TWEED SHIRE COUNCIL

White Lace Flower Translocation Plan

Eviron Road Quarry and Landfill v5

June 2019

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1 Introduction and background

Tweed Shire Council (TSC) was issued Concept Approval (Application No. 08_0067) and Stage 1 Project Approval (Application No. 08_0068) by the NSW Department of Planning (DoP) for the Eviron Road Quarry and Landfill project, Tweed Shire. As part of the assessment documentation, a preliminary translocation plan for threatened species was developed. The plan was prepared primarily for one threatened species, the White Lace Flower (*Archidendron hendersonii*) which was considered to be impacted from West Valley quarry and landfill operations. The preparation of a translocation plan was subsequently included into the project statement of commitments (refer Schedule 1 Stage 1 Project Approval).

In accordance with Schedule 4 (Specific Environmental Conditions – West Valley Quarry), the preparation of a White Lace Flower Translocation Plan was subsequently conditioned as part of the Stage 1 project approval which reads:

30. The Proponent shall prepare and implement a Translocation Plan for the White Lace Flower to the satisfaction of the Director-General. This plan must:

(a) be prepared by suitably qualified and experienced persons whose appointment has been approved by the Director-General;

(b) be prepared in consultation with OEH;

(c) be submitted to the Director-General for approval by the end of July 2013 or as otherwise agreed to in writing by the Director-General;

(d) describe the measures that will be implemented to:

- translocate and manage the seedlings/cuttings;
- monitor and report on the success of the translocation; and
- ensure suitable contingency measures are implemented if the monitoring suggests the translocation is not working as well as intended; and

(e) provide for the findings of the translocation process to be published in a suitable scientific publication.

This translocation plan is one element of the management measures committed to by TSC as part of the Eviron Rd Q&L project to achieve a ‘maintain or improve’ outcome for biodiversity values. It is noted that in developing the management measures for the Eviron Rd Q&L project, the hierarchy of: avoidance, mitigation and offsetting has been followed. The development footprint was designed to avoid areas of higher conservation significance. Construction and operational impact mitigation measures were developed to minimise direct and indirect impacts within the development footprint and receiving environment; these will be incorporated into an approved Environmental Management Plan (EMP) for the site. A strategy for offsetting residual impacts has also been prepared including the retention and on-going management of bushland which is to be set aside as conservation areas. The larger of the two conservation areas would be set aside in perpetuity for conservation and would require management in accordance with a Habitat Management Plan. The appropriate long term

conservation security of area 1 would be subject to consultation with the Office of Environment and Heritage (OEH).

1.1 Objectives

The objectives of the translocation program are as follows:

- To directly support the conservation of the target species, and to maintain self-sustaining populations capable of surviving in both the short and long term.
- To preserve individuals of threatened species in situ wherever possible and limit transplanting to those species within the quarry and landfill footprint.
- To maximise the genetic robustness of threatened species populations which are to be impacted as part of the Eviron Rd Q&L, within the site.
- To re-establish the affected individuals in analogous habitat in close proximity to the source site, with long-term security of tenure.
- To manage the key threatening processes of the target species at the recipient site, particularly during the establishment phase.
- To produce propagated stock from the in-situ plants as well as other individuals in the population.
- To provide an ecologically sound, practical plan that will maximise the chance for successful translocation.

2 Pre-translocation assessment

2.1 Ecological considerations of target species

A sound understanding of the target species ecological and biological attributes is required to maximise the chance of translocation success.

2.1.1 White Lace Flower (*Archidendron hendersonii*)

White Lace Flower has been recorded in two locations of the Eviron Rd Q&L site. One cluster of five stems was recorded within the understorey of Camphor Laurel Closed Forest on the north-east facing slopes of the western ridgeline (record 1). The average height of individuals within cluster 1 was 6 m. Given that these stems are clustered in such close proximity, it is considered likely that they are closely related if not ramets (genetically identical individuals reproduced vegetatively). Accordingly, all stems within this cluster are considered the ‘source plant’.

The second record of White Lace Flower on site was in the understorey of Blackbutt Wet Sclerophyll Open Forest on the lower section of the north-east facing slopes of the western ridgeline in the far northwest of the site. The proposed development is to retain and manage this community as a conservation area. One juvenile plant was recorded in this location (record 2).

The on-site records of White Lace Flower and potential recipient sites for translocation are depicted in Figure 1.

Conservation status

White Lace Flower is designated Vulnerable under the BC Act. There is currently no recovery plan available for this species. Four priority action strategies have been identified for this species (discussed below).

Description

White Lace Flower is a tree to 18 m in height and a stem diameter of up to 60 cm (NPWS, 2002; Floyd, 2008). The leaves are alternate and bipinnate with each primary leaf stalk bearing one pair of secondary leaf stalks which each typically bear six leaflets (Floyd, 2008). The leaflets are usually opposite and the terminal leaflets are often larger than the lower leaflets (Floyd, 2008). The leaflets are distinctly asymmetrical. There is a raised gland approximately half way along the primary stalk (Harden, 2006). The creamy-white flowers are fluffy and fragrant with up to ten grouped within a bunch (NPWS, 2002). The fruit is a woody curved orange pod, 7-10 cm and 12 mm wide, constricted between seeds (Floyd, 2008). The pod splits open to reveal glossy black seeds and a red or yellow pod interior (NPWS, 2002).

Distribution

White Lace Flower is endemic to Australia occurring in disjunct populations along the east coast in North Queensland (wet tropics and Mackay region) and subtropical Australia (SEQ/far northern NSW and Coffs Harbour) (CSIRO, 2010; ALA, 2018). The Tweed is situated within the SEQ/far northern NSW population for which records of this species occur scattered along the coast from Nerang on the Gold Coast to Broadwater (south of Ballina). Records within Tweed Shire are all from the coastal hills and plains within the east of the Shire (GIS Enlighten, 2010).

Habitat

White Lace Flower is known to occur in riverine, littoral and lowland subtropical rainforest on a variety of soils including coastal sands and those derived from basalt and metasediments (NPWS, 2002). In the Tweed Shire and on the site it has been found in the understorey of Camphor Laurel dominant forest and Wet Sclerophyll forest (pers. obs).

Figure 1

Legend

- White Lace Flower Record 1
- White Lace Flower Record 2
- Recipient_site_1
- Recipient_site_2
- Site_boundary
- Parcel Boundary

0 40 80 160M

1:6,573

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Cadastre: 09 May, 2011
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Boundaries shown should be considered approximate only.

DO NOT SCALE
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GDA
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

Date Printed: 4 May 2011
Author: Sally Cooper, Design Unit

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Reproductive ecology

White Lace Flower flowers between September and December (NSW Scientific Committee, 2010) with fruit ripe between June to January. This species has 'mimetic fruit', which is brightly coloured fruit or seed with no associated pulp or aril. It mimics fleshy fruit thereby facilitating consumption and dispersal of the seed without providing any nutritional benefit to the seed disperser (usually a bird) (Galetti in Levey *et al*, 2002). White Lace Flower, like most mimetic fruit species, has a long fruiting period meaning fruit is available to seed dispersers for a long period of time (Galetti in Levey *et al*, 2002). Mimetic fruit species are often high in secondary compounds that are thought to deter seed predators; the secondary compound in *Archidendron* spp. are saponins (Galetti in Levey *et al*, 2002). Galetti notes, in Levey *et al* (2002), that there is little evidence in the published literature of avian frugivores eating mimetic seeds in the wild.

Most subtropical rainforest tree species are pollinated by a diverse suite of insects (eg. flies, beetles, bees and wasps) (Williams and Adams, 2010). However, Williams and Adams (2010) note that the morphology of the closely related species *Archidendron grandiflorum* suggests potential for pollination by birds. Given the similar flower morphology of *A. grandiflorum* and *A. hendersonii* and the highly-mobile nature of most nectarivorous birds, there is theoretically the potential for long distance pollen-mediated gene flow amongst white lace flower individuals.

White Lace Flower is known to flower and fruit well; however, it is often represented by only single trees per stand and seedlings are rare (NSW Scientific Committee, 2010). This suggests that germination or seedling survival, rather than fecundity or pollination, is the limiting factor for this species to increase its population size. However, Floyd (2008) reports excellent germination results with fresh seed of 33-100% after 7-19 days. Some growers claim better results with filing of seed (scarification) (Floyd, 2008). Tweed Shire Council Nursery Manager Greg Newland reported high germination rates for this species followed by slow seedling growth (pers. coms., 23/3/11). Slow establishment by seedlings is likely to increase the risk of seedling mortality and may be a contributing factor to the threatened nature of this species, particularly where it establishes in sub-optimal habitat and where threatening process are present. This highlights the importance of post-planting care and maintenance during the establishment phase of the translocated individuals.

Another possible explanation for the low level of natural recruitment is that the mimetic fruit of White Lace Flower may not be attractive to bird dispersers and as a result seed dispersal rates may be low. If seed is not being readily dispersed it is likely falling close by and competing with the parent plant.

Population genetics

At a site-specific scale, the two clusters identified on site are located approximately 700 m apart and associated with the same ridgeline (Condong Range). This distance is well within the home range of pollinators and dispersers of this species (birds and insects). Accordingly, it is considered likely that they are from the same breeding population with on-going gene flow potential and therefore there is unlikely to be significant genetic variation between them. In discussions with the Curator of the Australian Plant DNA Bank, Dr Martin Elphinstone, it was noted that the site is approaching the southern limit of this species range which extends to far north Queensland. Dr Elphinstone suggests there is likely to be minimal genetic divergence between two local groups of individuals separated by

700 m, relative to the amount of genetic diversity distributed throughout the species as a whole (pers coms., M. Elphinstone, 1/4/11). given that there has been little genetic research done on any members of the genus and virtually none on the species *Archidendron hendersonii*, it would be difficult and expensive to get any data quickly on the conservation genetics consequences of translocating individuals (pers coms., M. Elphinstone, 1/4/11). Sampling throughout the species range would be required to give the genetic population on site some context. Consequently, population genetic testing is not considered warranted in this case.

At a regional scale, it is considered appropriate to include propagule collections from individuals throughout the subtropical (SEQ/far northern NSW) population as the arrangement of known records indicates a contiguous patch (ALA, 2018). This patch is likely to have been better connected historically, prior to the widespread vegetation clearing associated with colonisation. Even if distant individuals within this population are no longer connected by gene flow, they likely were prior to land clearing. As such, they are unlikely to exhibit strong genetic structuring given the short period of time, in an evolutionary sense, for adaptive genetic differentiation to have occurred (Frankham et al., 2011). However, genetic isolation resulting from habitat fragmentation, may have contributed to non-adaptive genetic differentiation (eg genetic drift) (Broadhurst et al. 2008). Populations subject to genetic drift often exhibit reduced genetic diversity (Falk et al, 1991). Reduced genetic diversity is considered unfavourable as genetic diversity is important in enabling populations to survive short-term stochastic disturbance events (eg disease outbreak) and long-term changes to environmental conditions (eg climate change) (Broadhurst et al., 2008; Breed et al. 2013). Conservation genetics is increasingly emphasising the importance of maximising genetic diversity in restored communities in order to increase their genetic robustness and chance of persistence in the facing of changing environmental conditions. Accordingly, restricting propagule collections to the local area may not be in the best interest of creating the most genetic robust population. It is considered preferable to include propagules from a representative sample of individuals throughout the SEQ/far north NSW population in order to maximise genetic diversity in the restored population. Furthermore, it is recommended that a composite provenancing strategy be applied. Composite provenancing involves mixing seed from healthy local populations with smaller amounts of seed from more distant populations (Broadhurst, et al. 2008).

Threatening processes and recovery strategies

Threats identified for the conservation of White Lace Flower include:

- Loss of habitat through clearing and fragmentation.
- Habitat degradation through weed invasion and disturbance.
- Illegal collection of seeds for horticulture (DEC, 2005).

In making the final determination for listing White Lace Flower as Vulnerable, the NSW Scientific Committees (2010) note the small size of the known populations, and the small size of the stands of rainforest in which they are found, put the species at risk from further fragmentation of rainforest and from degradation of stands from weed invasion and disturbance.

Four recovery strategies, and associated priority actions, have been identified for White Lace Flower (DEC, 2005). These are detailed in Table 2.1 below.

Table 2.1: Recovery strategies and priority actions for White Lace Flower

Recovery strategy	Priority action	Priority
Habitat management: Fire	Ensure regional fire plans, hazard reduction burn guidelines include protocols for protecting rainforest habitats.	High
Habitat management: Other	Ensure that managers are aware of populations and habitat and that PoMs, fire plans, pest management plans take account of requirements for the recovery of White Lace Flower. Survey before road and track maintenance in the habitat of the species, protect road and trackside plants.	Medium
Habitat management: Weed Control	Assess weed threats to populations, manage as necessary. Implement Bitou bush control as described in the approved TAP.	Medium
Community and land-holder liaison/ awareness and/or education	Encourage the community to participate in the detection of White Lace Flower at new locations, and encourage their participation in habitat rehabilitation projects.	Low

The highest priority recovery strategy is the management of fire regimes to protect the rainforest habitat of this species. This highlights the significance of inappropriate fire regimes as a threat to the conservation of this species and the success of translocating this species.

Transplanting potential

No information could be found relating to past translocation attempts of this species or genus.

Recommended method of propagation

Germination from seed is known to be successful if sown fresh, as seed is reputedly short-lived (Floyd, 2002; Ralph, 2003). Preferably seed should be collected before it falls from the pod and sown immediately after collection (Nicholson, 2007). Ralph (2003) recommends soaking seed overnight in water to drown any insect larvae.

The Australian Native Plant Society (ANPS) note that the closely related *Archidendron grandiflorum* is relatively easily propagated from seed and that is responds to the same methods as used for the related Acacia sp. (ie. pre-treatment by soaking in boiling water or by scarification). ANPS (2010) also suggest cuttings should be successful for the closely related *A. grandiflorum*.

The available data suggests propagation by freshly sown seed is the best method for this species. It is recommended that the collected seed be equally split into four treatment groups for experimental purposes:

1 A control group that is sown fresh without any treatment.

2 A group that is soaked in room-temperature water overnight prior to sowing.

3 A group that is briefly soaked in boiling water prior to sowing.

4 A group that is scarified prior to sowing (either nicked with knife or abraded with sandpaper).

Experimenting with different pre-sowing treatments will provide useful information for future propagation of this species and can be shared with other environmental managers, land care groups and nurseries. The findings of the propagation experiments are to be documented in the first of the annual reports required throughout the five year program. In the event that the source plants do not produce enough seed to enable experimentation of seed propagation techniques, the report is to document the effort made to source seed, the limitations of relying on seed for propagation and discuss the success of cutting propagation. This information is to then be made into to a format suitable for submission to an ecological conservation publication (ie the Australian Network for Plant Conservation newsletter or a note/short article in the Journal Ecological Management & Restoration).

If seed availability is insufficient to meet the requirements of this project (and the florabank Model Code of Practice), cuttings may be required. Based on previous unsuccessful attempts to strike cuttings from this species at the TSC nursery, it is recommended that a specialist cuttings nursery be contracted to raise the cuttings.

2.2 Assessment of recipient sites

Two potential recipient sites have been identified and considered. The proposed recipient sites are:

- Recipient site 1: within the patch of retained Blackbutt Forest on Lot 1 DP1159352 in the sites far north-west.
- Recipient site 2: within the patch of retained Blackbutt Forest also on Lot 1 DP1159352 in the central west of the site (refer to Figure 1).

An assessment of the suitability of the two potential recipient sites is provided in Table 2.2 below.

Table 2.2: Suitability assessment of the two potential recipient sites.

Assessment criteria	Recipient site 1	Recipient site 2
Current or past presence of species within site	Yes – one juvenile species recorded in understorey of Blackbutt forest community.	None known.
Suitable habitat	Yes Historically, it is expected that the site would have been vegetated with sclerophyll forest on the hill slopes and ridgelines, with drier sclerophyll dominating the ridgelines and more exposed slopes and wet sclerophyll on the lower hills slopes. The wet sclerophyll forest on the lower, more protected slopes would have likely intergraded into lowland rainforest on the floodplain, which has since been converted to sugar cane crop fields. Recipient Site 1 encompasses wet sclerophyll forest on hill slopes, with rainforest elements in the understorey. The community is not expected to regenerate completely into a rainforest community; however, the wet sclerophyll forest of the lower slopes is considered suitable habitat. The metasediment soils are suitable.	Uncertain This is a drier community than that occurring at Recipient Site 1. The canopy may be too open and subsequently the understorey may be too exposed for translocated plants. The drier nature of this community is likely a result of the increased exposure of this site due to its topographic position on an easterly spur which projects from the main ridgeline. This site would have likely intergraded into lowland rainforest or possibly swamp sclerophyll forest in the low-lying areas. The lower south-facing slopes are likely to be most protected and subsequently most suitable for translocation of rainforest species. The metasediment soils are suitable.
Appropriateness of successional stage of community.	Vegetation descriptions of this community identify characteristic early successional rainforest species within the mid stratum. However, it is not expected to succession completely to a rainforest community. Rather, the understorey of the wet sclerophyll community will continue to harbour rainforest plants in the understorey, so long as disturbance by fire and weed invasion are managed. Given that this species grows to 18 m, it is capable of living out its lifecycle in the lower tree stratum, beneath the eucalypt canopy.	Fewer rainforest trees and shrubs have been recorded in the mid stratum of this community. It is not expected to succession into a rainforest community. Rather, the understorey of the dry sclerophyll community on the more protected lower south-facing slopes may be suitable to harbour rainforest plants in the understorey, as long as disturbance by fire and weed invasion are managed. Given that this species grows to 18 m, it is capable of living out its lifecycle in the lower tree stratum, beneath the eucalypt canopy.
Adequacy of habitat area to support self-sustaining population.	Approximately 3 ha. In modern times, White Lace Flower is characteristically found in small populations within small patches of rainforest. Accordingly, this site is expected to be sufficient to support a small population.	Approximately 1.2 ha; however, the suitable areas within this patch are restricted to a smaller area. This site is expected to be of sufficient size to support a small population.

Assessment criteria	Recipient site 1	Recipient site 2
Disturbances/threatening processes present at the site.	Weed invasion is moderate within this community, with Camphor Laurel scattered throughout the canopy. Weed management will be incorporated into a Habitat Management Plan for the site. Grazing by exotic and native herbivores is a potential threat to the success of the translocation. There is the potential for grazing by rabbits and macropods. Tree guards may be required for out-planted individuals until they establish themselves, if grazing becomes a problem. There is low potential for a wild fire or escaped fuel reduction fire to burn this community and destroy the translocated and naturally occurring plants and/or alter the community's structure and floristics. Fire management will be incorporated into the site-wide EMP for this site and is discussed further in Section 3.3.1.	Due to the proximity of this area to disturbed and future operational areas, it is likely to be susceptible to weed invasion. Management of this site would be incorporated into a site Restoration Plan (see TSC, 2010). The Translocation Plan and Restoration Plan actions will be incorporated into a site-wide EMP to provide for more wholistic environmental management of the site. Grazing by exotic and native herbivores is a potential threat to the success of the translocation. There is the potential for grazing by rabbits and macropods. Tree guards may be required for out-planted individuals until they establish themselves, if grazing becomes a problem. This community is expected to be more susceptible to fire than recipient site 1 because it is a drier community. Fire management will be incorporated into a site-wide EMP and is discussed further in Section 3.3.1.
Additional threatening processes that the site is susceptible to.	Future quarrying at North and West Valley has the potential to increase dust pollution in the sites vicinity. Smothering of vegetation by dust can be detrimental to growth and vigour of plants. Dust deposition on the leaves of plants can impede plant growth by inhibiting photosynthesis and evapo-transpiration. Dust management and monitoring will be incorporated into all Q&L operations at the site. Leachate pollution could potentially impact upon vegetation if not adequately contained. The EMP addresses leachate management.	Future quarrying at North and West Valley has the potential to increase dust pollution in the sites vicinity. Smothering of vegetation by dust can be detrimental to growth and vigour of plants by inhibiting photosynthesis and evapo-transpiration. Dust management and monitoring will be incorporated into all Q&L operations at the site. Leachate will be managed according to the EMP.
Security of land tenure	As previously stated, Recipient Site 1 would be part of the conservation area and managed in accordance with an approved Habitat Management Plan.	This site would be managed in accordance with the site EMP.

Assessment criteria	Recipient site 1	Recipient site 2
Compatibility of current and future land tenure at site with translocated population.	The proposed Eviron Rd Q&L has an expected lifespan of 40 years. However, as previously discussed the bushland within which Recipient Site 1 occurs will be managed as a conservation area throughout the life of the Q&L. Accordingly, the land use is considered compatible with the translocation program. Beyond the life of the Q&L, it is intended that the site be developed into a regional botanic garden. The approach to the planned Tweed Regional Botanic Gardens is one that promotes and conserves regional native flora. Accordingly, the botanic gardens land use is viewed as supportive of the translocation program.	During the 40 year lifespan of the Eviron Rd Q&L, the site will be retained as bushland. The close proximity to quarry and landfill operational land makes this site susceptible to disturbances such as weed invasion and dust pollution; however, these disturbances will be managed in accordance with the site-wide EMP. The regional botanic garden planned, post-Q&L, is viewed as compatible with the translocation program.
Access for out-planting and maintenance.	Access would be via the haul road or existing site access roads.	Access would be via an existing access road that is located adjacent the site.
Potential conflict with cultural values at the site.	The Cultural Heritage Assessment for the Proposed Eviron Rd Q&L (Converge, 2009) did not locate any areas or objects of Indigenous cultural heritage significance. However, the assessment noted that this may be attributed to the low ground integrity (GI) and poor ground surface visibility (GSV) levels that predominated over the majority of the project area and the recent ground disturbance of ridgelines, locations where there would have been a higher possibility of identifying Indigenous cultural heritage. The translocation works require minimal ground disturbance, being restricted to small holes to be excavated for the out-planting of propagated stock. Any unexpected finds of potential cultural heritage significance are to follow the procedures outlined in the Converge Cultural Heritage Assessment (2009).	As previously stated, the Cultural Heritage Assessment for the Proposed Eviron Rd Q&L (Converge, 2009) did not locate any areas or objects of Indigenous cultural heritage significance. Any unexpected finds of potential cultural heritage significance are to follow the procedures outlined in the Converge Cultural Heritage Assessment (2009).
Potential for ecological values of the site to be impacted upon by translocation works.	Recipient Site 1 occurs within Blackbutt Wet Sclerophyll Open Forest which is not considered an Endangered Ecological Community. The bushland associated with the site is however considered ecologically significant for its habitat values. Translocation works have the potential to impact upon the ecological values of the community if inappropriate genetic stock	Recipient Site 2 occurs within Blackbutt Dry Sclerophyll Open Forest which is not considered an Endangered Ecological Community. It is; however, considered to have habitat values including for fauna movement (eg. koala). The translocation plan addresses the potential ecological impacts associated with

Assessment criteria	Recipient site 1	Recipient site 2
	or diseased stock is introduced to the site or if site preparation, out-planting and maintenance activities disturb the existing vegetation and/or habitat. The translocation plan addresses these risks and provides measures to minimise them.	translocation works and provides measures to minimise them.
Determination of suitability as recipient site	**Yes – it is recommended to proceed.**	**No – not recommended to proceed. Suitability of habitat is sub-optimal and translocation risk is considered too high.**

2.3 Number of plants required

The goal of the translocation plan is to establish a viable self-sustaining population at the recipient site. Plant attrition is commonly very high in translocated populations. The general rule of thumb provided by Vallee *et al* (2004) is to propagate enough plants as resources allow to compensate for expected high attrition rates.

Little is known about the size of naturally occurring White Lace Flower populations, except that the known populations are small, generally occurring within small stands of remnant rainforest (NSW Scientific Committee, 2010). It is inferred that this species would naturally occur as isolated individuals or small clusters scattered throughout suitable habitat. The aim of the translocation is to retain the existing genetic stock on site by transplanting stock from those individuals subject to clearing to protected bushland habitat and supplement the existing individuals with stock propagated from a selection of parent trees within the SEQ/far northern NSW range. The supplementary stock is intended to enhance the existing population size and genetic diversity so that it is better equipped to cope with natural stochastic events.

Propagule collections may require replicate samples from each parent tree to account for expected high mortality rates. As discussed in Section 2.1.1, the cluster of stems is considered one source plant. A higher attrition rate would be expected from cuttings, compared with seeds, and collections should account for this.

The total number of seedlings planted will depend on the number of propagules successfully sourced and propagated from the source areas. However, it is recommended that the program aim to successfully establish ~50 seedlings (10 x the number subject to clearing) by the end of the five-year contract. Applying the composite provenancing strategy, most would be sourced from the Tweed with decreasing amounts sourced from further afield. Table 2.3 provides a suggestion for how many seedlings should be from each source local government area. The total number of seedlings and proportions may be varied if justifiable and in consultation with TSC.

Collections from each local government area should comprise propagules for a variety of individuals, from a variety of locations.

Table 2.3. Recommendations for number of plants from source locations and different parent plants

Location sourced	Number of seedlings to be planted	Minimum required number of seedlings surviving from different parent plants
Tweed	25	10
Gold Coast	10	4
Byron	10	4
Ballina	5	2
Total	**50**	**20**

2.4 Threats to translocation success and management measures

Potential threats to the success of the translocation plan and the measures proposed to manage these threats are discussed in Table 2.4.

Table 2.4: Threats to translocation success and mitigation measures

Threats	Threat rating	Management measures
Insufficient seed produced prior to clearing.	Moderate	If seed production is insufficient, it will be substituted with cuttings for propagation.
Source stock becomes diseased or dies prior to completion of seed collection.	Low	No propagation material to be collected from diseased stock. Source stock to be treated with appropriate insecticide/fungicide prior to collection, if necessary.
Poor germination rate	Moderate	Seed to be sown fresh and treated according to treatment group (eg. soaked overnight, soaked in boiling water or scarified). Review and modify germination conditions as required (eg watering rate, sunlight exposure, growing medium).
Poor strike rate of cuttings	Moderate	The number of cuttings would be maximised to allow for high attrition rates. If attrition is so high as to produce insufficient stock to establish a local population at the recipient sites alternative measures such as enhancement works for existing White Lace Flower plants in the area. The pre-clearing targeted surveys would potentially locate additional records. It is recommended that a specialist cutting nursery be commissioned to propagate the collected cuttings to maximise the chance of survival.
High tubestock mortality post-out-planting	High	Careful selection of out-planting sites based on micro-climatic conditions. Out-plant in clusters separated from each other to reduce chance of mass mortality from isolated events (eg tree fall). Manage threatening processes such as weed invasion and fire. Provide adequate maintenance and monitoring (eg. regular watering during establishment and ongoing weed management).
Accidental clearing or disturbance during construction of haul road and/or operation of quarry and landfill.	Low	The recipient site is within an area proposed for retention and management for conservation. . Identification of this area as a conservation area and no-go zone for construction and operational personnel will be clearly stated within the site induction program, EMP and construction design plans. Measures will be in place to protect the conservation area during construction and operation, including clear

		identification of no-go zone.
Natural disaster (eg bushfire)	Low	Incorporate fire management measures into habitat management plan and EMP and ensure fire trails and water supplies are maintained sufficiently.

2.5 Licensing requirements

A Biodiversity Conservation Licence is required under Part 2 of the *Biodiversity Conservation Act 2016* to pick a threatened plant for scientific, educational or conservation purposes. All personnel involved in the collection of propagation material, propagation and out-planting require a Biodiversity Conservation Licence.

3 Translocation proposal

3.2 Translocation team

The proposed translocation team and key responsibilities are detailed in Table 3.1.

Table 3.1: Proposed translocation team and key responsibilities

Team member	Organisation	Key responsibilities
Eviron Rd Q&L project manager	TSC	Ensure translocation plan is implemented and adequately funded.
Environmental Scientist/Ecologist/Botanist	TSC/consultant	Provide technical advice and supervision during translocation.
Nursery staff	TSC / commercial cutting specialist nursery	Propagate and raise seedlings.
Seed collector	Contractor	Collect the recommended number of seed from the recommended locations.
Bush regenerator	Contractor	Undertake site preparation, planting and plant maintenance.

3.3 Proposed methodology

3.3.1 Pre-translocation tasks and considerations

Pre-clearing targeted threatened plant survey

It is important to have a good understanding of all threatened species on site and the population characteristics of each threatened species such as: number of populations, size of each population and location in relation to other populations. It is also important to accurately determine the number of individuals subject to removal as a result of the proposed development. To acquire this information, targeted threatened plant surveys are required. These will be undertaken as early as possible to allow for incorporation of additional information into the translocation plan. The need for targeted threatened plant species surveys was identified in the environmental assessment report for the Eviron Rd Q&L (GHD, 2010). This report suggested targeted surveys be undertaken once the final development footprint is determined.

Once finalised, the development footprint would be surveyed and marked in the field to clearly demarcate the vegetation subject to disturbance and allow environmental scientists/botanists to accurately target their surveys. All threatened plant species identified during targeted surveys will be flagged and relevant information including species name, number of stems, height of each stem, condition and general observations recorded.

It can be difficult to discern whether clusters of stems are ramets (individuals which are physically distinct but genetically the same – formed by asexual reproductive means such as coppicing) or genets (genetically distinct individuals). Each stem will be given a plant identification number. Clusters of stems seemingly from the same rootball will be considered ramets. The plant code will identify both the plant and stem number (eg. 'AH_1_1', which represents *Archidendron hendersonii*, plant 1, stem 1).

Record keeping

Records will be kept for each sample of propagation material and maintained from the time of collection, to the raising of seed/cuttings, planting out of tubestock and maintenance and monitoring period. The following information will be collected for each sample:

- Sample id code (unique code to be created for each sample – eg. 'AH_1_1_1', which represents *Archidendron hendersonii*, plant 1, stem 1, seed 1);
- Source plant location (GPS coordinates and description);
- Date of collection;
- Type of material collected (eg. seed, cutting);
- Amount of material collected;
- Seed treatment technique;
- Date of sowing;

- Date of germination;
- Date of out-planting;
- Location of out-planting (GPS coordinates and description);
- Monitoring results (refer to Section 3.3.3 for proposed monitoring method).

Each sample will be tagged with its Sample id code for the duration of its life cycle.

Baseline data

Prior to out-planting, baseline data is to be collected from the out planting site. This will provide data on habitat traits at a micro level that can be compared between sites and over time to provide a better understanding on the species most preferable micro-habitat traits. Data to be collected includes:

- GPS location;
- Altitude;
- Slope;
- Aspect;
- Canopy coverage;
- Vegetation community association;
- Soil type;
- Landform morphology;
- Disturbances and overall ecological condition.

Recipient site preparation

The recipient site needs to be prepared for out-planting. In particular, the threatening processes (as outlined in Section 2.1.1) need to be removed or controlled.

Weed control works within the recipient site will be undertaken as early as possible in the translocation program, preferably well ahead of out-planting. This is to minimise the risk of habitat modification and competition by exotic species.

The habitat management plan for the conservation area is to incorporate fire management measures to protect the wet sclerophyll habitat of the recipient site. The fire regime for the wet sclerophyll forest will depend upon the conservation objectives. There is evidence to suggest that a wet sclerophyll forest can maintain itself with a healthy mature canopy without necessarily requiring fire to inhibit rainforest incursion (Watson, 2001). It has been suggested that logging, rather than fire, is more responsible for facilitating rainforest incursion in wet sclerophyll forest (Watson, 2001). Blackbutt regenerates with epicormic buds rather than lignotubers and is subsequently more sensitive to intense fires. A carbon-dating study from northern NSW suggests wet sclerophyll forests are adapted to very long interfire intervals, at least in terms of intense stand replacing fires (Turner,

1984 in Watson, 2001). The study found twelve layers of charcoal within the soil of wet sclerophyll Blackbutt forest and an average interfire interval of 280 years; however, it is possible that low intensity fires occurred within these intervals but did not show up in the charcoal record (Turner, 1984 in Watson, 2001). Fire, even low intensity burns, would jeopardise the success of the translocation program, at least until individuals are well established and have reached reproductive maturity. Accordingly, the translocation program relies on exclusion of bushfire in this area. This information will be incorporated into the conservation area habitat management plan and site EMP.

Staff training

The staff involved in the translocation program will be provided with an induction into the translocation program and a copy of the translocation plan. This includes seed collectors, nursery staff propagating stock, bush regeneration contractors undertaking weed control and out-planting and relevant site managers including the quarry and landfill supervisors and waste management coordinator. The program will be coordinated by TSC Botanist/Environmental Scientists.

The translocation plan will be integrated with the habitat management plan and restoration plan as well as the site EMP. This is to ensure that site personnel are familiar with the translocation program and its management requirements are incorporated into daily site management practices.

3.3.2 Translocation tasks and considerations

Type of translocation proposed

The type of translocation proposed is ‘ameliorative enhancement’. This describes an attempt to increase population size by adding individuals to an existing population to ameliorate the loss of part or all of that population as a result of development (Vallee *et al*, 2004).

The loss of a cluster of White Lace Flower from the development footprint will be compensated for by increasing the population size within the area of retained bushland where another White Lace Flower has been recorded. This will be done using individuals sourced from on-site and off-site from throughout the SEQ/northern NSW extent of the range.

Collection of propagules

Seed is to be collected from the source plant during the fruiting period between June and January.

In accordance with the florabank Model Code of Practice, it is recommended that no more than 20% of fruit is removed from any one plant (in any one season), unless clearing is imminent. If no fruit is borne prior to clearing, cuttings are to be taken from young growing tips.

Collected seed is to be stored in accordance with the florabank *Guidelines for Native Seed Storage for Revegetation*.

Collected seed is to be delivered to a contracted nursery for propagation. Sample id codes are to be kept with the sample at all times on a label that is not going to deteriorate with water and sun exposure.

Propagation

The seed is to be categorised, in equal numbers, into one of four treatment groups:

1. Group 1: control group that is sown fresh without any treatment.
2. Group 2: group that is soaked in room-temperature water overnight prior to sowing.
3. Group 3: group that is briefly soaked in boiling water prior to sowing.
4. Group 4: group that is scarified prior to sowing (either nicked with knife or abraded with sandpaper).

Group 1 seed is to be sown directly into the growing medium as soon as possible after collection, preferably on the same day.

Group 2 is to be soaked in room temperature water overnight and sown into the growing medium on the following day.

Group 3 is to be soaked in boiling water. Some seeds do not tolerate excessive time in boiling water (ANPSA, 2009) and given that White Lace Flower is a rainforest plant it is not considered a fire adapted species and is potentially intolerant of long periods of soaking in boiling water. Accordingly, it is recommended that the boiling water treatment be restricted to a brief (one minute) immersion/s in boiling water then allowed to cool. Seeds that soften and swell to 1.5-2 times their original size can be sown; those that don't swell are to be retreated, up to three times. Any seeds which float are usually infertile and can be discarded (ANPSA, 2009).

Group 4 seed is to be pre-treated with scarification. This can be achieved by abrading the seed with fine sandpaper; either manually or by gluing sandpaper to the inside surfaces of a small plastic container, placing the seeds in and then shaking the container vigorously (ANPSA, 2009). Alternatively, the seed coat can be nicked with a sharp knife taking care to restrict the cut to the seed coat and avoid damage to the inner portion of the seed. The method of scarification used should be recorded for each sample.

The different treatment groups provide an opportunity to experiment with seed treatment methods and ultimately determine the most successful method for this species. This information can guide future propagation and translocation programs for White Lace Flower.

In the event that seed production is insufficient, propagation would be undertaken using cuttings. In accordance with the Australian Native Plant Society (Australia) (ANPSA) recommendations, cuttings should be taken from firm, current season's growth; both hard woody material and soft 'floppy'

growth are likely to be unsuccessful. A test of suitability is to bend the stem through 60 - 90 degrees, if it springs back to its original position it's suitable but if it breaks or remains limp its best avoided. However, where clearing is imminent and propagation material is scarce, it is better to collect sub-optimal material rather than none at all. It is noted that cuttings can be taken at any time of year but root formation is very slow in the colder months (ANPSA, 2009). Potted cuttings would be approximately 75 mm long with leaves trimmed to reduce leaf surface area and treated with a root-promoting hormone.

The recommended growing medium is a standard commercial seed raising mix or if made in-house: a mix of 80-85% washed river sand and 15 - 20% peat moss (ANPSA, 2009). Artificial peat moss made from waste products such as coconut fibre is a more sustainable option and is readily available.

Seed should be sown to a depth approximately twice the seed diameter and spaced to allow easy ‘potting-on’ post-germination.

Cuttings should be propagated and grown on at a nursery specialising in cutting propagation.

A fungicide treatment is recommended to prevent 'damping-off' (rotting of the seedling stem at soil level). The use of sterilized seed-raising mixes and sowing so that seedlings are not crowded are effective ways of preventing infection (ANPSA, 2009).

To minimise risk of introducing diseased stock to the site, the following practices are to be adhered to:

- Only clean, healthy and disease free material is to be collected.
- When collecting propagation material, new, clean, tagged and separate bags/containers are to be used for each source plant (if more than one is located within the development footprint).
- Any cuttings are to be taken using clean secateurs which are to be disinfected between plants (eg. sprayed with a 70% methylated spirits solution).
- Propagation and growing benches are to be kept clean and sterilised.
- Fungicide treatment to be used on seed, as required.
- Growing medium is to be fresh and prepared and stored hygienically, such as from an accredited growing media supplier.
- Trays/pots or tubes are to be new or if re-used, sterilised.
- Over-wetting propagating material is to be avoided and air-circulatation is to be maintained around the pots/trays/tubes.
- The propagation and hardening off areas are to be kept free from weeds, liverwort and moss (NGIA, 2004).

Tweed Shire Council Nursery staff has indicated that approximately 24 months is required to propagate and raise the stock to a stage when it is ready for out-planting (pers. com. Greg Newland, 23/3/11).

Out-planting

Tubestock is to be 'hardened off' prior to out-planting to assist in their adaptation to natural conditions.

Out-planting should preferably be undertaken during late spring to take advantage of good growing conditions (warming temperatures, more sunlight hours). This will ensure the most intensive period of maintenance (watering and weeding) occurs during the first spring and summer when hot and sometimes dry conditions may otherwise cause heat stress and rapid weed growth.

The recommended planting arrangement is clusters of tubestock throughout the recipient site. This mimics the natural occurrence of this species in low density isolated clusters. Successfully propagated stock would be arranged in 5-10 clusters, with the number of individuals within each cluster dependent upon propagation success. Indicative locations of out-planting clusters are depicted in Figure 2. During out-planting each plant will remain tagged with its plant id code. A GPS coordinate will be taken for each plant planted into the ground and a mud map of the location of each plant, labelled with its plant id code, will be prepared.

Each transplant is to be planted in a hole approximately 1.5 – 2 times the width and depth of the existing rootball. Care is to be taken when digging holes to avoid damage to the root system of existing vegetation. Planting in close proximity to the existing White Lace Flower is to be avoided. The stock is to be watered in; fertilizer is optional. Weed-free mulch is to be placed around the base of the stock but kept clear of the stem.

A minimum of 10 healthy tubestock is to be retained at the nursery as insurance in the event of mass losses of the planted stock. The insurance stock could be out-planted as replacement stock but only after the initial five year monitoring period to allow adequate time to assess the suitability of the recipient site and gain a better understanding of the micro-habitat preferences.

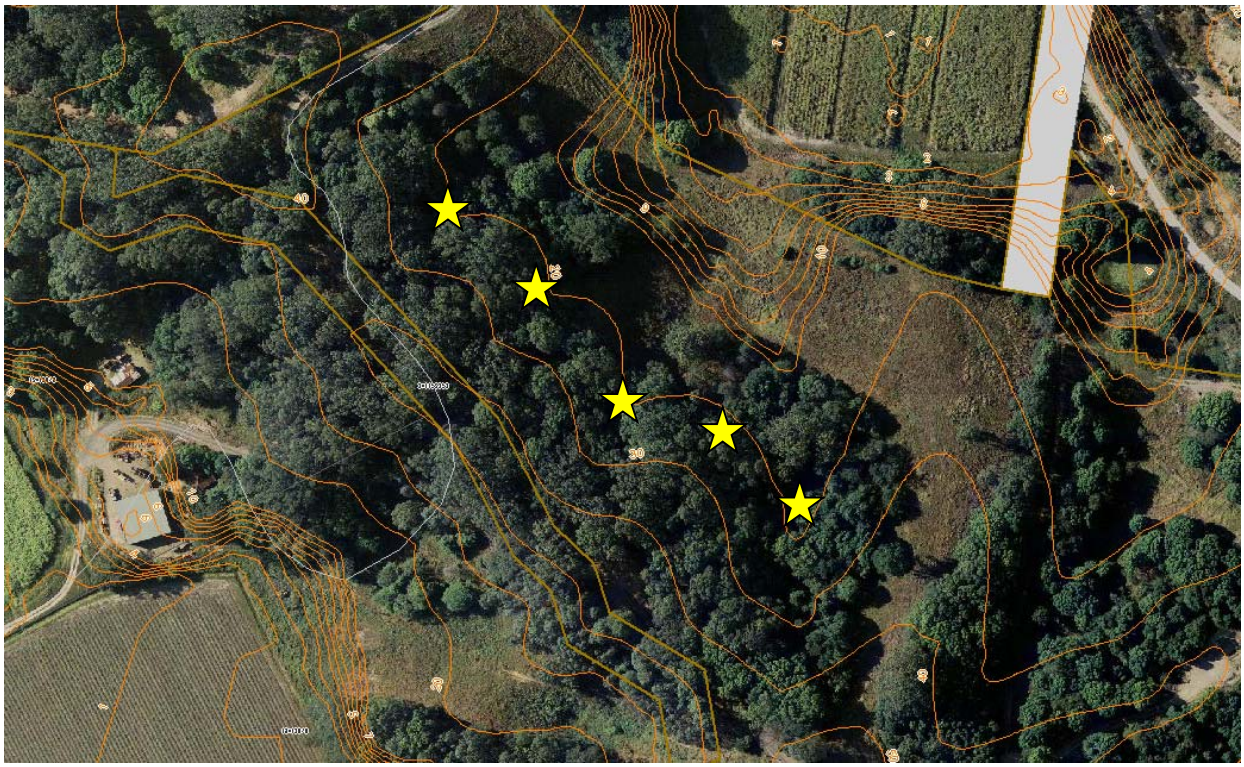

Figure 2: Indicative locations of out-planting clusters.

3.3.3 Post-translocation tasks and considerations

Maintenance

As previously stated, translocated populations are renowned for having high attrition rates. To minimise plant losses a good maintenance program is required. The proposed maintenance program is provided in Table 3.2.

Table 3.2: Proposed maintenance program

Task	Frequency and method
Watering	The plants would initially be watered in during out-planting. For the first six month post-planting, watering would be undertaken once a month (or as required). Watering events may be skipped in the event of adequate rainfall.
Weed control	Primary weed control would be undertaken prior to out-planting as part of site preparations. For the first year post-planting, a minimum of six weed control events would be undertaken. All weeding within 10 m of the transplanted stock would be hand-weeded to minimise risk of spray drift damage. For the subsequent four years, weed control events would be undertaken quarterly (four times a year). Beyond the five year period, weed control would be addressed in the overall weed management of the conservation area as directed by the habitat management plan.

Monitoring

The proposed monitoring program is to run over a five year period. The proposed monitoring schedule is annually for the first five years.

The following key performance indicators would be assessed during each monitoring event:

- Translocated stock survival – proportion of tubestock planted survived;
- Likely cause of any translocated stock mortalities;
- Height of translocated stock;
- Dust deposition on leaves of translocated stock (qualitative visual observation);
- Qualitative assessment of translocated stock health (eg. visual observations on the presence of fungi or insect infestations and dieback or discolouration of foliage);
- Evidence of any damage to surrounding native vegetation (eg. dieback from possible root damage, trampling, spray drift damage);
- The presence of flowers or fruit on translocated stock;
- The presence of any natural recruitment (seedlings);

- Presence of threatening processes (eg. weed encroachment, fire, evidence of herbivore grazing).

The key performance indicators have been selected to allow the translocation objectives to be measured.

Adaptive management

The data collected during monitoring will be analysed to attempt to recognise any patterns or potential causal relationships between transplant success and micro-habitat traits and environmental management practices (eg. weed management, dust suppression).

This information will guide maintenance practices and frequency, inform which sites are most suitable for replacement plantings (if required) and guide site management practices. The findings can be disseminated to assist future conservation of this species.

Reporting

Progress reports will be produced annually during the five year monitoring program. The annual progress report will be a brief document (1-2 pages) including the following:

- a brief discussion of works completed since commencement/last progress report;
- a description of outstanding works planned for the subsequent year, highlighting priority tasks;
- presentation of monitoring results;
- any recommendations for adapting works to suit changing conditions, shifting priorities (eg. new threatening processes).

In addition to progress reports, an evaluation report is to be prepared at the end of the five year program. The evaluation report will summarise the monitoring data over the five year period, discuss findings and provide recommendations for future translocation plans.

The reports will be submitted to the TSC primary contact or as directed by DoP/OEH.

Contingency

In the event that the translocation is deemed unsuccessful, due to either insufficient propagation material or very high attrition rates, there may be the potential to provide enhancement works to existing White Lace Flower plants (ie targeted weed control works). This would focus on the existing White Lace Flower within Recipient Site 1 and any other individuals of White Lace Flower on site, as determined through pre-clearing targeted surveys proposed to be undertaken once the development footprint is finalised.

4 Schedule of works

The proposed works have been incorporated into a schedule provide in Table 4.1. Note that the schedule is subject to change with adaptive management guiding maintenance frequency and development and seasonal timeframes (eg. construction schedule and fruiting period) all influencing the works schedule.

Table 4.1: Proposed schedule of works

Task	Prior to clearing	Year 1												Year 2												Year 3												Year 4												Year 5											
		A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Pre-clearing targeted threatened plant survey																																																												
Propagule collection and propagation																																																												
Baseline data collection																																																												
Site preparation																																																												
Out-planting																																																												
Watering																																																												
Weed control																																																												
Monitoring																																																												
Reporting																																																												

Note: A coloured box indicates one event for the month; if more than one event is proposed, the number within the box indicates the total events proposed for the month.

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5 Conclusion

To maximise the success of the program, the translocation plan will be incorporated into the other management plans; namely, the conservation area habitat management plan and site-wide EMP.

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