Appendix 2: Flora and Fauna Assessments
1. Introduction

The Office of the Prime Minister – Renewable Energy Development Division is currently implementing the Cook Islands Renewable Energy Sector Project (CIRESP). The CIRESP aims to install solar photovoltaic power stations on Rarotonga, Aitutaki, Atiu, Mitiaro, Mangaia and Mauke. Construction of the solar photovoltaic power station at Mangaia will include the clearing and levelling of land for the installation of solar panels and a new solar power house containing batteries and inverters. Connection to the existing electricity distribution network will include the installation of a new high voltage cable connecting the new power house to the existing power station and the rehabilitation of the existing distribution network (refer to Figure 1).

This flora and fauna assessment was undertaken to identify flora and fauna values present within the clearing footprint of the proposed project on Mangaia. The following tasks were undertaken as part of the assessment:

- A review of terrestrial flora and fauna data held on the Cook Islands Biodiversity Database to identify the occurrence of native species and potential occurrence of threatened flora and fauna species recorded as Endangered (Moderate and Serious).
- A review of the IUCN Red List of Threatened Species (Version 2014.3) to identify the potential occurrence of listed flora and fauna species.
- Consultation with Gerald McCormick (Director for the Cook Islands Natural Heritage Trust (CINHT)) to identify the potential occurrence of significant flora and fauna species.
- A field survey was undertaken to investigate and verify the potential fauna and flora issues identified in the desktop review. The field survey included:
  - identification of vegetation communities present
  - a survey of terrestrial flowering annual and perennial plants
  - the identification and assessment of existing terrestrial flora and fauna values including for environmental, medicinal and economic use.
  - the identification and assessment of potential habitat for threatened terrestrial and aquatic fauna species.

The results of the database review, consultation and field survey were used to identify any potential impacts from the proposed project which may require further assessment and/or mitigation strategies to avoid and minimise impacts.
2. Methods

The vegetation and fauna habitat survey was carried out on the 7\textsuperscript{th} May, and 3\textsuperscript{rd} of June 2015 by Teariki Rongo and David Procter. A meandering survey for flora was carried out within the works area. A timed meander search method involves walking over the survey area with local informants with local knowledge in a random manner and recording all flora species encountered. The search was stopped when no new flora species were identified following at least 20 minutes of searching since the previous species record. All species of flora encountered during the survey were recorded. Threatened species locations if recorded were mapped using a hand held GPS.

Important fauna habitat components were also recorded during the survey. In addition, all fauna species encountered during the survey were recorded, including indirect evidence of fauna presence (e.g. bird calls) and information from local informants.

2.1. Limitations

Due to varying flowering times and seasonality of occurrence it is likely that not all flora species that occur at the site were identified in the survey. In particular, short lived annuals that may be present at the site may have been missed because they were not able to be identified (they were not flowering) or they were not evident at this time of year (they were annual plants that had died back or not emerged at the time of survey). It should be noted that there were no threatened short lived annuals that were identified as potentially occurred within the survey area.
3. Results

3.1. Flora

The survey area at Aratane is forested with secondary forest dominated by the following canopy species: *Cocos nucifera*, *Syzygium cumini*, *Elaeocarpus tonganus*, *Hernandia moerenhoutiana*, *Aleurites moluccana*, *Adenanthera pavonina* and *Falcataaria moluccana*. The lower tree species were comprised mainly of *Eugenia uniflora* and *Morinda citrifolia*.

The survey recorded 36 species in the survey area of which 16 were native species and 20 were introduced species. A full list of flora species is provided in Appendix A. No species were identified during the survey that are recorded as Endangered on the Cook Islands Biodiversity Database or listed on the IUCN Red List. Of the 20 introduced plants 10 are from the moderate to serious weeds category and the others are shared almost evenly in the other categories.

Medicinal uses

Of the recorded flora species 19 have medicinal uses. According to the local informants all plants of medicinal use are also found in other places on the island and are therefore not at risk of being endangered. All species are listed as very common on the CIDB supporting the information provided by local informants.

Economic uses

The survey site was dominated by secondary growth forest and the only trees within the survey area that were considered to have economic some economic value were the coconut trees. Ninety coconut trees were counted in the survey area (as at 3rd of June). The trees, based on 16 dried nuts a year with 30 years remaining life on each of the trees at $0.10 per nut have an estimated economic value of NZD 4,320.00.

As with the Pa Enua of the Cook Islands, the use of plants for medicine does have an economic and social value to the local community. The economic value of these plants to the local population has not been assessed. Most of the medicinal plants are weeds and those native species used are widely distributed on the island. It is therefore unlikely that the project will have adverse impact on medicinal species.

Weeds / invasive species

Of the weeds recorded on the CIDB as moderate to serious weeds all were found on the edge of the road bordering the north western side of the survey site. Two creepers; the hard and soft shell passion fruits (*Passiflora edulis* and *Passiflora maliformis*) are listed on the CIDB as moderate and serious invasive species respectively and two small trees the menemene (*Eugenia uniflora*) and the guava (*Psidium guajava*) are listed as serious weeds. *Syzygium cumini* and *Adenanthera pavonina* are both trees that are listed as both serious invasive species and serious weed species.
3.2. Fauna habitat

The Mangaia Kingfisher (*Todiramphus rufficollaris*) a native species endemic to Mangaia is reported by local informants to be regularly sighted in the vicinity of the survey site. The species was not sighted or heard during either of the site surveys. No siting of the bird or of its call was heard during the survey times. The survey site is likely to provide foraging habitat for the Mangaia Kingfisher but is unlikely to provide breeding habitat. Nesting areas are inland in the secondary forest and below the cliff line especially in the barringtonia forests (G. McCormack *pers comm*). The Cook Islands Reed-Warbler (*Acrocephalus kerearako*) was not sighted or heard during either of the site surveys. The Cook Islands Reed-Warbler is listed as moderately threatened on the CIBD and Near Threatened on the IUCN Red List.

4. Conclusion and Recommendations

The flora found on the project site is dominated by species that are widespread and clearing of the survey site will not have a significant impact on any native species.

No species were recorded that are listed as Endangered on the CIBD or listed on the IUCN Red List. The survey site is reported as utilised by both the Mangaia Kingfisher and Cook Islands Reed-Warbler though neither species are likely to nest on the site. The vegetation on the survey site is widespread and the clearing of the survey site is not expected to have a negative impact on potential foraging habitat for either species.

The owners of coconut trees removed for the project should be compensated.

Prepared by:

Teariki-Taoiau Rongo and David Procter

<table>
<thead>
<tr>
<th>T</th>
<th>682 75176</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td><a href="mailto:tiutematangi@yahoo.com">tiutematangi@yahoo.com</a></td>
</tr>
</tbody>
</table>

Appendix A
### Mangaia Site – Flora

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cocos nucifera</em></td>
<td>Coconut</td>
<td>Nū</td>
<td>Native and listed significance – see use</td>
<td>++++</td>
<td>Food/Timber/Medicine</td>
</tr>
<tr>
<td><em>Hibiscus tiliaceus</em></td>
<td>Tree Hibiscus</td>
<td>‘Au</td>
<td>Native and Listed significance – invasive and weed, see use</td>
<td>++++</td>
<td>Medicine and Material (fibre/ wood)</td>
</tr>
<tr>
<td><em>Syzygium cumini</em></td>
<td>Jambolan, Java plum</td>
<td>Pitāti</td>
<td>Introduced and listed significance – serious invasive and weed, see use</td>
<td>++++</td>
<td>Food (fruit)</td>
</tr>
<tr>
<td><em>Polynesian Elaeocarpus</em></td>
<td>Polynesian Elaeocarpus</td>
<td>Orotea</td>
<td>Native and listed significance – food for Pacific Dove</td>
<td>++++</td>
<td>Material (Wood), fruits for birds</td>
</tr>
<tr>
<td><em>Hernandia moerenhoutiana</em></td>
<td>Mountain Lantern-tree</td>
<td>Turina</td>
<td>Native and listed significance – See use</td>
<td>++++</td>
<td>Medicine</td>
</tr>
<tr>
<td><em>Aleurites moluccana</em></td>
<td>Candle nut</td>
<td>Tuitui</td>
<td>Native and listed significance – See use</td>
<td>++++</td>
<td>Medicine, food (dried nut), light</td>
</tr>
<tr>
<td><em>Barringtonia asiatica</em></td>
<td>Barringtonia</td>
<td>Utu</td>
<td>Native and listed significance – See use</td>
<td>++++</td>
<td>Medicine, poison</td>
</tr>
<tr>
<td><em>Adenanthera pavonina</em></td>
<td>Red-bead Tree</td>
<td>Mata Köviriviri</td>
<td>Introduced and listed significance – serious invasive and moderate weed</td>
<td>+++</td>
<td>Food and Material</td>
</tr>
<tr>
<td><em>Falcataaria moluccana</em></td>
<td>Albizia</td>
<td>ʻĀrapitia</td>
<td>Introduced and listed significance - Forestry and moderate invasive and serious weed.</td>
<td>++++</td>
<td>Timber</td>
</tr>
<tr>
<td><strong>Small Trees (shrubs)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Eugenia uniflora</em></td>
<td>Surinam Cherry</td>
<td>Menemene</td>
<td>Introduced and listed significance – serious invasive</td>
<td>++++</td>
<td>Food (fruit)</td>
</tr>
</tbody>
</table>
### Species

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Citrus sinensis</em></td>
<td>Sweet Orange tree</td>
<td>ʻĀnani</td>
<td>Introduced and listed significance – See use</td>
<td>++++</td>
<td>Medicine and Food</td>
</tr>
<tr>
<td><em>Cordyline fruiticosa</em></td>
<td>Cordyline</td>
<td>Rauti</td>
<td>Introduced and listed significance – See use</td>
<td>++++</td>
<td>Medicine, ornamental leaves, cultural significance, food (root)</td>
</tr>
<tr>
<td><em>Psidium guajava</em></td>
<td>Common guava</td>
<td>Tūava</td>
<td>Introduced and listed significance – moderate invasive and serious weed, see use</td>
<td>++++</td>
<td>Medicine and food (fruit)</td>
</tr>
<tr>
<td><em>Pipturus argenteus</em></td>
<td>Pipturus</td>
<td>Ōrongā</td>
<td>Native and listed significance, see use</td>
<td>+++</td>
<td>Medicine, fruits formerly eaten, fibre</td>
</tr>
<tr>
<td><em>Morinda citrifolia</em></td>
<td>Indian Mulberry</td>
<td>Nono</td>
<td>Native and listed significance – see use</td>
<td>++++</td>
<td>Medicine, Ornamental Tree, Food (fruit), material (Dye)</td>
</tr>
</tbody>
</table>

### Ferns and small plants on Makatea including Creepers

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Asplenium australasicum</em></td>
<td>Sharp bird’s nest fern</td>
<td>Kōta’a Tua Koi</td>
<td>Native and listed significance – see uses</td>
<td>++++</td>
<td>Wrapping food/ornamental fern</td>
</tr>
<tr>
<td><em>Asplenium nidus</em></td>
<td>Smooth bird’s nest fern</td>
<td>Kōta’a Tua Rua</td>
<td>Native and listed significance – see uses</td>
<td>++</td>
<td>Wrapping food/ornamental fern</td>
</tr>
<tr>
<td><em>Microsorum grossum</em></td>
<td>Unscented Oak-leaf fern</td>
<td>Maire Tutae-puaka</td>
<td>Native and listed significance – see uses</td>
<td>++++</td>
<td>Medicine and ornamental</td>
</tr>
<tr>
<td><em>Nephrolepis hirsutula</em></td>
<td>Lobed Sword Fern</td>
<td>Turoutou</td>
<td>Native and listed significance – see uses</td>
<td>++++</td>
<td>Medicine and ornamental</td>
</tr>
<tr>
<td><em>Passiflora edulis</em></td>
<td>Yellow Passion fruit</td>
<td>Pārapōtini Papa’ā</td>
<td>Introduced and listed significance – Invasive</td>
<td>++++</td>
<td>Food</td>
</tr>
<tr>
<td><em>Passiflora maliformis</em></td>
<td>Hard passionfruit</td>
<td>Pārapotini Enua</td>
<td>Introduced and listed significance – serious invasive, see uses</td>
<td>++++</td>
<td>Food and Medicine</td>
</tr>
<tr>
<td><em>Peperomia pallida</em></td>
<td>Bold-Vein Pepe romia</td>
<td>Pikimato</td>
<td>Native and listed significance –</td>
<td>++++</td>
<td>Medicine</td>
</tr>
<tr>
<td>Species</td>
<td>Common name</td>
<td>Traditional name</td>
<td>Cook Islands Status</td>
<td>Distribution</td>
<td>Use</td>
</tr>
<tr>
<td>---------</td>
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<td>-----</td>
</tr>
<tr>
<td>Momordica charautia</td>
<td>Balsam Pear</td>
<td>Menemene-na-te-kiore</td>
<td>Introduced and listed significance – moderate weed, see uses</td>
<td>+++</td>
<td>food for the rats</td>
</tr>
<tr>
<td>Morinda myrtifolia</td>
<td>Morinda vine</td>
<td>Pirita</td>
<td>Native and listed significance – see use</td>
<td>+++</td>
<td>Fibre</td>
</tr>
<tr>
<td>Pandanus tectorius complex</td>
<td>Pandanus</td>
<td>‘Ara-ta’atai</td>
<td>Native and listed significance – injurious spine, see use</td>
<td>+++</td>
<td>Medicine, ornamental leaves and material (Fibre)</td>
</tr>
</tbody>
</table>

### Moderate to Serious Weeds

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stachytarpheta cayennensis</td>
<td>Blue Rats tail</td>
<td>Tiāki (MT)</td>
<td>Introduced and listed significance – weed, see uses</td>
<td>+++</td>
<td>Medicinal</td>
</tr>
<tr>
<td>Ocimum gratissimum</td>
<td>Wild Basil</td>
<td>Miri Ngangaere (MG)</td>
<td>Introduced and listed significance – weed, see use Medicine</td>
<td>+++</td>
<td>medicine</td>
</tr>
<tr>
<td>Tithonia diversifolia</td>
<td>Tree Marigoki</td>
<td>Pua Renga</td>
<td>Introduced and listed significance – serious weed, see uses</td>
<td>+++</td>
<td>No known use</td>
</tr>
<tr>
<td>Indigofera suffruticosa</td>
<td>Indigo</td>
<td>Initiko</td>
<td>Introduced and listed significance – serious weed, see uses</td>
<td>+++</td>
<td>No known use</td>
</tr>
<tr>
<td>Caesalpinia major</td>
<td>Yellow Nickernut</td>
<td>Tātaraka (Tātarāmoa)</td>
<td>Native and listed significance – Moderate injurious spined, see use</td>
<td>++</td>
<td>No known use</td>
</tr>
<tr>
<td>Cenchrus echinatus</td>
<td>Burr Grass</td>
<td>Piripiri (Pārango)</td>
<td>Introduced and listed significance – serious agriculture and lawn weed, see use</td>
<td>+++</td>
<td>Medicine</td>
</tr>
</tbody>
</table>

1 Found mainly on the outer edge of the Makatea (near the road)
<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desmodium incanum</td>
<td>Spanish Glover</td>
<td>Ngātoro (piripiri)</td>
<td>Introduced and listed significance – Serious weed, see use</td>
<td>+++</td>
<td>Manure</td>
</tr>
<tr>
<td>Elephantopus mollis</td>
<td>Elephant’s foot grass</td>
<td>Tapuae Erepani</td>
<td>Introduced and listed significance – moderate weed, see uses</td>
<td></td>
<td>Medicine</td>
</tr>
<tr>
<td>Brachiaria mutica</td>
<td>Para Grass</td>
<td>Mauku Puakatoro</td>
<td>Introduced and listed significance – serious weed, see uses</td>
<td>-</td>
<td>Not usually found on Mangaia</td>
</tr>
<tr>
<td>Sida rhombifolia</td>
<td>Broom weed</td>
<td>Purūmu</td>
<td>Introduced and listed significance – serious weed, see uses</td>
<td>+++</td>
<td>Material (Fibre)</td>
</tr>
<tr>
<td>Sorghum bicolor drummondii</td>
<td>Sudan Grass</td>
<td>Tarapī</td>
<td>Introduced and listed significance – serious weed, see use</td>
<td>++</td>
<td>Livestock feed</td>
</tr>
</tbody>
</table>

Source: Mr Tangi Mouauri (Site guide 07/05/15), Teariki Rongo, and the Cook Islands Biodiversity Database. Key to status, ++ (not common), +++ (common) and ++++ (very common).

Mangaia Site – Fauna

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Status/Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrocephalus kerearako</td>
<td>Cook Islands Warbler</td>
<td>Kerearako (Mangaia), Ka’oko (Miti’aro)</td>
<td>Native to Mangaia and Mitiaro. Endemic of Cook Islands and moderately endangered. Listed as Near Threatened under the IUCN Red List of Threatened species (v.2014.3)</td>
<td>++?</td>
<td>Native of Mangaia and Miti’aro, native scrubland and horticulture lands</td>
</tr>
<tr>
<td>Todiramphus rufficollaris</td>
<td>Mangaia Kingfisher</td>
<td>Tanga’eo</td>
<td>Native to Mangaia and endemic to</td>
<td>++</td>
<td>Endemic of the Cook Islands, found only on Mangaia, Live on land</td>
</tr>
<tr>
<td>Species</td>
<td>Common name</td>
<td>Traditional name</td>
<td>Cook Islands Status</td>
<td>Distribution</td>
<td>Status/Habitat</td>
</tr>
<tr>
<td>-----------</td>
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<td>--------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cook Islands and globally and moderately endangered. Listed as Vulnerable under the IUCN Red List of Threatened species (v.2014.3)</td>
<td>and on Barringtonia, Makatea and inland lowlands</td>
<td></td>
</tr>
</tbody>
</table>

Source: Mr Tangi Mouauri (Site guide 07/05/15), Teariki Rongo and the Cook Islands Biodiversity Database.
Key to status, ++ (not common), +++ (common) and ++++ (very common).

References:

Local Informants are: Tangi Mouauri (MIG).

Cook Islands Biodiversity Database (http://www.cookislands.bishopmuseum.org)

IUCN List of Threatened Species (Version 2014.3)
1. Introduction

The Office of the Prime Minister – Renewable Energy Development Division is currently implementing the Cook Islands Renewable Energy Sector Project (CIRESP). The CIRESP aims to install solar photovoltaic power stations on Rarotonga, Aitutaki, Atiu, Mitiaro, Mangaia and Mauke. Construction of the solar photovoltaic power station at Mauke will include the clearing and levelling of land for the installation of solar panels and a new power house containing batteries, inverters and new backup diesel generators (Refer to Figure 1). The solar photovoltaic power station will be connected to a refurbished electricity distribution network. Refurbishment of existing electricity distribution network will be part of the project and will include replacing existing grid equipment including cables, poles, substation, transformers, and switchgear along the existing lines.

This assessment was undertaken to identify flora and fauna values present within the clearing footprint of the proposed project on Mauke. The following tasks were undertaken as part of the assessment:

- A review of terrestrial flora and fauna data held on the Cook Islands Biodiversity Database (CIBD) to identify the occurrence of native species and potential occurrence of threatened flora and fauna species recorded as Endangered (Moderate and Serious).
- A review of the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Version 2014.3) to identify the potential occurrence of listed flora and fauna species that are recorded as threatened.
- Consultation with Gerald McCormick (Director for the Cook Islands Natural Heritage Trust (CINHT)) to identify the potential occurrence of significant flora and fauna species.
- A field survey was undertaken to investigate and verify the potential flora and fauna issues identified in the desktop review. The field survey included:
  - identification of vegetation communities present
  - a survey of terrestrial flowering annual and perennial plants
  - the identification and assessment of existing terrestrial flora and fauna values including for environmental, medicinal and economic use.
  - the identification and assessment of potential habitat for threatened terrestrial and aquatic fauna species.

The results of the database review, consultation and field survey were used to identify any potential impacts from the proposed project which may require further assessment and/or mitigation strategies to avoid and minimise impacts.
2. Methods

The vegetation and fauna habitat survey was completed 28th of May 2015 by Teariki Rongo. A meandering survey for flora was carried out within the works area. A timed meander search method involves walking over the survey area and recording all flora species encountered. The search was stopped when no new flora species were identified following at least 20 minutes of searching since the previous species record. All species of flora encountered during the survey were recorded. Threatened species locations if recorded were mapped using a hand held GPS.

Important fauna habitat components were also recorded during the survey. In addition, all fauna species encountered during the survey were recorded, including indirect evidence of fauna presence (e.g. bird calls).

2.1. Limitations

Due to varying flowering times and seasonality of occurrence it is likely that not all flora species that occur at the site were identified in the survey. In particular, short lived annuals that may be present at the site may have been missed because they were not able to be identified (they were not flowering) or they were not evident at this time of year (they were annual plants that had died back or not emerged at the time of survey). It should be noted that there were no threatened short lived annuals that were identified as potentially occurred within the survey area.
3. Results

3.1. Flora

The survey area at Tengaru 6B, in Areora Village, is mainly grassed. It is bordered in the south east corner by nine Teak trees \textit{(Tectona grandis)} and to the north east by Java Plum \textit{(Syzygium cumini)}. There are twenty nine Macadamia trees \textit{(Macadamia integrifolia)}, thirteen coconut trees \textit{(Cocos nucifera)}, one local banana trees \textit{(Musa ABB Group)} and one lime tree \textit{(Citrus aurantifolia)} on the south end of the site.

The field survey recorded 31 flora species within the survey area of which four were native species, two Polynesian introduced and twenty five introduced species. A full list of flora species is provided in Appendix A. No species were recorded that are listed as Endangered on the CIBD or listed on the IUCN Red List.

**Medicinal uses**

Of the recorded flora species within the survey area eleven have medicinal uses. All medicinal plants are labelled as ‘very common’ on the CIBD and therefore widely distributed on Mauke.

**Economic uses**

Ten species recorded have economic value. These are: Coconut, Teak, Mango \textit{(Mangifera indica)}, Macadamia, Lime, dry land taro \textit{(Xanthosoma sagittifolium)}, Kumara \textit{(Ipomoea batatas)}, Nono \textit{(Morinda citrifolia)}, Banana \textit{(Musa ABB group)} and Pineapple \textit{(Ananas cosmosus)}.

Only four of the species listed above are considered for evaluation. These species once removed will no longer be productive (see Table 1 below). The other species can be transferred to other lands outside of the survey site and they are short term crops.

The species listed have the following values: Coconut for its oil and multiple general uses, Teak for its timber, Macadamia for its nuts and Lime for its juice. Other species include the plant crops of dry land taro valued for its edible tuber root (Taruā), kumara also valued for its edible tuber roots and Nono, bananas and pineapples for their fruits.
Mimosa pudica and Senna obtusifolia are two very serious weeds found on the site. The estimated economic value of the species is NZD3,680.00. A breakdown of value is provided in Table 1. Nine of the species recorded are also used for fuel for cooking however; this is not valued as an economic use.

<table>
<thead>
<tr>
<th>Asset</th>
<th>Est. age (yr.)</th>
<th>#</th>
<th>Description of Estimation of Value</th>
<th>Estimated Total Cost (NZD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teak trees</td>
<td>&gt;60</td>
<td>9</td>
<td>2m3 wood/tree x 9 mature trees x $85.00/m3 wood</td>
<td>1,530.00</td>
</tr>
<tr>
<td>Macadamia trees</td>
<td>10</td>
<td>29</td>
<td>$2.50/tree/yr. x 20-years (remaining economic lifespan) x 29 trees</td>
<td>1,450.00</td>
</tr>
<tr>
<td>Lime trees</td>
<td>3</td>
<td>1</td>
<td>$10.00/tree/yr. x 16 years (remaining economic lifespan) x 1 tree</td>
<td>160.00</td>
</tr>
<tr>
<td>Coconut trees</td>
<td>20</td>
<td>13</td>
<td>16 dry nuts/tree/yr. x $0.10/nut x 13 trees x 30-years (remaining economic lifespan/tree)</td>
<td>540.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>3,680.00</strong></td>
</tr>
</tbody>
</table>

**Weeds / invasive species**

Species recorded as moderate to serious weeds were found scattered on throughout the survey site and on the edge of the track along the eastern side of the site. Six of the weeds are medicinal. The Java Plum and Acacia (Acacia mangium) are both trees that are classified on the CIBD as serious invasive species and series weed species. The photo to the right shows the two most common ground weeds on the site; the Mimosa (Mimosa pudica) and the Sickle pod (Senna obtusifolia). Bermuda grass (Cynodon dactylon), a moderate weed, was also recorded.

3.2. Fauna habitat

The survey site has been under the management and use of the National Ministry of Agriculture for agriculture research development purposes for the last 50 years. No habitat for species listed as Endangered on the CIBD or listed under the IUCN Red List was recorded. The Chattering Kingfisher (Todiramphus tuta) is reported to utilise the area but was not seen or heard during the survey.

4. Conclusion and Recommendations

The survey site has been subjected to continuous use for agricultural purposes and is highly modified.

No species or fauna habitat was recorded that are listed as Endangered on the CIBD or listed on the IUCN Red List. The flora found on the site is commonly found throughout Mauke and the clearing of the site will not have a negative impact on any species recorded.
Site clearance will result in the loss of some species of economic values and owners will be compensated. *Tectona grandis*, if removed, the best part of mature trees, be milled and made available to the landowners to remove from site. All other ‘trees’ removed will be cut into firewood sizes and be made accessible to landowners to remove from site.

Control measures for serious weeds, especially the Mimosa and Sickle pod must be put in place to prevent their spread to land disturbed by clearing for the project. Bermuda grass was recorded on the site and this species, although a moderate weed is easy to control and would make a good long term ground cover for the project site. Consideration should be given to the collection and propagation of Bermuda grass seed for use in revegetating the site. Regular mowing of the site would also prevent the establishment of many of the other weed species recorded during the survey.

Prepared by: Teariki-Taoiau Rongo and David Procter

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## Appendix A

### Mauke Site – Flora

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cocos nucifera</em></td>
<td>Coconut</td>
<td>Nū</td>
<td>Native and listed significance – See use</td>
<td>+++</td>
<td>Food/Timber/Fire wood for cooking/Medicine</td>
</tr>
<tr>
<td><em>Hibiscus tiliaceus</em></td>
<td>Tree Hibiscus</td>
<td>‘Au</td>
<td>Native and Listed significance – Invasive and weed, see use</td>
<td>+++</td>
<td>Medicine, Material (fibre/ wood)/Fire wood for cooking</td>
</tr>
<tr>
<td><em>Syzygium cumini</em></td>
<td>Jambolan, Java plum</td>
<td>Pītāti</td>
<td>Introduced and listed significance – Serious invasive and weed, see use</td>
<td>+++</td>
<td>Food (fruit)/Fire wood for cooking</td>
</tr>
<tr>
<td><em>Acacia mangium</em></td>
<td>Acacia</td>
<td>‘Ākātia</td>
<td>Introduced and listed significance Serious invasive, Forestry, see use</td>
<td>+++</td>
<td>Forest, Material (timber)/Fire wood for cooking</td>
</tr>
<tr>
<td><em>Tectona grandis</em></td>
<td>Teak</td>
<td>Tiki</td>
<td>Introduced and listed significance - see use</td>
<td>+</td>
<td>Material (timber) for furniture/Fire wood for cooking</td>
</tr>
<tr>
<td><em>Falcatoria</em></td>
<td>Albizia</td>
<td>‘Arapītia</td>
<td>Introduced and listed significance Moderate invasive, Forestry, see use</td>
<td>+++</td>
<td>Material (timber)/Fire wood for cooking</td>
</tr>
<tr>
<td><em>Mangifera indica</em></td>
<td>Mango</td>
<td>Vi</td>
<td>Introduced and listed significance – Food and export, see use</td>
<td>+++</td>
<td>Food and Fruit/Fire wood for cooking</td>
</tr>
<tr>
<td><strong>Small Trees and Crops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Macadamia integrifolia</em></td>
<td>Macadamia</td>
<td>Macadamia Nuts</td>
<td>Introduced and listed significance – See use</td>
<td>+</td>
<td>Fruit and food</td>
</tr>
<tr>
<td><em>Citrus aurantifolia</em></td>
<td>Lime</td>
<td>Tiporo</td>
<td>Introduced and</td>
<td>++</td>
<td>Medicine and</td>
</tr>
<tr>
<td>Species</td>
<td>Common name</td>
<td>Traditional name</td>
<td>Cook Islands Status</td>
<td>Distribution</td>
<td>Use</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>------------------</td>
<td>---------------------</td>
<td>--------------</td>
<td>-----</td>
</tr>
<tr>
<td>Carica papaya</td>
<td>Pawpaw</td>
<td>Vi-puaka</td>
<td>Introduced and listed significance – See use</td>
<td>+++</td>
<td>Medicine and food.</td>
</tr>
<tr>
<td>Xanthosoma sagittifolium</td>
<td>Dry land Taro</td>
<td>Taruā</td>
<td>Introduced and listed significance – see use</td>
<td>++</td>
<td>Food (root crop)</td>
</tr>
<tr>
<td>Ipomoea balatas</td>
<td>Sweet Potato</td>
<td>Kumara</td>
<td>Polynesian introduced and listed significance – see use</td>
<td>+++</td>
<td>Food (root crop and leaves used as vegetable), some species are endangered</td>
</tr>
<tr>
<td>Musa ABB Group</td>
<td>Banana</td>
<td>Mario Taruā</td>
<td>Polynesian introduced and listed significance – see use</td>
<td>+++</td>
<td>Fruit, Food, Medicine and Food</td>
</tr>
<tr>
<td>Morinda citrifolia</td>
<td>Indian Mulberry</td>
<td>Nono</td>
<td>Native and listed significance – Medicine and Food, see use</td>
<td>++++</td>
<td>Fruit, Food, Medicine, Ornamental, Material (dye)</td>
</tr>
<tr>
<td>Ananas cosmosus</td>
<td>Pineapple</td>
<td>‘Ara Painapo</td>
<td>Introduced and listed significance – see use</td>
<td>++++</td>
<td>Fruit, Food, Medicine</td>
</tr>
</tbody>
</table>

**Moderate to serious weeds**

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stachytopheta cayennensis</td>
<td>Blue Rats tail</td>
<td>Tiāki (MT)</td>
<td>Introduced and listed significance – see uses</td>
<td>++++</td>
<td>Weed/Medicinal</td>
</tr>
<tr>
<td>Ocimum gratissimum</td>
<td>Wild Basil</td>
<td>Miri Ngangaere (MG)</td>
<td>Introduced and listed significance – see use</td>
<td>++++</td>
<td>Weed/medicine</td>
</tr>
<tr>
<td>Tithonia diversifolia</td>
<td>Tree Marigoki</td>
<td>Pua Renga</td>
<td>Introduced and listed significance – see uses</td>
<td>++++</td>
<td>Weed/serious</td>
</tr>
<tr>
<td>Indigofera suffruticosa</td>
<td>Indigo</td>
<td>Initiko</td>
<td>Introduced and listed significance – see uses</td>
<td>+++</td>
<td>Serious weed</td>
</tr>
<tr>
<td>Caesalpinia major</td>
<td>Yellow</td>
<td>Tātaraka</td>
<td>Native and</td>
<td>++</td>
<td>Moderate</td>
</tr>
<tr>
<td>Species</td>
<td>Common name</td>
<td>Traditional name</td>
<td>Cook Islands Status</td>
<td>Distribution</td>
<td>Use</td>
</tr>
<tr>
<td>---------------------------------</td>
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<td>------------------</td>
<td>--------------------------------------</td>
<td>--------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Nickernut (Tātarāmoa)</td>
<td></td>
<td></td>
<td>listed significance – see use</td>
<td></td>
<td>injurious spines</td>
</tr>
<tr>
<td>Cenchrus echinatus Burr Grass</td>
<td>Piripiri (Pārango)</td>
<td></td>
<td>Introduced and listed significance – see use</td>
<td>+++</td>
<td>Medicine, serious agriculture and lawn weed</td>
</tr>
<tr>
<td>Cynodon dactylon Bermuda Grass</td>
<td>Matie ‘Enua</td>
<td></td>
<td>Introduced, and listed significance – moderate weed</td>
<td>+++</td>
<td>Medicine and lawn grass</td>
</tr>
<tr>
<td>Desmodium incanum Spanish Glover</td>
<td>Ngātoro (piripiri)</td>
<td></td>
<td>Introduced and listed significance – see use</td>
<td>+++</td>
<td>Serious weed, Manure</td>
</tr>
<tr>
<td>Elephantopus mollis Elephant’s foot grass</td>
<td>Tapuae Erepani</td>
<td></td>
<td>Introduced and listed significance – see uses</td>
<td>+++</td>
<td>Moderate weed</td>
</tr>
<tr>
<td>Brachiaria mutica Para Grass</td>
<td>Mauku Puakatoro</td>
<td></td>
<td>Introduced and listed significance – see uses</td>
<td>-</td>
<td>Serious weed and livestock feed</td>
</tr>
<tr>
<td>Sida rhombifolia Broom weed</td>
<td>Purūmu</td>
<td></td>
<td>Introduced and listed significance – see uses</td>
<td>+++</td>
<td>Material (Fibre) and serious weed</td>
</tr>
<tr>
<td>Sorghum bicolor drummondii Sudan Grasss</td>
<td>Tarapī</td>
<td></td>
<td>Introduced and listed significance – see use</td>
<td>++</td>
<td>Serious Weed</td>
</tr>
<tr>
<td>Senna obtusifolia Sickle pod</td>
<td>Pi ‘Aungakino</td>
<td></td>
<td>Introduced and listed significance – see use</td>
<td>+++</td>
<td>Very serious weed, good for the soil (nitrogen fixing)</td>
</tr>
<tr>
<td>Mimosa pudica Sensitive weed</td>
<td>Titā ‘Āarevare</td>
<td></td>
<td>Introduced and listed significance – see use</td>
<td>++</td>
<td>Medicine, serious weed and injurious spine</td>
</tr>
<tr>
<td>Leucaena leucocephala Leucaena</td>
<td>Nītō</td>
<td></td>
<td>Introduced and listed significance – see use</td>
<td>+++</td>
<td>Serious weed, used for tomato stakes and fire wood for cooking</td>
</tr>
<tr>
<td>Bidens pilosa Beggar’s-tick</td>
<td>Piripiri Kerekere</td>
<td></td>
<td>Introduced and listed significance – see use</td>
<td>+++</td>
<td>Medicine, moderate invasive, serious weed</td>
</tr>
<tr>
<td>Ocimum gratissimum Wild basil</td>
<td>Miri Taratoni</td>
<td></td>
<td>Introduced and</td>
<td>++</td>
<td>Medicine, serious weed</td>
</tr>
<tr>
<td>Species</td>
<td>Common name</td>
<td>Traditional name</td>
<td>Cook Islands Status</td>
<td>Distribution</td>
<td>Use</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>------------------</td>
<td>---------------------</td>
<td>--------------</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>listed significance – see use</td>
<td>weed</td>
<td></td>
</tr>
</tbody>
</table>

Source: Mr Teariki Rongo and the Cook Islands Biodiversity Database. Key to status, ++ (not common), +++ (common) and ++++ (very common).

**Mauke Site – Fauna**

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Status/Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Todiramphus tuta</em></td>
<td>Chattering Kingfisher</td>
<td>Ngōtare</td>
<td>Native and listed significance – widespread, see use</td>
<td>+++</td>
<td>Ecotourism</td>
</tr>
</tbody>
</table>

Source: Mr Teariki Rongo and the Cook Islands Biodiversity Database. Key to status, ++ (not common), +++ (common) and ++++ (very common).

**References:**

Cook Islands Biodiversity Database (http://www.cookislands.bishopmuseum.org)

IUCN List of Threatened Species (Version 2014.3)
1. Introduction

The Office of the Prime Minister – Renewable Energy Development Division is currently implementing the Cook Islands Renewable Energy Sector Project (CIRESP). The CIRESP aims to install solar photovoltaic power stations on Rarotonga, Aitutaki, Atiu, Mitiaro, Mangaia and Mauke. Construction of the solar photovoltaic power station at Mitiaro will include the clearing, filling and levelling of Makatea land for the installation of solar panels and a new power house containing batteries, inverters and new backup diesel generators. Connection to the existing electricity distribution network will be carried out and will include refurbishment of the existing distribution system. (Refer to Figure 1).

This flora and fauna site assessment was undertaken to identify flora and fauna values present within the clearing footprint of the proposed project on Mitiaro. The following tasks were undertaken as part of the assessment:

- A review of terrestrial flora and fauna data held on the Cook Islands Biodiversity Database to identify the occurrence of native species and potential occurrence of threatened flora and fauna species recorded as Endangered (Moderate and Serious).
- A review of the IUCN Red List of Threatened Species (Version 2014.3) to identify the potential occurrence of listed flora and fauna species.
- Consultation with Gerald McCormick (Director for the Cook Islands Natural Heritage Trust (CINHT)) to identify the potential occurrence of significant flora and fauna species.
- A field survey was undertaken to investigate and verify the potential fauna and flora issues identified in the desktop review. The field survey included:
  - identification of vegetation communities present
  - a survey of terrestrial flowering annual and perennial plants
  - the identification and assessment of existing terrestrial flora and fauna values including for environmental, medicinal and economic use.
  - the identification and assessment of potential habitat for threatened terrestrial and aquatic fauna species.

The results of the database review, consultation and field survey were used to identify any potential impacts from the proposed project which may require further assessment and/or mitigation strategies to avoid and minimise impacts.
Figure 1.0: Proposed Mitiaro solar power station site and site layout
2. Methods

The vegetation and fauna habitat survey was carried out on the 20th of May 2015 by Teariki Rongo and David Procter with the assistance of a local informant. A meandering survey for flora was carried out within the works area. A timed meander search method involves walking over the survey area in a random manner and recording all flora species encountered. The search was stopped when no new flora species were identified following at least 20 minutes of searching since the previous species record. All species of flora encountered during the survey were recorded. Threatened species locations if recorded were mapped using a hand held GPS.

Important fauna habitat components were also recorded during the survey. In addition, all fauna species encountered during the survey were recorded, including indirect evidence of fauna presence (e.g. bird calls and knowledge of local informant).

2.1. Limitations

The rugged and sharp coral rocks of the Makatea terrain (refer to photo) made it extremely difficult to walk over the survey site which restricted the survey area to one survey path on the western boundary of the survey site. The remainder of the site was visible from the area surveyed and the distribution of species appeared to be uniform. The survey area was therefore considered to provide an adequate sample for the survey site.

Due to varying flowering times and seasonality of occurrence it is likely that not all flora species that occur at the site were identified in the survey. In particular, short lived annuals that may be present at the site may have been missed because they were not able to be identified (they were not flowering) or they were not evident at this time of year (they were annual plants that had died back or not emerged at the time of survey). It should be noted that there were no threatened short lived annuals that were identified that potentially occurred within the survey area.

3. Results

3.1. Flora

Of the larger plant species, the dominant species found in the survey area were Timonius polygamus, Guettarda speciosa, Pisonis grandis, Myrsine cheesemani and Pipturus argenteus. Patches of Pandanus tectorius complex were recorded with Pouteria grayana. Cassytha filiformis, a minor invasive creeper, covered parts of the survey area. This is apparent in the photo to the right where Pisonis grandis is partly covered.

Below the larger plant species were the more shade tolerant species comprising of ferns and small plants. The field survey recorded 28 flora species.
within the survey area of which 18 were native species and 10 were introduced species. A full list of flora species is provided in Appendix A. Two species were identified that were recorded as Locally Endangered on the Cook Islands Biodiversity Database however; neither was listed on the IUCN Red List. The two species; *Pouteria grayana* and *Pisonia grandis* are recorded as very common on Mitiaro on the CIBD and the Locally Endangered listing refers to other islands where they occur less commonly.

**Medicinal uses**

Of the recorded flora species within the survey area 18 have medicinal uses. The local informant advised that all plants of medicinal use are also found elsewhere on Mitiaro and are therefore not at risk. All the medicinal plants reorded are listed as very common on the CIBD supporting the information provided by the local informant.

**Economic uses**

As with the Pa Enua of the Cook Islands, the use of plants for medicine does have an economic and social value to the local community. The economic value of these plants to the local population has not been assessed. Most of the medicinal plants are weeds and those native species used are widely distributed on Mitiaro. It is therefore unlikely that the project will have adverse impact on medicinal species.

**Weeds / invasive species**

Of the weeds recorded on the CIDB as moderate to serious weeds all were found on the edge of the Makatea and along the access road. Without adequate control it is expected that these species will spread into the project site once it is cleared and levelled. It is expected that these species will spread into the project area once the area is cleared and levelled. *Cassytha filiformis*, listed as minor invasive on the CIBD, covered a significant part of the survey area. According to the local informant this species has become widespread on the island.

Bermuda grass (*Cynodon dactylon*), a moderate weed that was found along the newly formed access road, may be useful ground cover to prevent the spread of more serious weeds on the project site.

**3.2. Fauna habitat**

The Pacific Pigeon (*Ducula pacifica*) is very common in the area. Although none were sighted on the survey area during the survey they were seen nearby. The Pacific Pigeon feeds on the berries of species such as *Guettarda speciosa*, *Alyxia stellate*, *Myrsine cheesemanii* and *Timonius polygamus* which occur on the project site. It is unlikely that the Pacific Pigeon will utilize the project site once all the trees with berries are removed.

According to local informant, the Cook Islands Warbler (*Acrocephalus kerearako*), normally more visible along the Makatea side of the villages, can also be seen in the Makatea area including the project site. This species is endemic to the Cook Islands and is listed as Locally Endangered on the CIBD but very common on Mitiaro. It is not listed on the IUCN Red List of Endangered species.
4. Conclusion and Recommendations

The survey site is a typical naturally rugged and sharp coral Makatea terrain. It is extremely difficult to walk over and for this reason has remained unused.

The survey recorded 18 native flora species and all are widespread on Mitiaro including two species that are listed as Locally Endangered on the CIBD.

The survey site is likely to provide habitat for the Cook Islands Warbler as it is attracted to places where people are present.

Clearing of the project site will not have a negative impact on any native species or species listed as Endangered on the CIBD or listed on the IUCN Redlist.

Several serious weeds occur on the cleared boundary of the site (adjacent to the road) and these have the potential to spread on to the site once cleared. Control measures for serious weeds, must be put in place.

Bermuda grass was recorded on the site and this species, although a moderate weed, is easy to control and would make a good long term ground cover for the project site. Consideration should be given to the collection and propagation of Bermuda grass seed for use in revegetating the site.

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### Appendix A

**Mitiaro – Flora**

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pouteria grayana</em></td>
<td>Pouteria</td>
<td>Karaka Mitiaro</td>
<td>Native, and listed significance - Locally endangered, Not listed on the IUCN Red List for Threatened Species, See use</td>
<td>+++</td>
<td>No use provided</td>
</tr>
<tr>
<td><em>Guettarda speciosa</em></td>
<td>Guettarda</td>
<td>‘Ano</td>
<td>Native, and listed significance See use</td>
<td>+++</td>
<td>Material (Wood)</td>
</tr>
<tr>
<td><em>Pandanus tectorius complex</em></td>
<td>Pandanus</td>
<td>‘Ara-ta’atai</td>
<td>Native, and listed significance See use</td>
<td>+++</td>
<td>Medicine, ornamental leaves. Material (Fibre), injurious spine.</td>
</tr>
<tr>
<td><em>Pisonia grandis</em></td>
<td>Pisonia</td>
<td>Pukatea</td>
<td>Native, and listed significance - locally endangered, Not Threatened under the IUCN Red List for Threatened Species, see use</td>
<td>+++</td>
<td>Medicine</td>
</tr>
<tr>
<td><em>Timonius polygamous</em></td>
<td>Timonius</td>
<td>Kopara</td>
<td>Native, and listed significance see use</td>
<td>+++</td>
<td>Medicine, fruits are poisonous to eat</td>
</tr>
<tr>
<td><em>Myrsine cheesemani</em></td>
<td>Cook Islands Myrsine</td>
<td>Kaika Makatea</td>
<td>Native, and listed significance - endemic to the Cook Islands (4 islands including Mitiaro), Food</td>
<td>+++</td>
<td>Fruit and Food</td>
</tr>
<tr>
<td><em>Pipturus argenteus</em></td>
<td>Pipturus</td>
<td>Ōrongā</td>
<td>Native, and listed significance, see use</td>
<td>+++</td>
<td>Medicine, fruits formerly eaten, fibre</td>
</tr>
<tr>
<td><em>Asplenium australasicum</em></td>
<td>Sharp bird’s nest fern</td>
<td>Kōta’a Tua Koi</td>
<td>Native, and listed significance, see use</td>
<td>+++</td>
<td>Wrapping food/ornamental fern</td>
</tr>
<tr>
<td><em>Davallia solida</em></td>
<td>Polynesian Davallia</td>
<td>Poenū</td>
<td>Native, and listed significance, see</td>
<td>+++</td>
<td>Medicine</td>
</tr>
<tr>
<td>Species</td>
<td>Common name</td>
<td>Traditional name</td>
<td>Cook Islands Status</td>
<td>Distribution</td>
<td>Use</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------</td>
<td>------------------</td>
<td>---------------------</td>
<td>--------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Microsorum grossum</td>
<td>Unscented Oak-leaf fern</td>
<td>Tureimang amanga</td>
<td>Native, and listed significance, see use</td>
<td>++++</td>
<td>Medicine and ornamental</td>
</tr>
<tr>
<td>Nephrolepis hirsutula</td>
<td>Lobed Sword Fern</td>
<td>Turoutou</td>
<td>Native, and listed significance, see use</td>
<td>++++</td>
<td>Medicine and ornamental</td>
</tr>
<tr>
<td>Cassytha filiformis</td>
<td>Cassytha or Devil’s Twine</td>
<td>Tainoka</td>
<td>Native, and listed significance – minor invasive, See use</td>
<td>++++</td>
<td>Medicine</td>
</tr>
<tr>
<td>Alyxia stellate</td>
<td>Alyxia</td>
<td>Maire</td>
<td>Native, and listed significance, see use</td>
<td>+++</td>
<td>Ornamental</td>
</tr>
<tr>
<td>Eugenia reinwardtiana</td>
<td>Reinwardt’s Cherry</td>
<td>Ni’oi</td>
<td>Native, and listed significance, see use</td>
<td>++</td>
<td>Fruit</td>
</tr>
<tr>
<td>Peperomia pallida</td>
<td>Bold-Vein Peperomia</td>
<td>Pikimato</td>
<td>Native, and listed significance, see use</td>
<td>++++</td>
<td>Medicine</td>
</tr>
<tr>
<td>Aclypha lanceolata</td>
<td>Aclypha weed</td>
<td>Puapua</td>
<td>Introduced, and listed significance, see use</td>
<td>+</td>
<td>Medicine</td>
</tr>
<tr>
<td>Morinda myrtifolia</td>
<td>Morinda vine</td>
<td>Pirita</td>
<td>Native, and listed significance, see use</td>
<td>+++</td>
<td>Fibre</td>
</tr>
<tr>
<td>Charmaesyce forbergii</td>
<td>Polynesian Beach-Spurge</td>
<td>Tototo</td>
<td>Native, and listed significance, see use</td>
<td>++++</td>
<td>Weed</td>
</tr>
</tbody>
</table>

**Moderate to serious weeds**

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stachytarpheta cayennensis</td>
<td>Blue Rats tail</td>
<td>Tiāki (MT)</td>
<td>Introduced, and listed significance - weed, see use</td>
<td>++++</td>
<td>Medicinal</td>
</tr>
<tr>
<td>Phyllanthus amarus</td>
<td>Weedy Phyllanthus</td>
<td>Moemoe</td>
<td>Introduced, and listed significance – minor weed, see use</td>
<td>+++</td>
<td>Medicine</td>
</tr>
<tr>
<td>Catharanthus roseus</td>
<td>Rosy Periwinkle</td>
<td>Tiare Mākurāta</td>
<td>Introduced, and listed significance, see use</td>
<td>++++</td>
<td>Medicine, ornamental flowers</td>
</tr>
<tr>
<td>Cenchrus echinatus</td>
<td>Burr Grass</td>
<td>Piripiri (Pārango)</td>
<td>Introduced, and listed significance – serious agriculture and</td>
<td>++++</td>
<td>Medicine</td>
</tr>
</tbody>
</table>

1 Weeds found mainly in the outer edge of the Makatea along roads
### TasRail re-sleepering project: Ecological assessment

#### 17 August 2015

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Desmodium incanum</em></td>
<td>Spanish Glover</td>
<td>Ngātoro (piripiri)</td>
<td>Introduced, and</td>
<td>+++</td>
<td>Manure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>listed significance - serious weed, see use</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Vigna marina</em></td>
<td>Beach Pea</td>
<td>Pō’ue</td>
<td>Native, and listed significance – minor weed, see use</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Bidens pilosa</em></td>
<td>Beggar’s-tick</td>
<td>Piripiri Kerekere</td>
<td>Introduced, and</td>
<td>+++</td>
<td>Medicine</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>listed significance – moderate invasive and serious weed, see use</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Sorghum bicolor drummondii</em></td>
<td>Sudan Grass</td>
<td>Tarapī</td>
<td>Introduced, and</td>
<td>++</td>
<td>Livestock feed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>listed significance – serious weed, see use</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Eleusine indica</em></td>
<td>Wire grass</td>
<td>’Ātangaroa</td>
<td>Introduced, and</td>
<td>+++</td>
<td>No use identified</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>listed significance – moderate weed, see use</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cynodon dactylon</em></td>
<td>Bermuda Grass</td>
<td>Matie ‘Enua</td>
<td>Introduced, and</td>
<td>+++</td>
<td>Medicine and lawn grass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>listed significance – moderate weed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Informant Mr Nooroa Pouao (20/05/15), Teariki Rongo, and the Cook Islands Biodiversity Database. Key to status, ++ (not common), +++ (common) and ++++ (very common).

#### Mitiaro Site – Fauna

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Status/Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acrocephalus kerearako</em></td>
<td>Cook Islands Warbler</td>
<td>Ka’oko (Miti’aro)</td>
<td>Native, and</td>
<td>++?</td>
<td>Native of Mangaia and Miti’aro, native scrubland and horticulture lands</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>listed significance - resident Breeder, endemic of the Cook Islands, Globally endangered (moderate), Not Threatened under IUCN Red List for Threatened Species</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Ducula pacifica</em></td>
<td>Pacific Pigeon</td>
<td>Rupe</td>
<td>Native, and</td>
<td>+++</td>
<td>Food, spreads</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Species</td>
<td>Common name</td>
<td>Traditional name</td>
<td>Cook Islands Status</td>
<td>Distribution</td>
<td>Status/Habitat</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>------------------</td>
<td>---------------------</td>
<td>--------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>listed significance – resident breeder, see use</td>
<td></td>
<td>seeds of fruits, e.g. ‘Ano.</td>
</tr>
</tbody>
</table>

Source: Mr Noo Pouao (20/05/15), Teariki Rongo, and the Cook Islands Biodiversity Database. Key to status, ++ (not common), +++ (common) and ++++ (very common).

References:

Local Informants are: Noo Pouao (Environment Officer for Mitiaro).

Cook Islands Biodiversity Database (http://www.cookislands.bishopmuseum.org)

IUCN List of Threatened Species (http://www.iucnredlist.org/search)
1. Introduction

The Office of the Prime Minister – Renewable Energy Development Division is currently implementing the Cook Islands Renewable Energy Sector Project (CIRESP). The CIRESP aims to install solar photovoltaic power stations on Rarotonga, Aitutaki, Atiu, Mitiaro, Mangaia and Mauke. Construction of the solar photovoltaic power station at Atiu will include the clearing and levelling of approximately 1.5 Ha of land for the installation of solar panels. Connection to the existing electricity distribution network will include the installation of a new high voltage cable connecting a new renewable power house to the existing power house (refer to Figure 1).

This assessment was undertaken to identify flora and fauna values present within the clearing footprint of the proposed project on Atiu. The following tasks were undertaken as part of the assessment:

- A review of terrestrial flora and fauna data held on the Cook Islands Biodiversity Database to identify the occurrence of native species and the potential occurrence of threatened flora and fauna species recorded as Endangered (Moderate and Serious).
- A review of the IUCN Red List of Threatened Species (Version 2014.3) to identify the potential occurrence of listed flora and fauna species.
- Consultation with Gerald McCormick (Director for the Cook Islands Natural Heritage Trust (CINHT)) to identify the potential occurrence of significant flora and fauna species.
- A field survey was undertaken to investigate and verify the potential fauna and flora issues identified in the desktop review. The field survey included:
  - identification of vegetation communities present
  - a survey of terrestrial flowering annual and perennial plants
  - the identification and assessment of existing terrestrial flora and fauna values including for environmental, medicinal and economic use.
  - the identification and assessment of potential habitat for threatened terrestrial fauna species.

The results of the database review, consultation and field survey were used to identify any potential impacts from the proposed project which may require further assessment and/or mitigation strategies to avoid and minimise impacts.
2. Methods

The vegetation and fauna habitat survey was completed on the 19th and 20th of May 2015 by Teariki Rongo and David Procter together with local informants with knowledge of local species. A meandering survey for flora was carried out within the works area. A timed meander search method involves walking over the survey area in a random manner and recording all flora species encountered. The search was stopped when no new flora species were identified following at least 20 minutes of searching since the previous species record. All species of flora encountered during the survey were recorded. Threatened species locations, if recorded, were mapped using a hand held GPS.

Important fauna habitat components were also recorded during the survey. In addition, all fauna species encountered during the survey were recorded, including indirect evidence of fauna presence (e.g. bird calls).

2.1. Limitations

Due to varying flowering times and seasonality of occurrence it is likely that not all flora species that occur at the site were identified in the survey. In particular, short lived annuals that may be present at the site may have been missed because they were not able to be identified (they were not flowering) or they were not evident at this time of year (they were annual plants that had died back or not emerged at the time of survey). It should be noted that there were no threatened short lived annuals that were identified as potentially occurring within the survey area.
3. Results

3.1. Flora

The survey area was forested with Caribbean pine (*Pinus Caribaea*) and Java plum (*Syzygium cuminii*). These two introduced species dominated the top canopy of the forest. The fine needle leaves of the Caribbean pine cover the forest floor allowing only a few shade tolerant species to prevail.

The field survey recorded 15 flora species within the survey area of which four were native species and 11 were introduced species. A full list of flora species is provided in Appendix A. No species were identified during the survey that are recorded as Endangered on the CIBD or listed on the International Union for Conservation of Nature (IUCN) Red List.

3.1.1. Medicinal uses

Of the recorded flora species within the survey area five have medicinal uses. Three of these species are found mainly on the edge of the Pine forest and are listed as serious weeds on the CIBD. The distribution of all medicinal species is recorded as very common on the CIBD and the local informants confirmed they were all found in other locations on Atiu. Comments by the Director of the CINHT also supported the information provided by the local informants.
3.1.2. Economic uses

Four species of tree found on the project site were introduced for economic purposes and all four have become invasive species (some are listed on the CIBD as serious weeds). Albizia (*Folcataria moluccana*) was introduced in the 1930s as a source of timber for making crates used to pack and export tomatoes and bananas. Caribbean pine, the most common tree on the project site, was introduced for the purpose of protecting soil from further erosion and therefore has a strong conservation value. Its economic value is not in the form of timber but more in the conservation of soil resources to curb soil erosion. Caribbean pine was planted in the early 1980s after the collapse of the pineapple industry on Atiu which left lands on slopes vulnerable to sheet and rill erosion. Acacia (*Acacia mangium*) on the other hand was introduced to Atiu as a source of fuel wood for the purpose of wood burning power generation in the mid-1980s. Java plum, one of the most aggressive and serious invasive species and weeds on Atiu was introduced as a wind breaker for the citrus industry in the Southern Group islands that included Atiu. Protecting orange plantations from moderate to strong winds aid the fruiting process of oranges. Today acacia has become a serious invasive, Albizia and Java plum are moderate invasive and a serious weeds, and Caribbean pine is spreading fast threatening native species outside the project site.

3.1.3. Weeds / invasive species

Of the weeds found on the project site and listed as moderate to serious on the CIBD all are found on the edge of the Caribbean pine forest. Albizia and Java Plum, as mentioned above, are the two serious tree weeds found growing inside the Caribbean pine forest.

3.2. Fauna habitat

According to the local informants the Chattering Kingfisher (*Todiramphus tuta*) and Cook Islands Fruit Dove (*Ptilinopus rarotongensis*) are regularly found at the project site where they feed on the fruit of the Java plum during its fruiting season. Neither species was observed or heard during the survey. The Cook Islands Fruit Dove is listed as moderately endangered under the CIBD and vulnerable under the IUCN Red List.

The Java plum and the native Polynesian Elaeocarpus (*Polynesian Elaeocarpus*) both provide fruit and potential habitat for several species of birds found on Atiu. The distribution of the Java plum and Polynesian Elaeocarpus is recorded as very common on the CIBD and are widespread on Atiu.

4. Conclusion and Recommendations

The flora found on the project site is dominated by introduced species that are widespread on Atiu. Five species with medicinal uses and four with economic uses were recorded on the project site. All are listed on the CIBD as very common and are widespread on Atiu.

The proposed Atiu solar power station will not have a significant negative impact on native species nor will it result in the loss of significant source of medicinal or economic species.

It is important for the project to note that the existence of the Caribbean pine on the project site has conservation values and their removal will require the implementation of best practice environmental management that will include managing potential soil erosion.

The loss of a small area (1.5 Ha) of potential habitat containing the Java plum and Polynesian Elaeocarpus is unlikely to have a negative impact on the Cook Islands Fruit Dove as both species are widespread on Atiu. It is likely that the Cook Islands Fruit Dove will continue to use the project site as it moves between surrounding habitat.
Prepared by:

Teariki-Taoiau Rongo and David Procter
T 682 75176
E tiutematangi@yahoo.com
## Appendix A

### Atiu Site – Flora

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Acacia mangium</em></td>
<td>Acacia</td>
<td>‘Ākātia</td>
<td>Introduced and listed significance - Forestry</td>
<td>++++</td>
<td>Timber, serious invasive (introduced in 1985)</td>
</tr>
<tr>
<td><em>Cocos nucifera (not mature)</em></td>
<td>Coconut</td>
<td>Nū</td>
<td>Native and listed significance – See use</td>
<td>++++</td>
<td>Food/Timber/Medicine</td>
</tr>
<tr>
<td><em>Syzygium cumini</em></td>
<td>Jambolan, Java plum</td>
<td>Pitāti</td>
<td>Introduced and listed significance – See use</td>
<td>++++</td>
<td>Food (fruit), serious invasive and weed</td>
</tr>
<tr>
<td><em>Pinus Caribaea</em></td>
<td>Caribbean pine</td>
<td>Paina Papa’a</td>
<td>Introduced and listed significance - Forestry</td>
<td>++++</td>
<td>Timber, spreading fast</td>
</tr>
<tr>
<td><em>Polynesian Elaeocarpus</em></td>
<td>Polynesian Elaeocarpus</td>
<td>Rare</td>
<td>Native and listed significance – Material (Wood)</td>
<td>++++</td>
<td>Material (Wood), fruits for birds, i.e. pigeons</td>
</tr>
<tr>
<td><em>Adenanthera pavonina</em></td>
<td>Red-bead Tree</td>
<td>Mata Kōviriviri</td>
<td>Introduced and listed significance – Food and Material</td>
<td>+++</td>
<td>Food, Material, Serious invasive and moderate weed</td>
</tr>
<tr>
<td><em>Falcataaria moluccana</em></td>
<td>Albizia</td>
<td>‘Ārapitia</td>
<td>Introduced and listed significance - Forestry</td>
<td>++++</td>
<td>Moderate invasive, serious weed</td>
</tr>
<tr>
<td><strong>Small Trees (Shrubs)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Morinda citrifolia</em></td>
<td>Indian Mulberry</td>
<td>Nono</td>
<td>Native and listed significance – Medicine and Food</td>
<td>++++</td>
<td>Medicine, Ornamental Tree, Food (fruit), material (Dye)</td>
</tr>
<tr>
<td><em>Mangifera indica</em></td>
<td>Mango</td>
<td>Vi (young plant)</td>
<td>Introduced and listed significance – Food and export</td>
<td>++++</td>
<td>Food and Timber (used for making canoes)</td>
</tr>
<tr>
<td><strong>Moderate to Serious Weeds</strong>[^1]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Stachytarpheta cayennensis</em></td>
<td>Blue Rats tail</td>
<td>Tiāki (MT)</td>
<td>Introduced and listed significance – Serious weed</td>
<td>++++</td>
<td>Weed/Medicinal</td>
</tr>
<tr>
<td><em>Ocimum gratissimum</em></td>
<td>Wild Basil</td>
<td>Miri Ngangaere (MG)</td>
<td>Introduced and listed significance – Medicine, serious weed -</td>
<td>++++</td>
<td>Weed/medicine</td>
</tr>
</tbody>
</table>

[^1]: Found on the outer edge of the Pine Forest and near tracks
<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Caesalpinia major</em></td>
<td>Yellow Nickernut</td>
<td>Tātaraka (Tātarāmoa)</td>
<td>Native and listed significance – See use</td>
<td>++</td>
<td>Moderate injurious spines</td>
</tr>
<tr>
<td><em>Cenchrus echinatus</em></td>
<td>Burr Grass</td>
<td>Piripiri (Pārango)</td>
<td>Introduced and listed significance – See use</td>
<td>+++</td>
<td>Medicine, serious agriculture and lawn weed</td>
</tr>
<tr>
<td><em>Desmodium incanum</em></td>
<td>Spanish Glover</td>
<td>Ngātoro (piripiri)</td>
<td>Introduced and listed significance – Manure</td>
<td>+++</td>
<td>Serious weed, Manure</td>
</tr>
<tr>
<td><em>Sorghum bicolor drummondii</em></td>
<td>Sudan Grass</td>
<td>Tarapī</td>
<td>Introduced and listed significance – See use</td>
<td>++</td>
<td>Serious Weed</td>
</tr>
</tbody>
</table>

Source: Mr Teariki Rongo (19/05/15), Atiu informants, the Cook Islands Biodiversity Database, and IUCN List of Threatened Species (Version 2014.3). Key to status, ++ (not common), +++ (common) and ++++ (very common).

**Atiu Site - Fauna**

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Status/Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Todiramphus tuta</em></td>
<td>Chattering Kingfisher</td>
<td>Ngōtare</td>
<td>Native and listed significance – widespread, Ecotourism</td>
<td>+++</td>
<td>Native to Atiu and Mauke, and live on land. None spotted during survey</td>
</tr>
<tr>
<td><em>Ptilinopus rarotongensis</em></td>
<td>Cook Island Fruit Dove</td>
<td>Kūkupa</td>
<td>Native and listed significance – Moderately endangered (Vulnerable under IUCN Red List), Ecotourism</td>
<td>++++</td>
<td>Native to Atiu, Mauke and Rarotonga, and live on land. None spotted during survey</td>
</tr>
</tbody>
</table>

Source: Atiu informant (19/05/15), the Cook Islands Biodiversity Database, and IUCN List of Threatened Species (IUCN List of Threatened Species 2014.3). Key to status, ++ (not common), +++ (common) and ++++ (very common).

**References:**

Local informants are: Upokoina Tearai (Mayor), Apii Polio (Manager for Infrastructure Division, AIG), Teariki Maurangi (Executive Officer for AIG).

Cook Islands Biodiversity Database (http://www.cookislands.bishopmuseum.org)

IUCN List of Threatened Species (Version 2014.3 )

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2 Information given by Atiu Informants (19/05/15)
1. Introduction

The Office of the Prime Minister – Renewable Energy Development Division is currently implementing the Cook Islands Renewable Energy Sector Project (CIRESP). The CIRESP aims to install solar photovoltaic power stations on Rarotonga, Aitutaki, Atiu, Mitiaro, Mangaia and Mauke. Construction of the solar photovoltaic power station at Aitutaki will include the clearing and levelling of approximately 1.1 Ha of land for the installation of solar panels. Connection to the existing electricity distribution network will include the installation of a new high voltage cable connecting a new renewable power house to the existing power house (refer to Figure 1).

This assessment was undertaken to identify flora and fauna values present within the clearing footprint of the proposed project on Aitutaki. The following tasks were undertaken as part of the assessment:

- A review of terrestrial flora and fauna data held on the Cook Islands Biodiversity Database (CIBD) (accessed 5th February 2016) to identify the occurrence of native species and the potential occurrence of threatened flora and fauna species recorded as Endangered (Moderate and Serious).
- A review of the IUCN Red List of Threatened Species (Version 2014.3) to identify the potential occurrence of listed flora and fauna species.
- Consultation with Gerald McCormick (Director for the Cook Islands Natural Heritage Trust (CINHT)) to identify the potential occurrence of significant flora and fauna species (29 April 2015).
- A field survey was undertaken to investigate and verify the potential fauna and flora issues identified in the desktop review. The field survey included:
  - identification of vegetation communities present
  - a survey of terrestrial flowering annual and perennial plants
  - the identification and assessment of existing terrestrial flora and fauna values including for environmental, medicinal and economic use.
  - the identification and assessment of potential habitat for threatened terrestrial fauna species.

The results of the database review, consultation and field survey were used to identify any potential impacts from the proposed project which may require further assessment and/or mitigation strategies to avoid and minimise impacts.
2. Methods

The vegetation and fauna habitat survey was completed on the 5th of February 2016 by Teariki Rongo with local informants with knowledge of local species. A meandering survey for flora was carried out within the works area. A timed meander search method involves walking over the survey area in a random manner and recording all flora species encountered. The search was stopped when no new flora species were identified following at least 20 minutes of searching since the previous species record. All species of flora encountered during the survey were recorded. Threatened species locations, if recorded, were mapped using a hand held GPS.

Important fauna habitat components were also recorded during the survey. In addition, all fauna species encountered during the survey were recorded, including indirect evidence of fauna presence (e.g. bird calls).

2.1. Limitations

Due to varying flowering times and seasonality of occurrence it is likely that not all flora species that occur at the site were identified in the survey. In particular, short lived annuals that may be present at the site may have been missed because they were not able to be identified (they were not flowering) or they were not evident at this time of year (they were annual plants that had died back or not emerged at the time of survey). It should be noted that there were no threatened short lived annuals that were identified as potentially occurring within the survey area.
3. Results

3.1. Flora

The survey area at the Aitutaki site is overgrown with weeds. The site at the time of the survey looked like an abandoned maniota (*Manihot esculenta*) plantations with remanent Java plum (*Syzygium cumuni*) trees bordering the western and southern boundaries of the site. A large Barringtonia (*Barringtonia asiatica*) tree stands in the middle of the northern boundary.

Eight mango (*Mangifera indica*) trees grow along the inside of the Java plum lined boundary to the west. Six of the trees are still very productive and may be around 8 to 10 years old, and the remaining two look like old trees of the lesser preferred variety.

The field survey recorded 21 flora species within the survey area of which two were native species and 19 were introduced species. A full list of flora species is provided in Appendix A. No species were identified during the survey that are recorded as Endangered on the CIBD or listed on the International Union for Conservation of Nature (IUCN) Red List.

3.1.1. Medicinal uses

Of the recorded flora species within the survey area, nine have medicinal uses. Two are trees, the Barringtonia, and Morinda (*Morinda citrifolia*), and the rest are listed as serious to moderate weeds on the CIBD. The distribution of all medicinal species is recorded as very common on the CIBD and the local informants confirmed they were all found in other locations on Aitutaki. Comments by the Director of the CINHT also supported the information provided by the local informants (29 April 2015).

3.1.2. Economic uses

The six mango trees located inside of the remaining Java Plum boundary trees are the only trees with economic use. All other trees have no economic value.

3.1.3. Weeds / invasive species

Of the weeds found on the project site and listed as moderate to serious on the CIBD all are commonly found on the island and on abandoned plantations. Outstanding weeds that require
some attention are the para grass (*Brachiaria mutica*) and the Calopo (*Calopogonium mucunoides*).

The para grass, introduced for stock feed, mainly cattle, is very aggressive and hard to get rid of. Of all the creepers, Calopo is very aggressive and can become a problem in maintaining the solar panels during the operational phase of the project.

3.2. Fauna habitat

According to the local informants the Blue Lorikeet (*Vini peruviana*) can be seen regularly at the proposed project site and is commonly seen on the island in areas like the proposed project site and other areas where it has not been used or cleared of weeds for a while. They are known to build their nest in old rotting trees. They feed on ground forage, nectar and insects.

No Blue Lorikeet was sited during the field survey.

The Blue Lorikeet is listed as globally endangered (seriously) under the CIBD and vulnerable under the IUCN Red List.

Blue Lorikeet is primarily endangered by invasive species including rats and cats.

4. Recommendations

The survey site has been subjected to continuous use for agricultural purpose and is therefore no longer a site for special species or habitat of a special fauna.

The existing flora is found widely on the island and their removal from the site is not expected to have any significant impact on their existence and access.

Economic uses of some species on site will be lost but will not affect their existence and access on the island. All of the ‘tree’ species are also found somewhere else on the island.

Control measures of serious weeds, especially the para grass (*Brachiaria mutica*) and the more aggressive creepers like the Calopo (*Calopogonium mucunoides*) should be put in place to ensure ease of maintenance of site after commissioning.

Prepared by:

Teariki-Taoiau Rongo
T 682 75176
E tiutematangi@yahoo.com

References:

Local informants are: Tuangaru Bishop (Senior Environment Officer for NES Aitutaki), Vavia Puapii (Environment Officer for NES Aitutaki).
Cook Islands Biodiversity Database (http://www.cookislands.bishopmuseum.org)

IUCN List of Threatened Species (http://www.iucnredlist.org/search)
## Appendix A

### Aitutaki Site – Flora

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Mangifera indica</em></td>
<td>Mango</td>
<td>Vī</td>
<td>Introduced</td>
<td>+++</td>
<td>Food/Timber</td>
</tr>
<tr>
<td><em>Syzygium cumini</em></td>
<td>Jambolan, Java plum</td>
<td>Pitāti</td>
<td>Introduced and listed significance – See use</td>
<td>+++</td>
<td>Food (fruit), serious invasive and weed</td>
</tr>
<tr>
<td><em>Barringtonia asiatica</em></td>
<td>Barringtonia</td>
<td>‘Utu</td>
<td>Native</td>
<td>++</td>
<td>Medicine, material (use to stun fish, a way to catch fish), poisonous to eat the raw seed.</td>
</tr>
<tr>
<td><strong>Small Trees (Shrubs)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Morinda citrifolia</em></td>
<td>Indian Mulberry</td>
<td>Nono</td>
<td>Native and listed significance – Medicine and Food</td>
<td>+++</td>
<td>Medicine, Ornamental Tree, Food (fruit), material (Dye)</td>
</tr>
<tr>
<td><em>Solanum mauritianum</em></td>
<td>Tobacco Tree</td>
<td>Rau ‘Ava’ava</td>
<td>Introduced – recent; naturalised and common</td>
<td>+++</td>
<td>Fumery, invasive (moderate), weed (moderate)</td>
</tr>
<tr>
<td><strong>Moderate to Serious Weeds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Stachytarpheta cayennensis</em></td>
<td>Blue Rats tail</td>
<td>Tiāki (MT)</td>
<td>Introduced and listed significance – Serious weed</td>
<td>+++</td>
<td>Weed/Medicinal</td>
</tr>
<tr>
<td><em>Ocimum gratissimum</em></td>
<td>Wild Basil</td>
<td>Miri Ngangaere (MG)</td>
<td>Introduced and listed significance – Medicine, serious weed</td>
<td>+++</td>
<td>Weed/medicine</td>
</tr>
<tr>
<td><em>Tithonia diversifolia</em></td>
<td>Tree Marigold</td>
<td>Pua Renga</td>
<td>Introduced – Recent; naturalised; and very common</td>
<td>+++</td>
<td>Weed (serious)</td>
</tr>
<tr>
<td><em>Cenchrus echinatus</em></td>
<td>Burr Grass</td>
<td>Piripiri (Pārango)</td>
<td>Introduced and listed significance – See use</td>
<td>+++</td>
<td>Medicine, serious agriculture and lawn weed</td>
</tr>
<tr>
<td><em>Desmodium incanum</em></td>
<td>Spanish Glover</td>
<td>Ngātoro (piripiri)</td>
<td>Introduced and listed significance – Manure</td>
<td>+++</td>
<td>Serious weed, Manure</td>
</tr>
<tr>
<td><em>Commelina diffusa</em></td>
<td>Commelina</td>
<td>Mauku-vai</td>
<td>Introduced, recent, naturalised and</td>
<td>+++</td>
<td>Stock food, medicine and weed (moderate)</td>
</tr>
</tbody>
</table>

---

1 Found on the outer edge of the Pine Forest and near tracks
<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Sorghum bicolor drummondii</em></td>
<td>Sudan Grass</td>
<td>Tarapī</td>
<td>Introduced and listed significance – See use</td>
<td>++</td>
<td>Serious Weed</td>
</tr>
<tr>
<td><em>Mikania micrantha</em></td>
<td>Mile-a-minute</td>
<td>Pōkutekute Teatea</td>
<td>Introduced, very common and widespread – See use</td>
<td>+++</td>
<td>Medicine, invasive (serious), weed (serious)</td>
</tr>
<tr>
<td><em>Sida rhombifolia</em></td>
<td>Broom weed</td>
<td>Purūmu</td>
<td>Introduced, naturalised and common – See use</td>
<td>+++</td>
<td>Material, weed (serious)</td>
</tr>
<tr>
<td><em>Leucaena leucocephala</em></td>
<td>Leucaena</td>
<td>Nītō</td>
<td>Introduced, recent, naturalised and very common</td>
<td>+++</td>
<td>Forestry, weed (serious)</td>
</tr>
<tr>
<td><em>Mimosa pudica</em></td>
<td>Sensitive weed</td>
<td>Rākau pikika’a</td>
<td>Introduced, recent, naturalised and very common</td>
<td>+++</td>
<td>Medicine, weed (serious), Injurious spine - moderate</td>
</tr>
<tr>
<td><em>Bidens pilosa</em></td>
<td>Beggars-tick</td>
<td>Piripiri Kerekere</td>
<td>Introduced, recent, naturalised and very common</td>
<td>+++</td>
<td>Medicine, invasive (moderate), weed (serious)</td>
</tr>
<tr>
<td><em>Brachiaria mutica</em></td>
<td>Para grass</td>
<td>Mauku Puakatoro/Par a Karāti</td>
<td>Introduced, recent, naturalised and very common</td>
<td>+++</td>
<td>Forage, weed (serious)</td>
</tr>
<tr>
<td><em>Calopogonium mucunoides</em></td>
<td>Calopo</td>
<td></td>
<td>Introduced, recent, naturalised and common on horticulture lands</td>
<td>+++</td>
<td>Cover, weed (serious)</td>
</tr>
<tr>
<td><em>Centrocema pubescens</em></td>
<td>Centro butterfly-pea</td>
<td>Piriirero</td>
<td>Introduced, recent, naturalised and common</td>
<td>+++</td>
<td>Medicine; cover; Weed (serious)</td>
</tr>
</tbody>
</table>

**Crop**

| *Manihot esculenta*           | Cassava              | Māniota          | Introduced, recent, not naturalised | +++³        | Food (root), cooked, medicine,          |

Source: Mr Teariki Rongo (05/02/16), Aitutaki informants, the Cook Islands Biodiversity Database, and IUCN List of Threatened Species (http://www.iucnredlist.org/search). Key to status, ++ (not common), +++ (common) and ++++ (very common).

² Specie planted for food (root fibre)

³ Observed (05/02/16)
## Aitutaki Site - Fauna

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Traditional name</th>
<th>Cook Islands Status</th>
<th>Distribution</th>
<th>Status/Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vini peruviana</td>
<td>Blue Lorikeet</td>
<td>Kurāmo'o</td>
<td>Introduced, recent, naturalised and common&lt;sup&gt;5&lt;/sup&gt;</td>
<td>+++</td>
<td>Globally endangered (seriously) IUCN List of Threatened Species (Vulnerable).</td>
</tr>
</tbody>
</table>

Source: Aitutaki informant (05/02/16), the Cook Islands Biodiversity Database, and IUCN List of Threatened Species (<http://www.iucnredlist.org/search>). Key to status, ++ (not common), +++ (common) and ++++ (very common).

<sup>4</sup> Information given by Aitutaki Informants (05/02/16)

<sup>5</sup> Common according to Tuangaru Bishop, NES Officer for Aitutaki
Appendix 3: Marae Letters
14 June 14, 2015

Mangaia.

Tangi ke Teariki Rongo.

Ko au teia ko te mata o te au atu enua, te akapapu atu nei e kare e Historical site me kare e marae I runga I te enua o te solar power e kare katoa e cultural significance site I runga I teia enua.

Meitaki ngao.

Periki Poila.

Atu-Enua;

Teremoana Poila

Aerenga Matapo

Pareina Ngatupuna
9th June 2015

Teariki-Taoiau Rongo
Monitoring and Environmental Specialist
Sub-Contractor to Entura
Rarotonga

Kia orana

This is to confirm that there is no marae or important historic sites on each of the identified solar project sites on Mauke Island. This includes the site for the solar farm and 6x sub stations.

Regards

Josephine Ivirangi
Executive Officer
Mauke Island

George Samuela
Mayor of Island
11 June 2015

Teariki-Taoiau Rongo
Monitoring and Environmental Specialist
Sub-Contractor to Entura
Rarotonga
COOK ISLANDS

Marae or Historic sites on the identified solar project site

Kia orana,

This letter is to confirm the solar project site is free and does not dwell any marae and historic features on Mitiaro.

Kia Manuia

Frederick Tereva
Mayor
Mitiaro Island Government
12th June 2015

Mr Teariki Rongo
Avatiu
Rarotonga.

Re: Marae on Solar Sites

Kia Orana.

I am pleased to confirm that there are no Marae or important historical significant on the proposed land required for the Solar Energy Project. The findings include landowner’s verbal clearance of any distractions on the site such as family cemetery.

Meitaki ranuinui
Teariki Maurangi
Executive Officer
3rd February 2016

TO: Teariki Rongo

FROM: Tiraa Arere
       Executive Officer

As requested, this letter is to confirm that there is no cultural heritage or marae on the proposed land for the Solar Farm.

This block of land had been used for Agriculture purposes for many years.

Meitaki Atupaka

Regards.

Tiraa Arere
Executive Officer.