

Sunrise Aquaculture Estate Point Ceylon, Bynoe Harbour Northern Territory

Study of Terrestrial Flora

Client:

Suntay Aquaculture Pty. Ltd.

Project:

Sunrise Aquaculture Estate –
Environmental Impact Assessment

Project number:

SAPL0201

Prepared by:**Name**

Kylie Harvey and Ian Morris

Signed**Date****Reviewed and approved by:****Name**

Noel Preece

Signed**Date****File ref:**

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ECOZ ENVIRONMENTAL SERVICES

1st Floor Arkaba House
13 The Esplanade

GPO Box 381
Darwin NT 0801

Ph: (08) 8981 1100
Fax: (08) 8981 1102
Email: ecoz@ecoz.com.au

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Acknowledgements

NT Herbarium assisted with the identification of some plants species. Jason Hill, DIPE, assisted with the provision of data from the Lower Finniss Land Resources Study.

1. INTRODUCTION

Suntay Aquaculture Pty. Ltd proposes to construct 'Sunrise Aquaculture Estate,' a land-based aquaculture development, at Point Ceylon in Bynoe Harbour. The site of the proposed project is located 40 km south-east of Darwin in the Northern Territory. The project plans to grow Black Tiger Prawns *Penaeus monodon* in contained aquaculture ponds. Development of the site will be undertaken in 2 stages, with Stage 1 incorporating the development of 46.5 ha of the project lease area, and Stage 2 incorporating development of a further 136 ha.

The Guidelines for the Preparation of a Draft Environmental Impact Statement on the proposed Sunrise Aquaculture Estate (Department of Infrastructure, Planning and Environment, 2003) require an examination of the existing terrestrial and aquatic vegetation at the site of the proposed development. In order to fulfil the requirements of the Guidelines, a study of terrestrial flora was undertaken. The study incorporated field surveys of the development footprint and adjacent areas, and collation and review of previous studies undertaken in the region. Specifically the study of terrestrial flora was designed to meet the following objectives:

- To described the vegetation communities within and adjacent to the development footprint, including species composition and distribution within the project area.
- To identify the conservation status of vegetation communities and flora species that occur, or are likely to occur in the project area.
- To assess the potential for the proposed development to impact on species or communities of conservation significance.
- To document the distribution of weed species and identify 'declared weeds' that occur in the project area.
- To described the potential for introduction and spread of weed species, and document mitigation measures to reduce the risk of transporting weeds to and from the site.
- To identify and described the potential and anticipated impacts from the project on the floral species and communities.
- To discuss monitoring and reporting procedures for each of the potential impacts.

This report documents the study of terrestrial vegetation and flora undertaken for the proposed Sunrise Aquaculture Estate. The aquatic flora has been separately assessed as part of the aquatic survey undertaken by EWL Sciences (Welch, 2003).

2. PREVIOUS STUDIES

2.1. NT Herbarium records

The NT Herbarium database was consulted to identify species of conservation significance. The Herbarium holds no records for the Sunrise Aquaculture Estate project lease area.

2.2. Lower Finnis Land Resources Study (LFLRS)

The Lower Finnis Land Resources Study documents the results of a systematic land resources assessment undertaken in the Lower Finnis locality over the period 1997-2002 (Hill *et al.*, 2002). This study describes and maps information on land use, land units, soil and vegetation with the aim of providing detailed land capability information that can be used to ensure sustainable land use in the region. The Sunrise Aquaculture Estate project lease area falls within the area covered by the LFLRS.

The LFLRS maps the vegetation of the Lower Finnis locality at a scale of 1:25 000. These communities were derived through the amalgamation of land units with similar species composition and structure (Hill *et al.*, 2002). It is noted that a landunit may not equate to a pure vegetation community (Brocklehurst *et al.*, 1996).

Thirteen vegetation communities have been mapped within the Sunrise Aquaculture Estate project lease area. Ground assessment of vegetation undertaken by Hill *et al* (2002) and EcOz (2003) identified some misclassifications in the mapping, especially associated with small isolated patches of vegetation that occur in the transitional zone between the upland and intertidal habitats. For instance, a large proportion of Point Ceylon is mapped as monsoon vine thickets, when in fact this community is confined to a more narrow (<200m) zone landward of the mangroves. Where these errors have a bearing on the assessment undertaken in this study they have been identified and discussed in the relevant sections of this report.

Vegetation surveys were undertaken at 427 across the Lower Finnis locality as part of the LFLRS. Thirty-five of these survey sites are located within the Sunrise Aquaculture Estate project lease area. The survey sites are distributed across 7 of the 13 vegetation groups mapped as occurring in the project lease area.

2.3. Mangrove Survey of Bynoe Harbour

The Mangrove Survey of Bynoe Harbour maps and describes the mangrove and saltflat vegetation of Bynoe Harbour, from Mandorah (the western edge of Darwin Harbour) to Native Point, at a scale of 1:50 000 (Brocklehurst and Edmeades, 2003). Ten distinct mangrove communities have been identified in areas fringing the Sunrise Aquaculture Estate project lease area. The structure and composition typical of each community has been described and distribution of each community has been mapped. The Mangrove Survey of Bynoe Harbour provides a substantial base of information for characterisation of the mangrove vegetation of the project lease area.

3. METHODOLOGY

3.1. Flora survey

Field survey of vegetation and flora was undertaken in 2 stages. In April 2003 a survey was undertaken to characterise the vegetation and flora of the lease area. This survey was followed up with a more focused survey undertaken in May 2003 to document the vegetation and flora that characterise the development footprint. The methodologies used in each of these surveys are described in the following sections

3.1.1. *Vegetation and flora in the project lease area*

In April 2003 a survey was undertaken to document the species composition of the major vegetation communities and to assess the conservation significance of the vegetation and flora that occur within the project lease area. Previous surveys have involved the documentation of species composition at 35 sites within the project lease area (see section 2.2). The current survey was designed to:

- document the species composition of communities not adequately surveyed during previous studies;
- undertake a more detailed assessment of communities and species of conservation significance; and
- verify the vegetation mapping.

A total of 13 survey sites were established in 7 vegetation communities across the project lease area. Four sites were located in communities which had not been surveyed in previous studies and a further 9 sites were established in communities of conservation significance, namely rainforest patches, riparian corridors and *Callitris intratropica* forest, to further describe and document these communities and to examine for the presence of plant species of conservation significance. The sites surveyed as part of the current study brought the total number of sites surveyed in the project lease area to 42. The locations of all survey sites are shown in Figure 1 and coordinate locations are listed in Appendix 1.

At each of the survey sites the following baseline data were collected:

- Vegetation community descriptions.
- GPS coordinate location (recorded in WGS84 datum).
- Community floristics.
- Site photo.
- Observations on weed invasion, fire, and disturbance by feral animals.

Most species were identified in the field by Ian Morris. Those that could not be identified in the field were collected and identified with the assistance of the NT Herbarium.

The results of these surveys are documented at Appendix 1.

3.1.2. *Vegetation and flora within the development footprint*

In May 2003 traverses of the project lease area were undertaken to document and describe the vegetation communities that characterise the development footprint and to further survey for the presence of vegetation communities and species of conservation significance. A number of transects through the development footprint, including along the proposed road corridors, were traversed on quad-bikes. Information on the structure and composition of communities within the development footprint was recorded at random locations, and where distinct vegetation communities were identified. The location of transects traversed during the survey and sites where community structure and composition data were recorded are shown in Figure 1.

The results of this survey are documented at Appendix 3.

3.2. Review of conservation significance

The project lease area was surveyed for the presence of rare plant species and ecological communities of conservation significance. Surveys focused on areas that will be directly affected by project construction and in rainforest communities, where rare plant species are most likely to be found. Traverses of the development footprint and access road were undertaken as described in section 3.1.2. Rainforest patches in the project lease area were surveyed at a total of 13 locations.

The national, regional and local conservation significance of the vegetation and flora that characterise the project lease area was assessed with reference to species lists under the *Territory Parks and Wildlife Conservation Act (NT) 2000 (TPWC Act 2000)* and the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)*, and through reference to previous regional studies.

4. THE EXISTING ENVIRONMENT

4.1. Vegetation and flora of the lease area

The survey data collected during the LFLRS and the current surveys undertaken in April and May 2003 have been collated in producing a description of the vegetation communities and flora species that occur in the project lease area, and specifically in assessing those communities that will be directly affected by the project.

Thirteen vegetation groups have been mapped within the project lease area (see Figure 2). Site descriptions and photos of each community surveyed during the April\May 2003 surveys are included at Appendix 1.

A total of 281 plant species have been recorded during surveys of the site. A species list is included at Appendix 2.

4.1.1. Terrestrial vegetation

Upland Eucalyptus woodlands (Vegetation groups A1, A2, A3)

The project lease area is mostly upland habitats which are dominated by open woodlands of *Eucalyptus spp.* The dominant species in the upper stratum is typically *Eucalyptus miniata*, which occurs in association with *Erythrophleum chlorostachys* and *Corymbia bleeseri*. Species dominance, however, varies according to changes in local topography. Accordingly, on rocky laterite ridges, *E. tetradonta* becomes co-dominant to dominant, in association with *Corymbia bleeseri*.

The mid-stratum of the upland woodland habitats is comprised of a mixture of tree and shrub species, but is typically dominated by *Livistona humilis* and *Cycas maconochiei*. Other species that commonly occur in the mid-storey include *Terminalia ferdinandiana*, *Pandanus spiralis*, *Planchonia careya*, *Petalostigma pubescens*, *Persoonia falcata* and *Canarium australianum*. The grassy understorey is typically comprised of *Eriachne spp.*, *Heteropogon spp.* and *Sorghum spp.*, and a variety of herbaceous species.

This community is widespread across the Top End and constitutes 44% of the total area of the Lower Finniss Region (Hill *et al.*, 2002).

Paperbark swamps (Vegetation group D1)

Woodlands dominated by *Melaleuca spp.* fringe the landward edge of mangrove forests in the project lease area. This community occurs in areas subject to seasonal inundation and is typically dominated by *Melaleuca viridiflora*, which often forms pure stands over a grassy understorey of *Eriachne spp.* and *Sorghum spp.* A diverse mid-storey is present at some locations, which commonly includes species such as *Acacia spp.*, *Livistona humilis*, and *Pandanus spiralis*.

Woodlands of *Melaleuca spp.* are the second most dominant vegetation type in the project lease area. In the western half of the project lease area and along the peninsula out to Ceylon Point, this community forms a continuous fringe along the landward edge of the mangroves and in some locations covers large areas up to 27ha in size. A number of old dams that occur at Point Ceylon have been colonised by *M. leucadendra*.

The *Melaleuca* communities found on the project area are common and constitute 6.4% of the Lower Finniss Region.

Rainforest

Monsoon vine forests occur throughout the project area. The most diverse patches in terms of structure and composition occur on old beach ridges that fringe the mangroves, and in association with freshwater streams. Some small patches of less well developed monsoon vine forest occur on shallower, gravelly soils.

The monsoon vine forests in the project lease area can generally be classified as 'dry' forests. The structure and composition of this community varies but is typically comprised of a high proportion of semi deciduous species. Common canopy species include: *Acacia auriculiformis*, *Canarium australianum*, *Brachychiton diversifolius*. Other species include: *Acacia spp.*, *Bridelia tomentosa*, *Buchanania obovata*, *Capparis umbonata*, *Cycas maconochiei*, *Denhamia obscura*, *Drypetes deplanchei*, *Exocarpus latifolius*, *Ficus opposita*, *Flueggea virosa*, *Grevillea spp.*, *Livistona humilis*, *Pandanus spiralis*, *Persoonia falcata*, *Petalostigma pubescens*, *Planchonia careya*, *Pouteria sericea*, *Strychnos lucida*, *Stenocarpus acacioides*, *Terminalia spp.*

Large patches of monsoon vine forest are mapped in the north-east of the project lease area. The presence of monsoon vine forest on the ground has been verified at one location in this part of the lease area during ground-truthing work undertaken as part of the LFLRS. This area will not be affected by the proposed development and therefore further ground-truthing of the mapped extent of rainforest in this area was not undertaken during this study.

Monsoon vine forest patches occur at Point Ceylon, confined to a narrow 100-200m wide zone landward of the mangrove forests. The mapped distribution of monsoon vine forest in this area extends 800m south along the peninsula, which is a substantial over representation of its actual distribution. The hinterland vegetation that occurs on the peninsula does comprise a substantial incursion of rainforest elements, however, it has a low open woodland structure. Site ECOZB1 surveyed during May 2003 is representative of this community type (see Appendix 2). The vegetation map included as Figure 2 has been adjusted to reflect the actual distribution of monsoon vine forest at Point Ceylon.

A number of monsoon vine forest patches also occur in the south-east of the project lease area. The largest mapped patches occur on the landward fringe of mangrove forests on the western side of Wheatley Creek. The presence of these patches has been verified on the ground with 5 sites surveyed during the surveys undertaken for this project and 6 sites surveyed as part of the LFLRS. The extent of the patches, however, has not been verified.

Monsoon vine forests (rainforest) are well represented in the Lower Finniss Region covering 5.6% of the total vegetated area, compared to their coverage of only 0.2% of the NT.

Riparian woodlands

Tall mixed species riparian forest occurs in association with the seasonal freshwater reaches of Wheatley Creek in the south-west of the project lease area. 400-500m upstream of the extent of the tidal influence the Wheatley Creek forks into two channels each supporting a 100-200m riparian corridor, which is distinctly different in structure and composition from the surrounding vegetation. Typical canopy forming species include: *Corymbia bella*, *Acacia auriculiformis*, *Erythrophleum chlorostachys*, *Melaleuca nervosa*, *Lophostemon lactifluus* and *Xanthostemon eucalyptoides*. Common mid-storey species include *Terminalia ferdinandiana*, *Livistona humilis*, *Ficus opposita*, *Barringtonia acutangula*, *Canarium australianum*, *Cycas maconochiei*, *Drypetes deplanchei*, *Buchanania obovata*, *Vitex glabrata*, *Diospyros calycantha* and *Petalostigma pubescens* occurring over a mixed grassy understorey.

A number of broad drainage basins across the project lease area support mixed species low open woodland. These areas are subject to seasonal inundation and contain species typically adapted to this situation. Species typically recorded in these seasonally inundated areas include: *Melaleuca viridiflora*, *Eucalyptus polyclada*, *Calytrix extipulata*, *Grevillea pteridifolia*, *Pandanus spiralis*, *Terminalia ferdinandiana*, *Acacia aulococarpa*, *Buchanania obovata*, *Owenia vernicosa*, *Persoonia falcata*, *Acacia latescens*, *Alphitonia excelsa*.

Riparian communities comprise only 1.3% of the Lower Finniss Region (Hill *et al.*, 2002).

Other communities

The transitional zone between the upland Eucalyptus woodlands and lowland Melaleuca swamps supports a variety of community types, which typically occur as small patches, and are variable in structure and composition. A brief description of transitional communities mapped and surveyed in the lease area is provided below.

Callitris intratropica forest (Northern Cypress Pine)

Tall open forests of *Callitris intratropica* occur along the landward edge of mangroves associated with Wheatley Creek in the south-west of the project lease area. These forests typically occur as mono-specific stands, however, a number of rainforest elements were also recorded at the surveyed sites representative of this community. The mapped distribution of this community identifies four patches ranging in size from 1.2 – 4.6 ha (see Veg Group N1 Figure 2). The presence of the two patches that occur on the eastern side of Wheatley Creek has been confirmed during field surveys (see Appendix 1 - sites ECOZAN1 and LFLRS389).

Large patches of *Callitris intratropica* up to 39 ha in size are also mapped as occurring on an island of vegetation isolated by mangrove forests in the north-west corner of the project lease area. These patches are topographically protected from fire by the surrounding mangrove forests. This area is not accessible from the areas proposed for development as part of this project, and will not be affected by the proposed development.

This community has a limited distribution across the NT and in the Lower Finnis Region is represented only by the patches that occur in the project lease area.

Tall open shrubland of *Calytrix exstipulata*

Tall open shrublands of *Calytrix exstipulata* occur in association with isolated laterite outcrops in the woodland floodplain transitional zone along Wheatley Creek. Survey at site ECOZAL1, which is representative of this community, identified a number of rainforest elements occurring in association with *Calytrix exstipulata*. The outcropping rock provides a natural barrier to fire allowing for colonisation by rainforest species.

The mapped distribution of this community identifies one large patch in the south-west of the project lease area. Ground survey did not confirm the presence of a large patch at this location, however, a number of small patches were observed in the woodland-floodplain transitional zone along the eastern side of Wheatley Creek.

Low open woodland of *Petalostigma pubescens*

Low woodlands to mid high open woodlands of *Petalostigma pubescens* are mapped as occurring at two locations within the project lease area. Common mid-storey species in this community include *Livistona humilis* and *Pandanus spiralis*, which occur over a grassy understorey commonly comprised of *Ectrosia* spp., *Pseudopogonatherum contortum*, *Sorghum* spp. and *Themeda triandra*. The locations within the project area have not been confirmed by ground survey.

Low open woodland to mid high open woodland of *Lophostemon lactifluus*

This community does not exist as a distinct community on the project lease area. Sites mapped as this community type are, according to ground surveys, more correctly classified as mixed species low open woodland. This community occurs in association with broad drainage lines throughout the project lease area.

Grassland of *Sorghum* sp. and *Eriachne* sp.

This community is mapped as occurring in the southern part of the project lease area as isolated patches within the *Eucalyptus* dominated open woodland. Open grasslands were not identified at these locations, which were typically associated with seasonally inundated broad drainage lines vegetated by mixed species low open woodland (refer to description above).

4.1.2. Mangrove vegetation

The project lease area is located on a narrow peninsula which is fringed to the north, east and west by extensive mangrove forests. All development associated with the proposed project is to take place at elevations above 10-20m and therefore will not require clearing of any mangrove vegetation. Despite there being no direct impact on mangrove environments, it must be acknowledged that this proposal is being developed on a site with substantial mangrove resources which must be protected from any potential impacts. The mangrove vegetation that fringes the project lease area is described below based on information collated in the Mangrove Survey of Bynoe Harbour (Brocklehurst and Edmeades, 2003).

Within the intertidal zone fringing the project lease area, 10 distinct mangrove plant communities have been mapped. These communities occur in zones which are arranged roughly parallel to the shore or tidal creeks and inlets. The pattern of zonation is shown in Figure 3.

Point Ceylon is characterised by a narrow band of mangrove forest comprised of 2 distinct zones. The most seaward zone (Map Unit 8a) is comprised of *Sonneratia alba* dominated woodland. This community is restricted to the seaward edge of the tidal flats and occurs on fine mud substrates. Bare mudflats extend to the main seaward channel. Landward of this zone is dominated by *Rhizophora stylosa* closed shoreline forest (Map unit 1b). The mid-stratum is generally absent or sparse in this community and may include scattered *Avicennia marina*, *Bruguiera exaristata*, *B. parviflora* or *S. alba*. Both communities are inundated twice daily by every tide.

More extensive areas of mangrove forest are associated with the tidal creeks and inlets that occur to the east and west of Point Ceylon. These creeks and inlets are dominated by *R. stylosa*, which occurs in association with other species dependent on location within the intertidal zone. On the edge of the tidal creeks and inlets *R. stylosa* is characteristically dominant, with *Camphostemon schultzei* often co-dominant or locally dominant (Map unit 2a). Within this zone, thickets of *C. schultzei* and *Aegiceras corniculatum* line the creek banks, particularly in higher reaches of tidal creeks. Scattered *Xylocarpus mekongensis* also occur.

Further up the tidal creeks and inlets, *Bruguiera parviflora* is generally dominant, with *R. stylosa* co-dominant in many instances (Map unit 2c). *Avicennia marina* also occurs in the canopy stratum and *Ceriops decandra*, *C. tagal* and *C. schultzei* are common mid and ground stratum species. Landward of these communities a transition zone supports a mixed closed forest to open forest community in which *R. stylosa* occurs in association with *Bruguiera spp.* and *Ceriops spp.* (Map unit 3). The mid to high tidal flat supports *Ceriops tagal* low closed forest-open forest (Map unit 4a), which receives irregular tidal inundation. Salt flats (Map unit 9a) are typically associated with this community and in the project area are scattered throughout the forest where it occurs along the tidal channel on the eastern boundary of the project lease area. Salt flats also occur at Toss Point and in association with the tidal inlet to the west of Point Ceylon. This community is usually devoid of vegetation, but does contain low growing plants comprised of sedges, grasses and samphires, depending on position and saltwater/freshwater influences.

The low to mid tidal flats in the downstream sections of Wheatley Creek support extensive *R. stylosa* low closed forest (Map unit 2c). The mid stratum is typically more marked in this community with the major proportion made up of smaller *R. stylosa* trees. Scattered *Avicennia marina*, *Bruguiera parviflora* and *Camptostemon schultzei* also occur.

5. CONSERVATION SIGNIFICANCE OF FLORA

The lowlands of the project lease area support a number of vegetation communities which are of conservation significance at a local and regional level. Previous development and exploration activities have caused vegetation degradation in the project lease area through the impacts of clearing, weed invasion and fire. These impacts have mostly been confined to the upland woodland communities. The lowland parts of the project lease area do not appear to have been significantly degraded by human activities and therefore have maintained their conservation significance. However, some impacts of fire and feral animals have been noted. The communities and species that occur in the project lease area that are considered to be of value to conservation are described below. The potential impacts of the proposed project on conservation values is also discussed.

5.1. Vegetation communities of conservation significance

5.1.1. Mangroves

The project lease area is surrounded by extensive areas of mangrove forest covering an area of approximately 150 ha. The mangroves of Bynoe Harbour have remained relatively intact through limited foreshore development in the region and are considered to be a significant resource both locally and globally (Brocklehurst and Edmeades, 2003). The mangrove forests fringing the project lease area constitute 0.6% of the total area of Bynoe Harbour/Tapa Bay mangrove communities which represent approximately 6% of the mangrove areas of the NT and 0.1% of remaining world mangrove regions.

The construction of the proposed project will not require direct removal of any mangrove vegetation. Saltwater intakes for the production ponds and breeding facility complex are constructed of flexible piping, which will allow the intakes to pass through the mangrove forests with minimal disturbance. The intake for the breeding facility complex will be located approximately 500m south of the breeding facility site where there is an existing clearing through the narrow mangrove fringe. The construction and operation of the proposed project is not expected to have any significant impacts on the surrounding mangrove environments.

5.1.2. Rainforest

Patches of dry monsoon vine forest ranging in size from 0.3 ha to 5 ha are located in the project lease area. Rainforest patches (incorporating monsoon vine forest) are generally small in area and contain distinct plant species assemblages which warrant conservation measures. Rainforests occupy only 0.2% of the land area of the Northern Territory (Price *et al.*, 1995). Comparatively, rainforest patches in the Finnis Region cover a total area of 47.7km² comprising 5.6% of the region's vegetation (Hill *et al.*, 2002). Rainforest communities are typically species rich (Dunlop *et al.*, 1994), and often contain species which are considered to be rare.

Rainforest patches also provide significant habitat for a variety of fauna species. Research has found that an important relationship exists between frugivorous birds (birds that feed on fruit) and monsoon rainforests. Rainforests provide fruit resources required by frugivorous birds, which in turn assist in the dispersal of seed between monsoon rainforest patches to maintain gene flow (Price *et al.*, 1999). Some bat species may also play an important role in maintaining patchy rainforest habitats in the seasonal tropics of northern Australia (Palmer, 2000).

No rare plant species were identified in any of the monsoon vine forest patches that occur in the project lease area. The condition and integrity of the patches varies. Most of the patches surveyed had been impacted to some extent by weed invasion, fires and feral animal activity. The monsoon vine forest that occurs in the project area is not of outstanding conservation significance, however, the regional significance of this community through its role in maintaining the regional network of rainforest patches should be noted. All rainforest patches are significant in a regional context because of the high level of patch interdependence (Price *et al.*, 1998).

The construction of the proposed project will not result in the removal of any monsoon vine forest vegetation. The proposed breeding facility site at Point Ceylon is located in close proximity to a large

patch of monsoon vine forest and the saltwater intake for the complex runs south along a sand spit vegetated by monsoon vine forest elements. Construction activities at the breeding facility site will require strict management to ensure that the development does not encroach on the monsoon vine forest that occurs at Point Ceylon. The saltwater intake will be a flexible pipe to allow for the intake to be put into position with limited disturbance to the vegetation on the sand spit.

Weeds and fire are the factors that have the greatest potential to cause negative impacts on the monsoon vine forests that occur in the project lease area. Degradation of patch integrity has already been observed in a number of monsoon vine forests at the site as a result of weed invasion, fires and feral animal activity. Construction and operation of the proposed project has the potential to exacerbate the impacts of weeds and fire on these patches. Implementation of weed and fire management programs will minimise these impacts and may actually enhance the protection of these sites. Recommendations on weed and fire management are further discussed in section 6.

5.1.3. Riparian

The upper reaches of Wheatley Creek are vegetated by a dense 100-200m wide corridor of riparian forest. Riparian vegetation communities comprise only 1.4% of the total vegetation of the Finnis Region (Hill *et al.*, 2002). Each community plays a direct role in maintaining the ecological stability of the particular watercourse with which it is associated. Riparian communities also provide movement corridors and seasonal refuges for fauna.

Clearing of any riparian vegetation has potential to cause significant impacts, which can extend beyond the immediate site. Impacts may include destabilisation of banks and erosion and siltation of rivers and creeks. Construction activities may also disturb fauna utilising riparian areas as habitat. This may have specific impacts on species of fauna and impacts on ecosystem health in general.

The proposed development will result in the periodic wet season inundation of 12 ha of riparian forest at the site of the freshwater weir. Inundation may result in the death of some trees, however, it is expected that most of the riparian forest vegetation will survive this inundation due to the following:

- Clearing at the weir site prior to construction will involve minimal vegetation removal.
- During the wet season, water will be pumped from the weir to off-stream storage, which will reduce the area inundated.
- Off-stream storage in storage ponds will hold water pumped from the creek. The maximum period of inundation is during the wet season, corresponding with natural inundation patterns experienced by this community. The weir will self-drain over a period of less than 5 days resulting in near normal flow conditions.
- No vegetation will be permanently inundated.

5.1.4. Northern Cypress Pine communities (Northern Cypress Pine)

Tall open forests of *Callitris intratropica* occur along the landward edge of mangroves associated with Wheatley Creek in the south-east of the project lease area. In the Finnis Region this community is confined to remnant pockets on Point Ceylon and adjacent coastal islands that are protected from bushfires (Hill *et al.*, 2002). The mapped distribution of *C. intratropica* forest in the project lease area covers a total area of approximately 8 ha which is the entire regional extent of this community. The patches that occur in the project lease area are therefore of high regional conservation significance.

The proposed development will not result in clearing of any *Callitris intratropica* forest. Construction of the production ponds will be taking place in close proximity to the patch of *Callitris intratropica* forest that occurs on the eastern side of Wheatley Creek. Construction activities will need to be managed to ensure that this community is not impacted.

The community is highly susceptible to fire, and therefore fire management at the site must incorporate strategies to protect this community from fire (see section 6.3).

5.2. Plant species of conservation significance

5.2.1. Threatened species

No threatened species have been recorded in the project lease area.

The LFLRS recorded 12 species within the Lower Finnis Region that are considered to be of conservation significance. Two of these species, *Callitris intratropica* and *Cycas maconochiei*, have been recorded in the project lease area (see sections 5.1.4 and 5.2.2 for discussion of these species). These species do not have any formal conservation status.

Of the other 10 species of conservation significance identified in the LFLRS, 4 have been recorded on landunits or in vegetation groups that occur in the project lease area. These species are listed below:

Chamaecrista grisea

Located at only one site on a hillslope (6a2) close to the River Annie. This landunit is represented by a small area (<1ha) in the project lease area.

Indigofera schultziiana

Predominantly found in the ground layer of tall open woodlands of *Eucalyptus miniata* and *E. tetradonta* (Veg GroupA1). It has been located at six sites in the Lower Finnis Region where its distribution is confined to within the Finnis Range and a peninsula between the Annie and Charlotte Rivers. The vegetation group in which this species is found dominates the upland areas of the project lease area.

Polymeria pusilla

This species was found only at one site near Crab Claw Island, in a low open woodland of *Melaleuca viridiflora* (8j1). The *Melaleuca* woodlands in the project lease area occur on landunit 8ji, which is widespread.

Tephrosia crocea

This species was wide spread, occurring in mid high open to tall woodlands with *Eucalyptus miniata*, *E. tetradonta*, *Erythrophleum chlorostachys*, *Xanthostemon paradoxus* and *Corymbia polysciada* (A1, A3, C1, J1). These communities are widespread in the project lease area.

Surveys of the project lease area did not identify the presence of these species, however, the possibility that they do occur there should be noted.

5.2.2. Cycads

There are 11 recognised *Cycas* species in the Northern Territory, most of which are endemic and are considered of conservation significance (PWCNT, 1997). *Cycas maconochiei* is a species of Cycad which is a common mid-storey species in the project lease area. The distribution of this species is confined to the coastal areas west of Darwin from the Cox Peninsula to Fog Bay. It is locally abundant, however, is under threat of substantial population decline through land clearing (PWCNT, 1997).

All Cycads in the Northern Territory are protected under section 43(2) of the *Territory Parks and Wildlife Act* 2000. The legislation does not preclude development in areas where Cycads occur but requires that Cycad plants may not be 'taken or interfered with' without a permit from PWCNT. Construction of the proposed project will result in inadvertent clearing of Cycad plants. The number of plants affected will be low in the context of its abundance in the region. A permit will be required. Salvage of Cycads prior to construction should be considered.

5.2.3. Orchids

All flora species belonging to the family Orchidaceae (Orchids) are protected under section 43(2) of the *TPWC Act* (2000). The orchid *Dendrobium affine* was commonly identified on the trunks of Cycad plants throughout the project lease area during ground surveys. This species has a widespread

distribution and is common in the Top End. Construction of the proposed project will result in the inadvertent destruction of some orchid plants. Statutory listing of orchids is mainly to protect them from illegal trade. As with Cycads, the presence of orchids does not preclude development, however, it does impose the requirement that a permit from PWCNT be sought prior to construction.

6. POTENTIAL ENVIRONMENTAL IMPACTS ON FLORA

6.1. Clearing and other direct impacts associated with construction and operation

Construction of the production ponds, freshwater weir, breeding facility, production areas and access roads will result in the clearing of up to a total of 182.5 ha of vegetation in the project lease area. 46.5 ha of this will be cleared for the construction of Stage 1. Further clearing up to a maximum of 136 ha will take place to accommodate Stage 2-5 expansion of the project.

6.1.1. Vegetation communities traversed by the access road

The main access track to the site will be off the Fog Bay Road. Construction of the track will require the removal of a 20 m wide corridor of vegetation in areas where a new alignment is required. Approximately 3.4 km of the access track follows existing track alignments. Where this is the case further clearance will be required to widen the track to a total width of 20m.

A new road alignment will be cleared from the Fog Bay road north to an existing track alignment. This new alignment will cover a total distance of 6.3 km and will require clearing of 12.6 ha of vegetation. The vegetation of the country traversed by the new road alignment is generally *Eucalyptus* dominated woodland to open woodland, with a mixed species understorey. The vegetation corresponds to map units C1 and A3, which do not occur as distinct communities as indicated on the vegetation map but rather grade into each other. Dominant species include: *Eucalyptus polyclada*, *E. tetradonta*, *E. miniata* and *Erythrophleum chlorostachys*. Common species recorded in the mid-storey include: *Cycas maconochiei*, *Livistona humilis*, *Petalostigma pubescens*, *Planchonia careya*, *Pandanus spiralis* and *Grevillea spp.* The alignment traverses a number of broad drainage lines mapped as vegetation group B1. The vegetation of these broad drainage lines is structurally distinct but similar in species composition to the surrounding vegetation.

The proposed access road follows an existing track alignment west for 1 km from [669460E, 8587740N] to [668450E, 8587760N]. The vegetation traversed by this section of the proposed alignment is tall open woodland of *E. tetradonta*. In some areas *E. polyclada* is a co-dominant species in this community. The mid storey of this community was typically comprised of *Cycas maconochiei*, *Livistona humilis*, *Petalostigma pubescens*, *Planchonia careya*, *Acacia aulacocarpa*, *Timonius timon* and *Vitex glabrata*. Construction of this section of the access track will require the removal of 1.7 ha of vegetation.

From [668450E, 8587760N] a new access track alignment will be cleared north for a distance of 5.5km. This new track alignment traverses through the middle of the production ponds and meets up with an existing track alignment at [667740E, 8592760N]. Construction of this section of the access track will require clearing of 11 ha of *Eucalyptus spp.* dominated woodland to open woodland. Dominant species include: *Eucalyptus miniata*, *Erythrophleum chlorostachys*, *Corymbia bleeseri*, and *E. tetradonta*. Species dominance in the upper and mid layers of this community varies according to local variations in topography. A detailed description is provided in section 4.1.1.

The access track follows an existing track alignment from [667740E, 8592760N] to the proposed breeding facility site at Point Ceylon. Construction of this section of the access track will require clearing of 4.4 ha of vegetation. The vegetation along the existing alignment is characterised by a low mixed species woodland with an incursion of monsoon vine forest elements. Dominant species in this community include: *Acacia auriculiformis*, *Acacia latescens*, *Eucalyptus polycarpa*, *Eucalyptus miniata*, *Alstonia actinophylla*, *Terminalia ferdinandiana*, *Persoonia falcata*, *Buchanania obovata*, *Grevillea dryandri*, *Grevillea heliosperma*, *Stenocarpus acacioides*, *Strychnos lucida*, *Cycas maconochiei*. There are a number of old dirt mounds along the track, which have been colonised by weed species.

6.1.2. Vegetation communities at the proposed breeding facility site

The proposed breeding facility complex is located on the hinterland peninsula at Point Ceylon. The removal of 0.35 ha of vegetation will be required to construct Stage 1 of the breeding facility complex.

Progressive removal of up to an additional 4.8 ha of vegetation will be required during Stages 2-5 to accommodate expansion of the breeding facility.

The vegetation at the proposed breeding facility site is mixed species low open woodland with an incursion of monsoon vine forest elements. The site has been significantly disturbed by historic development and exploration activities as is evidenced by the presence of numerous unrehabilitated excavations, old dams and infrastructure. Most of the site has been previously cleared and therefore the vegetation present at the site is largely regrowth. Dominant species in this community include: *Acacia auriculiformis*, *Acacia latescens*, *Eucalyptus polycarpa*, *Eucalyptus miniata*, *Alstonia actinophylla*, *Terminalia ferdinandiana*, *Persoonia falcata*, *Buchanania obovata*, *Grevillea dryandrii*, *Grevillea heliosperma*, *Stenocarpus acacioides*, *Strychnos lucida*, *Cycas maconochiei*.

6.1.3. Vegetation communities at the proposed pond site

Construction of the production ponds, accommodation compound and sludge drying beds will require clearing of 0.6 ha of vegetation during Stage 1. Progressive removal of up to a further 2.4 ha will occur at Stages 2-5. The vegetation that will be cleared is predominantly *Eucalyptus spp.* dominated woodland to open woodland. Dominant species in this community include: *Eucalyptus miniata*, *Erythrophleum chlorostachys*, *Corymbia bleeseri*, and *E. tetradonta*. Species dominance in the upper and mid layers of this community varies according to local variations in topography. A detailed description is provided in section 4.1.1.

The saltwater and freshwater intakes for the production ponds are flexible pipes which can be put into place without removing any vegetation.

6.1.4. Vegetation communities inundated by the freshwater weir

The proposed freshwater weir is located upstream of the extent of tidal influence on Wheatley Creek. The weir during high flows will result in the temporary inundation of 12 ha of riparian forest upstream of the weir. The vegetation of the area proposed for the freshwater weir is characterised by tall closed forest where the dominant species include: *Acacia auriculiformis*, *Erythrophleum chlorostachys*, *Lophostemon lactifluus*, *Melaleuca nervosa* and *Xanthostemon eucalyptoides*. The mid storey of this community is dominated by: *Exocarpos latifolius*, *Canarium australianum*, *Cycas maconochiei*, *Drypetes deplanchei*, *Barringtonia acutangula*, *Terminalia ferdinandiana*, *Livistona humilis*, *Petalostigma pubescens*, *Diospyros calycantha*, *Vitex glabrata*, *Buchanania obovata* and *Timonius timon*, which occur over grass and sedge species such as *Eulalia spp.*, *Scleria spp.*, *Flagellaria indica* and *Imperata cylindrica*.

The impacts on the flora as a result of construction and operation of the freshwater weir will depend on the management of construction activities and the nature and duration of flooding. Construction of the weir will involve substantial disturbance of the creek banks in the immediate area. The potential for this disturbance to cause erosion and siltation of the creek should be minimised by ensuring that the weir is constructed in the dry season so that rehabilitation is well advanced prior to the onset of the first wet season rains.

The freshwater weir will alter the wet season flow regime of the creek and may result in the death of some riparian vegetation. However, the potential impacts on riparian vegetation have been minimised by the following aspects of the weirs design and operation:

- The freshwater weir will not be used for permanent water storage, but to collect water for transfer to off-stream storage.
- Clearing at the weir site prior to construction will involve minimal vegetation removal.
- During the wet season, water will be pumped from the weir to off-stream storage, which will reduce the area inundated.
- Off-stream storage in storage ponds will hold water pumped from the creek. The weir will self-drain over a period of less than 5 days resulting in near normal flow conditions.
- No water will be retained during the dry season.

6.2. Introduction and spread of weeds

Weeds are abundant in those parts of the project lease area that have been disturbed by previous development and exploration activities. Point Ceylon, which has been most intensely disturbed by previous activities, is probably the area most affected by weeds. Infestations have also been recorded along existing access tracks.

Eight weed species were recorded in the project lease area. Six of these species are classified as 'declared weeds' under the NT *Weeds Management Act 2001*. Each of the recorded species and their statutory classification is documented in Table 1. It should be noted that these classifications are currently under review.

Table 1 Weed species recorded in the project lease area. Notes taken from Smith (2002) and Parsons and Cuthbertson (2001).

Weed species		Classification in project area	Notes
Species name	Common name		
<i>Andropogon gayanus</i>	Gamba Grass	Not to be introduced	A highly productive annual grass that increases fuel loads, cures later than the native annual grasses and produces intense late dry season fires which seriously damage native woody species.
<i>Bidens pilosa</i>	Cobbler's Peg	Not to be introduced	
<i>Passiflora foetida</i>	Wild Passionfruit	Not to be introduced	A fast growing species that spreads quickly, choking native vegetation.
<i>Hyptis suaveolens</i>	Hyptis	D & C	Forms dense thickets rendering infested areas unproductive.
<i>Pennisetum pedicellatum</i>	Annual Mission Grass	D & C	Cures later than native annual grasses and produces late dry season fires.
<i>Sida obtusifolia</i>	Sicklepod	D & C	Competes with and excludes native species.
<i>Themeda quadrivalvis</i>	Grader Grass	E & C (only C applicable to project site)	Can invade native pastures or grasslands and seriously reduce diversity.
<i>Pennisetum polystachion</i>	Mission Grass	E & C (only C applicable to project site)	Competes with and displaces native species. Remains green until late in the dry season and provides fuel for very hot fires.

Key:

Class C – not to be introduced.

Class D – not to be spread by human means.

Class E – species under an approved strategy. Note: No strategies are currently in place for the project lease area.

The *Weeds Management Act 2001* places obligations on land owners and occupiers to manage the introduction and spread of declared weeds, and to comply with approved weed management plans relating to declared weeds that occur on their land. The proponent of the proposed Sunrise Aquaculture Estate must take all reasonable measures to prevent the spread of Class D weeds that currently occur in the project lease area, and to ensure that declared weeds of any class are not introduced into the project lease area during construction and operation of the project. A list of weeds declared under the *Weeds Management Act 2001* is included at Appendix 4, however, it should be noted that this list is currently being reviewed and changes are likely.

Management of weed species not declared under the *Weeds Management Act 2001* is encouraged in order to minimise the potential impacts of these species on the environment and on the efficient operation of the project. Management of Gamba Grass is especially recommended, as this species provides fuel for hot, late season fires, which have the potential to negatively impact on the environment and to place project personnel and infrastructure at risk.

The greatest risk of weeds being introduced and spread will occur during the construction phase of the proposed project. Parts of the proposed access road, and the site of the breeding facility complex at Point Ceylon are infested with weeds. Construction activities in these areas especially have the potential to spread weeds across the project area. Furthermore, the movement of plant onto and off the site has the potential to introduce new weeds into the project lease area, and to transport weeds off the project area. A weed management program that covers the construction and operation of the proposed project is recommended.

6.3. Fire management

Fire is inevitable in the savanna forest vegetation found in the project area. The project and surrounding vegetation are likely to be affected by fire. The Bushfires Council of the NT requires landholders to undertake a number of actions to manage fire, including managing the perimeters of properties. This may require slashing or burning to prevent entry of wildfires or escaped fires from the property. Firebreaks coupled with adequate and appropriate prescribed burns will effectively manage fires on the property and reduce the risks of wildfires entering the property.

A fire management program which plans for the development and maintenance of fire breaks and which outlines measures for lighting prescribed burns is recommended. Particular attention should be paid to:

- protection of infrastructure;
- protection of *Callitris intratropica* stands;
- protection of monsoon vine forest patches and riparian forests.

These can be achieved by prescribed burning early in the dry season. Specific attention will also be required for grass-weed affected areas. Weed control programs must be planned in conjunction with fire management to ensure that fires do not jeopardise the weed control.

7. SUMMARY OF MANAGEMENT RECOMMENDATIONS

The potential impacts of the construction and operation of the proposed Sunrise Aquaculture Estate on the vegetation and flora of the project lease area are documented throughout this report. Mitigation measures and safeguards to minimise identified impacts have been discussed to some extent in each section. This section summarises the management measures and safeguards that are recommended to minimise the impacts of the project on vegetation and flora.

7.1. Clearing of vegetation

- Clearing of the natural vegetation should be kept to a minimum required for each stage of the development. In order to ensure that contractors clear only that area required, the boundaries of areas to be cleared should be clearly marked prior to any works taking place in the project lease area.
- Additional areas required for plant turn-around areas, construction access tracks, storage areas, construction camps, should be kept to a minimum and be immediately rehabilitated after construction.
- Clearing of vegetation for the freshwater weir should be kept to the minimum required for construction of the weir.
- Vegetation regrowth should be promoted in areas disturbed during construction. To facilitate this, soil and vegetative matter should be stockpiled near to the area from which it was taken so that it can be respread over the area.
- Vegetation removed as part of site clearing should be burnt on-site with an appropriate permit from Bushfires Council NT. The vegetation pile should be located as far as possible from areas susceptible to fire, and the burning should be done under supervision with a fire fighting unit present.
- All construction staff should be briefed about the importance of protecting all vegetation communities, but specifically, monsoon vine forests, riparian forests and *Callitris intratropica* forests. Where these communities are located in areas close to construction activities the boundaries of the community should be clearly marked.
- A permit must be obtained from Parks and Wildlife prior to clearing due to the presence of Cycads and Orchids at the site.

7.2. Earthworks, earth materials and stockpiles

- Excavated soil should either be stored on-site in an area previously cleared of vegetation or taken to an appropriate area off-site. Any on-site or off-site location should be approved by DIPE prior to dumping. Appropriate locations for dumping of spoil should be clearly demarcated to contractors.
- The boundaries of areas to be excavated should be clearly demarcated to contractors.
- Any construction materials sourced from outside the project lease area should be inspected for weeds prior to taking it onto the site.
- Road construction should be undertaken to ensure that natural drainage patterns are not significantly altered, especially where the road traverses broad drainage lines.

7.3. Weeds

A weed management program should be developed and implemented for the construction and operation phases of the project. The weed management program should incorporate the following:

- All vehicles and plant to be used in construction should be subject to washdown and inspection prior to moving on to the project lease area. Washdown should be verified by the site supervisor.
- All construction materials sourced outside the project lease area must be declared weed free prior to being taken on site.
- Vehicles and plant working in areas of existing weed infestations, should be subject to washdown prior to moving around the project lease area.
- A weed monitoring and treatment program should be implemented immediately following construction and should continue throughout the operation stage of the project.

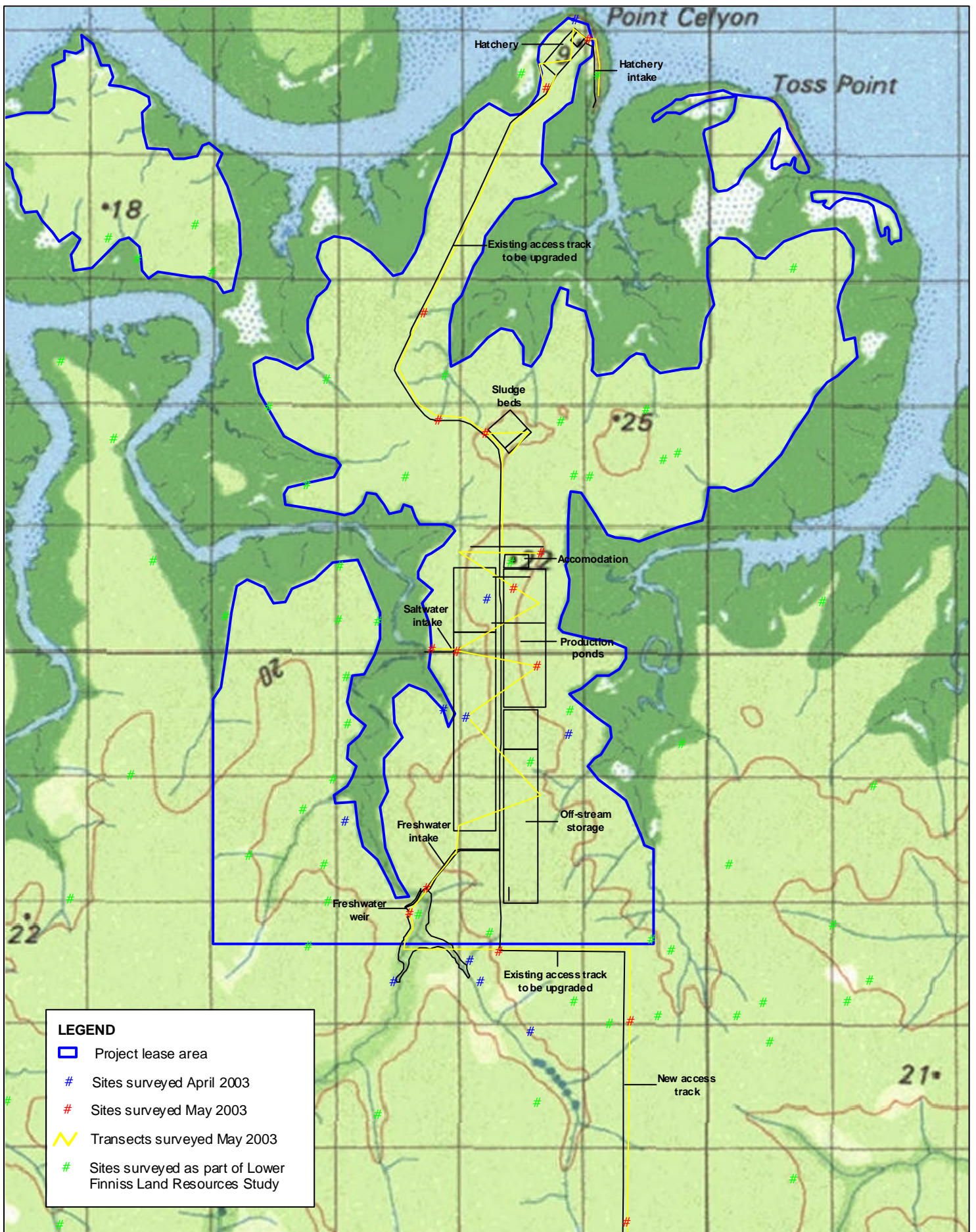
7.4. Fire

A fire management program should be developed and implemented for the construction and operation phases of the project. The program should aim to protect fire sensitive vegetation communities, such as monsoon vine forests, *Callitris intratropica* forest and riparian forests, which can be significantly degraded by fire.

8. REFERENCES

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Figures



LEGEND

- Project lease area
- # Sites surveyed April 2003
- # Sites surveyed May 2003
- ~ Transects surveyed May 2003
- # Sites surveyed as part of Lower Finniss Land Resources Study

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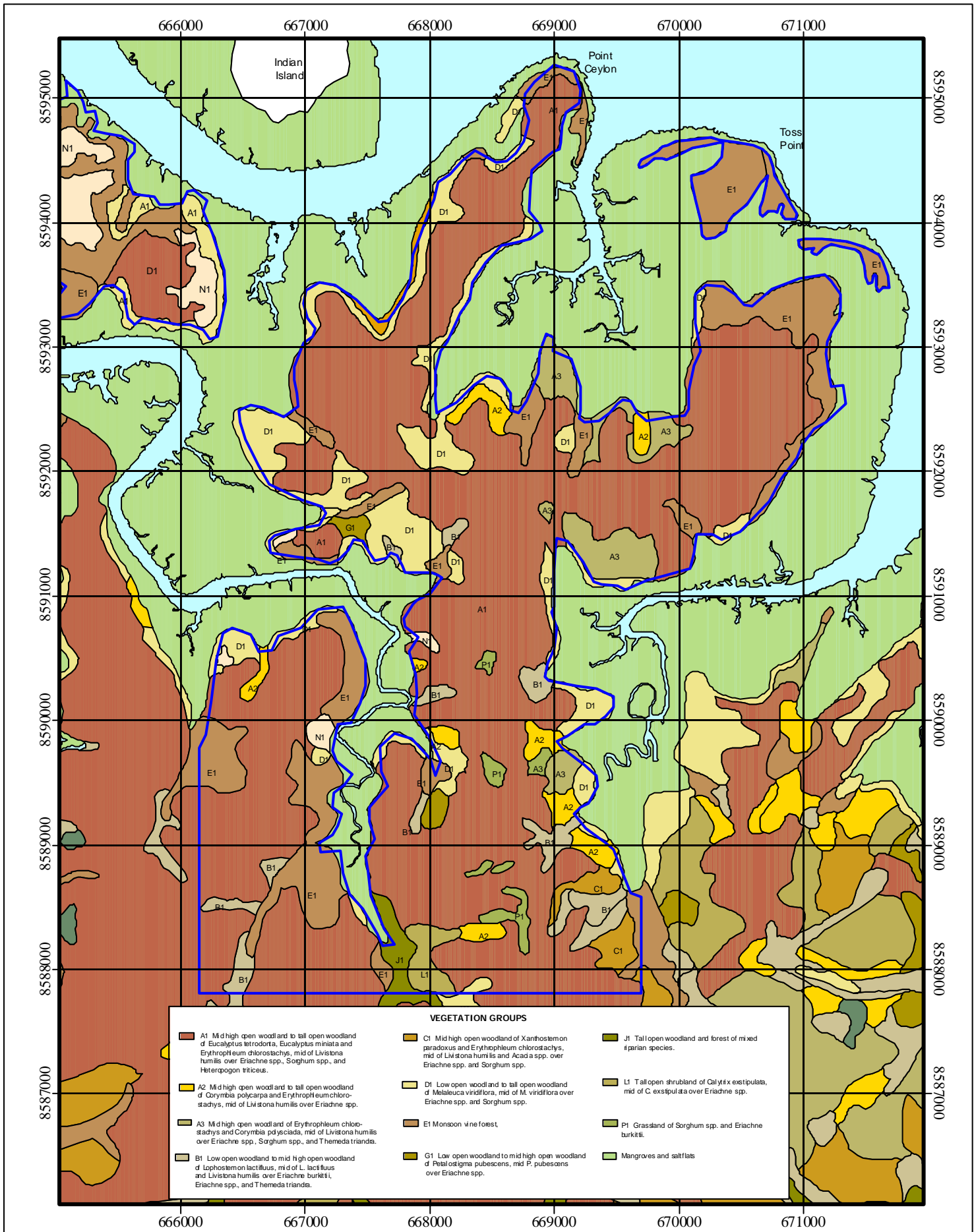
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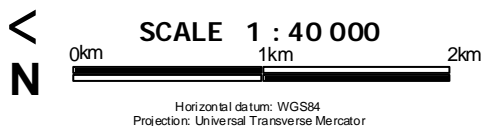
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FIGURE 1
LOCATION OF FLORA
SURVEY SITES

Map produced by:
EcOz Environmental Services
 June 2003



SUNTAY AQUACULTURE PTY. LTD.
 SUNRISE AQUACULTURE ESTATE
 DRAFT EIS



Source:
 Hill, J., Fett, D. and Perrett, F. (2002) Land Resources of the Lower Finniss. Department of Infrastructure, Planning and Environment, NT. (Technical Report No. 19/2/002.
 Brocklehurst, P. and Edmeades, B. (2003) Mangrove Survey of Bynoe Harbour. Department of Infrastructure, Planning and Environment, Palmerston, NT.

**FIGURE 2
 VEGETATION OF THE PROJECT
 LEASE AREA**

Map produced by:
EcOz Environmental Services
 June 2003





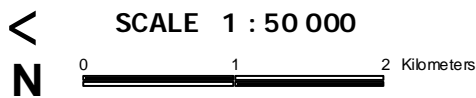
LEGEND

- Project lease boundary

MANGROVE COMMUNITIES

- 1b *Rhizophora stylosa* closed forest
- 1c *Rhizophora stylosa* low closed forest
- 2a *Rhizophora stylosa*/*Campostemon schultzei* closed-forest/open-forest
- 2c *Bruguiera parviflora*/*Rhizophora stylosa* co-dominant closed-forest
- 3 *Rhizophora stylosa*/*Bruguiera* spp./*Cerriops* spp. closed-forest/open-forest
- 4a *Cerriops tagal* low closed-forest/open-forest
- 5b *Avicennia marina*/*Cerriops tagal* open-forest
- 7a Mixed species low-woodland/samphire
- 8a *Sonneratia alba* woodland
- 9a Salt flats

SUNTAY AQUACULTURE PTY. LTD.
 SUNRISE AQUACULTURE ESTATE
 DRAFT EIS



Source:
 Brocklehurst, P. and Edmeades, B. (2003) Mangrove Survey of Bynoe Harbour. Department of Infrastructure, Planning and Environment, Palmerston, NT.
 Raster100K topographic map data was supplied by Geoinage and AUSLIG.

FIGURE 3
MANGROVE VEGETATION
FRINGING PROJECT LEASE AREA

Map produced by:
 EcOz Environmental Services
 June 2003



Appendix 1

Results of April 2003 flora survey

Summary of vegetation survey sites in project lease area

Veg Group	Description	Sites surveyed in Hill et al 2002			Sites surveyed by EcOz 2003		
		Site no. LFLRS	East	North	Site no. ECOZA	East	North
A1	Mid high open woodland to tall woodland of Eucalyptus tetrodonta, Eucalyptus miniata and Erythrophleum chlorostachys, mid of Livistona humilis over Eriachne spp., Sorghum spp. and Heteropogon triticeus.	347 351 378 381 384 386 420 426	667149 667066 668010 668941 669045 669770 668540 668698	8590421 8588150 8592387 8592016 8591587 8591708 8590881 8589273			
A2	Mid high open woodland to tall woodland of Corymbia polycarpa and Erythrophleum chlorostachys, mid of Livistona humilis over Eriachne spp.						
A3	Mid high open woodland to tall woodland of Eucalyptus alba and Corymbia latifolia, mid of Grevillea pteridifolia and Lophostemon lactifluus over Sorghum spp. And Themeda triandra.	382 385 421	669626 669177 669019	8592114 8591573 8589684			
B1	Low open woodland to mid high open woodland of Lophostemon lactifluus and Livistona humilis over Eriachne burkittii, Eriachne spp., Sorghum spp., and Themeda triandra. Regrowth of Melaleuca spp. and L. lactifluus.	341 350	666434 666865	8588516 8588891			
C1	Mid high open woodland of Xanthostemon paradoxus and Erythrophleum chlorostachys, mid of Livistona humilis, Acacia spp. Over Eriachne spp. and L. lactifluus.						
D1	Low open woodland to tall open woodland of Melaleuca viridiflora, mid of M. viridiflora over Eriachne spp. and Sorghum spp.	346 379 388	666589 667693 668373	8592135 8591569 8587895			
E1	Monsoon vine thicket, upper including Acacia auriculiformis and Erythrophleum chlorostachys, mid of Petalostigma pubescens, Acacia spp., Livistona humilis and Syzygium spp., over Eriachne trisetata and Eragrostis spp. Vines of Smilax australis and Flagellaria indica	343 345 348 349 353 376 377 380 383 387	667226 667157 667472 667111 667033 669239 668629 667060 670819 669881	8589577 8590846 8590402 8589136 8588450 8594801 8594811 8592358 8593241 8591762	E11 E12 E13 E15	669000 668000 667200 668700	8595100 8589600 8588800 8587100
J1	Tall woodland and forest of mixed riparian species including Xanthostemon eucalyptoides, Acacia auriculiformis, Melaleuca leucadendra and Lophostemon lactifluus, mid of mixed species over Eriachne trisetata.	352	667799	8588041			
G1	Low open woodland to mid high open woodland of Petalostigma pubescens, mid of P. pubescens over Eriachne spp.					667900	8589300
L1	Tall open shrubland of Calytrix exstipulata, mid of C. exstipulata over Eriachne spp. Regrowth of C. exstipulata.				L1	668000	8587900
N1	Tall woodland to tall open forest of Callitris intratropica, mid of mixed species over Eriachne pallescens.	344 389	667220 666899	8589956 8591511	N1	668200	8590700
P1	Grassland of Sorghum spp. And Eriachne burkittii.				P11 P12	668500 669000	8589500 8589500
S1	Mangroves and saltflats.						

Summary of April 2003 flora survey results

Site	Coordinates		Species	Photos
	Easting	Northing		
Weeds	669191	8595065	* <i>Sida obtusifolia</i>	1419
			* <i>Themeda quadrivalvis</i>	1421
			* <i>Hyptis suaveolens</i>	
			* <i>Passiflora foetida</i>	
			* <i>Pennisetum polystachion</i>	
	669083	8595159	* <i>Pennisetum pedicellatum</i>	
			* <i>Andropogon gayanus</i>	
			* <i>Hyptis suaveolens</i>	1431-1432
			* <i>Passiflora foetida</i>	
			* <i>Pennisetum polystachion</i>	
Monsoon Forest	669000	8595100	<i>Aidia racemosa</i>	1422-1427
ECOZAE11	669055	8595252	<i>Xanthoxylum parviflorum</i>	1428-1430
			<i>Drypetes deplanchei</i>	
			<i>Sterculia quadrifida</i>	
			<i>Memecylon pauciflorum</i>	
			<i>Bridelia tomentosa</i>	
			<i>Alyxia spicata</i>	
			<i>Denhamia obscura</i>	
			<i>Premna serratifolia</i>	
			<i>Acacia auriculiformis</i>	
			<i>Trema tomentosa</i>	
			<i>Flagellaria indica</i>	
			<i>Adenia heterophylla</i>	
			<i>Ziziphus oenopolia</i>	
			<i>Glycosmis trifoliata</i>	
			<i>Ampelocissus acetosa</i>	
			<i>Allophylus cobbe</i>	
			<i>Micromelum minutum</i>	
			<i>Breynia cernua</i>	
			<i>Dioscorea bulbifera</i>	
			<i>Canarium australianum</i>	
			<i>Glochidion ferdinandiana</i>	
			<i>Pouteria sericea</i>	
			<i>Denhamia affine</i>	
			<i>Vitex acuminata</i>	
			<i>Canthium schultzei</i>	
			<i>Smilax australis</i>	
			<i>Alphitonia excelsa</i>	
			<i>Thespesia populneoides</i>	
			<i>Litsea glutinosa</i>	
			<i>Abelmoschus moschatus</i>	
			<i>Melodinus australis</i>	
			<i>Secamone elliptica</i>	
			<i>Cyathostemma micrantha</i>	
			<i>Capparis jacobsii</i>	
			<i>Brachychiton diversifolius</i>	
			<i>Wrightia saligna</i>	
			<i>Vitex glabrata</i>	
			<i>Panicum trichoides</i>	
			<i>Grewia oxyphylla</i>	
			<i>Clerodendrum floribundum</i>	
			<i>Tabernaemontana orientalis</i>	
			<i>Exocarpus latifolius</i>	
			<i>Eucalyptus miniata</i>	
			<i>Plectranthes scutellarioides</i>	
			<i>Clematis pickeringi</i>	
			<i>Gymnanthera oblonga</i>	
			<i>Canavalia papuana</i>	

Summary of April 2003 flora survey results

Site	Coordinates		Species	Photos
	Easting	Northing		
Callitris creek	668200	8590700	<i>Callitris intratropica</i>	1433-1434
ECOZAN1	668354	8590581	<i>Canarium australianum</i>	
	667812	8590904	<i>Drypetes diplanchei</i>	
	667814	8590742	<i>Pouteria sericea</i>	
	667807	8590609	<i>Cycas maconochiei</i>	
			<i>Buchanania obovata</i>	
			<i>Lily sp.</i>	
			<i>Grevillea decurrens</i>	
			<i>Livistona humilis</i>	
			<i>Ampelocissus acetosa</i>	
			<i>Acacia aulacocarpa</i>	
			<i>Eucalyptus clavigera</i>	
			<i>Smilax australis</i>	
			<i>Sterculia quadrifida</i>	
			<i>Glochidion perakense</i>	
			<i>Exocarpus latifolius</i>	
			<i>Planchonia careya</i>	
			<i>Croton arnhemica</i>	
			<i>Persoonia falcata</i>	
			<i>Premna serratifolia</i>	
			<i>Tacca leontopetaloides</i>	
			<i>Eucalyptus miniata</i>	
			<i>Dioscorea transversa</i>	
			<i>Alyxia spicata</i>	
			<i>Vigna radiata</i>	
			<i>Denhamia obscura</i>	
			<i>Strychnos lucida</i>	
			<i>Syzygium suborbiculare</i>	
			<i>Gymnanthera oblonga</i>	
			<i>Elaeocarpus arnhemica</i>	
			<i>Memecylon pauciflora</i>	
			<i>Vitex glabrata</i>	
			<i>Melaleuca viridiflora</i>	
			<i>Eucalyptus bleeseri</i>	
			<i>Cymbidium canaliculatum</i>	
			<i>Petalostigma pubescens</i>	
			<i>Xanthostemon paradoxus</i>	
			<i>Tebernaemontana orientalis</i>	
			<i>Helicteres hirsuta</i>	
Rainforest	668000	8589600	<i>Erythrina vespertilio</i>	1435
ECOZAE12	668002	8589701	<i>Terminalia grandiflora</i>	
	668002	8589544	<i>Canarium australianum</i>	1436
			<i>Carallia branchiata</i>	
			<i>Exocarpus latifolius</i>	
			<i>Melaleuca nervosa</i>	
			<i>Carpentaria acuminata</i>	
			<i>Timonius timon</i>	
			<i>Livistona humilis</i>	
			<i>Livistona bethamii</i>	
			<i>Imperata cylindrica</i>	
			<i>Glochidion perakense</i>	
			<i>Syzygium suborbiculare</i>	
			<i>Acacia auriculiformis</i>	
			<i>Corymbia bella</i>	
			<i>Helicteres hirsuta</i>	
			<i>Cycas maconochiei</i>	
			<i>Gymnanthera nitida</i>	
			<i>Strychnos lucida</i>	

Summary of April 2003 flora survey results

Site	Coordinates		Species	Photos
	Easting	Northing		
			<i>Miliusa brahei</i>	
			<i>Polyalthia australis</i>	
			<i>Ampelocissus acetosa</i>	
			<i>Vitex glabrata</i>	
			<i>Bridelia tomentosa</i>	
			<i>Allophylus cobbe</i>	
			<i>Hyptis suaveolens</i>	
			<i>Persoonia falcata</i>	
			<i>Tinospora smilacina</i>	
			<i>Planchonia careya</i>	
			<i>Petalostigma pubescens</i>	
			<i>Terminalia ferdinandiana</i>	
			<i>Alphitonia excelsa</i>	
			<i>Premna serratifolia</i>	
			<i>Antidesma ghaesembilla</i>	
			<i>Buchanania obovata</i>	
			<i>Eucalyptus tetradonta</i>	
			<i>Plectranthes scutellarioides</i>	
			<i>Tacca leontopetaloides</i>	
			<i>Brachychiton diversifolius</i>	
			<i>Pandanus spiralis</i>	
			<i>Smilax australis</i>	
			<i>Ficus opposita</i>	
			<i>Sterculia quadrifida</i>	
			<i>Euraria cylindracea</i>	
			* <i>Bidens pilosa</i>	
Grassland	668500	8589500	<i>Sorghum intrans</i>	1437
ECOZAP11	668181	8589630	<i>Sorghum stipoideum</i>	
			<i>Pandanus spiralis</i>	
			<i>Ficus opposita</i>	
			<i>Terminalia grandifolia</i>	
			<i>Timonius timon</i>	
			<i>Hakea arborescens</i>	
			<i>Terminalia ferdinandiana</i>	
			<i>Dolichandrone filiformis</i>	
			<i>Erythroxylum ellipticum</i>	
			<i>Buchanania obovata</i>	
			<i>Livistona spiralis</i>	
			<i>Planchonia careya</i>	
			<i>Melaleuca viridiflora</i>	
			<i>Syzygium eucalyptoides</i>	
			<i>Wrightia saligna</i>	
			<i>Acacia latescens</i>	
Woodland (grassland) swamp fringe	669000	8589500		1438-1439
ECOZAP12			<i>Eucalyptus clavigera</i>	
			<i>Erythrophleum chlorostachys</i>	
			<i>Corymbia ferruginea</i>	
			<i>Owenia vernicosa</i>	
			<i>Xanthostemon paradoxus</i>	
			<i>Calytrix exstipulata</i>	
			<i>Hakea arborescens</i>	
			<i>Melaleuca viridiflora</i>	
			<i>Buchanania obovata</i>	
			<i>Terminalia ferdinandiana</i>	
			<i>Livistona humilis</i>	
			<i>Sorghum intrans</i>	
			<i>Sorghum stipoideum</i>	

Summary of April 2003 flora survey results

Site	Coordinates		Species	Photos
	Easting	Northing		
			<i>Cycas maconochiei</i>	
			<i>Grevillea pteridifolia</i>	
Rainforest	668700	8587100	<i>Cycas maconochiei</i>	1451
ECOZAE15			<i>Ampelocissus acetosa</i>	
			<i>Planchonia careya</i>	1452
			<i>Lophostemon lactifluus</i>	
			<i>Dioscorea transversa</i>	1453
			<i>Canarium australianum</i>	
			<i>Panicum tricoides</i>	
			<i>Antidesma ghaesembilla</i>	
			<i>Timonius timon</i>	
			<i>Glochidion perakense</i>	
			<i>Melicope elleryana</i>	
			<i>Eucalyptus clavigera</i>	
			<i>Pandanus spiralis</i>	
			<i>Melastoma polyanthum</i>	
			<i>Osbeckia australiana</i>	
			<i>Xanthostemon eucalyptoides</i>	
			<i>Erythrophleum chlorostachys</i>	
			<i>Desmodium heterocarpum var. strigosum</i>	
			<i>Syzygium suborbiculare</i>	
			<i>Chelianthes</i>	
			<i>Microsorium grossum</i>	
			<i>Canthium lucidum</i>	
			<i>Helecia australasica</i>	
			<i>Gmelina schlechteri</i>	
			* <i>Bidens pilosa</i>	
			* <i>Hyptis suaveolens</i>	
			<i>Breynia cernua</i>	
			<i>Sterculia quadrifida</i>	
			<i>Smilax australis</i>	
			<i>Dianella odorata</i>	
			<i>Strychnos lucida</i>	
			<i>Brachychiton diversifolius</i>	
			<i>Ficus opposita</i>	
			<i>Acacia auriculiformis</i>	
			<i>Bridelia tomentosa</i>	
			<i>Alphitonia excelsa</i>	
			<i>Alyxia spicata</i>	
			<i>Protoasparagus racemosus</i>	
			<i>Helicteres hirsuta</i>	
			<i>Petalostigma pubescens</i>	
			<i>Hibiscus meraukensis</i>	
			<i>Crinum angustifolium</i>	
			<i>Terminalia ferdinandiana</i>	
			<i>Syzygium armstrongii</i>	
			<i>Melaleuca leucadendron</i>	
			<i>Imperata cylindrica</i>	
			<i>Barringtonia excelsa</i>	
			<i>Exocarpus latifolius</i>	
			<i>Persoonia falcata</i>	
			<i>Dendrobium affine</i>	
			<i>Banksia dentata</i>	
			<i>Tacca leontopetaloides</i>	
			<i>Carpentaria acuminata</i>	
Calytrix laterite shelf	668000	8587900	<i>Calytrix exstipulata (dominant)</i>	
ECOZAL1	668212	8587673	<i>Calandrinia uniflora</i>	

Summary of April 2003 flora survey results

Site	Coordinates		Species	Photos
	Easting	Northing		
			<i>Cheilanthes sp.</i>	1458
			<i>Vitex glabrata</i>	1459
			<i>Dendrobium affine</i>	1460
			<i>Plectranthes scutellarioides</i>	
			<i>Livistona humilis</i>	
			<i>Lily sp.</i>	
			<i>Hibiscus meraukensis</i>	
			<i>Acacia auriculiformis</i>	
			<i>Owenia vernicosa</i>	
			<i>Canarium australianum</i>	
			<i>Corymbia bella</i>	
			<i>Grevillea pteridifolia</i>	
			<i>Terminalia ferdinandiana</i>	
			<i>Dioscorea bulbifera</i>	
			<i>Erythrophleum chlorostachys</i>	
			<i>Glochidion perakense</i>	
			<i>Lophostemon lactifluus</i>	
			<i>Ficus opposita</i>	
			<i>Syzygium eucalyptioides</i>	
			<i>Cycas maconochiei</i>	
			<i>Melaleuca nervosa</i>	
			* <i>Hyptis suaveolens</i>	
			* <i>Bidens pilosa</i>	
Monsoon Forest	667200	8588800	<i>Strychnos lucida (dominant)</i>	1462-1465
ECOZAE13			<i>Acacia auriculiformis</i>	
			<i>Miliusa brahei</i>	
			<i>Bridelia tomentosa</i>	
			<i>Alphitonia excelsa</i>	
			<i>Helicteres hirsuta</i>	
			<i>Dioscorea transversa</i>	
			<i>Antidesma ghaesembilla</i>	
			<i>Brachychiton diversifolius</i>	
			<i>Erythrophleum chlorostachys</i>	
			<i>Ampelocissus acetosa</i>	
			<i>Exocarpus latifolius</i>	
			<i>Premna serratifolia</i>	
			<i>Brachychiton paradoxus</i>	
			<i>Terminalia ferdinandiana</i>	
			<i>Canarium australianum (dominant)</i>	
			<i>Livistona humilis</i>	
			<i>Tacca leontopetaloides</i>	
			<i>Allophylus cobbe</i>	
			<i>Grewia retusifolia</i>	
			<i>Smilax australis</i>	
			<i>Glochidion perakense</i>	
			<i>Cycas maconochiei</i>	
			<i>Denhamia obscura</i>	
			<i>Sterculia quadrifida</i>	
			* <i>Bidens pilosa</i>	
			<i>Secamone elliptica</i>	
			<i>Planchonia careya</i>	
			<i>Plectranthes scutellarioides</i>	
			<i>Stenocarpus acacioides</i>	
			<i>Grevillea heliosperma</i>	
			<i>Corymbia bella</i>	
			<i>Hibiscus meraukensis</i>	
			<i>Petalostigma pubescens</i>	
			* <i>Hyptis suaveolens</i>	

Site photos



Monsoon vine forest (Veg group E1)
Survey site ECOZAE11



Callitris intratropica forest (Veg group N1)
Survey site ECOZAN1



Monsoon vine forest (Veg group E1)
Survey site ECOZAE12



Grassland (Veg group P1)
Survey site ECOZAP11



Grassland (Veg group P1)
Survey site ECOZAP12



Monsoon vine forest (Veg group E1)
Survey site ECOZE15



Calyx exstipulata shrubland (Veg group L1)
Survey site ECOZAL1



Monsoon vine forest (Veg group E1)
Survey site ECOZAE13

Appendix 2
Results of May 2003 flora survey

Summary of May 2003 flora survey results

Facility	Site	Easting	Northing	Description	Species_upper	species_mid	species_lower	Photo					
Stage 1 Hatchery	ECOZB1	669160	8595090	Low open coastal woodland with incursion of monsoon vine forest elements. Site previously cleared and now regrowth vegetation. Still substantially disturbed through unrehabilitated excavations, old infrastructure etc.	<i>Acacia auriculiformis</i>			1614 Hatchery saltwater intake					
					<i>Alstonia actinophylla</i>			1618 Pt Ceylon monsoon vine forest					
					<i>Terminalia ferdinandiana</i>			1620 Excavations, old infrastructure					
					<i>Corymbia polycarpa</i>			1622 Stage 1-5 hatchery site NW					
					<i>Persoonia falcata</i>			1623 Stage 1-5 hatchery site SW					
					<i>Buchanania obovata</i>			1624 Stage -5 hatchery SE					
					<i>Strychnos lucida</i>								
					<i>Cycas maconochiei</i>								
					<i>Stenocarpus acacioides</i>								
					<i>Acacia latescens</i>								
					<i>Grevillea dryandrii</i>								
					<i>Grevillea heliosperma</i>								
					<i>Eucalyptus miniata</i>								
								Old dams in area have been colonised by Melaleuca leucadendra and a number of weed species.	<i>Melaleuca leucadendra</i>				
				<i>Pennisetum polystachion*</i>									
				<i>Hyptis suaveolens*</i>									
				<i>Themeda quadrivalvis*</i>									
Access track - hatchery site to production ponds. Proposed upgrade to existing track.	ECOZB2	668817	8594648	Low mixed species woodland with monsoon rainforest elements. Largely cleared in the past and a number of unrehabilitated dirt mounds colonised by weed species.	<i>Drypetes diplanchei</i>			1625 Existing access track between hatchery and production ponds					
					<i>Diospyros compacta</i>			1626 Existing access track between hatchery and production ponds. Track traverse near to Melaleuca Swamp.					
					<i>Trema tomentosa</i>								
					<i>Stenocarpus acacioides</i>								
					<i>Strychnos lucida</i>								
					<i>Pittosporum moluccanum</i>								
								Mid high open woodland of Eucalyptus miniata, Corymbia polycarpa and Acacia auriculiformis.	<i>Eucalyptus miniata</i>	<i>Persoonia falcata</i>	<i>Heteropogon contortus</i>		
									<i>Corymbia polycarpa</i>	<i>Acacia latescens</i>	<i>Grevillea dryandrii</i>		
									<i>Acacia auriculiformis</i>	<i>Stenocarpus acacioides</i>	<i>Cycas maconochiei</i>		
										<i>Hakea arborescens</i>	<i>Flagellaria indica</i>		
											<i>Eriachne sp.</i>		
						ECOZB3	667840	8592889	Broad drainage line - mixed species low open woodland.	<i>Melaleuca viridiflora</i>			1628 Broad drainage line
							667955	8592031		<i>Calytrix exstipulata</i>			1629 Broad drainage line
										<i>Grevillea pteridifolia</i>			
					<i>Pandanus spiralis</i>								
					<i>Terminalia ferdinandiana</i>								
					<i>Acacia aulacocarpa</i>								
					<i>Buchanania obovata</i>								
					<i>Owenia vernicosa</i>								
					<i>Persoonia falcata</i>								
					<i>Acacia latescens</i>								
					<i>Alphitonia excelsa</i>								

Summary of May 2003 flora survey results

Facility	Site	Easting	Northing	Description	Species_upper	species_mid	species_lower	Photo					
Sludge drying beds	ECOZB4	668340	8591920	Tall open woodland Eucalyptus miniata and Eucalyptus bleeseri	<i>Eucalyptus miniata</i>	<i>Terminalia ferdinandiana</i>	<i>Boronia sp.</i>						
					<i>Eucalyptus bleeseri</i>	<i>Pandanus spiralis</i>	<i>Cycas maconochiei</i>						
						<i>Livistona humilis</i>	<i>Dendrobium affine</i>						
						<i>Alphitonia excelsa</i>	<i>Mitrasacme sp.</i>						
							<i>Grevillea dryandri</i>						
Production ponds and accomodation area	ECOZB5	668780	8590960	Tall open woodland Eucalyptus miniata	<i>Eucalyptus miniata</i>	<i>Terminalia ferdinandiana</i>	<i>Heteropogon contortus</i>	1634 Production ponds NW					
					<i>Erythroleum chlorostachys</i>	<i>Grevillea pteridifolia</i>	<i>Livistona humilis</i>						
					<i>Xanthostemon paradoxus</i>	<i>Planchonia careya</i>	<i>Jasminum molle</i>						
						<i>Persoonia falcata</i>	<i>Cycas maconochiei</i>						
						<i>Calytrix exstipulata</i>	<i>Grevillea dryandri</i>						
						<i>Pouteria arnhemica</i>	<i>Boronia sp.</i>						
						<i>Timonius timon</i>							
						<i>Alphitonia excelsa</i>							
					ECOZB6	668561	8590675		Tall open woodland Eucalyptus tetradonta on laterite ridge. Outcropping laterite boulders.	<i>Eucalyptus tetradonta</i>	<i>Canarium australianum</i>	<i>Pandanus spiralis</i>	1636, 1635
										<i>Eucalyptus bleeseri</i>	<i>Petalostigma pubescens</i>	<i>Heteropogon contortus</i>	1642
<i>Erythroleum chlorostachys</i>	<i>Cycas maconochiei</i>	<i>Terminalia ferdinandiana</i>											
<i>Eucalyptus miniata</i>	<i>Livistona humilis</i>												
	<i>Grevillea pteridifolia</i>												
ECOZB7	668751	8590046	Mid high open woodland of mixed species	<i>Xanthostemon paradoxus</i>	<i>Planchonia careya</i>	<i>Heteropogon contortus</i>							
				<i>Vitex acuminata</i>	<i>Cycas maconochiei</i>	<i>Jasminum molle</i>							
				<i>Brachychiton diversifolius</i>	<i>Livistona humilis</i>								
				<i>Terminalia ferdinandiana</i>	<i>Erythroleum chlorostachys</i>								
				<i>Corymbia porrecta</i>	<i>Canarium australianum</i>								
				<i>Grevillea pteridifolia</i>	<i>Acacia latescens</i>								
					<i>Melaleuca viridiflora</i>	<i>Livistona humilis</i>	<i>Heteropogon contortus</i>						
					<i>Corymbia polysciada</i>	<i>Planchonia careya</i>	<i>Glochidion perakense</i>						
					<i>Vitex acuminata</i>	<i>Buchanania obovata</i>	<i>Imperata cylindrica</i>						
					<i>Melaleuca nervosa</i>	<i>Acacia latescens</i>							
Saltwater intake for production ponds	ECOZB8	668100	8590160	Low open woodland of Melaleuca viridiflora	<i>Alstonia actinophylla</i>	<i>Pandanus spiralis</i>		1639-1641 Laterite shelf near saltwater intake.					
					<i>Terminalia ferdinandiana</i>								
					<i>Melaleuca viridiflora</i>								
					<i>Gardenia megasperma</i>								
					<i>Acacia dimidiata</i>								
					<i>Syzygium eucalyptoides</i>								
					<i>Corymbia polysciada</i>								
					<i>Verticordia cunninghamii</i>								
					<i>Grevillea heliosperma</i>								
						<i>Denhamia obscura</i>			1637				
ECOZB9	667906	8590182	Monsoon rainforest mangrove ecotone	<i>Pleomele angustifolia</i>									
				<i>Pouteria sericea</i>									
				<i>Antidesma ghaesembilla</i>									
				<i>Ixora klanderiana</i>									
				<i>Cupaniopsis anarcardioides</i>									
				<i>Flagellaria indica</i>									
				<i>Exocarpos latifolius</i>									
				<i>Owenia vernicosa</i>									
				<i>Acacia auriculiformis</i>									

Summary of May 2003 flora survey results

Facility	Site	Easting	Northing	Description	Species_upper	species_mid	species_lower	Photo
					<i>Strychnos lucidum</i>			
					<i>Canarium australianum</i>			
					<i>Breynia cernua</i>			
					<i>Stenocarpus acacioides</i>			
					<i>Ziziphus sp.</i>			
					<i>Vitex glabrata</i>			
					<i>Sterculia quadrifida</i>			
					<i>Glochidion perakense</i>			
					<i>Premna seratifolia</i>			
Freshwater Dam	ECOZB10	667860	8588250	Riparian forest. Convergence of several streams at top of tidal influence.	<i>Melaleuca nervosa</i>	<i>Exocarpos latifolius</i>	<i>Acrostichum speciosum</i>	1647, 1648
					<i>Acacia auriculiformis</i>	<i>Canarium australianum</i>	<i>Dianella odorata</i>	
					<i>Erythrophleum chlorostachys</i>	<i>Cycas maconochiei</i>	<i>Eulalia sp.</i>	
					<i>Xanthostemon eucalyptoides</i>	<i>Drypetes deplanchei</i>	<i>Flagellaria indica</i>	
					<i>Lophostemon lactiflorus</i>	<i>Buchanania obovata</i>	<i>Scelria sp.</i>	
						<i>Vitex glabrata</i>		
						<i>Diospyros calycantha</i>		
						<i>Petalostigma pubescens</i>		
	ECOZB11	667720	8588053	Riparian forest. Upstream of freshwater dam site. Representative of community to be inundated by freshwater dam.	<i>Corymbia bella</i>	<i>Timonius timon</i>	<i>Eulalia sp.</i>	1650
		667600	8587500		<i>Acacia auriculiformis</i>	<i>Barringtonia acutangula</i>	<i>Imperata cylindrica</i>	1651
		668300	8587500		<i>Erythrophleum chlorostachys</i>	<i>Livistona humilis</i>	<i>Gymnanthera nitida</i>	1652
					<i>Melaleuca nervosa</i>	<i>Terminalia ferdinandiana</i>	<i>Grewia retusifolia</i>	
					<i>Xanthostemon eucalyptoides</i>	<i>Ficus opposita</i>		
Access track to Fogg Bay Rd	ECOZB12	668440	8587750	Eucalyptus tetrodonta tall open woodland	<i>Eucalyptus tetrodonta</i>	<i>Cycas maconochiei</i>	<i>Pandanus spiralis</i>	1653
					<i>Corymbia polysiada</i>	<i>Petalostigma pubescens</i>	<i>Glochidion perakense</i>	
					<i>Alstonia actinophylla</i>	<i>Planchonia careya</i>	<i>Bridelia tomentosa</i>	
						<i>Livistona humilis</i>	<i>Grevillea dryandri</i>	
						<i>Acacia aulacocarpa</i>		
						<i>Xanthostemon paradoxus</i>		
						<i>Timonius timon</i>		
						<i>Vitex glabrata</i>		
	ECOZB13	669507	8587185	Mixed species low open woodland broad drainage.	<i>Corymbia polysiada</i>	<i>Calytrix exstipulata</i>	<i>Pandanus spiralis</i>	
					<i>Erythrophleum chlorostachys</i>	<i>Petalostigma pubescens</i>		
						<i>Grevillea pteridifolia</i>		
						<i>Livistona humilis</i>		
	ECOZB14	669474	8585560	Eucalyptus tetrodonta, E. Miniata tall open woodland	<i>Eucalyptus miniata</i>	<i>Planchonia careya</i>	<i>Grevillea dryandri</i>	
					<i>Corymbia polysiada</i>	<i>Buchanania obovata</i>		
					<i>Erythrophleum chlorostachys</i>	<i>Terminalia ferdinandiana</i>		
						<i>Livistona humilis</i>		
						<i>Owenia vernicosa</i>		
						<i>Cycas maconochiei</i>		

Site photos



Breeding facility site



Access track between breeding facility and production ponds



Old dirt mounds along access track between breeding facility and production ponds – weed infestations



Broad drainage line traversed by access track between breeding facility and production ponds.

Site photos



Eucalyptus miniata woodland at production ponds site



Eucalyptus tetradonta woodland at production ponds site



Laterite shelf in the vicinity of saltwater intake site



Dendrobium affine orchid on trunk of *Cycas maconochiei* at production ponds site

Site photos



Riparian forest at freshwater weir site



Broad drainage line on proposed new access track alignment from Fog Bay Road

Appendix 3
List of species recorded in project lease area

Abelmoschus moschatus
Abrus precatorius
Acacia aulacocarpa
Acacia auriculiformis
Acacia difficilis
Acacia dimidiata
Acacia holococarpa
Acacia latescens
Acacia leptocarpa
Acacia oncinocarpa
Acrostichum speciosum
Adenia heterophylla
Aidia racemosa
Allophylus cobbe
Alloteropsis semialata
Alphitonia excelsa
Alstonia actinophylla
Alyxia spicata
Ampelocissus acetosa
Aniseia martinicensis
Antidesma ghaesembilla
Aristida holathera
Aristida macroclada
Aristida sp.
Banksia dentata
Barringtonia acutangula
Barringtonia excelsa
Bidens pilosa
Boronia sp.
Brachychiton diversifolius
Brachychiton paradoxus
Breynia cernua
Bridelia tomentosa
Buchanania obovata
Buchnera linearis
Bulbostylis barbata
Calandrinia uniflora
Callitris intratropica
Calytrix brownii
Calytrix exstipulata
Canarium australianum
Canavalia papuana
Canthium lucidum
Canthium schultzei
Capparis jacobsonii
Capparis sepiara
Capparis umbonata
Carallia branchiata
Carpentaria acuminata
Cartonema spicatum
Cassytha filiformis
Catratia maritima
Chelianthes sp.
Chrysopogon latifolius
Chrysopogon setifolius
Clematis pickeringii
Clerodendrum costatum
Clerodendrum floribundum
Corymbia bleeseri
Corymbia bella
Corymbia ferruginea
Corymbia porrecta
Corymbia polycarpa
Corymbia polysciada
Corymbia porrecta
Crinum angustifolium
Croton arnhemica
Cupaniopsis anarcardioides
Cyanthillium cinereum
Cyathostemma micrantha
Cycas maconochiei
Cymbopogon bombycinus
Cymbidium canaliculatum
Cyperus javanicus
Cyperus sp.
Dapsilanthus spathaceus
Dendrobium affine
Denhamia obscura
Desmodium heterocarpum var. strigosum
Desmodium sp.
Dianella odorata
Dimeria acinaciformis
Dioscorea bulbifera
Dioscorea transversa
Diospyros calycantha
Diospyros compacta
Dioscorea transversa
Distichostemon hispidulus
Dolichandrone filiformis
Drosera indica
Drosera petiolaris
Drypetes diplanthei
Ectrosia agrostoides
Ectrosia leprina
Elaeocarpus arnhemica
Elaeocarpus sp.
Eragrostis brownii
Eragrostis cummingii
Eriachne armitii
Eriachne avenacea
Eriachne burkittii
Eriachne obtusa
Eriachne palescens
Eriachne trisetata
Erythrophleum chlorostachys
Erythroxyllum ellipticum
Erythrina vespertilio
Eucalyptus miniata
Eucalyptus miniata
Eucalyptus polycarpa
Eucalyptus polysciada
Eucalyptus tetradonta
Eulalia aurea
Eulalia sp.
Euraria cylindracea
Evolvulus alsinoides
Exocarpos latifolius
Ficus opposita
Fimbristylis densa
Fimbristylis pachyptera
Fimbristylis tetragona
Fimbristylis trachycarya
Flacourtia territorialis
Flagellaria indica
Fleuggea virosa
Fuirena ciliaris
Ganophyllum falcatum
Gardenia megasperma
Glochidion ferdinandiana
Glochidion perakense
Glochidion xerocarpum
Glycosmis trifoliata
Gmelina schlechteri
Gompholobium sp.
Goodenia armstrongiana
Goodenia holziana
Grevillea decurrens
Grevillea dryandri
Grevillea heliosperma
Grevillea pteridifolia
Grewia oxyphylla
Grewia retusifolia
Grewia retusifolia
Gymnanthera nitida
Gymnanthera oblonga
Hakea arborescens
Helecia australasica
heliA78389
Helicteres hirsuta
Helicteres dentata
Heteropogon contortus
Heteropogon triticeus
Hibbertia goyderi
Hibbertia lepidota
Hibiscus meraukensis
Hibiscus tiliaceus
Hypoestes floribundum
Hyptis suaveolens
Ichnocarpus frutescens
Imperata cylindrica
Ipomoea abrupta
Ischaemum australe
Ixora klanderiana
Jasminum molle
Lantana camara
Leea rubra
Limnophylla fragrans
Lindernia lobelioides
Litsea glutinosa
Livistona bethamii
Livistona humilis
Livistona spiralis
Lomandra tropica
Lophostemon lactifluus
Ludwigia hyssopifolia
Maranthes corymbosa
Marsdenia velutina
Marsdenia viridiflora
Melaleuca cajuputi
Melaleuca nervosa
Melaleuca leucadendra
Melaleuca leucadendron
Melaleuca viridiflora
Melastoma polyanthum
Melicope elleryana
Melodinus australis
Memecylon pauciflora
Memecylon pauciflorum
Merremia quinata

Micromelum minutum
Microsorium grossum
Miliusa brahei
Mitrasacme connata
Mnesithea formosa
Mnesithea rottboellioides
Murdannia graminea
Myristica insipida
Opilia amentacea
Osbeckia australiana
Owenia vernicosa
Pachynema dilatatum
Pandanus spiralis
Panicum trichoides
Panicum mindanaense
Parsonsia velutina
Passiflora foetida
Pavetta brownii
Pennisetum pedicellatum
Pennisetum polystachion
Persoonia falcata
Petalostigma pubescens
Petalostigma quadriloculare
Phylidrum lanuginosum
Pittosporum moluccanum
Planchonia careya
Plectranthes scutellarioides
Pleomele angustifolia
Pogonolobus reticulatus
Polyalthia australis
Polygala eriocephala
Pouteria arnhemica

Pouteria sericea
Premna acuminata
Premna serratifolia
Protoasparagus racemosus
Pseudopogonatherum contortum
Psydrax odorata
Ptilotus distans
Rhynchospora pterochaeta
Sacciolepis indica
Sarcostema viminale
Sauropus glaucus
Schizachyrium fragile
Sebastiana chamaelea
Secamone elliptica
Setaria apiculata
Smilax australis
Solanum echinatum
Sorghum intrans
Sorghum stipoideum
Spermacoe breviflora
Spinifex longifolius
Stemodia lythrifolia
Stenocarpus acacioides
Sterculia quadrifida
Strychnos lucidum
Stylidium multiscapum
Syzygium bleeseri
Syzygium armstrongii
Syzygium eucalyptoides
Syzygium suborbiculare
Tabernaemontana orientalis

Tacca leontopetaloides
Tarenna pentamera
Tephrosia porrecta
Terminalia ferdinandiana
Terminalia grandiflora
Terminalia pterocarya
Thaumastochloa major
Thecanthes punicea
Themeda quadrivalvis
Themeda triandra
Thespesia populneoides
Timonius timon
Tinospora smilacina
Trachymene hispida
Trema tomentosa
Triodia bitextura
Utricularia chrysantha
Verticordia cunninghamii
Vigna radiata
Vigna lanceolata
Vitex acuminata
Vitex glabrata
Waltheria indica
Wrightia saligna
Xanthostemon eucalyptoides
Xanthostemon paradoxus
Xanthoxylum parviflorum
Xenostegia tridentata
Xyris complanata
Ziziphus oenoplia

Total = 282 species

Appendix 4 Declared weeds