Macrozamia conferta **Translocation Management Plan Monitoring Report – Year 1 – review of the assessment of the effectiveness of the management actions.**

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Short bio
James is a leading cycad specialist research scientist with research interests that focus on understanding the evolution and diversity of cycad and other gymnosperms using modern molecular and morphological approaches, including using novel and new DNA sequencing techniques for conservation genomics, forensics and phylogenetics to understand plant evolution and to help conserve species. He is also the Regional co-chair for BGCI Global Conservation Consortium for Cycads, Oceania and a member of the IUCN SSC Cycad Specialist Group and has been working with cycads for over 13 years.

General comments
Very good attention to detail on removal of plants to prevent damage by equipment and impressed that over 12,000 plants were removed. This clearly demonstrates the populations of the species are in much better condition, than stated previously. The equipment and methods used to remove and store plants seem good,

The original monitoring frequency of the plants after removal seems to be too frequent when compared to the slow development and growth cycle of cycads. This seems like a waste of initial resources and time. However, it does seem like modifications to monitoring have been made and the frequency reduced in the future.

When considering the sex ratios of the populations it could be considered to carry out a PCR based sex determination assessment. This would allow genetic sex determination of all plants in populations and more accurately determine sex ratios of populations. This can even be done with seedlings.

The seed germination rates seem very low, and I am wondering if all the seeds are being given enough time to germinate or if there was good checking of seeds at the nurseries. The

seeds may have gone past the recovery point even before collection and I do not think this is being recorded correctly and would more accurately reflect the true germination rate.

Page specific comments

Page 28: I would be cautious about leaf counting as it is likely that these plants will deplete old leaves during or before a leaf flush. However, you would likely still see the older leaf for a short period of time. This is normal with most Australian Cycas and Macrozamia.

Recommendations
Specific recommendations for changes to management actions (which are outside the scope of this review of the assessment) have been made in a separate document provided to the client.

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Macrozamia conferta Translocation Management Plan Monitoring Report – Year 1

Prepared for:
ACCIONA Energy Australia Global Pty Ltd

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Attexó

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1.0 Introduction

ACCIONA Energy Australia Global Pty Ltd (ACCIONA) is developing the MacIntyre Wind Farm (MIWF) and associated Overhead Transmission Line (OHTL) (the Project), which were approved under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 22 February 2022. EPBC Act conditions of approval for the Project (EPBC 2020/8756 and EPBC 2020/8759) required the development and approval of a *Macrozamia conferta* Translocation Management Plan (MTMP) (Attexo 2022a) to support the translocation and propagation of impacted *M. conferta* specimens. This Plan was approved by the Department of Agriculture, Water and the Environment (now the Department of Climate Change, Energy, the Environment and Water) on 13 May 2022.

1.1 Purpose and Scope

As set out in the MTMP, and as required to address Condition 25 of the EPBC Act approvals for the Project, a monitoring report that assesses the effectiveness of the management actions of the MTMP is required (this report). This assessment must be prepared *"within every twelve months for the first five years following the date on which the Minister first approved the MTMP and subsequently by every fifth anniversary of the date on which the Minister first approved the MTMP until the number of* Macrozamia conferta *individuals impacted by the action that survive for at least twenty years after translocation exceeds the number of* Macrozamia conferta *individuals impacted by the action"* (see **Table 1.1**Table 1.1).

This report is the first monitoring report (Year 1) on the effectiveness of management actions in the approved MTMP.

1.2 Compliance Summary

Table 1.1 Table 1.1 summarises how the *Macrozamia conferta* translocation project has (or will) achieve compliance with the EPBC approval conditions which require reporting against the progress of the MTMP.

Table 1.1 Compliance Summary of MTMP Conditions EPBC 2020/8756 and EPBC 2020/8759.

Condition Number	Condition Requirement	How Condition has been Addressed
25.	To determine the likely effectiveness of the management actions in the approved MTMP to translocate *Macrozamia conferta* individuals impacted by the action, the approval holder must engage a suitably qualified field ecologist to undertake, within every twelve months for the first five years following the date on which the Minister first approved the MTMP and subsequently by every fifth anniversary of the date on which the Minister first approved the MTMP, until the number of *Macrozamia conferta* individuals impacted by the action that survive for at least twenty years after translocation exceeds the number of *Macrozamia conferta* individuals impacted by the action, an assessment of the effectiveness of the management actions in the approved MTMP.	This report is the first monitoring report set to assess the effectiveness of management actions in the approved MTMP. Section 10.5 of the MTMP outlines reporting requirements including the following: • The final number of *M. conferta* collected from the Project footprint – see **Section 3.1**; • The final number of seeds collected from translocated plants – see **Section 5.25.2**; • Propagation success in nursery of seeds collected – see **Section 5.25.2**; • The success rate and health status of translocated *M. conferta* – see **Section 3.20**; • The success rate and health status of propagated seedlings transferred into Recipient Site – see **Section 5.35.3**; • Unforeseen issues arising during the project, translocation methods and overall success – see **Section 2.62.6**;

Condition Number	Condition Requirement	How Condition has been Addressed
		• Demonstrated compliance with management actions outlined in this Plan – see **Section 2.0**.
26.	The approval holder must ensure that each assessment of the effectiveness of the management actions in the approved MTMP is: a. subject to a peer-review completed within 6 months of the completion each such assessment; and b. published on its website with the findings of the peer-review within 6 months of the completion of the peer-review and remains published for the remaining duration of this approval.	This report will be subject to peer review, with findings published on the Project website within the required timeframes.

2.0 Assessment of Management Actions

The effectiveness of management actions involved in the translocation program have been assessed in the following section. Details have been provided to elaborate on the implementation of approved management actions outlined in the MTMP. Where implemented actions have varied from the MTMP, these variations are explained and justification for the variation provided.

Metadata associated with the Translocation Database is provided in **Section 2.1**, including structure and content of data capture, storage, and analysis processes. Implementation of weed and fire management procedures involved in the preparation of Recipient Site are described in **Section 2.2**. Details of the translocation works, and methodology variations are explained in **Section 2.3**. **Section 2.4** outlines information relating to propagation of collected seed by accredited nurseries and germination rates current at the time of writing. **Section 2.5** establishes a reporting template for ongoing monitoring of the Recipient Site and contains baseline data captured in the first monitoring event for survival rate, health metrics, and potential threats. Issues encountered during the translocation program are listed in **Section 2.6**, along with recommendations for adjustments to the frequency of future monitoring events.

2.1 Translocation Database

During translocation, data was collected using customised, digital forms built on the ArcGIS Survey123 platform. Two forms were used for the collection of *Macrozamia conferta* translocation data, including one to record data prior to extraction (the extraction form), and one used to record data following planting (the planting form). Some of the data fields proposed in the initial design of the Translocation Database (TD) were modified to align with site observations. Table 2.1 presents a summary of the information proposed in the TD compared with what was collected.

Table 2.1 Assessment of features listed in the MTMP to be recorded for plants requiring translocation and stored in the Translocation Database (TD) across project Extraction and Planting Forms.

MTMP Features to be Recorded	Assessment of Feature and Corrections
Site ID	***Extraction Form:*** This feature provides approximate locations within the Project of where plants were identified in the project area prior to translocation. Extant plants identified at the "Recipient Site" were recorded in this form but were not extracted from the ground.
	Planting Form: This feature provides GPS coordinates of each planting location. All plants have "Recipient Site" attributed to their Site ID upon planting.
Specimen ID	***Extraction Form:*** This feature is the primary key identifier assigned to each plant by attachment of a stainless-steel tag bearing a unique number. This feature facilitates tracking of specific plant specimens through the translocation process and subsequent monitoring events. A photo taken of ID tags when making an entry allows for auditing of entered data.
	Planting Form: This feature is the primary key identifier assigned to each plant by attachment of a stainless-steel tag bearing a unique number. This feature is used to reconcile records of translocation, maintenance, and monitoring activities relating to specific plant specimens over time. A photo taken of ID tags when making an entry allows for auditing of entered data.

MTMP Features to be Recorded	Assessment of Feature and Corrections
GPS location	***Extraction Form:*** GPS coordinates indicate extraction location of the specimen. Data collection by ecologists and field technicians using a variety of digital devices resulted in location error ranging from 2 m to 10 m. In some instances, GPS recording has failed and so Site ID has been used to support aggregate statistics relating to locations of impacted plants.
	Planting Form: GPS coordinates indicate planting location and allow for specific individuals to be located again in future as required (e.g. a specimen ID photo is too blurry to be verifiable). Individuals that have had extra measurements taken as part of research outlined in the *Macrozamia conferta Research Plan* (Attexo 2022b) required by other conditions of these permits, will need to be measured again in future and can be located using this data feature. In some instances, GPS has failed and currently there is no plan to re-identify these plants and attribute coordinates given that the plants are located within the translocation plots and have ID tags.
Time and date	***Extraction Form:*** The time and date that appears in the TD is the time at which plants are tagged with their Specimen ID rather than excavated. This may be between a few minutes to a couple of days prior the actual excavation of the plant. To maintain an efficient workflow, plants are typically tagged, and individual trait data is collected ahead of the excavator. Due to the way data is collected in the Survey123 app, data can only be edited by the same submitter when in the field. As multiple people are typically working to excavate and tag plants, it proved unfeasible for the original tagger of each plant to edit the timestamp at the time of excavation. An additional person noting the Specimen ID and time of excavation for each plant to be edited later was a possibility but was deemed impractical and unnecessary as this data still shows the general order and timeframe of excavation across the Project.
	Planting Form: Time of planting has been recorded however is not wholly relevant to the MTMP requirements.
Age class (Seed, Seedling, Juvenile, Sub-adult, Adult at reproductive maturity)	***Extraction Form:*** Age class is recorded in accordance with class options outlined in the MTMP. Seeds have not been recorded as an age class however, as all seeds were collected for cultivation and were not planted or given a unique specimen ID on site. The number of seeds taken from a single plant was recorded alongside the maternal plant ID where possible including the time and location of seed collection. Plants have been labelled as "Seedlings" when only having 1-2 very small leaves. Initially, all other plants were assumed as "Juvenile" when smaller-leaved, "Sub-adult" when larger-leaved, and "Adult at reproductive maturity" when a cone or cone debris was present. As extraction proceeded, it was observed that plants may have very large caudices but display juvenile-like growth after recent resprouting, and many plants labelled as sub-adults are likely reproductively mature adults without recent evidence of coning. Communication with experts in the field confirmed that determination of age class from above-ground features is unreliable. It is unlikely that this metric is entirely useful for determining population demography.
	Planting Form: Age class was not re-recorded in the planting form.
Sex (when cones present)	***Extraction Form:*** Sex was recorded when cones or cone debris was present.
	Planting Form: Sex was not re-recorded in the planting form.
Female to male ratio	***Extraction Form:*** This ratio is not recorded in the TD. This data is derived from the results of monitoring.
	Planting Form: Sex was not re-recorded in the planting.

MTMP Features to be Recorded	Assessment of Feature and Corrections
Presence of cones and maturity (Undeveloped, Ripe, Old)	***Extraction Form:*** Cone presence and maturity (if present) was recorded.
	Planting Form: This feature was not re-recorded in the planting form.
Proximity of Seedlings to the maternal parent and identification number of maternal parent	***Extraction Form:*** Few seedlings (<10) were found during translocations (**Table 3.2**). Proximity to maternal parent was not recorded for these plants due to issues in identifying the maternal plant. Not all seedlings were found near an obviously mature-looking plant or female cone debris was not present to further verify whether nearby mature-looking plants were female and capable of producing seed.
	Planting Form: This feature was not relevant to the planting form as plants have been moved from their original locations.
Number of fronds	***Extraction Form:*** The number of fronds on a given plant was recorded.
	Planting Form: This feature was not re-recorded in the planting form. Note that leaf numbers were typically reduced upon planting due to a loss of fronds during transit or from pruning following translocation.
Number of new fronds	***Extraction Form:*** This metric was recorded.
	Planting Form: This feature is not re-recorded in the planting form.
Number of dead fronds	***Extraction Form:*** This metric was recorded.
	Planting Form: This feature is not re-recorded in the planting form.
Evidence of disturbance (Fire damage, Insect damage, Defoliation)	***Extraction Form:*** Evidence of the type of disturbance was not recorded for translocated individuals. Where possible notable disturbance or features of the plant may were recorded in the "Notes" section.
	Planting Form: This feature was not recorded in the planting form.
Disturbance severity (Low, Medium, High)	***Extraction Form:*** Plant disturbance severity was recorded as the percentage area of disturbance across all living leaves. "Intensity level of disturbance" was classified into three levels: "<5%" (low), "5-50%" (medium), ">50%" (high).
	Planting Form: This feature is not re-recorded in the planting form.
Evidence of damage incurred to the plant through the translocation process (especially caudex damage and loss of the coralloid root clusters critical for nitrogen uptake)	***Extraction Form:*** Damage to the caudex was not recorded at the time of extraction as entries were made when tagging plants ahead of the excavator. Instead, any damage from excavation was noted, with appropriate photos taken before specimens were planted at the Recipient Site.
	Planting Form: Any notable damage to the caudex of the plant, or if all fronds are lost, was recorded under the "Notes" section of the Planting Form with photos taken of the damage. Coralloid root clusters were often not seen on the plants, but it is unknown whether this is due to many plants not having them, or whether they broke off easily. Some plants that had coralloid root clusters were noted to have such in the "Notes" section.

Table 2.2 Additional features recorded in the *Macrozamia conferta* translocation database.

New Features	Assessment of Feature and Corrections
Supervisor	The name of the ecologist supervising the activity was recorded for future reference in both the extraction form and planting form.
Presence of pollinators	This feature was only recorded in the extraction form and captured the presence of pollinators if seen on a plant to be translocated. Note that no confirmed pollinators were spotted during extraction.
Number of seeds collected	This feature was recorded in the extraction form and records the number of seeds collected from a mature female if present.
Notes (including photos)	In both extraction and planting forms, this feature was used to record any additional information of interest. Before extraction, features such as largely noticeable disturbance or strange growth habits were noted. During planting, this feature included notes on damage incurred during translocation, presence of coralloid roots, or whether a plant had been re-planted due to an issue in its previous planting location (e.g. hole subsidence after a period of heavy rain). Photos were often taken of the noteworthy observation. Additionally, some photos were taken regardless of whether notes are made. In the extraction form, these photos included a photo of the plant prior to excavation (as a representative photo of the individual for potential future comparisons) and a photo of the specimen ID tag (for verification purposes). In the planting form, these included one or multiple images that showed the planted individual (to show its status upon planting), the specimen ID tag (for verification purposes) and the plant's position relative to the stake with the ID tag (to assist with location of the plant during future monitoring events).
Time of planting	This feature was recorded in the planting form and captured the time at which an individual was planted.

2.2 Recipient Site Preparation

2.2.1 Weed Management

The Recipient Site was found to have three species listed as Weeds of National Significance (WoNS) and Restricted Invasive Weeds (Category 3) under the Queensland *Biosecurity Act 2014*; *Opuntia tomentosa*, *O. stricta,* and *Senecio madagascariensis* (fireweed). *Opuntia* spp. were controlled through physical removal using hand tools before being buried to a depth of 2 m at a site outside the offset area (Plate 2.1) but within the same property allotment. *Senecio madagascariensis* records were minimal and plants were removed by hand, sealed in a suitable container, and disposed of according to relevant advice from state and local authorities. Weeds will be monitored and dealt with as needed post-translocation during *Macrozamia conferta* monitoring events (**Section 2.5.2**).

Plate 2.1 The physical removal (A and B) and storage (C) of *Opuntia spp*. at the Recipient Site.

2.2.2 Fire Management

Stick raking was undertaken to consolidate fallen timber fuel sources in preparation for future controlled burns. As planting holes for translocated *Macrozamia conferta* were dug, woody debris was made into small piles located away from translocated plants (see **Plate 2.2**).

To minimise the risk of intense fire at the Recipient Site, fire breaks, fuel loads and the presence of high-risk weeds will be monitored and maintained appropriately during *Macrozamia conferta* monitoring events (**Section 2.5.2**).

Plate 2.2 Piles of woody debris collected for future controlled burning.

2.3 Translocation Methods Undertaken

Translocation methods presented in the approved MTMP are described in **Table 2.3** with notes on alterations made to methodology during implementation where relevant.

Table 2.3 Assessment of translocation and planting methodology from the MTMP.

MTMP Methodology	Assessment of Methodology and Corrections
Plant and Soil Removal	
1. Use marker paint or fluorescent dye to denote the north side of every plant to ensure translocated plants retain similar north-south orientation.	The stem of *Macrozamia conferta* presents as a subterranean caudex, and so the implementation of this step proved unfeasible. Fronds of *M. conferta* were difficult to mark in a way that highlights a single direction, with fronds sometimes twisting or dropping during excavation or transit.
2. Trim all fronds back to the point of attachment between rachis and stem.	This method was altered so that approximately two-thirds of fronds per plant were removed, with fronds in the best condition being kept. This change was adopted to allow photosynthesis to continue whilst minimising evaporative stress upon translocation. Reducing the number of leaves cut also reduced the risk of infection by plant pathogens.
3. Apply an anti-transpirant (e.g., Envy®), if required, to the foliage of each plant to reduce the risk of desiccation.	Anti-transpirant was generally not required with above average rainfall in the region during the winter months keeping the plants moist most of the time (BOM 2023). Access to water to drench the plants following excavation (**Step 7**) was plentiful, where required further reducing the need for anti-transpirant. There is also evidence suggesting that anti-transpirant likely has little effect on aiding the growth of replanted cycads (Deloso et al. 2020a).
4. Assess the topography and soil conditions (moist or dry) for each plant and overall safety of the area. If soil is too dry, water root ball prior to excavation.	Above average rainfall in the winter months for the region resulted in relatively wet soils in the area (BOM 2023) for much of the translocation, aiding in excavation. The location that plants were translocated from were generally moist enough that extra water was not applied prior to excavation. Damage to plants predominantly occurred in areas where the underground stems were embedded in rocky soils or entwined in the root ball of large trees, rather than dry soil areas.
5. Depending on soil conditions, hand-digging may be required for small individuals, however, excavation of mature plants will ideally be with an excavator (nominally 13 t) mounted tree spade with basket attachment. ***Note:*** care will be taken during excavation to avoid damaging the subterranean caudex which can be up to 1 m long and in retaining as much of the soil around the root ball as possible should be retained, as the weight of the soil falling off the root ball can damage the roots of the plant.	Small excavators (1.8 t, 2.7 t, 5 t) were utilised to carefully excavate most *Macrozamia conferta* individuals without use of a tree-spade attachment (**Plate 2.3**). Manual methods using shovels and crowbars were used in some locations, particularly in the initial stages of the Project, and in areas with restricted access.
6. Movement of larger and heavier individuals will likely be done using a tree spade. Where soil conditions make this impractical a soft sling on an excavator bucket and packed using hessian sacking (or similar material) will be employed to avoid bruising and damage of stems and roots.	No excavated plants were too heavy or too large for more than one person to safely pick-up and wrap. As such, this methodology was not required.

MTMP Methodology	Assessment of Methodology and Corrections
7. Wrap the root ball and roots in rolls of hessian sacking (or similar) and spray with water to retain moisture of the root ball while the plant is awaiting replanting.	Subterranean features of the plant (roots and caudex) are wrapped in hessian or a similar bio-weed mat material after excavation and watered to be kept damp by hose or bucket ( Plate 2.4).
8. If roots become damaged, they will be trimmed with sterilised secateurs and a fungicide applied by spraying the roots with Banrot® to prevent infection. Damaged root ends will either be allowed to form a callus (by leaving plants in the shade within the holding area for two weeks) or be painted with a standard arboricultural stem sealant. A rooting hormone will also be applied to promote root growth.	Damaged lateral roots were trimmed with secateurs to produce a clean cut where needed to minimise surface area for infection. The use of fungicides was deemed inappropriate as it may harm potential mycorrhizal fungi utilised by *Macrozamia conferta*. Although little research has been undertaken on the presence of mycorrhizal fungi in cycads, such beneficial fungi have previously been found on the roots of other Australian *Macrozamia* species (Brockhoff & Allaway 1989, Brundrett & Abbott 1991). To preserve the benefit conferred from mycorrhizal fungi if present, plants were not left to form calluses at the risk of dehydrating any fungus. Where practical, damaged root ends were allowed to form a callus or treated with stem sealant. Horticultural rooting hormones may have little effect on cycads (Deloso et al. 2020b) and initial application of exogenous auxin on some plants resulted in no obvious benefits to health or growth. Its use was discontinued for remaining translocations.
9. Translocation will be managed to limit the time period that M. *conferta* specimens are out of the ground and to minimise bruising of plant stems.	Plant exposure out of the ground was minimised, with most plants (~74%) being planted in less than three days from when they were extracted (**Figure 3.3**).
Replanting of Translocated Plants	
1. Holes to receive translocated plants will be dug, either by hand or machine depending on the size of individual plants. The soil within the hole will be loosened, and the hole should be not much deeper than the root ball of the plants being transplanted.	An excavator with auger attachment was used to drill holes for planting to a depth of ~450 mm (Plate 2.5). This depth represents the approximate average length of subterranean features of 100 random plants. For plants with caudex length above 450 mm, holes were modified by hand using a post hole shovel or creating a deeper hole with the excavator. For plants with belove average caudex length, dirt was pushed back into the holes and compacted prior to the placement of the plant in the hole. Holes for small juvenile plants were dug by hand. Soil subsidence had previously occurred in some cases where hole depth was significantly greater than caudex length (**Section 2.6**).

MTMP Methodology	Assessment of Methodology and Corrections
2. Plants will be positioned in new holes. Just prior to planting, the hessian will be removed, and any further damaged roots will be trimmed and Banrot® (or similar) reapplied.	Plants were left in their transportation buckets, with each plant wrapped in a hessian cover. The hessian was removed immediately prior to planting or for taking measurements where required. As outlined above, fungicide application was not undertaken (see Plant and Soil Removal **Step 8**).
3. The root ball of each plant will be re-packed with sandy loam from the site to provide a suitable substrate for new roots to grow and original topsoil removed from the hole will be used to fill the remainder. Plants will be placed in a vertical alignment.	Sandy loam was not used in planting. The Recipient Site was assessed as having appropriate soil conditions and is positioned in an area in which *Macrozamia conferta* were already established. Plants were planted in the same orientation in which they were dug out of the ground (as determined by root and leaf emergence positions), typically vertical (although not always, see Plate 2.6), to increase the chances of continuing their pre-extraction growth habit. After placement, holes are filled in with the soil that was excavated from them, in approximately the reverse order in which it was excavated.
4. If required, the foliage will be sprayed a second time with an anti-transpirant (e.g. Envy®), to reduce the risk of desiccation.	The use of anti-transpirant was not required (see Plant and Soil Removal **Step 3**).
5. Each plant will be watered thoroughly with suitable quality irrigation water.	Upon planting, plants were watered thoroughly into the ground to allow root and soil settlement with water drawn from an onsite dam using a water trailer with at least 10 L of water per plant (Plate 2.7).
6. A systemic fungicide will be applied around each root ball.	Application of fungicide was not undertaken (see Plant and Soil Removal **Step 8**).
7. Each plant will be watered about once a month (10-20 litres) depending on rainfall for 6 months after replanting or as deemed appropriate.	Watering was undertaken in accordance with the schedule, taking into consideration precipitation volume at the planting site. Conditions for the first few months of translocations experienced above average rainfall (BOM 2023). Weather conditions on site will continue to be monitored and watering will be undertaken when necessary.
8. Where insect damage to translocated specimens is observed during monitoring, a control program will be employed that does not impact on pollinator populations.	Cycad Blue (*Theclinesthes onycha onycha*) butterfly were first observed in February 2023 ovipositing on a translocated plant (Plate 2.8). Damage resulting from *Theclinesthes onycha onycha* larvae was later found during the first monitoring event in March-April 2023 with ~1.5% of plants translocated impacted. Where possible larvae were physically removed (Table 5.1) at the time of inspection. Ongoing inspections will be undertaken to assess potential damage. A control program will be implemented should the extent of insect damage notably increase following future monitoring events.
9. Tree guards will be placed around juvenile *M. conferta* to limit impacts from native herbivores until individuals have achieved leaf lengths of 35-60 cm, at which time the specimens have reached maturity and defence mechanisms (cycasin) against browsing have developed.	Tree guards were not placed around translocated juveniles. Very few juvenile plants were translocated and their potential impact was assessed as likely to restrict photosynthesis of small plants, outweighing the potential benefits associated with reduced herbivory or reduced evaporation.

Plate 2.3 Mechanical extraction using small excavator.

Plate 2.4 Excavated plants were wrapped in hessian (A) and watered thoroughly (B) to reduce stress.

Plate 2.5 Excavator with auger attachment drilling holes for plants.

Plate 2.6 ***Macrozamia conferta*** **growing in sediments uplifted by a long-fallen tree prior to translocation.**

Plate 2.7 Watering of translocated *Macrozamia conferta* after planting.

Plate 2.8 Cycad Blue (*Theclinesthes onycha onycha*) ovipositing on a translocated *Macrozamia conferta*.

2.4 Propagation and Cultivation Information Collected

To offset potential post-translocation losses, the MTMP outlines a propagation program to supplement translocations. Propagation protocols outlined for seeds collected from *Macrozamia conferta* are being followed by two nurseries with previous experience in growing *Macrozamia* species (**Section 2.4.2**). These two nurseries report regularly on propagation progress and rates of successful gemination (**Table 5.2**).

2.4.1 Seed Collection and Storage

EPBC approval condition 21 requires "*a commitment to a program of propagation of seedlings to replace or exceed the number of Macrozamia conferta individuals impacted by the action that do not survive for at least twenty years after translocation*". The propagation program has so far included the collection of all seeds from translocated plants, with no seeds so far collected from wild populations. Steps for the collection of seeds as outlined in the MTMP are assessed in Table 2.4.

Table 2.4 Assessment of seed collection methodology from the MTMP.

MTMP Methodology	Assessment of Methodology and Corrections
1. Upon collection, maternal plant and seed will be labelled with: **a.** Unique ID; **b.** Date; **c.** GPS location; **d.** Collector's Details.	Following collection: **a.** A unique ID was given to the maternal plant and recorded in the Extraction Form (**Table 2.1**). All seeds from a single plant were temporarily stored together in a paper or fine mesh bag. Seeds have been given unique IDs upon propagation (**Section 2.4.2**); **b.** A date was assigned to the maternal plant in the Extraction Form (**Table 2.1**) which recorded the date when seeds were collected from a given plant; **c.** GPS coordinates were recorded for the location of the maternal plant in the Extraction Form (**Table 2.1**); **d.** Collector's details were collected. The name of the supervising ecologist was also recorded in the Extraction Form for the maternal plant (**Table 2.1**). Records maintained throughout the propagation process maintain an association between Maternal ID and new specimen ID. All other above details can be found in the Translocation Database (**Section 2.1**). Maternal ID field was left blank for any seeds collected from the ground and not conclusively associated with a particular maternal specimen.
2. Only fully ripe fruit to be collected.	Only ripe seeds that had fallen from the cone were collected (e.g. Plate 2.9).
3. Cuts to be made to fruit will be made with sterilised equipment as close to the base as possible.	Only ripe seeds that had fallen from the cone were collected, and as such cuts to the fruit were not required.
4. No more than 20% of the total number of fruits will be collected from any one plant in any 12-month period (for wild plants).	No seeds were collected from wild plants.
5. Seeds will be collected from any seed-bearing plants being translocated.	All seeds found from plants that need to be translocated were collected.
6. Some seeds collected will be suitable for germination straight away, with other seeds requiring storage for 8-12 months before germination. Where storage is required, these seeds will be stored in paper bags in dry, well ventilated space away from extremes of temperature.	All collected seeds had already lost their sarcotesta (fleshy outer layer) at the time of collection (e.g. **Plate 2.9**) and thus did not require 8-12 months of storage to dry. All collected seeds were stored in a dry, ventilated space in either paper or fine mesh bags with their maternal plant ID written on the bag (Plate 2.9). Seeds were distributed to relevant nurseries for propagation.

MTMP Methodology	Assessment of Methodology and Corrections
7. Information related to each seed collected will be stored and managed in the translocation database for monitoring the progress and survival rate of propagated individuals and allow the assessment of seed viability and fitness of maternal plants.	The nurseries undertaking propagation recorded seed survivability against maternal plant ID where available. This data will be uploaded to the TD following the future planting of propagated individuals. Total germination and survivability of individuals is reported in **Section 5.2**. Propagated individuals will be given a unique ID that can be linked to nursery data upon planting at the Recipient Site and have their health recorded during future monitoring events (**Section 5.3**).

Plate 2.9 *Macrozamia conferta* seeds temporarily stored in a cool, dry space.

2.4.2 Propagation

Seeds are currently being propagated at two nurseries with relevant experience to propagating *Macrozamia*; The Australian Botanic Garden Mount Annan, and Wallum Nurseries Pty Ltd. Both Nurseries operate under the *Australian standards for maintenance of plant health* and the *Nursery Industry and Garden Australia Standard*. Evidence of operation under these standards can be provided upon reasonable request.

The number of seeds provided to each nursery and the current number of propagated individuals can be found in **Section 3.0**. Attexo facilitated collaboration between the two propagation nurseries in using the same propagation methodology based on expert advice and available literature. Methods for propagation proposed in the approved MTMP are assessed against the methods employed by the nurseries in **Table 2.5**.

Table 2.5 Assessment of propagation methodology from the MTMP.

MTMP General Horticulture Methodology	Current Methodology Employed by Nurseries
1. Remove flesh from seed.	This step was not required as all seeds collected had already lost their flesh (e.g. Plate 2.9).
2. Initial planting of seed in suitable seed raising mix and irrigated regularly throughout growth in communal pots/trays. Seed will be lightly pressed into the substrate surface and not totally buried.	Seeds were germinated in barely moist sphagnum or non-buffered peat in a sealed bag at room temperature. Germinating seedlings were treated with a fungicide, then planted into communal trays filled with an open, free draining potting mix to minimise the risk of waterlogging (e.g. **Plate 2.10**). Moisture, temperature, light exposure, and soil conditions are carefully monitored throughout the propagation process to ensure optimal growing conditions.
3. After the seed takes root and the first leaf appears, seed will be planted into 140 mm pots and transferred into nursery;	Following the emergence of the first leaf, plants were then transferred to individual pots. Pots differed slightly in size, based on stock availability, but repotting will occur when needed to prevent constriction to growth.
4. Once root ball formed and filling 140 mm pot (9-12 months), transfer into 300 mm pot with same potting mix;	Propagated plants are currently not large enough to repot. The nurseries are expected to follow a similar methodology once plants have filled out their current pots.
5. Final transfer into translocation site will occur when the plant is large enough – approximately three years after germination.	Propagated plants are currently not large enough to plant at the Recipient Site. Translocation progress will and survivability will be monitored (**Section 5.3**).

Plate 2.10 Germinated *Macrozamia conferta* seeds in planting trays on a free-draining potting mix (The Australian Botanic Garden Mount Annan, February 2023).

Plate 2.11 Propagated *Macrozamia conferta* replanted into larger pots following the emergence of the first leaf (A – The Australian Botanic Garden Mount Annan, B – Wallum Nurseries Pty Ltd, February 2023).

2.4.3 Tissue Cultivation

Tissue cultivation was proposed in the MTMP as a way to make up for lost plants should there be significant failings in described translocation and propagation methods (**Sections 2.3, 2.4.1, 2.4.2**). As translocations are ongoing and propagation measures are resulting in successful seed germination (**Section 2.4.2**), tissue culture is not being considered at this time.

2.4.4 Planting from Nursery Stock

The planting of nursery stock will be undertaken using a similar methodology to translocated *Macrozamia conferta* (**Table 2.3**). It is expected that plants propagated in the nursery will be large enough to plant at the Recipient Site in late 2024 or 2025.

2.5 Monitoring Information Collected

2.5.1 Monitoring Plots

The MTMP specifies ongoing monitoring required to assess the health of the translocated population and ensure appropriate actions are taken to achieve a net-loss of zero individuals over 20 years. To assess population metrics in an efficient manner, three monitoring plots were established at the Recipient Site and two monitoring plots were established within existing populations of *Macrozamia conferta* in the nearby Durikai State Forest.

Selection of the reference sites included criteria that aimed to have similar population structure, density, vegetation community, soil quality and altitude to the Recipient Site. It should be noted that plant age class was hard to determine without excavation (see **Table 2.1**), making an assessment of population structure difficult. Density at the Recipient Site (**Appendix A**) was generally higher than the reference sites. (**Section 3.1**).

2.5.2 Monitoring Metrics and Parameters

Ongoing monitoring is specified by the MTMP to assess the performance of individual plants over time and compared performance between monitoring populations. The parameters by which this assessed performance is be reported are explained in **Table 2.6**. The metrics to underpin these parameters of performance are outlined in the MTMP and their implementation is shown in **Table 2.7**. Data was collected using ArcGIS Survey123 platform and included in the TD.

Initial monitoring undertaken in March and April of 2023 demonstrated a lack of meaningful survival data attributed to the slow rate of reestablishment and growth of the species. Additionally, threat monitoring work identified the presence of the Cycad Blue (*Theclinesthes onycha onycha*) - a butterfly - whose larvae are known to damage cycad foliage (see Section 4.5). To improve the quality of survival data and reduce the risk of damage to the population from known threats, change to the frequency of future monitoring events is proposed in Table 2.8.

Table 2.6 *Macrozamia conferta* monitoring parameters outlined in the MTMP, and their implementation.

MTMP Performance Measures	MTMP Description	Implementation using Data
Survival/mortality	Total number of individuals present and population structure (i.e. % dead, mature and coning, mature, juvenile or seedling)	The total number of individuals for each population will be reported based on the number of unique specimen ID entries for data collected in each plot. Each unique plant in a plot is expected to be monitored. Population structure will only be reported as: • Total number of plants; • Percentage of plants known to be mature (from coning in either the past or present as determining age for plants based on foliage alone is unreliable (see **Table 2.1**)); and • Recruitment (indicative of seedling or juvenile numbers). The length of potential dormancy for *Macrozamia conferta* is unknown, so distinguishing dormancy from death based on above ground organs is impossible. Survival will instead be reported using two proxy statistics: • Percentage of plants displaying new growth since the previous monitoring period (Performance Measure – New growth; and • Percentage of plants bearing living leaf material. These two metrics approximate survival as plants that display an increased number of leaves since the previous monitoring period and plants with live leaves are likely alive. Analysis of these metrics across monitoring periods, will allow the reporting of population trends, and (assuming all translocated plants were alive at the time of planting) an approximation of the success of efforts aimed at reaching a net zero loss of *M. conferta*.
Gender and reproduction	Presence of reproductive organs (i.e. cones and seed) and M:F ratio in population	Whether a cone is present, the sex of the cone, and the developmental stage of the cone will be used to report: • Percentage of plants that are known to be mature (individuals that have coned in the past or present [including sex identified from extraction data]); • Percentage of known-mature plants that are coning during that monitoring period (ripe or undeveloped cones); • Male : Female ratio of known-mature plants in each population; and • Percentage of known females that have ripe cones at the time of monitoring (indicating seeding potential / presence of seeds).

MTMP Performance Measures	MTMP Description	Implementation using Data
New growth	Presence or absence of new growth	New growth will be reported as the percentage of plants that have experienced an increase in either the total number of leaves or an increase in the total number of live leaves, since the last monitoring round. This encapsulates plants that have therefore experienced new growth since the last monitoring round, even if all leaves are senescent in the most recent round (e.g. a plant may have one live leaf in monitoring round 1, but two senescent leaves in monitoring round two, and so has experienced new growth between monitoring periods). The presence or absence of new growth is therefore not information that will be collected in the field but instead calculated from leaf count data. This metric of new growth is likely to be more useful in understanding population health than simply describing whether young or "new" leaves are present on a plant as in the Extraction Form (**Table 2.1**).
Predation	Presence or absence of insect damage (i.e. leaves or cones)	Any obvious insect damage will be recorded. The percentage of individuals affected by predation will be reported. Large infestations in translocated plants will be dealt with if noticed as per the MTMP (see **Table 2.8**).

Table 2.7 Features listed in the MTMP to be recorded for plants during monitoring events, method of recording, and additional features used to inform population health.

MTMP Collection Field	Implementation of Field
1. Ecologist on Site	The name of the ecologist undertaking monitoring surveys was recorded against each entry for an individual plant in the monitoring form.
2. Date and Time	The date and time at which an individual plant was assessed during monitoring was recorded.
3. Specimen ID	The unique identifier number of each plant was recorded so leaf data can be used to monitor plant growth over monitoring periods. A list of plant specimen IDs was be created for each plot to ensure all plants are checked during each monitoring event. Newly recruited plants will be given an ID for future monitoring purposes and added to the list.
4. Translocation Plot ID	Plot ID is recorded for each plant according to the ID of the monitoring plot in which it was found at either the Recipient Site (T1, T2, or T3) or reference site (R1 or R2).
5. GPS Location	GPS coordinates for each plant are automatically recorded and used to assess whether Site ID was correctly recorded. A list of plant specimen IDs was created for each plot so that Plot ID can be confirmed, should GPS fail to record or appear incorrectly.
6. Photo Log	A photo log will not be kept for each plant. Photos used in previous forms for the TD have proven useful for verification purposes of plant tag IDs and locations but given the large number of photos, it has been assessed as impractical to continue to take photos of each plant. Instead of photos, specimen IDs in a plot will be used to compare data on individual plants.
7. New Frond Growth	The presence or absence of new growth will not be recorded directly, but will be derived by calculation based on the number of leaves, alive (Collection Field **12**) and dead (Collection Field **13**), observed on each plant during a given monitoring period. This differs from new growth as recorded in the translocation Extraction Form (**Table 2.1**) but provides the ability to better assess whether plants are still growing outside of monitoring periods.

MTMP Collection Field	Implementation of Field
8. Cone Development and Sex	Whether a cone is present on a given plant will be recorded. If a cone is present, sex (Male, Female) and stage of development (Undeveloped, Ripe, Old) will be also recorded. Cones that are both 'Female' and 'Ripe' will be used to assess seed development (Collection Field **9**). A list of plants in which sex is known within the monitoring plots has been established and will be used to assign sex to those plants for analysis should no cone be present during a given monitoring period.
9. Seed Development	Seed development will be assessed using information collected for cone development and sex (see Collection Field **8**).
10. Recruitment	The number of newly recruited plants in a plot will be recorded during each monitoring period. New plants will be given a unique specimen ID and added to the ID list for the plot in which they are recruited.
11. Presence of Pollinators	Whether pollinators are present is recorded (Yes, No). It is expected that the type of potential pollinator will be recorded in the notes (Collection Field **15**) and have photos taken for verification (Collection Field **6**).
Additional Fields Added	**Purpose of Field**
12. Number of Alive Fronds	The number of alive fronds for each plant is recorded.
13. Number of Dead Fronds	The number of dead fronds for each plant is recorded.
14. Predation	Whether predation is present (Yes, No) is recorded. It is expected severe infestations be noted for maintenance purposes, preferably with photos (Collection Field **6**) and notes (Collection Field **15**) taken where appropriate.
15. Notes	Notes can be taken using the monitoring form for any reason, such as referencing the type of pollinator found or ID of a pest insect.

Table 2.8 Proposed Revisions to Monitoring Process and Parameters.

Monitoring Event Parameter	MTMP Description	MTMP Frequency/Quantity	Proposed Frequency/Quantity
Plant Growth/Population Monitoring Frequency	Growth of Macrozamia conferta individuals and population. Total number of individuals present and population structure (i.e. % dead, mature and coning, mature, juvenile or seedling, M:F ratio)	• Monthly (for months 1-3) • Quarterly (for months 4-24) • Annually (after 24 months)	• Bi-annually (for months 1-24) • Annually (after 24 months)
Threat Monitoring Frequency	Identification of potential and existing threats from: • Predation • Fire • Weeds	• Annually	• Monthly for the first 6 months • Each 6 months up to 24 months • Annually after 24 months
Plant Growth/Population Monitoring Sample Size	Plants within monitoring plots will be monitored post-translocation to measure and assess individual and population growth, identify potential threats or environmental factors within the translocation that may impact *M. conferta*, and provide recommendations to improve methods of translocation.	Three monitoring plots representing 15.1% of translocated plants and 10.4% of total Recipient Site area.	Two monitoring plots representing 10.9% of translocated plants and 6.9% of total recipient site area.

2.5.3 Fauna Pest Monitoring

The threat of disturbance to translocated plants from wild pig rootings was identified prior to the commencement of translocation works. Camera traps set out at the Recipient Site have identified the presence of some potential herbivores (**Appendix B**) but did not identify significant wild pig activity. General monitoring throughout the translocation process did not identify any instance of disturbance from vertebrates including wild pigs. Fencing to prevent disturbance by pigs and other feral animals is not required at this time.

2.6 Issues and Corrective Actions

As per the MTMP, any issues encountered during translocation, propagation and monitoring are to be reported. Unexpected issues and how they were resolved are discussed in **Table 2.9**.

Table 2.9 Issues encountered during the translocation, propagation, and monitoring processes.

Issue	Resolution
Translocation	
Soil subsidence in some areas of the Recipient Site	Soil subsidence occurred in some cases where hole depth was significantly greater than caudex length. Quality assurance processes identified the issue and initiated the replanting of some specimens found to be planted at a non-optimal depth. Hole drilling procedures were revisited to minimise the chance of requiring future replanting (**Table 2.3**).
Above average rainfall during translocation	Above average rainfall prior to and during the first few months of the translocation project (BOM 2023) led to areas of waterlogging at the Recipient Site. Some pre-drilled holes were situated in locations that filled up with water. Where these holes were already utilised, the plant was removed, replanted, and the database amended. Unused holes situated in locations that filled with water were filled back in without plant material.

Issue	Resolution
Taproot damage	Given the use of mechanical tree-spade was incompatible with the limited accessibility of the extraction sites, it was impossible to remove all the plants without exposing the caudex and roots of some plants. As such, some damage to root ball was incurred in most specimens where the surrounding substrate was not extracted in its entirety. Additionally, the attachment point between the caudex and taproot was relatively fragile, with some plants displaying evidence of historical taproot dislocation from unknown causes. A reasonable effort was made to avoid damage to caudices and taproots during extraction, and to document instances of damage incurred during the planting process.
Initially untagged individuals	Clusters of *Macrozamia conferta* foliage may represent a group of multiple plants or a single multi-stemmed plant with separate leaf clusters. This uncertainty leads to some plants requiring their unique specimen identification tag to be assigned and affixed post-planting. In other cases, a tag may be dislodged and separated from the plant during transportation to the Recipient Site. If the correct tag could not be re-associated with its corresponding plant specimen, a new tag was assigned to the plant. The database entries related to these processes are then updated accordingly. Some translocated plants do not appear to have an excavation entry after being assigned a new tag where the original ID could not be re-associated.
Propagation	
None	No direct issues have been reported by either nursery involved in *Macrozamia conferta* propagation in correspondence with Attexo.
Monitoring	
Monitoring plot density	Monitoring efforts began in March 2023 to complete the first monitoring report according to the schedule in Condition 25 of the EPBC Approvals (see **Table 1.1**). Given the large number of plants translocated, monitoring has been undertaken in specified monitoring plots that are representative of the Recipient Site and Reference Sites. Future monitoring is proposed to be undertaken at all plots except for T2. The removal of T2 would still allow the monitoring of 1,382 plants (10.9% of the translocated population) and still captures both sides of Recipient Site to account for any NW-SE environmental gradients.

3.0 Translocation and Propagation Data

3.1 Translocation Locations and Numbers

The total number of *Macrozamia conferta* translocated was 12,652 as of 30 June 2023). Translocations of plants within the construction footprint is complete, however, further incidental finds may occur during ongoing clearing works. The translocation effort took place over 13 calendar months, with ~61% of plants being translocated in the first 5 months (**Figure 3.1**). The location of plants extracted from the Project footprint is shown on **Figure 3.2**, with a breakdown of numbers translocated from construction zones presented in **Table 3.1**. An approximation of time taken for plants to be planted following extraction can be found in **Figure 3.3**.

Table 3.1 Number of *Macrozamia conferta* extracted for each EPBC approval area and construction zones.

Location	Construction Zone	Total Count
Overhead Transmission Line (EPBC 2020/8759)		237
MacIntyre Windfarm (EPBC 2020/8756)	MIWF Zone 1:	0
	MIWF Zone 2:	5232
	MIWF Zone 3:	5661
	MIWF Zone 4:	1522
	MIWF Total:	12,415
Total		**12,652**

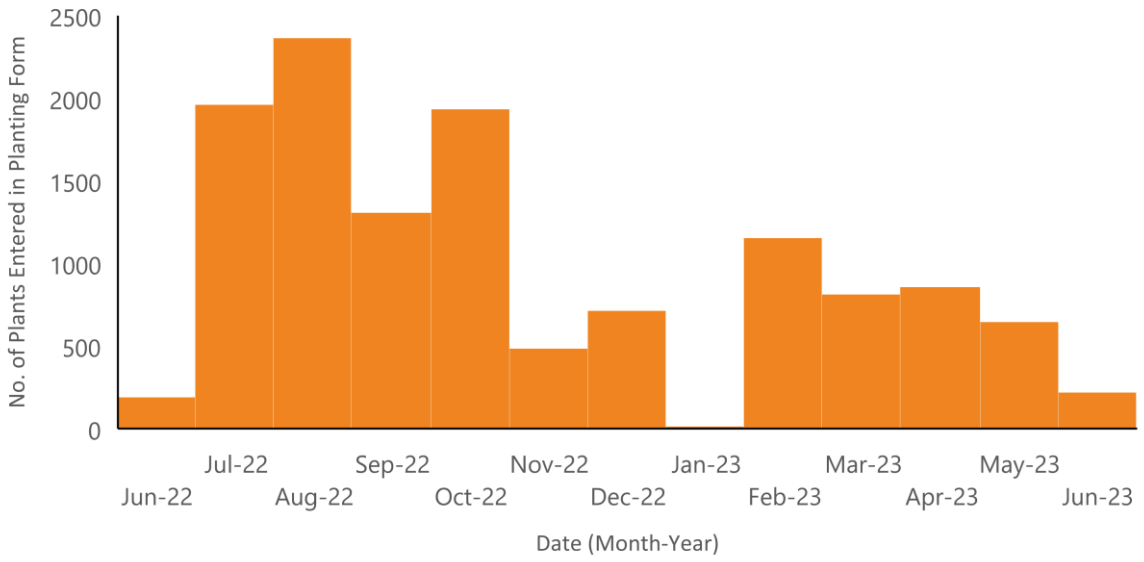
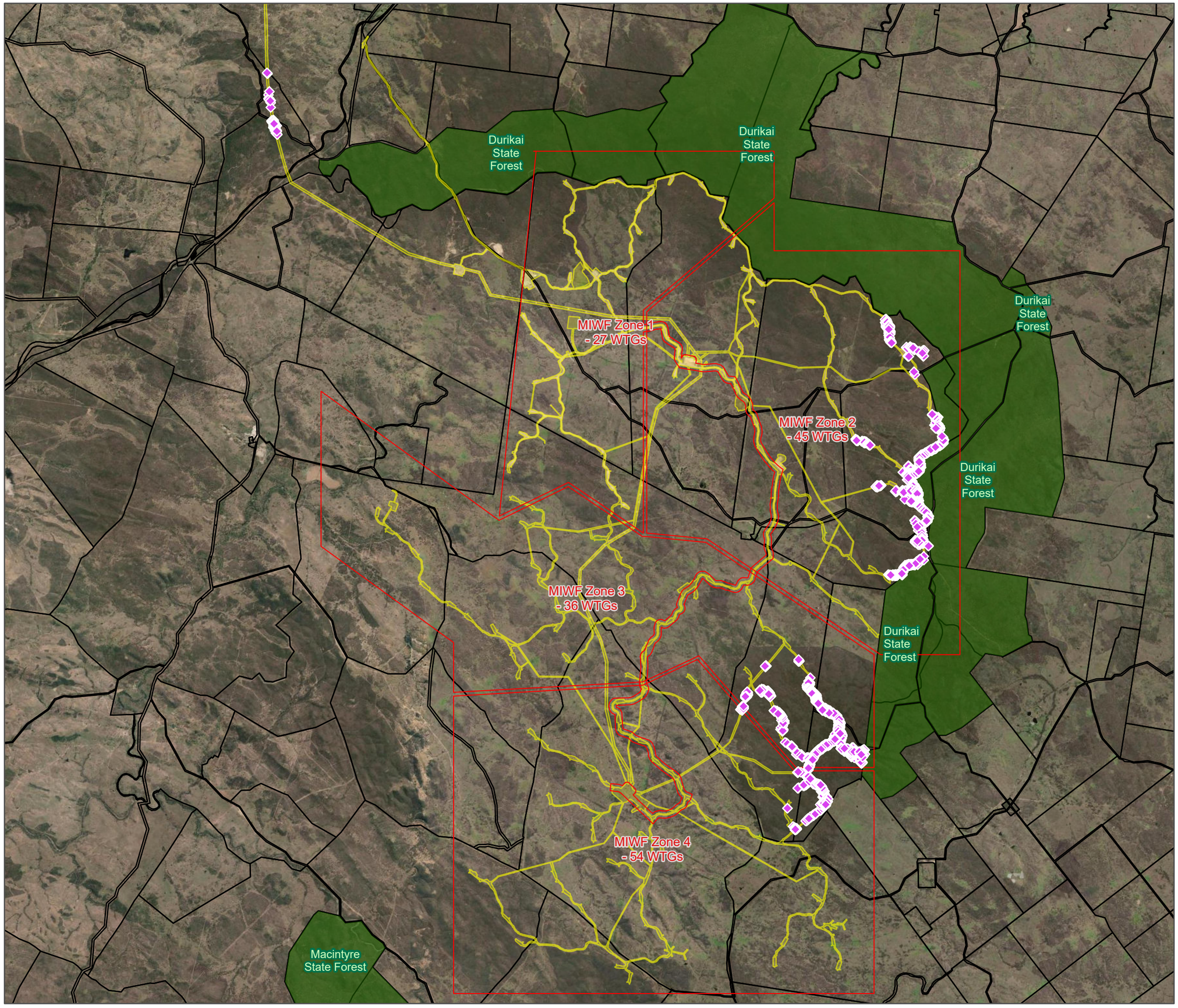


Figure 3.1 Histogram showing the number of *Macrozamia conferta* (n = 12,652) entered in the Planting Form each month since translocations started, as an indication of the number of plants translocated each month.



Attexo

MacIntyre Wind Farm and Overhead Transmission Line

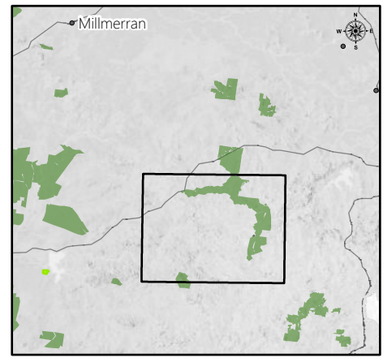
Extracted Plants

Figure 3.2

- Clearing Corridor
- Extracted *Macrozamia conferta*
- Protected areas of Queensland
- Construction Zone Boundary
- Property Boundary

Date: 28/07/2023 Reviewed: JC

Author: JT Project: ACC-017



0 1 2 3 4 5 Km

Scale: 1:100,000@A3

Data Source(s):
Digital Cadastral Database - Department of Natural Resources, Mines and Energy (2021)
Earthstar Geographics, © State of Queensland (Department of Resources) 2022, Esri, CGIAR

Path: C:\Users\FanMo\Attexo Group\Attexo - Documents\Projects\ACCIONA Energy\ACC-005 MIWF Offsets Delivery\5 GIS\v4.3 Cartography\02_MacrozamiaMP\02_MacrozamiaMP.aprx

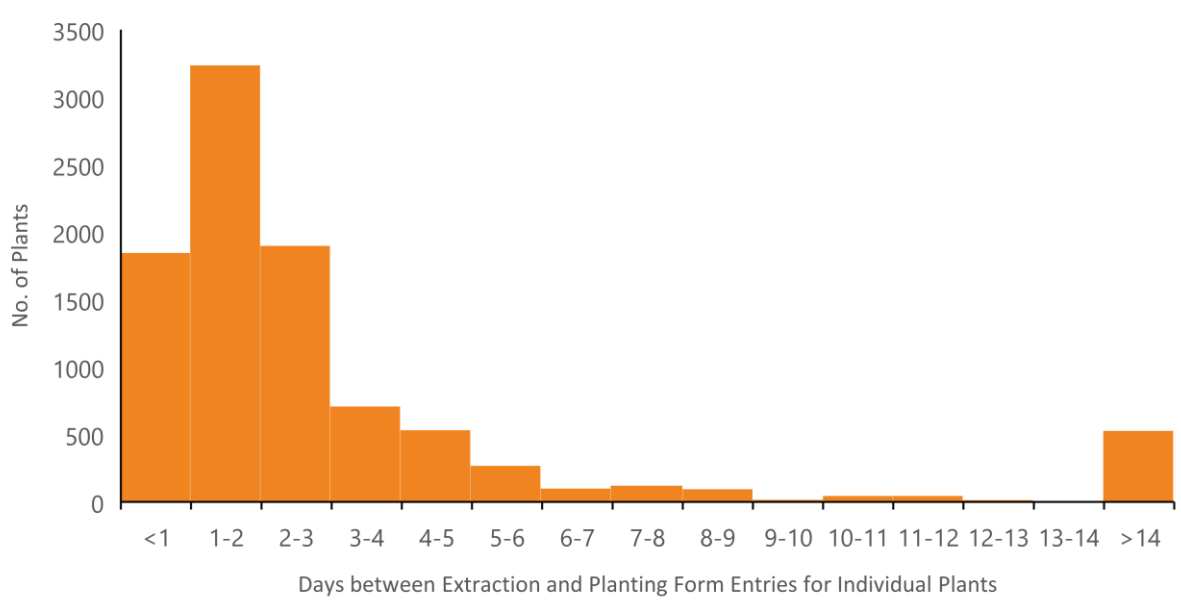


Figure 3.3 Histogram showing the number of days taken for a semi-random selection of *Macrozamia conferta* (n = 9,454) to be entered in the Extraction Form and then Planting Form as an indicator of the amount of time plants spent exposed above the surface.

3.2 Translocated Plant Statistics

Current data[1] gathered from plants translocated from the Project footprint reveal that over 95% of plants were recorded to be sub-adult or at reproductive maturity (**Table 3.2**), suggesting that the translocated population is largely mature overall (see **Table 2.1**). The sex ratio of coning plants approximates 2-to-1, male-to-female (1Total is 2.5% lower than the number of plants in the Planting Form. The causes of this discrepancy are explained in Table 2.9 *Initially untagged individuals*.

Table 3.3), with sex predominantly being assigned from old cone remnants (87%; **Table 3.4**). Most plants (68.5%) also displayed moderate signs of disturbance (**Table 3.5**).

[1] The review of data in the TD has not yet been finalised, with entries being checked for duplicates, missing data fields etc. As such, there may be some updates to the baseline data within the TD in future monitoring reports.

Table 3.2 Age Class of Extracted *Macrozamia conferta*

Age Class	Number of Plants in Extraction Form	Percentage of Plants in Extraction Form
Seedling	12	0.1
Juvenile	470	3.8
Sub-adult	11,582	93.9
Reproductively Mature	271	2.2
Total	12,335[1]	100

[1]Total is 2.5% lower than the number of plants in the Planting Form. The causes of this discrepancy are explained in **Table 2.9** *Initially untagged individuals*.

Table 3.3 Assigned sexes of extracted reproductively mature *Macrozamia conferta*.

Sex	Number	Percent Total
Male	178	65.7
Female	93	34.3
Total	271	100

Table 3.4 Cone ages of extracted *Macrozamia conferta*.

Cone Age	Number of Reproductively Mature Plants	Percentage of Reproductively Mature Plants
Undeveloped	28	10.3
Ripe	7	2.6
Old	236	87.1
Total	271	100

Table 3.5 Severity of disturbance of extracted *Macrozamia conferta* prior to translocation.

Severity of Disturbance	Number of Plants in Extraction Form	Percentage of Plants in Extraction Form
Low	1360	11.0
Moderate	8447	68.5
High	2528	20.5
Total	12,335	100

4.0 Management Activities Undertaken During Reporting Period

Management activities were undertaken informally during the first 12-months of the project while translocation was ongoing. Following completion of translocation works on 30 June 2023, threat monitoring will occur monthly for the first 6 months, every 6 months for the first 24 months and annually thereafter. Watering may occur more frequently if required according to the decision framework outlined in **Section 4.1**. Reporting on management activities will be provided in future monitoring reports according for each of the following categories of potential threat.

4.1 Water

4.1.1 Watering Requirements

Water is a critical abiotic factor of plant ecology and the associated risks and management actions outlined in the MTMP are shown in **Table 4.1**. To derive a required rainfall quality in millimetres, a water capture model was established to estimate the volume of water received by individual plants for a given rainfall quantity. To capture the minimum requirement of 10 L/month, this model predicts a required rainfall of approximately 35mm/month.

Table 4.1 Risks / Threats and Management Actions

Risk/Threat	Description	Management Action	Timeframe
Desiccation	Planting during poor climatic conditions in addition to insufficient watering can cause wilting, insufficient nutrient uptake and eventually death	• Controlled watering in the case of dry events • Local water supply and water cartage tanks will be available on site so watering can be done where/when necessary	• Watering will begin when seedlings and individuals are first introduced into sites and monthly post-introduction
Waterlogging	Too much watering can cause root rot and eventually death	• Controlled and monitored watering events, scheduled according to monthly rainfall received. • Inspect 10 cm of surrounding surface soil to check if too wet, rescheduling of future watering (i.e. no watering necessary during wet season)	• Watering of seedlings and individuals monitored and scheduled in accordance with rainfall patterns from first introduction into sites and monthly post-introduction

4.1.2 Rainfall Data

Daily rainfall data has been collected since the beginning of the translocation project. Details of the existing weather stations used as a proxy for rainfall at the translocation site are presented in **Table 4.2**.

Table 4.2 Weather Stations Used to Estimate Rainfall at Translocation Site

Description	Location	Distance from translocation site (km)	Suitability	Date range	Reason for discontinuation
Carbean (Registered BOM station)	-28.3541°, 151.6281°	2.7	Closest available weather station (2.7km from translocation site)	20220601 - 20221130	Carbean station ceased publication of weather data.
AE Site Office Rain Gauge (Carbean Road)	-28.299415°, 151.583407°	5.5	Closest available weather station (5.5km from translocation site)	20221201 - 20221217	Identified a weather station in closer proximity to translocation site.
ACA Mac North Weather Station (Remote Access)	-28.3285°, 151.6067°	2.1	Closest available weather station (2.1km from translocation site)	20221218 - present	This station is still in use.

4.1.3 Rainfall Data Analysis Procedure

Weather station data is inspected monthly, and data collated into a Weather Database. Long range forecasts are also considered in watering decisions and this data was inspected from the Bureau of Meteorology at http://www.bom.gov.au/climate/outlooks/#/overview/summary/

Total rainfall in each calendar month is plotted along with a moving total of daily rainfall from the previous 30-day period **Figure 4.1**. Target rainfall represent the quantity of rain required to deliver 10L of water per plant based on the water capture model presented in **Appendix A.**

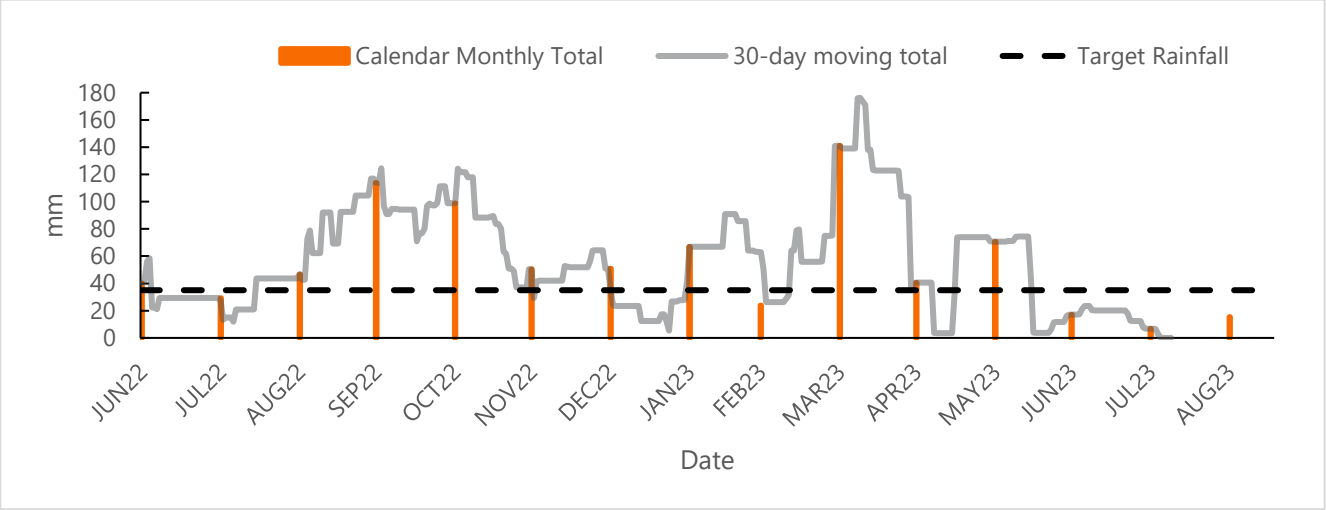


Figure 4.1 Historical Rainfall at the Macrozamia conferta Recipient Site.

4.1.4 Watering Decision Framework

Water management decisions seek to minimise the risks associated with both desiccation and waterlogging in the context of monthly total rainfall, long-term weather forecasts and physical assessment of conditions on site. Manual watering action may be triggered when rainfall received by the site drops below the target rainfall amount of 35mm in a given calendar month or moving 30-day period. Deferral of a triggered manual watering action may occur if sufficient rainfall is predicted within two weeks of the planned watering event. Where practical, on-ground inspections of site conditions will be used to support decisions related to manual watering.

Translocation works were conducted in a period with above average rainfall. The wet weather conditions revealed a dynamic water table at the Recipient Site with the potential to waterlog the translocated population. Between June 2022 and May 2023, in the context of high monthly rainfall and long-range forecasts of high rainfall additional watering was not required from June 2022 until December 2022.

Additional water (10L/plant) was applied in December 2022 in the context of forecast hot dry weather during January when no translocation staff were scheduled to be on site. Additional water (5L/plant) was applied in late February 2022 in response to low rainfall in that month.

Additional water (20L/plant) will be applied in late August 2023 in response to below target levels of rainfall in June and July and on-ground confirmation by field staff during July.

Given long-term forecasts of hot and dry conditions on site, extraordinary measures may be required including delivery of town water, installation of water storage infrastructure on site, and the application of products to assist in soil water absorption and retention.

4.1.5 Watering Quality

The quality of water will be tested prior to application on translocated plants, including pH and salinity.

4.2 Fuel Loads

Fallen timber and coarse-woody debris was consolidated into timber heaps prior to establishment of planting areas. A controlled burn by qualified personnel is planned, pending suitable weather conditions. Future monitoring events will report on the standing fuel load within the Recipient Site.

4.3 Erosion

Pre-translocation assessments of the Recipient Site did not identify specific threats from erosion. Future monitoring events will report on the threat level posed by erosion damage.

4.4 Weeds

All visible weeds were manually removed from site prior to the completion of translocation works. Future monitoring events will report on the levels of reinfestation of weed species listed as threats under state and federal legislation.

4.5 Insects

Insect damage:

- A small number of plants in translocation plots had Cycad Blue butterfly (*Theclinesthes onycha onycha*) larvae (right). Affected plants had all larvae physically removed. Due to the small number of affected plants (1.39% average predation in translocation plots, not all of which were *T. o. onycha)*, large-scale investigation and protection of plants was considered unnecessary at this time. Monthly monitoring will continue to be undertaken while translocation works are ongoing. Post-translocation, frequency of monitoring for insect damage will continue as part of scheduled monitoring events.
- Some plants from both Reference and Recipient Sites appeared to have insect galls on them, however, damage was minimal in these cases.

Theclinesthes onycha onycha larvae (purple oval) and damage on *Macrozamia conferta* within the Recipient Site.

5.0 Translocation and Propagation Monitoring Data

5.1 Monitoring Data

The following tables present data from monitoring plots for the first year of monitoring. More detailed statistics for each plot can be found in **Appendix A**. This reporting format is expected to be used for future monitoring events, as the first monitoring event provides the baseline data from which some statistics (e.g. recruitment, new growth) will be calculated in future monitoring events. As a result, some values in **Table 5.1** are blank and will be completed in future monitoring reports.

Table 5.1 Monitoring results for March-April 2023 (Year 1)

Monitoring Data								
Population	**Plot ID**	**Number Tagged Plants**		**% Plants Known Mature (plants with cone present or past)**		**Male : Female Ratio of Known Mature Plants**		**% Plants with Visible Predation**
	R-Average	130		1.21		2/1		0.54
	T-Average	636		1.70		5/1		1.39
	R-Total	260						
	T-Total	1,907						
Reproduction	**Plot ID**	**Number New Plants (recruitment)**	**% Population Increase (compared to last monitoring event)**	**% Population Increase (compared to initial numbers)**	**% Known Mature Plants Currently Coning (undeveloped or ripe cones)**	**Male : Female Ratio of Currently Coning Plants (undeveloped or ripe cones)**	**% Known Female Cones Ripe (seeding potential)**	**Any Pollinators Present?**
	R-Average	-	-	-	0.00	0/0	0.00	No
	T-Average	-	-	-	0.00	0/0	0.00	No
	R-Total	-						
	T-Total	-						
Survival	**Plot ID**	**% Plants Bearing Living Leaf**	**% Change in Plants Bearing Living Leaf (compared to last monitoring event)**	**% Plants Bearing Living Leaf (compared to initial number of plants in plot)**	**% Plants Displaying New Growth**	**% Plants Displaying New Growth (compared to last monitoring event)**	**% Plants Displaying New Growth (compared to initial number of plants in plot)**	
	R-Average	96.63		96.63				
	T-Average	61.72		61.72				

R-Average is the mean of two Reference plots located in Durikai State Forest. R–Total is the sum of the two Reference plots.
T-Average is the mean of three monitoring plots within the Recipient Site used to represent the translocated population. T-Total is the sum of three reference plots.

Representative Plot Conditions

R1

R2

T1

T2

T3

5.2 Propagation Data

Data regarding seed collection, propagation, and survival over the reporting period are presented in **Table 5.2** and will be updated at each reporting period. The average germination rate was 52% at the time of reporting, however both nurseries report that germination is still ongoing and so the rate is expected to increase over time.

Table 5.2 Seed collection and propagation data

Nursery	Seeds Provided to Date	Number of Plants Germinated to Date	% Germination Success	Current Number of Plants in Nursery	% Survival (compared to last monitoring period)
The Australian Botanic Garden Mount Annan	307	143	47	143	
Wallum Nurseries Pty Ltd (Batch 1)	380	219	58	219	
Wallum Nurseries Pty Ltd (Batch 2)	202	-	(n/a)[1]	-	
Total	889	280		280	
Average			52		

[1]Batch 2 was delivered to Wallum Nurseries Pty Ltd at the conclusion of translocation works – germination has not yet commenced.

Figure 5.1 Propagated seedlings at Royal Botanic Gardens, Mt Annan (27/07/2023)

5.3 Success Rate of Propagated Seedlings Planted at the Recipient Site

Propagated seedlings are currently too young to be planted at the Recipient Site. The survival statistics of propagated stock planted at the Recipient Site (within monitoring plots) in future will be displayed here in a way similar to the data presented in **Section 5.1**. Based on an expected timeframe of 18-24 months, propagated plants are expected to reach sufficient size for planting out between February and August 2024.

6.0 Conclusion

This report presents the results of monitoring activities, along with a summary of translocation and propagation activities undertaken in the first year of implementation of the MTMP. Future reports will present additional monitoring data for better assessment of the effectiveness of management actions outlined in the MTMP and actions taken during translocations aimed at improving future plant health and reporting outcomes.

At the time of this report, a total of 12,652 *Macrozamia conferta* plants had been translocated from the construction footprint of the MIWF and associated OHTL Projects.

Current monitoring data presents the following trends:

- Currently, the translocated population has a substantially lower percentage of plants bearing live leaves than the reference population (61.72% vs. 96.63%). This is not unexpected however, as many leaves were trimmed as part of the translocation process, or otherwise lost during transportation or excavation. Some die-off may have also occurred from the stress induced by translocation, with plants diverting their energy towards subterranean growth until conditions are ideal for shoot regeneration. Based on the limited period of time since translocation, no conclusions on the health of the translocated *M. conferta* can be made from the baseline data presented in this report.
- The translocated population has a greater male to female ratio than that of the reference population, although very few known-mature individuals have ultimately been found at this time, and this metric is expected to change with repeated monitoring of the same sites.
- Predation also appears to be more common in the translocated population and noted to be more common on some of the few plants displaying new growth, as expected of *Theclinesthes onycha onycha* larvae. As the level of predation is still relatively low (1.39%, not all *T. o. onycha*), no actions are being taken at this time. Staff on site monitored the situation while translocations were ongoing and pest monitoring will continue during future plant monitoring events.

Modifications to the monitoring processes and parameters originally outlined in the MTMP have been proposed to accommodate the developmental timeframe of the species and ensure timely detection of potential threats and administration of remedial actions. These adjustments will improve overall feasibility of the project without materially affecting plant health outcomes.

7.0 References

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Appendix A

Complete Monitoring Statistics

Appendix Table A - 1 March-April 2023 summary statistics for *Macrozamia conferta* monitoring plot data.

Population								
Plot ID	**Time Start**	**Time Stop**	**Total Number Tagged Plants**	**Number Known Mature Plants (plants with cone present or past)**	**% Plants Known Mature (plants with cone present or past)**	**Male : Female Ratio of Known Mature Plants**	**Number Plants with Visible Predation**	**% Plants with Visible Predation**
R1	8-Mar-2023 8:21	8-Mar-2023 10:09	75	1	1.33	1/0	0	0.00
R2	8-Mar-2023 11:17	8-Mar-2023 14:43	185	2	1.08	1/1	2	1.08
T1	5-Apr-2023 10:00	6-Apr-2023 11:18	842	7	0.83	6/1	13	1.54
T2	3-Apr-2023 12:42	4-Apr-2023 13:27	525	4	0.76	4/0	7	1.33
T3	9-Mar-2023 7:18	9-Mar-2023 14:50	540	19	3.52	15/4	7	1.30
R-Average			**130**	**2**	**1.21**	**2/1**	**1**	**0.54**
T-Average			**636**	**10**	**1.70**	**5/1**	**9**	**1.39**
R-Total			**260**	**3**			**2**	
T-Total			**1907**	**30**			**27**	
Reproduction								
Plot ID	**Number New Plants (recruitment)**	**% Population Increase (compared to last monitoring event)**	**% Population Increase (compared to initial number of plants in plot)**	**Number of Plants Currently Coning (undeveloped or ripe cones)**	**% Known Mature Plants Currently Coning (undeveloped or ripe cones)**	**Male : Female Ratio of Currently Coning Plants (undeveloped or ripe cones)**	**% Known Female Cones Ripe (seeding potential)**	**Any Pollinators Present?**
R1	-	-	-	0	0.00	0/0	No Females	No
R2	-	-	-	0	0.00	0/0	0.00	No
T1	-	-	-	0	0.00	0/0	0.00	No
T2	-	-	-	0	0.00	0/0	No Females	No
T3	-	-	-	0	0.00	0/0	0.00	No
R-Average	**-**	**-**	**-**	**0**	**0.00**	0/0	**0.00**	
T-Average	**-**	**-**	**-**	**0**	**0.00**	0/0	**0.00**	
R-Total	**-**	**-**	**-**	**0**				
T-Total	**-**	**-**	**-**	**0**				
Survival								

Plot ID	Number Plants Bearing Living Leaf	% Plants Bearing Living Leaf	% Change in Plants Bearing Living Leaf (compared to last monitoring event)	% Plants Bearing Living Leaf (compared to initial number of plants in plot)	Number Plants Displaying New Growth	% Plants Displaying New Growth	% Change in Plants Displaying New Growth (compared to last monitoring event)	% Plants Displaying Increased Growth (compared to initial number of plants in plot)
R1	74	98.67	-	-1.33	-	-	-	-
R2	175	94.59	-	-5.41	-	-	-	-
T1	536	63.66	-	-36.34	-	-	-	-
T2	284	54.10	-	-45.90	-	-	-	-
T3	364	67.41	-	-32.59	-	-	-	-
R-Average	**125**	**96.63**	**-**	**-3.37**	**-**	**-**	**-**	**-**
T-Average	**395**	**61.72**	**-**	**-38.28**	**-**	**-**	**-**	**-**
R-Total	**249**				**-**			
T-Total	**1184**				**-**			
Ecologists on Site: Kye Chamberlain, Daniel Etchells								

Appendix B

Camera Trap Data

Camera trapping took place on two occasions at the Recipient Site. The first camera trapping event primarily took place on the eastern side of the Recipient Site with two cameras from 1 Aug 2022 to 4 Oct 2022 (65 days). The second camera trapping event primarily took place in the western end of the site from 31 Oct 2022 to 24 Jan 2023 (86 days), however, one camera was removed earlier than the other. Animals identified from camera trap photos are listed below.

No disturbance of translocated plants was observed.

Appendix Table B - 1 Camera trap results.

Common name	Scientific Name	Photo Count
Feral Animals		
Cat	*Felis catus*	11
House mouse	*Mus musculus*	15
Pig*	*Sus scrofa*	1
European Red Fox	*Vulpes vulpes*	2
Macropods		
Eastern Grey Kangaroo	*Macropus giganteus*	8
Red-necked Wallaby	*Macropus rufogriseus*	1
Black wallaby	*Wallabia bicolor*	9
Unidentified Macropods*		49
Other Native Animals		
Brown Treecreeper	*Climacteris picumnus*	4
White-winged Chough	*Corcorax melanorhamphos*	12
White-throated Treecreeper	*Cormobates leucophaea*	2
Pied butcher bird	*Cracticus nigrogularis*	1
Laughing Kookaburra	*Dacelo novaeguineae*	10
Eastern Yellow Robin	*Eopsaltria australis*	2
Magpie-lark	*Grallina cyanoleuca*	2
Australian Magpie	*Gymnorhina tibicen*	1
Noisy Miner	*Manorina melanocephala*	1
Common Bronzewing	*Phaps chalcoptera*	1
Willie Wagtail	*Rhipidura leucophrys*	2

Common name	Scientific Name	Photo Count
Pied currawong	*Strepera graculina*	3
Apostlebird	*Struthidea cinerea*	2
Unidentified Birds		13
Unidentified Insects		9
Short-beaked Echidna	*Tachyglossus aculeatus*	1
Common Brushtail Possum	*Trichosurus vulpecula*	2
Other Unidentified Mammals		4
Common Tree Snake	*Dendrelaphis punctulatus*	1
Yellow-spotted Monitor	*Varanus panoptes*	4
Unidentified Skinks		2