12.11.24	>100	Industrial Zone	Average
5	1107	450	12.11.5/12.11.24	>100	Special Purpose Zone	Poor
6	1876	1189	12.3.6	>100	Open Space Zone	Good
7	2281	1904	12.11.5/12.11.24	>100	Special Purpose Zone	Poor
8	2149	1816	12.11.3/12.11.5	>100	Conservation Zone	Poor
9	2440	2149	12.11.5/12.11.24	>100	Freehold	Poor
10	2804	2515	12.11.18	>100	Conservation Zone	Average

Appendix 2 – Relocation Action Plan

Relocation actions and monitoring requirements are summarised in the Action Plan below. Timeframes will be refined in consultation with relevant stakeholders and the Development Project Manager. Translocation works must be conducted between October and March (outside the WTE breeding season).

Task	Who	Timeframe
Selection of translocation site		
Identify preferred translocation sites	Development Project Manager, Ecologist and other key stakeholders	December
Negotiate preliminary landholder agreements	Development Project Manager and other key stakeholders	January
Survey potential translocation sites for suitable trees and/or pole sites	Ecologist, Arborist	January
Identify final translocation site and trees	Development Project Manager, Ecologist, Arborist and other key stakeholders	January
Negotiate final landholder agreement for preferred translocation site	Development Project Manager and other key stakeholders	Before translocation
Develop translocation methods		
Inspect existing nest to assess structure and removal options	Ecologist, Arborist and other key stakeholders	December
Estimate nest dimensions and weight	Ecologist, Arborist and other key stakeholders	December
Identify preferred removal option	Ecologist, Arborist and other key stakeholders	January
Identify preferred installation option (tree or pole)	Development Project Manager, Ecologist, Arborist and other key stakeholders	January
Design appropriate temporary nest protection, cradle and attachment system based on nest and tree/pole information	Ecologist, Arborist, Engineers and other key stakeholders	January
Design access tracks for nest removal, transport and installation	Development Project Manager, Ecologist, Arborist, Machine Operators and other key stakeholders	January
Translocation preparation		
Construct appropriate temporary nest protection, cradle and attachment system	Suitably qualified people, Ecologist, Arborist and other key stakeholders	February
Construct access tracks for nest removal, transport and installation	Suitably qualified people, Ecologist, Arborist and other key stakeholders	February

Task	Who	Timeframe
Hire suitable equipment and machinery (e.g. crane, EWP)	Development Project Manager, Ecologist, Arborist and other key stakeholders	February
Source suitably qualified people for tree lopping, working at height, lifting and installation works	Development Project Manager, Ecologist, Arborist and other key stakeholders	February
Conduct pre-translocation meeting to plan translocation works	Development Project Manager, Ecologist, Arborist, suitably qualified people to conduct works and other key stakeholders	March
Construct and install pole if required	Development Project Manager, Ecologist, Arborist and other key stakeholders	March
Conduct pre-translocation tree lopping if required	Development Project Manager, Ecologist, Arborist and other key stakeholders	March
Inspect nest to ensure it is not active	Ecologist and other key stakeholders	March
Nest translocation		
Remove nest using preferred removal option	Suitably qualified people, eagle spotter and other key stakeholders	March
Install nest into cradle	Suitably qualified people, Ecologist, Arborist and other key stakeholders	March
Transport nest to installation site	Suitably qualified people, Ecologist, Arborist and other key stakeholders	March
Install nest into tree/pole using preferred installation option	Suitably qualified people, Ecologist, Arborist and other key stakeholders	March
Post-nest relocation		
Monitor nest to determine nest relocation success	Ecologist	Once each year for up to five years
Monitor integrity of nest attachment system	Arborist	1 and 6 months after installation to ensure the nest is stable and available for nesting and outside of nesting season for each subsequent year

Contingency planning

Relocation of a large raptor nest is a complex task with significant risks to personnel conducting works, the nest and wildlife associated with the removal and relocation environments. Table 10 provides a preliminary safety analysis, which should be refined in liaison with machinery operators, qualified personnel and the project team before works commence.

If any other fauna is located using the nest, it will be captured and relocated to nearby suitable habitat at the next species-appropriate time (e.g. diurnal fauna will be translocated immediately, nocturnal fauna the same evening). DES will be consulted if other fauna is breeding in the nest or another breeding site may be disturbed, or if a species listed as Endangered, Vulnerable or Near Threatened under the NC Act is observed at the eagle nest.

Wildcare Australia will be immediately contacted in an unforeseen event that an animal is injured or orphaned during the nest relocation (Emergency Hotline 07 55 272 444).

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	04/12/2018	Wedge-tailed eagle nest relocation plan Draft	Con Lokkers Principal Ecologist Nolan Lancaster Senior Ecologist Kalita Free Graduate Ecologist	Dr Natalie Toon Senior Environmental Scientist	Dave Fleming SEQ Manager
01	14/12/2018	Wedge-tailed eagle nest relocation plan Final	Kalita Free Graduate Ecologist	Dr Natalie Toon Senior Environmental Scientist	Dave Fleming SEQ Manager
02	20/12/2018	Wedge-tailed eagle nest relocation plan Final.R2	Dr Natalie Toon Senior Environmental Scientist	Dave Fleming SEQ Manager	
03	21/12/2018	Wedge-tailed eagle nest relocation plan Final.R2	Dr Natalie Toon Senior Environmental Scientist	Dave Fleming SEQ Manager	

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Copy #	Date	Type	Issued to	Name
1	20/12/2018	Electronic	Kathryn Tibbles	Gassman Development Perspectives
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