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Consultancy Services for the Supervision of the Central Cross Island Road Upgrading Project

Biodiversity Survey Results and Assessment

Prepared for the Land Transport Authority, Samoa

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SMEC Company Details

Approved by	Zahid Iqbal			
Address	Level 1, Unit 1			
	313-335 Flinders Street			
	Townsville, QLD	Australia		4810
Telephone	+61 7 4729 6700		Website	www.smec.com
Email	Zahid.iqbal@smec.com			
Signature				

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List of Abbreviations

Abbreviation	Meaning
ADB	Asian Development Bank
AoI	Area of Influence
CCIR	Central Cross Island Road
CCIRUP	Central Cross Island Road Upgrade
CEMP	Construction Environmental Management Plan
CHA	Critical Habitat Assessment
CW	Civil Works
EAAA	Ecologically Appropriate Area of Analysis
EcIA	Ecological Impact Assessment
EPC	Electricity Power Corporation
GoS	Government of Samoa
IBA	Important Bird Area
IEE	Initial Environmental Examination

Abbreviation	Meaning
IFC	International Finance Corporation
KBA	Key Biodiversity Area
LIDAR	Light Detection and Ranging
LTA	Land Transport Authority
MNRE	Ministry of Natural Resources and Environment
MOF	Ministry of Finance
MWTI	Ministry of Works, Transport, and Infrastructure
PCC	Project Coordinating Committee
SPRC	Source - Pathway - Receptor - Consequence
SPREP	Secretariat of the Pacific Regional Environment Programme
SPS	Safeguard Policy Statement
VER	Valued Environmental Receptor
WP	Waypoint

1 Introduction and Objectives

1.1 Preamble

This report relates to a biodiversity survey conducted for the Samoan, Central Cross Island Road Upgrade (CCIRUP) which is being mainly financed through an Asian Development Bank (ADB) grant. The Grant is to the Samoan Government, the Land Transport Authority (LTA) is responsible for overall contracting and implementation of the proposed upgrade works. Additional Information on contracting and project responsibilities is provided in Section 2.

This report is intended to be a standalone document and so background information on the project and context of the work is provided. Additional information, such as full project descriptions and environmental and social safeguard reports can be found published on ADB's Website (**https://www.adb.org/projects/51268-001/main**).

1.2 Objectives

Preamble

The CCIRUP has been in the planning stages for a number of years. Initial approval for the project to be financed by ADB was received in December 2020. The project was classed as a Category 2 project for Environment, therefore requiring production of an Initial Environmental Assessment (IEE) in accordance with ADB Safeguard Policy Statement of 2009 (Asian Development Bank, 2009). An Initial Environmental Examination (IEE) was produced in 2019 and further updated in 2020.

However, COVID-19 related restrictions on travel and external visits to Samoa meant that detailed data collection for the purposes of the IEE were not possible. The IEE biodiversity assessment process therefore did not rely on actual site field work. The work for the assessment of likely impacts of the road on biodiversity was based on existing records, first principles and author knowledge. ADB accepted the IEE, with an understanding that additional work, including biodiversity studies would be conducted once travel restrictions were lifted and prior to commencement of the implementation works for the project.

The current report presents the findings of the biodiversity studies which have been conducted on site during November and December 2022.

1.3 Objectives of Study

The objective of the undertaken study was to obtain data from the project area with a view to:

- Confirming; or otherwise, assumptions made in the original IEE
- Enable a more targeted and site-specific evaluation of habitats, species and value of the area of influence
- Determine if additional resources in terms of budget and manpower (species specialists) are required for the completion of the biodiversity assessment
- Provide data for an updated impact assessment relating to biodiversity
- Prepare mitigation, monitoring plans and produce a discipline specific environmental management plan relating to biodiversity

The study protocols were developed to meet the above objectives. These were presented as a protocol report (REF) supplied to ADB for comment in November 2022.

1.4 Report Format

Following this Introductory Chapter, the report contains the following sections. Chapter 2 provides an outline project description. This is provided to enable readers of the current report to understand the project context and determine if the impact assessment is based on reasonable assumptions and logic.

Chapter 3 sets the scene for the study, including the reasons for certain studies which have been undertaken and the general context of the project and area of influence. A listing of what elements of biodiversity have been included in the study is provided.

The detailed assessment of specific groups of animals and vegetation/habitat are divided into individual chapters for clarity and ease of presentation. These are:

- Habitat and Land Use (Chapter 4)
- Land Snails and Slugs (Chapter 5
- Rare Palm Species (Chapter 6)
- Avifauna (Chapter 7)
- Volant Mammals (Chapter 8)
- Reptiles (Chapter 9)

Two additional chapters are presented to provide information on Invasive Species (Chapter 10) and Ecosystem Services and Function (Chapter 11).

Each of the above chapters consists of a section providing the approach taken to collecting data (including field work, literature review and consultation), the results of the data collection activities and an evaluation of the status of species, species groups or habitat types is provided. From this description of status, a listing of Valued Ecological Receptors is developed for use in the impact assessment process.

The assessment of the impacts of the proposed CCIRUP is presented in Chapter 12. This includes identification of mitigation measures to ensure impacts are avoided or minimised and established monitoring procedures and specific monitoring activities (where required) to ensure that the committed mitigation is fully implemented and is effective.

Chapter 13 provides a short conclusion to the study report. Chapter 14 provides a reference list of articles, books etc referred to in the report text.

An Executive Summary of the Report is provided above this Introductory Chapter.

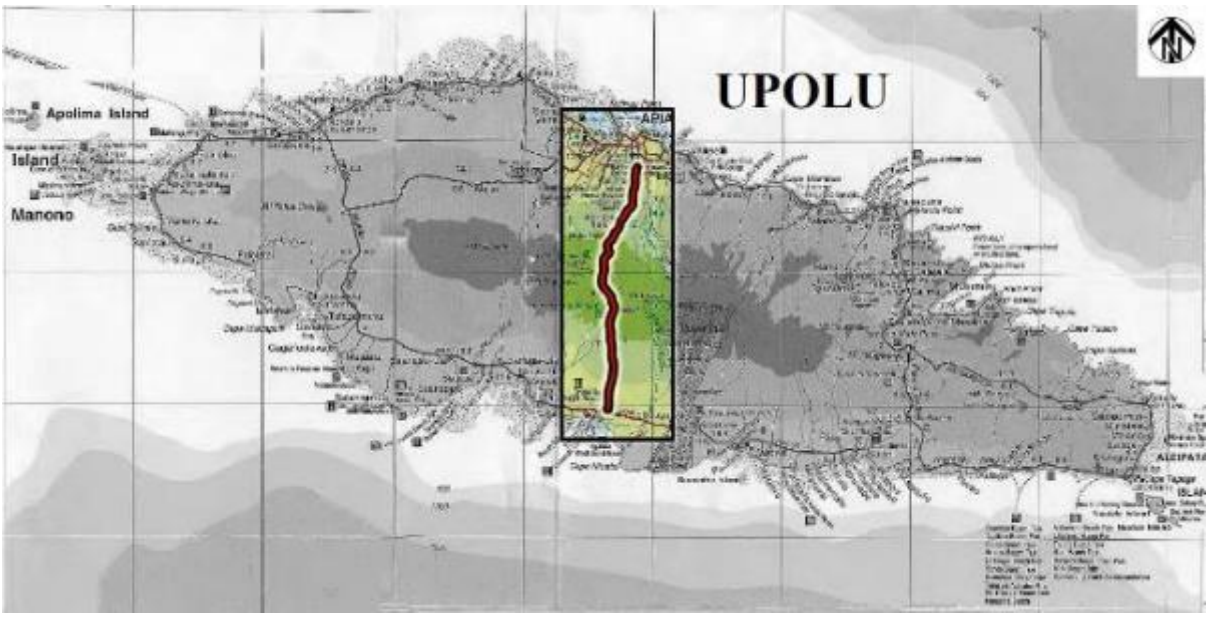
2 Project Description and Potential Effects

2.1 Summary Description

The following short project description has been extracted from the project inception report produced by SMEC, the LTA appointed Construction Supervision contractor.

The Central Cross Island Road (CCIR) is one of the main economic arterial roads on Upolu Island. It is approximately 20 km long, starting in the outskirts of Apia (Leufisa) at the Ififi Street intersection and running southwards to the South Coast Road intersection at Siumu. It connects eight villages enroute. Figure 2.1 identifies its location on Upolu Island.

Figure 2.1: CCIR Locality Plan



The CCIRUP has been prepared under an ADB Transaction Technical Assistance grant. For the implementation of CCIRUP, the Government of the Independent State of Samoa (GoS) received financing from the ADB. Project outputs include the following:

- Upgrading of about 20 km of national road with climate proofing considerations, incorporating innovative technologies, road safety and gender-inclusive elements
- Improved maintenance regime targeting female participation in community-based maintenance contracts
- Institutional capacity development for the road subsector, complementing World Bank's longstanding initiatives

The upgrading of the CCIR will include: (i) minor realignment and widening of the existing narrow 4 to 5 m wide carriageway to safe design speeds of 40 kph along the urban road section and 60 kph along the rural road section; (ii) reconstructing road pavements with new subbase and basecourse for a 20-year design life with asphalt surfacing for urban and 2-coat chip seal surfacing for rural sections to a carriageway width of 7.0 m; (iii) kerb and channel in urban areas and 2 m wide shoulders in rural areas (iv) improved road drainage system including complete piped-network (along with kerb and channel) in the urban areas, open side drains and piped cross drains in rural areas; (v) dedicated and neatly arranged utility corridors both sides, common to both urban and rural areas; and (vi) roadside facilities incorporating gender-sensitive and vulnerable road user-friendly features such as footpaths, pram crossings, pedestrian crossings, bus stops (including bus bays), and wider shoulders to allow vehicles to pull off the road in case of emergency or breakdown. Two slow vehicle bays (short passing lanes) are also included for the rural area.

The CCIRUP is divided into two distinct contract packages, as follows:

CW-1: KM 0+000 to 15+500, Urban Section km 0+000 to 4+420 and Rural Section km 4+420 to 15+500 (one contract package)

CW-2: KM 15+500 to 19+686, Lot 1 – CW-2A KM 15+500 to 17+500 and Lot 2 – CW-2B KM 17+500 to 19+686 (one contract package with two lots)

The upgraded CCIR will significantly improve safety for all road users, including pedestrians. It will increase access to social services (education, health) and economic and employment opportunities for the communities served, contributing towards reducing poverty that is concentrated in rural areas and achieving inclusive growth and development. The climate resilient road will also be a major contributor to the island's disaster preparedness as it will provide a sustainable alternative route between the northern and southern coasts for evacuation, post disaster relief, and during possible other road rehabilitation work. Improved road maintenance capabilities and road network management along with a strengthened land transport institution are other anticipated outcomes of the project.

The executing agency is the Ministry of Finance (MOF). The LTA is the implementing agency for overall project implementation, and the Ministry of Natural Resources and Environment (MNRE) implementing agency for resettlement activities and environmental monitoring. The LTA are the Employer to civil works (CW) contracts. The Engineer to Contract is SMEC International Pty Ltd of Australia, engaged directly by LTA.

The CCIRUP is overseen by a Project Coordinating Committee (PCC). The PCC is responsible for ensuring coordination across all aspects of project implementation, for resolving technical and contractual issues as they arise, and for monitoring implementation of the project's safeguards programs; in particular, programs for involuntary resettlement and for environmental impact mitigation.

The PCC is chaired by the Ministry of Works, Transport, and Infrastructure (MWTI). Core membership of the PCC includes representatives of the Centralised Technical Services Support Unit of MOF, the Transport and Infrastructure Sector Coordination Division of MWTI, LTA, MNRE, and utility owners.

The current assessment process covers both packages as set out above.

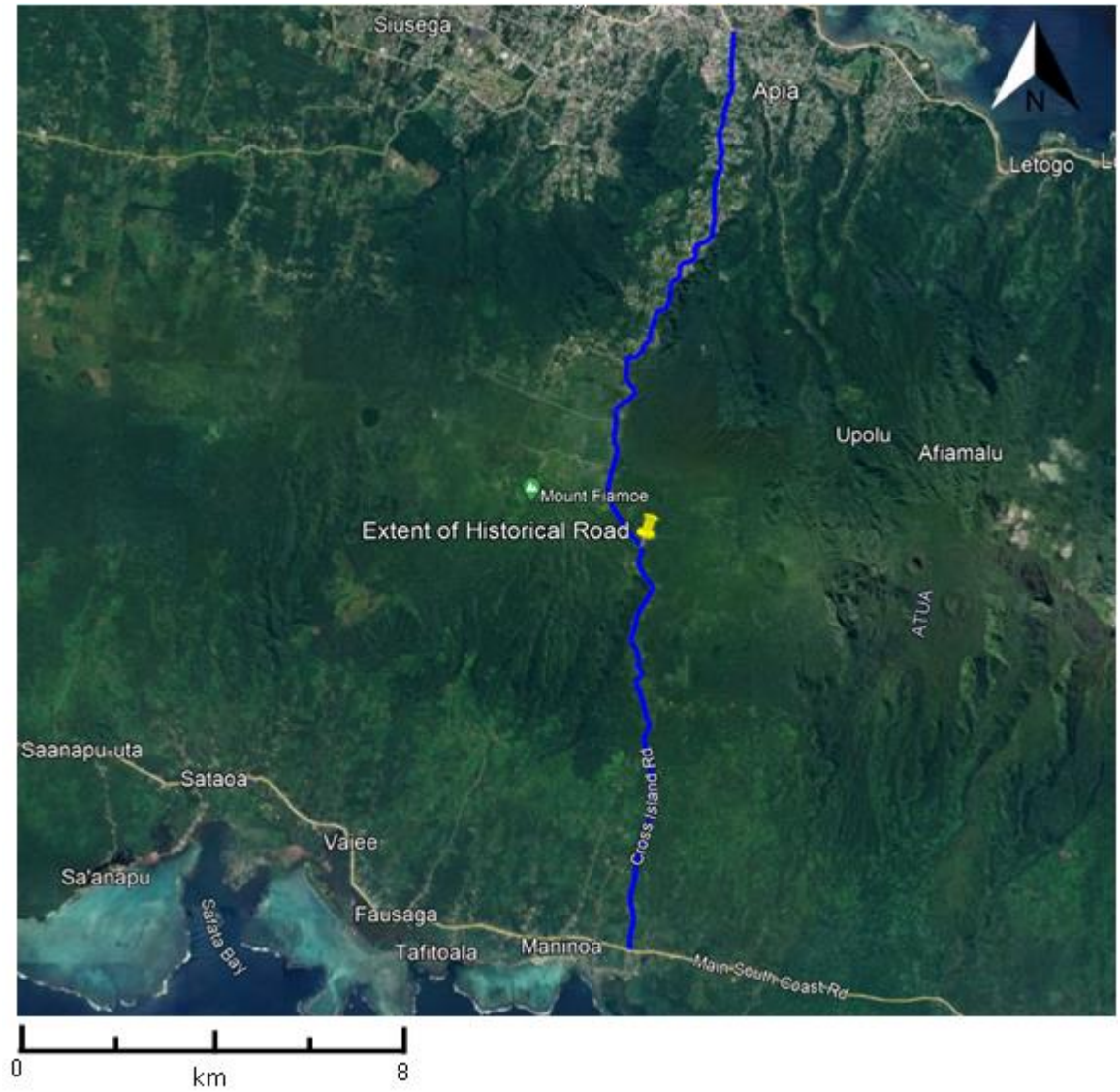
2.2 Historical and Potential Effects

History of the Route and Existing Effects

The project is an upgrade of an existing route. It is understood that the road alignment was established informally as a track used by villagers to travel from one side of the island to the other without the need to follow the coastline.

A review of historical mapping indicates that a made road of some form extended from Apia to Lanafala (approx. 13° 56' 02" S, 171° 46' 36" W) as early as 1921 (Airey, 1921). The approximate extent of this route, running from Apia is shown in Figure 2.2. From this point the map shows a track extending south to Siumu. Additionally, a track of some sort ran as far as Valima in 1890 when the Scottish author Robert Luis Stevenson bought land in the area and commenced constructing his house.

Figure 2.2 Approximate Extent of Historical Road - 1921



Approximately 30 years ago, the road was further upgraded and as of now extends from Apia in the north to Siumu in the south, forming the CCIR.

The route was surfaced and has provided the main link between the north and south sides of the island. In 2012, some sections of the road were damaged by Cyclone Evan. Short sections were repaired and upgraded following this catastrophic event. The upgrading included re-establishment of base layers, local widening of the carriageway and installation of positive drainage of storm water from the road using mainly concrete formed channels.

It is clear that the opening of the route to traffic over many years has led to secondary development pressures along the road. These include construction of residential properties and considerable change in land use along almost the entire route. In particular the swiddening[1] of primary and likely secondary forest areas to form land for agricultural plantations and grazing land.

The route essentially enabled significant land use changes in areas that were not previously readily accessible.

In addition, to the direct and secondary loss of vegetation and habitats, the road has created severance issues, producing ecological discontinuity between areas of high biodiversity value.

[1] Technique of using slash and burn to form agricultural land.

The historical tracks and road severed what would have once been contiguous forest cover. In particular, montane or upland tropical forest areas have become isolated stands with limited connectivity. Such severance can cause reduced gene flows in animals and plant species, making them more susceptible to local extinctions, for example making species and habitats less resilient to the periodical cyclones which have occurred in Samoa.

The road and the development of residential and agricultural areas along the alignment have provided a route for the introduction and spread of invasive species. The survey work has identified the presence of several non-native invasive species within the project area of influence.

Potential Effects of Proposed Route

In many ways, most of the worst impacts of road developments have already taken place over the past 30 or more years. The proposed upgrade will require limited additional land take, almost exclusively from existing Modified[2] Habitats.

The works require loss of existing roadside vegetation, changes to drainage patterns and in some urban areas additional lighting will be installed which may affect some species of insects and plants.

The current mix of vehicles using the road is limited to light vehicles and buses. The gradient in some locations constrains the use of the road by heavy goods vehicles. The key objective of the road upgrade is to provide a safe route for use in emergency situations, for example in a Tsunami or Cyclone warning. There is no intent for the route to have an increased speed limit or any anticipation of increased traffic, over and above natural changes in traffic flows. However, it is likely that an improved road surface will encourage some additional traffic and increased average speeds along the route. It is however considered that traffic related issues, such as increased risk of animal kill or increased localised pollution are not a significant risk, based on the current intent of the project and its design.

[2] Based on definition of Habitats (Modified or Natural) as set out in ADB SPS 2009 and IFC Definition which is Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition (International Finance Corporation, 2012).

3 Study and Biodiversity Context

3.1 Context of Work Undertaken

The project has been established as a Category B project for Environment. Based on the requirements of ADB Safeguard Policy Statement (SPS) of 2009, an IEE has been conducted and approved and published by ADB as part of the processing of the grant.

The IEE has gone through several iterations, with the latest version being dated July 2020. Within the IEE the potential for the project area to contain Natural and/or Critical Habitat was assessed. Additionally, species which may trigger the designation of Critical Habitat were assessed for their likely presence within the area of influence of the proposed road upgrade.

The 2020 IEE did not rely on actual site field work, due to Covid 19 pandemic restrictions. The work for the assessment of likely impacts of the road on biodiversity was based on existing records, first principles and author knowledge.

3.2 Overview of Biodiversity Context

Overview

Samoa is located within a tropical area with a year-round equitable climate in terms of temperature and two distinct seasons, one being wetter (approximately November through to April) and a drier season for the remainder of the year. As noted by the Samoa Meteorological Service, the weather is characterised by 'uniform temperature, pressure, abundant rainfall and high humidity'.

The climatic conditions, and the interrelated elevation are key factors in the distribution of species on the wider island.

As a volcanic island, and therefore relatively recently formed, and geographically isolated, Upolu exhibits some typical traits of island ecology. There are a low number of species which are less mobile as they have not been able to move to the island over the millennia and then evolve. For example, there are no native terrestrial non-volant mammals. The three native mammal species which are or have been recorded are all bat species (see Section 8).

The corollary of this is that species that did arrive early in the evolution of the islands biodiversity have found niches, and natural selection has resulted in new species or sub species. Many are considered endemic either to Samoa or a small number of islands within the Pacific. region

Also, as a result of human activities, the islands have experienced considerably more recent colonisation by both plant and animal species. Some of these species have been invasive and colonised large parts of the island and affected natural ecosystems and species.

Much of the Island of Upolu would have consisted of primary forest, with perhaps more open vegetation within the near coastal zone. The series of volcanic activities across many millennia have resulted in different soil series based on type of lava flows and duration of weathering.

Human activities have reduced the native forest to very small, isolated patches, Whistler (2002) opines that there is little natural primary rainforest remaining within Upolu.

Archaeological evidence indicates that even in pre-European days, the indigenous peoples of the islands lived further inland than previously considered, and likely included some clearance of primary forests. Recent LIDAR studies on the Island of Savai'i show large areas of development from a time prior to the early 19th Century and the arrival of Europeans (Jackmond, Fonoti, & Tautunu, 2018).

However, loss of primary forest accelerated following the arrival of Europeans and throughout the intervening period. The losses of vegetation and species has been caused by changes in agricultural practices;

development of plantations and grazing land, urban development, increased and unsustainable logging activities and due to the impacts of invasive species.

Increasingly, natural phenomena, or perhaps more accurately human induced climate changes, have had a significant effect on vegetation and species in Samoa. Recent cyclones have affected primary and secondary forests, caused landslides, and affected vegetation dynamics. Increasing temperatures due to climate change are predicted to significantly change the type and distribution of vegetation on the Island of Samoa (Atherton, 2015).

It is apparent from the literature review conducted and the outcomes of the survey work conducted, albeit of a limited scale, that Samoa represents an ecosystem under stress and experiencing significant loss and change.

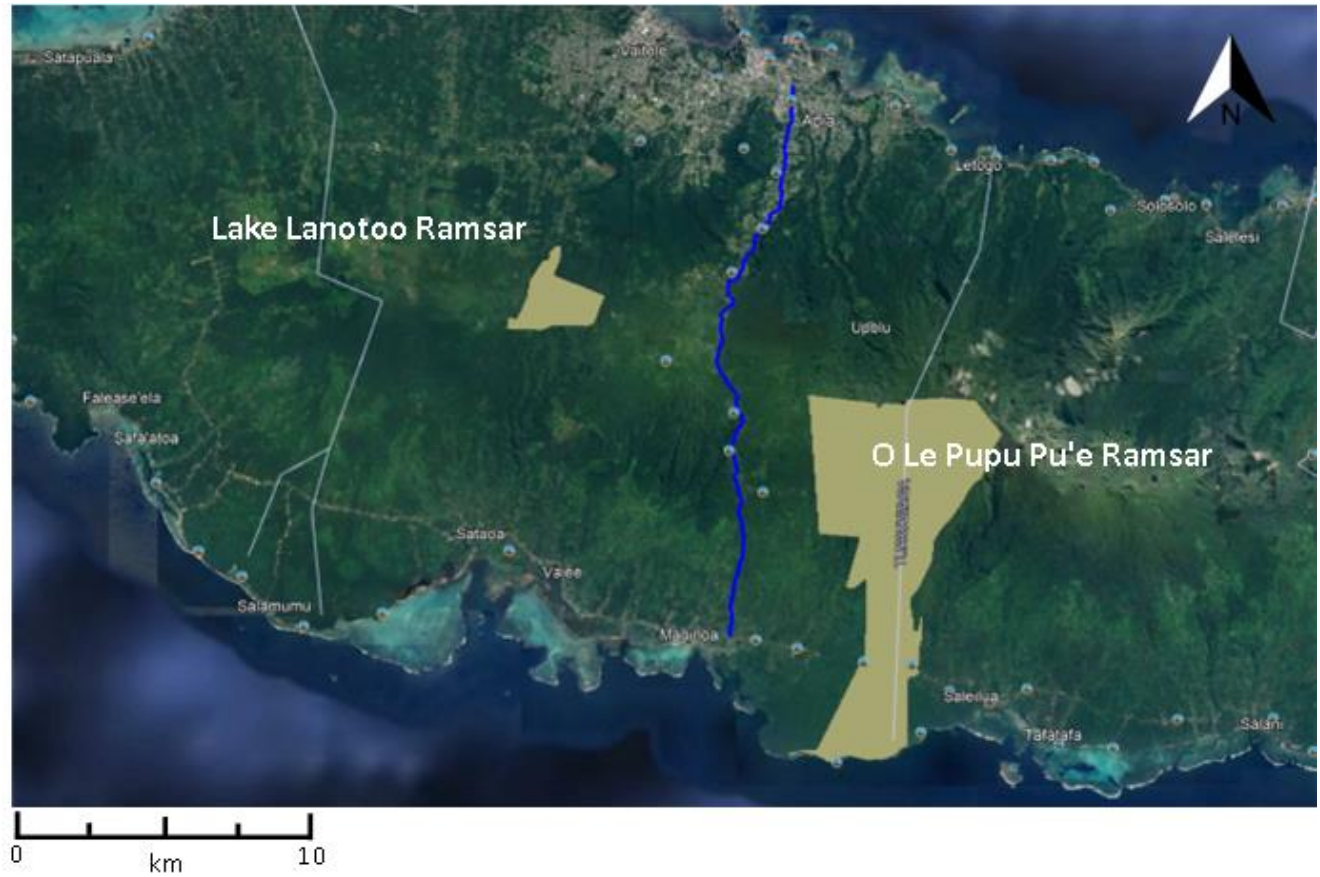
Conservation Designations

Notwithstanding the above discussion on ecosystem stress, Upolu does have areas of higher biodiversity interest, including sites designated at international level for their biodiversity value.

This includes two Wetlands of International Importance as designated under the Ramsar Convention. They are referred to as Lake Lanotoo Ramsar Site, and O Le Pupu Pu'e Ramsar Site, both are also designated as National Parks at a national level. The site areas are presented as Figure 3.1. The latter site is also considered as a Key Biodiversity Area (KBA).

Lake Lanotoo is a small site centred around a extinct volcano crate which has filled with water. The eastern edge boundary lies some 4.5 km from the road alignment. The second site is the O Le Pupu Pu'e Ramsar which is a larger site and focused on a catchment flowing southward to the marine environment.

Figure 3.1 Site Areas of Ramsar Sites



Source: Google Earth Base Map and Designation Areas from IBAT

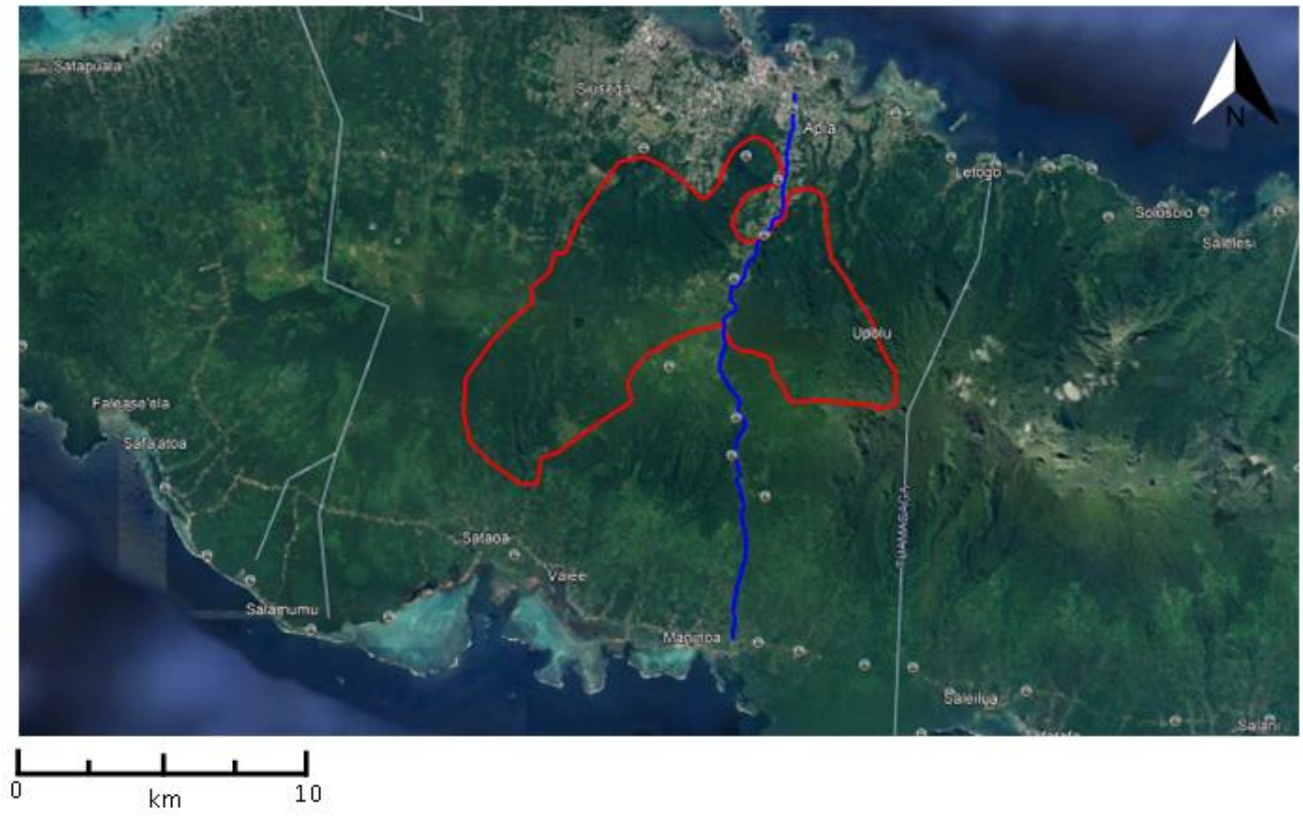
Lake Lanotoo Ramsar Site is situated some 4.5 km from the road alignment, whilst the nearest boundary of the O Le Pupu Pu'e site is about 2.5 km from the road alignment.

There is also a non-statutory designation of an Important Bird Area (IBA) which straddles the road and occupies a large area of the central island (see Figure 3.2). This is the Apia Catchments IBA and designated by Birdlife International. In general, such designations are given weight in determining potential impacts and effects of projects, although it is noted that ADB SPS does not refer to such sites in its guidance on determining the presence of Critical Habitat. This site is also considered as a KBA.

The IBA text account describes the site as follows:

> *'The site consists of a mixture of lowland rainforest along the ridges of the watershed areas, secondary forest dominated by Albizia spp. closer to settlements and disturbed montane forest in higher elevation. Although the site is predominantly secondary and disturbed forest, its importance as a watershed area for the capital provides some form of protection. Changes in the forest structure are as much the result of cyclones and seed dispersal nature of introduced plants such as Funtumia elastica and Albizia spp'*

Figure 3.2 Apia Catchments IBA Boundary



Source: Google Earth Base Map and Designation Area from IBAT

Birds of note set out in the IBA description are shown in Table 3-1. Nomenclature follows that used by Beichle and Baumann (Beichle & Baumann, 2016). It can be seen that two of the species are considered to be threatened, namely the Tooth-billed pigeon and Ma'oma'o. Both of these species rely heavily on mature forest with fruiting trees. The Tooth-billed pigeon has a narrow choice of food source, relying on the fruit of *Dysoxylum* trees of which there are three native species found in Samoa.

Table 3-1 Apia Catchment IBA Birds of Note

English Name	Samoan Name	Scientific Name	IUCN Red List Status
Tooth-billed pigeon	Manumea	*Didunculus strigirostris*	Critically Endangered
Many-coloured Fruit-dove	Manuma	*Ptilinopus perousii*	Least Concern
Samoan Fruit-dove	Manutagi	*Ptilinopus fasciatus*	Least Concern
Flat-billed Kingfisher	Ti'otala	*Todiramphus recurvirostris*	Least Concern
Blue-crowned Lorikeet	Sega vao	*Vini australis*	Least Concern
Ma'oma'o	Ma'oma'o	*Gymnomyza samoensis*	Endangered
Wattled Honeyeater	Lao	*Foulehaio carunculatus*	Least Concern
Cardinal Honeyeater	Segasegamau'u	*Myzomela cardinalis*	Least Concern
Samoan Whistler	Vasavasa	*Pachycephala flavifrons*	Least Concern
Polynesian Triller	Miti	*Lalage maculosa*	Least Concern
Samoan Triller	Miti vao	*Lalage sharpei*	Near Threatened
Samoan Fantail	Se'u	*Rhipidura nebulosa*	Least Concern
Samoan Flycatcher	Tolai fatu	*Myiagra albiventris*	Near Threatened
Polynesian Starling	Miti ula	*Aplonis tabuensis*	Least Concern
Samoan Starling	Fuia	*Aplonis atrifusca*	Least Concern
Red-headed Parrotfinch	Manu ai pa'u la'au	*Erythrura cyaneovirens*	Near Threatened

Source (Birdlife International , 2023)

In addition to the more natural areas of habitat to the east of the road alignment, the IBA boundary extends across the urban area and road alignment into areas of secondary woodland, parks, and gardens.

4 Habitat / Land Use

4.1 Habitat / Ecosystem Classification

The vegetation communities on Upolu Island have received limited detailed analysis and assessment.

There have been previous attempts to classify the vegetation of Samoa, (e.g. (Whistler, 2002), (Pearsall & Whistler, 1991)). As Whistler noted, it is not an easy task and 'types' of vegetation within the island are not clearly defined.

A review of available literature suggests that previous attempts to produce a workable vegetation classification have been based on vegetation communities present, with key species and associates determining the community classification (Whistler, 2002). The same author and his colleague Pearsall used ecosystem types to attempt to define the vegetation of Western Samoa (Pearsall & Whistler, 1991).

A review of the various classification systems suggests that a significant driver in vegetation variation across the island is altitude. Associated with the altitudinal changes are rainfall and atmospheric moisture, which also influence the distribution of plant species.

Across the island the age of the soils, based on volcanic formations and date of lava flows also affects the distribution of plants. However, for the most part the soil types in along the CCIRUP are based on the Salani Volcanic series (Kear, 1967). These are described as moderately weathered volcanic soils.

Whistler (2002) used the following classification of plant communities in Samoa.

Littoral Vegetation
- Littoral strands

Wetlands
- Marshes
- Mangroves
- Freshwater swamps

Rainforest
- Lowland forest
- Montane forest
- Cloud forest

Upland Scrub Vegetation
- Summit scrub
- Montane scrub

Volcanic Vegetation
- Volcanic scrub

Disturbed Vegetation
- Managed Land vegetation
- Successional vegetation
- Secondary forest
- Fernlands

Pearsall and Whistler (1991) used a classification system for terrestrial vegetation based on soil moisture content, namely hydric, mesic, xeric and littoral (haline). The suggested system was:

A. Hydric

Coastal Depressions, Craters, and Montane Valleys

a. Swamp Forest
b. Herbaceous Marsh
c. Mangrove

B. Mesic

Coastal Plains and Tuff Cones

a. Coastal rain forest

Lowlands and Foothills

a. Lowland rain forest

Ridges

a. Ridge Rain Forest
b. Fernland

Mountains

a. Montane Rain Forest
b. Cloud Forest

Riparian Areas

a. Riparian woodland

C. Xeric

Ash Plains

a. Grassland

Recent Inland Lava Flows and Cinder Cones

a. Volcanic succession

Volcanic Talus

a. Montane scrub

D. Littoral (Halic/Xeric)

Rock Coasts, Sand Beaches, and Dunes

a. Herbaceous Strand
b. Littoral Scrub
c. Littoral Shrubland
d. Littoral Forest

For the current study and assessment, the above classification systems provide interesting background information and importantly provide a baseline of historical widespread vegetation types on the Island of Upolu. However, even 20 years ago when Whistler published his account of the Vegetation of the Samoan Archipelago, it was clear that the natural vegetation patterns were being rapidly altered. Whistler (Ibid) discusses the reasons for this which include development, natural events, and agricultural practices and land management.

A preliminary assessment of the project alignment, by driving the route and walking some sections, showed that there were no obvious areas of natural vegetation communities remaining along the route or generally within a distance of more than 50 m from the centre line of the existing road.

On this basis it was determined that using a classification system based on natural vegetation or ecosystem types as defined either by Whistler (2002) or Pearsall and Whistler (1991) would not be helpful in describing the communities present.

Instead, of direct vegetation communities, land use has been used in this biodiversity assessment, with accompanying notes on main flora present within certain land types.

One observation regarding habitat types was that in areas which had been cleared of forest vegetation and was used for grazing and/or plantation, a dominant fern vegetation was common throughout the rural areas of the route, an example is shown in Figure 4.1.

Figure 4.1 Fern Invaded Plantation

This habitat was common, and indicative of invasion of the pastures following swiddening. A review of Whistler's (2002) description of fernlands referred to in his classification system, suggest that the two vegetation communities are not fully analogous. Whistler describes fernlands as being present on ridge lines and on FagAlaoa volcanic soils. He also notes that it is an uncommon vegetation community caused by localised burning of woodlands and pasture. Furthermore, Whistler (Ibid) states that the dominant fern present on ridge lines is *Dicranopteris linearis*. This does not appear to be the case for the observed fern invaded pastures and plantations along the route with the dominant fern likely being *Nephrolepis hirsutula*.

It is possible that the fernlands observed during the survey are a more recent evolution of a plant community and an expansion of areas as described by Whistler. Certainly, the factors creating the observed fernlands are similar and indicative of forest clearance and burning which has resulted in a loss of the thin organic layer, acidification of soils and concomitant reduction of nutrient availability. It is likely that this type of vegetation community will continue to expand in area.

4.2 Land Use

A general description of land use along the road alignment is provided in the following sections.

Commencing from the north and heading southwards, the predominant land use from the start of the project through to approximately km 7.00[3] is urban. The scheme is more urbanised at the northern end, closer to Apia with mixed land use of residential (with gardens), commercial (retail, restaurants) and community/special buildings. The latter includes churches, embassies, museums, and shrines. The open areas associated with this urban land use contain highly modified habitats, in the form of gardens or formally landscaped areas. The road verges along this section of highway are generally maintained as short grass. Some of the landscaped areas have mature trees present, most are non-native species. A typical view of the road at the northern end is shown in Figure 4.2.

[3] All km distances are based on project design sheets as supplied by SMEC, which commence at 0.00 at the northern (Apia) end of the scheme and runs through to 19.6 km at the southern extent of the project.

Figure 4.2 Typical View of Urban Land Use at Northern End of Project

However, the government land within which the Robert Louis Stevenson Museum stands and within some surrounding private lands, contain reasonable stands of mature and semi-mature trees which are a mix of native and non-native species. Figure 4.3 provides an image of the typical landscape around the Valima area with the road in the middle background. The denser secondary forest in the background forms part of the Apia Catchments IBA. This is perhaps the best vegetation along the route alignment but lies some distance from the route alignment.

Figure 4.3 View of Cross Island Road in Urban Section - Valima

From km 7.0, the road becomes more rural in nature with adjacent land use either being formed from cleared land used as plantation and/or for grazing of cattle. However, low density residential use continues for the majority of the remaining route southwards. Only at the highest part of the route is there a relatively short section (approximately 1.5 km) with no buildings immediately adjacent to the road alignment.

Land use in the higher elevation section of the route includes plantation, grazing land, residential use and associated subsistence farming.

There are some areas of secondary woodland present. In addition, there are occasional large fig trees (Banyans) which have presumably been avoided during forest clearance as they have limited timber value. A typical view of open grazing land with some secondary tree development is shown in Figure 4.4.

Figure 4.4 View of Open Grazing Land with Secondary Trees

Note the start of fern invasion (cf. Section 4.4 – fernlands), the invasive species Koster's curse can also be observed.

As the route continues southwards and falls from the highest levels, land use continues to be less intensive than the northern section and consist mainly of small residential units with associated plantations and subsistence farming activities. Open grazing land, plantations of coconut and taro are common. There remain little or no natural habitats along this section. A typical image of such land is shown in Figure 4.5.

Figure 4.5 Grazing Land under Coconut Plantation

4.3 Road Boundary Treatment

At the northern end of the route alignment, the road boundary is formed from formal fencing, non-native planting, walls, and managed verges. In other sections the boundary is either open where residential land is present or for much of the route, post and barbed wire is used to demarcate the edge of the right of way. A typical view of this approach is shown in Figure 4.6.

Figure 4.6 Typical Post and Wire Fence along Route

It is notable that in some locations, local landowners have traditionally used recently cut branches as fence posts, to which the barbed wire is attached with staples. In many instances, the use of smaller diameter posts, and presumably freshly cut, has resulted in these branches taking root and a rudimentary hedge line has formed (Figure 4.7). In some locations, these have grown into significant, albeit mainly non-native trees (Figure 4.8).

Figure 4.7 Example of Fence Posts Regenerating

Figure 4.8 Trees on left of Image have formed from Fence Post

4.4 Other Observations

Disturbance Activities

During the survey, there were two sets of activities ongoing which was directly affecting the habitats present and affected the survey procedures.

The Electricity Power Corporation (EPC) was conducting activities along the southern end of the route to clear the wayleave. This included cutting back hedges (see Section 0) and felling or topping larger trees (see Figure 4.9).

Figure 4.9 Example of Tree Felling due to EPC Way Leave Clearing

Secondly, the LTA had contractors working on clearing road verge vegetation. This consisted of using an excavator to scrap away grass and any scrub vegetation extending from the edge of the hard surface of the road to the edge of the Right of Way. The spoil was tipped over onto adjoining land and not removed from site. Figure 4.10 (a) shows the operations under way, whilst image (b) provides a view of the resultant cleared verge.

Figure 4.10 Road verge Clearance Under Operations (a) and Resultant Cleared Verge (b)

4.5 Critical Habitat

The original IEE for the project conducted a Critical Habitat Assessment (CHA). This was carried out in general alignment with the expectations of the International Finance Corporation's (IFC) approach to CHA as set out in IFC Performance Standard No 6 Guidance Notes as updated in 2019 (IFC, 2019).

The IEE CHA used a mixture of terminology from a previous version of the IFC Guidance and the updated version. However, the findings of the CHA are not affected by this difference in terminology and guidance. The IEE CHA found that while Critical Habitat could be inferred by the presence of the IBA and known Critically Endangered and Endangered species, that the road would not directly or indirectly affect such resources or the integrity of the IBA. This opinion was based primarily on the lack of suitable habitat for feeding, roosting, or breeding for key Threatened species such as the Tooth-billed pigeon and the Ma'oma'o.

However, the IEE did identify the potential presence of endemic species which may not be considered under Criterion 1 of the IFC CHA determination process, but which could trigger the area as qualified Critical Habitat under Criterion 2 - Endemic and Restricted-range Species. These included birds, ferns, molluscs, and bats.

Part of the intent of the current field work and assessment was to confirm the assumptions and conclusions of the IEE CHA, particularly around the endemic species. The following Chapter provides the approach and results of the survey work for each of these groups in addition to general survey data.

It should be noted that under ADB SPS (2009) an IBA designation does not, in and of itself, constitute a trigger for consideration of Critical Habitat. SPS restricts itself to sites designated for biodiversity under a recognised international convention, or species at risk of extinction as categorised by the IUCN Red List.

Within this document, a comment on the likelihood of species, surveyed and assessed, to trigger qualification of an area along the route as Critical Habitat is provided in species/group related text. Further information regarding the determination of the presence of Critical Habitat within the project area is provided in Section 10.

5 Molluscs

5.1 Preamble

Samoa has a rich assemblage of land snails which have been reduced considerably in numbers due to changes in the environment and introduction of predators or competing species affecting native species. See Cowie and Robinson for a discussion on declines in Samoan snail populations (Cowie & Robinson, 2003).

Whilst the IEE focused on the potential presence of the threatened species, *Thaumatodon hystricelloides*, along the section of road which passes through the IBA, it is considered that there is no specific reason why the species should not be found outside of this boundary. Cowie and his co-authors report that this species was formerly widespread across the Island of Upolu, but its range has contracted and appears to be restricted to higher ground with forest cover (Cowie, Rundell, & Yeung, 2017). This species is very small. 1 – 2 mm across and therefore difficult to locate and so may be under recorded.

5.2 Methodology

Survey effort was focused on the rural sections of the route. Hand searches, consisting of 20-man minutes effort at each selected location were undertaken. This involved searching of vegetation for live specimens, sifting through leaf litter or debris, searching under natural (or artificial refugia) such as logs, fallen coconuts and litter.

This approach was conducted within the road verge and where accessible adjacent land. In total 20 sites were surveyed. The location and notes regarding habitats are shown in Table 5-1. Sites were selected based on having a full coverage of elevations, land use and habitats present. In addition, safety of surveyors was considered, and so sample points tended not to be on road corners or dips in the road with poor visibility for road users. The locations of these points are shown in Figure 5.1.

Table 5-1 Snail Sampling Points

#ID	Latitude	Longitude	Elevation (m)	Notes
S01	-13.94558335	-171.7771389	640	Road verge, grass
S02	-13.93950798	-171.77563	696	Dense vegetation adjacent to road verge
S03	-13.93850902	-171.776314	703	Grassed verge
S04	-13.99871699	-171.778551	99	Dense vegetation at edge of plantation
S05	-13.986215°	-171.775926°	769	Agricultural land, under logs and debris
S06	-13.92522404	-171.782601	768	Grassland with ditch
S07	-13.97558704	-171.774783	309	Road verge - grass
S08	-13.95771699	-171.777277	507	Road verge with ferns
S09	-13.91275596	-171.781557	740	Adjacent to road, grassed area with rock outcrops
S10	-13.92340148	-171.7829636	738	Rough Grassland adjacent to road verge
S11	-13.92917896	-171.7802408	754	In small road cutting with earth bank and heavily vegetated with ferns and grasses
S12	-13.9671012	-171.7753005	414	Road verge at canopy of mature trees
S13	-13.90190768	-171.779233	620	Stream sides – dense vegetation
S14	-13.98354935	-171.7751257	217	Road verge adjacent to plantations
S15	-13.98790752	-171.7762635	163	Road verge adjacent to plantations
S16	-13.99453207	-171.77806	105	Plantation
S17	-13.973439°	-171.775062°	328	Dense vegetation at road verge
S18	-13.95085892	-171.7782722	591	Road verge and associated ditch
S19	-13.96296515	-171.7762495	431	Dry ditch bed
S20	-13.95536805	-171.7773986	544	Inside road alignment- rough grassland and scrub

Figure 5.1 Location of Snail Sampling Points

A second method of survey was attempted but did not produce any additional beneficial results. This consisted of setting out artificial refugia; in this case half coconut shells with lettuce as bait along the route. Initially, several the sites were lost due to the road verge clearance works being conducted by the LTA contractors. Checking of remaining artificial refugia suggested that they were not attracting snails, at least in the short term and so no remaining effort was applied to this method. The use of refugia will work in locations where natural refugia are limited and therefore provide shelter for the snails, in particular giving suitable humid and shaded conditions. However, along the existing road alignment refugia, deep cover and vegetation were not limited and the natural climate conditions during the period of survey were humid and warm.

5.3 Analysis

Live snails and old shells were collected in the field and placed into plastic boxes with dampened kitchen roll paper to maintain humidity levels. Specimens, such as live African land snails were measured in the field and not taken to the office for measurement.

Other specimens were removed to the office for measurement and photographing. Live specimens were returned to the site of collection either later in the same day or maintained overnight in holding boxes.

Shells were measured using vernier callipers, measuring across the width and the height. Other distinguishing features were recorded, such as the number of shell whorls.

Specimens were compared with the details provided in Cowie *et al* (Cowie, Rundell, & Yeung, 2017) and where possible identified to at least genera. Some species details and images will be provided to Professor Cowie for his opinion on identification.

5.4 Results

The survey results showed that snails or slugs were present in most survey locations, although the diversity of species was limited.

Table 5-2 shows the species recorded with a good degree of confidence; other species may be added to this after subsequent analysis. However, there was no specimens of *Thaumatodon hystricelloides* recorded. Some individual snails of other species down to similar size were found and measured, giving confidence that the methodology and surveyors were conducting a search which would have located this species if present.

Table 5-2 Results of Snail Survey

Name	Status (native, etc.)	IUCN Status	Comments
Allopeas gracile	Introduced	Not assessed	Common, especially old shells
Lissachatina fulica	Introduced	Not assessed	The African Land Snail – introduced and an invasive pest species
Paropeas achatinaceum	Introduced	Not assessed	Occasional
Succinea putamen	Endemic	Not assessed	Occasional
Lamprocystis (upolensis or perpolita)	Native	Not assessed	Single specimen collected difficult to determine to species level
Bradybaena similaris	Introduced	Not assessed	Frequent, common in road verge
Liardetia samoensis	Native	Not assessed	Very small snail, occasional

5.5 Potential for Critical Habitat Trigger

The IFC Criterion for Range Restricted species does not provide a suggested Extent of Occurrence (EOO) for invertebrates. It is considered that a reasonable approach for Samoan endemics is that they are all Range Restricted as the size of the island is relatively small; certainly well below the IFC suggested EOO for vertebrates and plants of 50,000 km^2.

On this basis *Succinea putamen*–which is found only on Upolu–is considered to be a range restricted endemic and therefore would be scoped into a Critical Habitat Assessment process.

This species' habitat requirements are described by Cowie *et al* as 'Mostly at mid-elevations, inland, in damp places in forest but sometimes in more open areas. On the ground under logs and other debris or on vegetation (ferns, shrubs, tree trunks). May tolerate some degree of habitat disturbance' (Cowie, Rundell, & Yeung, 2017). This implies that the species can be found in a variety of habitats within the island, including habitats such as the existing road verge as confirmed in the survey work.

The thresholds for Criterion 2 are:

Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.

Based on this species having somewhat generalised habitat requirements, it is considered highly unlikely that the road verge area which will be lost contains more than 10% of the global population of this species. It is likely that more than 10 reproductive units are present within the project area.

Therefore, this species does not trigger Critical Habitat under this criterion.

No other species are considered likely to meet the thresholds of Criterion 2 in terms of percentage of global population present within what would be considered a reasonable Ecological Appropriate Area of Analysis (EAAA) for molluscs.

6 Palm Species

6.1 Preamble

The initial IEE flagged up the possibility of rare palm species being present within the project area. One species was *Clinostigma samoense* and the other was referred to as *Drymophloeus samoensis*. The accepted name for the latter species is *Balaka insularis*. It is a rare small palm that is restricted to primary and secondary forest and so considered unlikely to be present along the road alignment.

Clinostigma samoense is classed as IUCN Red List Endangered, whilst *Balaka insularis* is classed as Critically Endangered.

6.2 Methodology

A visual search for specimens of *Clinostigma samoense* was conducted throughout the period of field work.

There are several similar species which need to be differentiated from *C. samoense*. In particular *C. warburgii* is similar in size, growth form etc. However, Hodel suggests that *C. samoense* is only found at elevations above 600 m, with the similar but more common species *C. warburgii*, tending to be found at the lower levels with some overlap in the central highlands (Hodel, 2007). Additionally, Hoidel (Ibid) suggests that the form of the inflorescence of these two species is a distinguishing field characteristic. *C. samoense* has a broom like appearance with thick and coarse rachillae while *C. warburgii* has a more branched inflorescence giving it a bushy appearance.

6.3 Results

A review of the IUCN Red List description for *C. samoense* shows that specimens have been previously recorded along the route of the CCIR. These locations are shown in Figure 6.1. The precise locations and records are unknown. A particular search for this species within these areas was conducted.

Figure 6.1 Location of Historical Records for *Clinostigma samoense*

Source: IUCN Red List

No specimens of *C samoense* were recorded along the route alignment. In some of the gardens at the Apia end of the road, there were specimens which had similar traits to *C. samoense* but were considered to be either non-native or hybrid species planted as part of a landscaping scheme.

Specimens of *C. warburgii* were recorded along the route but not within a zone which will be directly affected by the road upgrade.

6.4 Potential for Critical Habitat Trigger

As no specimens of *C. samoense* were recorded along the route, it is considered that this species will not trigger qualification of the area as Critical Habitat.

7 Avifauna

7.1 Preamble

The initial IEE raised several concerns regarding the IBA designation and for a small number of species.

As noted, the road, at its southern end passes through the Apia Catchments IBA. Based on the mapped boundary, the road alignment is part of the IBA. While more mature forest cover is present to the east and west of the road alignment, the actual alignment as noted previously contains highly modified habitats, mainly in the form of gardens in the south, closer to Apia, and plantations and grazing land elsewhere.

Avifauna species of note, in part leading to the IBA designation, include the Tooth-billed pigeon (*Didunculus strigirostris*) and the Ma'oma'o (*Gymnomyza samoensis*).

Whilst the IEE focused on the area of the IBA, it was considered that much of the route, outside of the urban area had the potential for avifauna interest, along with other species of note with a focus on endemic species.

7.2 Methodology

Preamble

At an early stage of the survey, preliminary assessment of habitats present along the route was conducted. This indicated that there were no specific areas likely to be of high value for uncommon species along the route. Additionally, access to private land away from the road alignment was not possible without significant consultation efforts and payment to landowners.

It was therefore determined that conducting transect surveys across the road alignment would bring little additional data benefits compared with the costs and time required to arrange access. However, previous studies indicated that Ma'oma'o had been recorded flying across the road in the vicinity of the village of Malololelei. This is situated in the semi-urban area of the IBA and lies to the west of the road and has good mature tree cover.

Three main survey approaches were used to assess bird species present and their use of the habitats along the road alignment. These are discussed below.

Electronic Recording

Call Recording

To determine potential use of areas close to the road by this species and the Tooth-billed pigeon, an automated bird song recorder (Micro Song Meter by Wildlife Acoustics) was deployed in two locations over the course of the survey period. This was arranged by local agreement with landowners. The two locations are shown in Figure 7.1. As can be seen these are both within the IBA and were aimed at looking at movement across the road where it runs through the IBA. Deployment location 1 was within dense tree cover near to the Forest Café, while the second deployment was in a more open area with large banyan trees.

The recorder was deployed in an area away from extraneous human noise to the extent possible and affixed at 2 m above ground level and secured with a python lock (see Figure 7.2).

The first deployment was from the 25th of November 2022 through to the 29th of November with the song meter running on day night cycle for recording. This provides for an automatic start to recording some 30 minutes before sunrise through to 30 minutes after nightfall. This resulted in approximately 60 hours of recording in Location 1.

The second deployment was from the 7th of December through to the 9th of December, with a 24 hour monitoring setting, giving approximately 56 hours of recording,

Figure 7.1 Location of Micro Song Meter

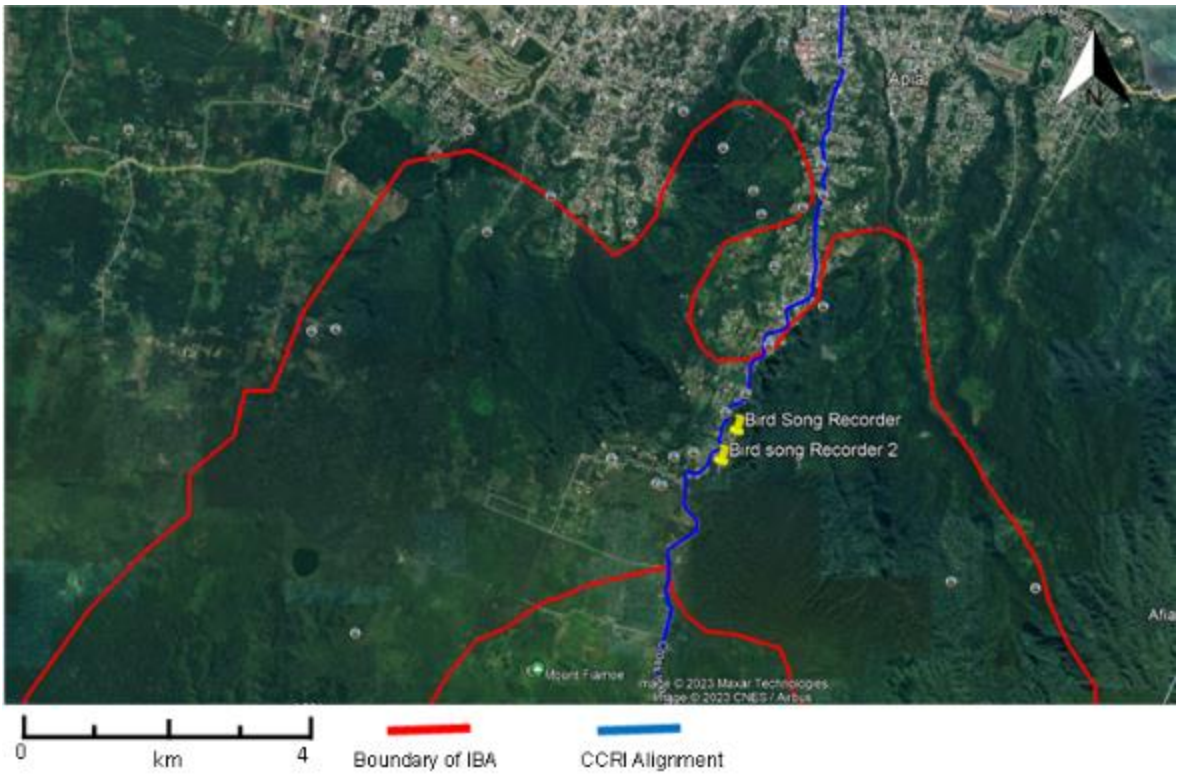


Figure 7.2 Wildlife Acoustics Song Meter Deployed at Location 2

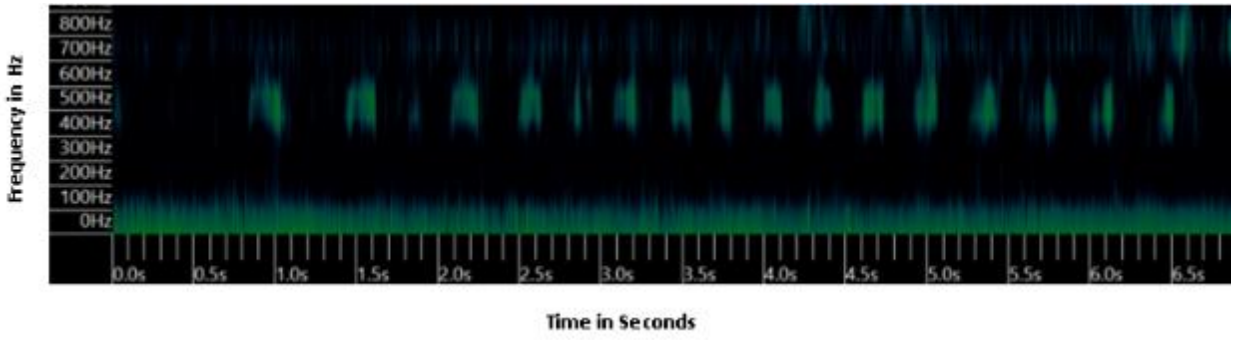
Call Analysis

All recorded calls were analysed using Kaleidoscope™ software using the non-bat setting. An initial screening of non-bird calls was conducted on all registrations.

Call sonograms were then compared with reference material including images and descriptions presented in (Beichle & Baumann, 2016) and web site calls and sonograms, principally https://xeno-canto.org/.

An example sonogram is provided for a Samoan Fruit-Dove in Figure 7.3

Figure 7.3 Example Sonogram - Samoan Fruit-Dove Call



Visual Surveys

Registrations of birds along the route were taken throughout the survey period with both specific bird surveys conducted using a sit and wait technique for a minimum of 20 mins and casual recording of species observed when driving or conducting other survey activities.

The 20-minute sit and wait surveys were conducted in areas along the route with nearby tree cover or other suitable habitats. Detailed surveys were not conducted in the urbanised areas of the northern section of the road.

7.3 Results

Overview

The combined results of the digital and visual survey are provided in Table 7-1 which shows the species recorded along with their status as an endemic, native, or non-native species and the current (January 2023) IUCN Red List status. Finally, notes on the observations including a subjective estimate of commonness are provided, although this is presented with a caveat that some species are more cryptic and secretive than others, so this is not a definitive statement of rarity within the project area.

In total 29[4] species were recorded along or near the route. Some of these were sea birds flying along the coastline near to the southern end of the route. Beichle and Baumann list some 59 species which are regularly occurring in Samoa, of these approximately 20 are shore or sea birds, leaving 39 mainly terrestrial species (Beichle & Baumann, 2016). Although it was noted that in some locations of the IBA, pairs of Brown Noddy and Common White Tern were present and exhibiting breeding behaviours some distance from the coastline.

The recorded 29 species represent approximately 75% of the regularly occurring terrestrial species.

[4] This is a minimum as detailed analysis of the many registrations of bird calls on the song meter is ongoing, although the recordings have been scanned for the two main target species.

Table 7-1 Listing of Birds Recorded During Survey Period

#	English Name	Samoan Name	Scientific Name	IUCN Red List Status	Local Status	Notes
1	Feral Pigeon	Lupe papalagi	*Columa livia*	Least Concern	Non-Native	Common in urban areas, not observed in rural areas and higher ground
2	Many-coloured Fruit-dove	Manuma	*Ptilinopus perousii*	Least Concern	Native	Occasional
3	Samoan Fruit-dove	Manutagi	*Ptilinopus fasciatus*	Least Concern	Native	Common throughout route, frequently heard calling
4	White-rumped swiftlet	Pe'a pe'a	*Aerodramus spodiopygius*	Least Concern	Sub species is endemic	Commonly observed flying in plantations and pasture – in larger numbers towards south of the island
5	Buff-banded Rail	Ve'a	*Hypotaenidia phillipensis*	Least Concern	Native	Common throughout much of the route, even in urban areas
6	Purple Swamp Rail	Manu ali'i	*Porphyrio porphyrio*	Least Concern	Native	Occasional in southern section of route
7	Lesser Frigate bird	Atafa	*Fregata ariel*	Least Concern	Visitor– non-breeding	Observed flying high over southern limit of route along coastline
8	Brown Booby	Fua'o	*Sula leucogaster*	Least Concern	Visitor – non-breeding	Observed flying high over southern limit of route along coastline
9	White-tailed Tropicbird	Tava'e	*Phaethon lepturus*	Least Concern	Native	Observed flying high across island
10	Pacific Golden Plover	Tuli	*Pluvialis fulva*	Least Concern	Winter visitor – non-breeding	Frequent in low lying areas with open grassland
11	Brown Noddy	Gogo	*Anous stolidus*	Least Concern	Native	Observed displaying breeding behaviour in and over high forest to east of road in IBA
12	Common White Tern	Manu sina	*Gygis alba*	Least Concern	Native	Observed displaying breeding behaviour in and over high forest to east of road in IBA
13	Flat-billed Kingfisher	Ti'otala	*Todiramphus recurvirostris*	Least Concern	Endemic	Common, along much of route including urban sections. Frequently on power line adjacent to road
14	Blue-crowned Lorikeet	Sega vao	*Vini australis*	Least Concern	Native	Rare, single observation in plantation at southern end of route
15	Polynesian Triller	Miti	*Lalage maculosa*	Least Concern	Native, possible subspecies - endemic	Uncommon, scrub and woodland

#	English Name	Samoan Name	Scientific Name	IUCN Red List Status	Local Status	Notes
16	Red-vented bulbul	Manu papalagi	*Pycnonotus cafer*	Least Concern	Non-Native – invasive	Common throughout the route and associated with human habitation
17	Samoan Thrush	Tutummalili	*Turdus poliocephalus*	Least Concern	Endemic	Only a single observation made, uncharacteristically in semi-urban area
18	Samoan Fantail	Se'u	*Rhipidura nebulosa*	Least Concern	Endemic	Occasional in scrub in fields and plantations
19	Samoan Flycatcher	Tolai fatu	Myiagra albiventris	Near Threatened	Endemic	Occasional in scrub in fields and plantations
20	Pacific Robin	Tolai ula	*Petroica pusilla*	Least Concern	Native – subspecies – endemic	Registration of call in Bird Recording Site 1
21	Cardinal Honeyeater	Segasegamau'u	*Myzomela cardinalis*	Least Concern	Native – sub species - endemic	Common throughout route including urban areas
22	Wattled Honeyeater	Lao	*Foulehaio carunculatus*	Least Concern	Native	Restricted to higher ground in central island, common on sound recordings
23	Samoan Starling	Fuia	*Aplonis atrifusca*	Least Concern	Endemic	Frequent – in areas with mature trees, observed flying over route alignment and in tops of trees, especially around banyans
24	Polynesian Starling	Miti ula	*Aplonis tabuensis*	Least Concern	Native – sub species endemic	Single observation in wider IBA, by Robert Louis Stevenson Museum
25	Common Maina	Maina	Acridotheres tristis	Least Concern	Non-native – invasive	Common throughout route – non-native species placed on Samoa Invasive species list
26	Jungle Maina	Maina	Acridotheres fuscus	Least Concern	Non-native – invasive	Common throughout route – non-native species placed on Samoa Invasive species list
27	Red-headed Parrotfinch	Manu ai pa'u la'au	*Erythrura cyaneovirens*	Near Threatened	Native – may be sub species	Single observation in urban area of route towards Apia
28	Samoan Whistler	Vasavasa	*Pachycephala flavifrons*	Least Concern	Endemic	Not observed but commonly recorded on song meter, notable early in dawn chorus and even during hours of darkness
29	Pacific Imperial Pigeon	Lupe	*Ducula pacifica*	Least Concern	Native	Recorded on Song Mater at both survey locations

Only two species with a higher IUCN status than Least Concern were recorded during the survey period. These being the Samoan Flycatcher and Red-headed Parrotfinch, both of which are classified as Near Threatened. The latter species was recorded in an urban area, and other observations outside of the project were made of this species being present in street trees in Apia.

Neither the Critically Endangered, Tooth-billed pigeon or the Ma'oma'o (Endangered) were recorded during the survey.

7.4 Potential for Critical Habitat Trigger

The two key species of Tooth-billed pigeon (Critically Endangered) and Ma'oma'o (Endangered) fall within consideration of IFC PS Critical Habitat assessment Criterion 1 (Critically Endangered and Endangered Species) under Criterion 1. Further assessment of their potential to qualify an area as Critical Habitat is presented in Section 10.

Other species, including endemics which may be classed as range restricted and be considered under Criterion 2 are not likely to meet the thresholds of 10 % of the global population of the species to qualify an area as Critical Habitat.

8 Volant Mammals

8.1 Preamble

There are two species of large fruit eating bat (also referred to as flying fox) within Samoa. These are the Samoan flying fox (*Pteropus samoensis*) classed as a Near Threatened species by IUCN, and the Pacific flying fox (*Pteropus tonganus*). The latter is classed as Least Concern within the IUCN Red List.

There is a single insectivorous bat species recorded, or historically recorded from Upolu. This is the Pacific sheath-tailed bat (*Emballonura semicaudata*). This species has an IUCN Red Listing of Endangered and is acknowledged in the IUCN Red List as Critically Endangered within Samoa. Furthermore, the IUCN description states that the species is likely locally extinct within the islands of Samoa.

8.2 Field Work

The field work was directed at the identification of the presence of the Pacific sheath-tailed bat within the route alignment. This was one of the species which was highlighted in the original IEE and CHA.

Field work primarily consisted of deployment of an Anabat Express automatic bat recorder. This work was supported by occasional use of a handheld bat detector in suitable locations and when driving along the road at night-time.

The Anabat was deployed initially in suitable habitat and left in situ for three days (Location -13.899097°, -171.775026°). During other field work discussions with local landowners were held regarding visual sighting of this small bat species. A number of landowners reported having seen the species around their properties. Based on this the Anabat was further deployed at such locations for extended periods ((location -13.994225°, -171.778293° for up to ten days and Location -13.895394°, -171.773317° for a further three days).

8.3 Results

No registrations of this species were made on the Anabat Express or the handheld detector.

It is considered that confusion about the species exists with the White-rumped swiftlet. This species is relatively common on the island and has a flight pattern that is similar to the fluttering of a bat. Both bat and bird species utilise caves as a roost, and both are feeding off small insects.

To further add to the confusion, the Samoan name for the bat and the White-rumped swiftlet are the same (pe'a pe'a). This is stated to be from an original belief that the bird continued flying and feeding at night without recognition it was actually a different animal.

No flying foxes were observed during the field work. This is not surprising as there are no extensive areas of suitable feeding or roosting habitat. It is noted that other studies conducted for the Alaoa Dam project indicate that flying foxes pass over the road in the vicinity of the Robert Louis Stevenson Museum. It is likely that they are using the wider area of the more mature forest which forms the Apia Catchment IBA.

Casual observations of flying fox were made along the southern coastline at dusk with large numbers flying from east to west and presumed to be using the safety of the extensive area of mangrove to the east of Siumu as a daytime roost.

8.4 Potential for Critical Habitat Trigger

The apparent absence of the Pacific sheath-tailed bat means that this species is not considered to be a trigger for Critical Habitat determination. The other fruit eating bats known to be within the wider area of the project are classed as Near Threatened and Least Concern and therefore do not fall within the scope of Criteria 1 – 3 of the IFC Guidance Note of PS6. Volant mammals are therefore not considered to qualify the area as Critical Habitat.

8.5 Discussion

It is considered that the Pacific sheath-tailed bat has been extirpated from Upolu Island, this is based on previous records and statements as well as the lack of evidence from the current survey work. This opinion is supported by similar drastic reductions and extirpations from other pacific islands. However, it is possible that a small remnant population is present in more remote locations of Upolu. Whilst outside the remit of the current project, it is considered that a valuable future study for the island biodiversity knowledge would be to conduct a comprehensive survey for this species, focused on suitable roost areas (caves and lava tubes) and better understand why the species has declined to such a degree or indeed become locally extinct.

9 Reptiles

9.1 Preamble

The original IEE highlighted two species of reptile which may be relevant to the planning and assessment of the project. These two species were named as *Emoia samoensis* and *E lawesi* both species of skink living in trees.

Emoia samoensis is an arboreal species, primarily found on tree trunks and low vegetation at heights of ground level to several metres from the ground. It can be seen in primary and secondary forest, although it is absent from urban areas. It has a clutch size of four to seven eggs (Brown, 1991).

It is questionable if *Emoia lawesi* is found in Samoa. The species is not shown as present in Samoa in the IUCN Red List mapping. The Land Reptiles of Samoa (Gill, 1993) does not list it at all for Samoa, and suggests it is a synonym for *Emoia adspersa*.

9.2 Methodology

A visual search was conducted of all mature trees close to the route alignment. Restricted land access meant that on occasions, the use of binoculars was necessary to scan the tree. This search technique was used throughout the survey period when conditions were suitable. These searches were combined with other techniques such as sit and wait and general observations along the route.

9.3 Results

There are few suitable trees for these species within the road alignment and adjacent land. A single observation of an arboreal skink was made at the southern end of the project. This was identified as a Polynesian Slender Treeskink (*Emoia tongana*, see Figure 9.1, a species of Least Concern within the IUCN Red List. The tree that this specimen was recorded from was subsequently felled by contractors working for the EPC during the field survey period.

No sightings of other tree skink were made during the survey period.

9.4 Potential for Critical Habitat Trigger

The apparent absence of *Emoia samoensis* from the project area means that this species does not qualify any parts of the alignment as Critical Habitat.

9.5 Discussion

The absence of *Emoia samoensis* from the survey area is not unexpected with few mature trees within route alignment and limited contiguous tree cover present. The road verge habitat and surrounding urban and farmed land is not suitable habitat for this species.

Figure 9.1 Polynesian Slender Treeskink (Emoia tongana)

10 Critical Habitat Assessment

10.1 Preamble

The following text is intended to update the Critical Habitat Assessment conducted as part of the original IEE submission. That text conducted the necessary screening for species and determined that it was unlikely that the project alignment contained or supported species which would qualify parts or all of the area as Critical Habitat. As previously noted, part of the aim of the current survey was to test the assumption of the original Critical Habitat Assessment through a site visit and field work.

The potential for species or groups of species to qualify an area as Critical Habitat has been outlined in relevant sections for each species or group. Only two species are considered to have the potential to qualify an area as Critical Habitat under Criteria 1 -5 of the IFC PS No 6 Guidance Note approach to determining Critical Habitat.

10.2 IFC Process for Critical Habitat Assessment

The screening for Critical Habitat has been conducted based on species which may qualify the habitat as Critical. This has been based on the approach as set out in the 2019 IFC updates to Performance Standard No 6 Guidance note (IFC, 2019). This utilises five criteria to determine if the area under consideration would qualify as Critical Habitat. Three of the criteria (1-3) relate to species and have thresholds which are based on the risk of extinction of species as designated by the IUCN Red List status for each species. Criteria 4 and 5 relate to Ecosystems and evolutionary processes and do not utilise thresholds. A summary of the criteria is set out below.

Criterion 1: Critically Endangered and Endangered Species

Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction in the wild.

As described in footnote 11 of Performance Standard 6, the inclusion in Criterion 1 of species that are listed nationally/regionally as CR or EN in countries that adhere to IUCN guidance shall be determined on a project-by-project basis in consultation with competent professionals.

Thresholds for Criterion 1 are the following:

(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species).

(b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds.

(c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

Criterion 2: Endemic and Restricted-range Species

For purposes of the Guidance Note, the term endemic is defined as restricted-range. Restricted-range refers to a limited extent of occurrence (EOO).

- For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an EOO less than 50,000 km^2
- For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km^2

- For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted-range is defined as having a global range of less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart)

The threshold for Criterion 2 is the following:

a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.

Criterion 3: Migratory and Congregatory Species

Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem).

Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis. Examples include the following:

- Species that form colonies
- Species that form colonies for breeding purposes and/or where large numbers of individuals of a species gather at the same time for non-breeding purposes (for example, foraging and roosting)
- Species that utilise a bottleneck site where significant numbers of individuals of a species occur in a concentrated period of time (for example, for migration)
- Species with large but clumped distributions where a large number of individuals may be concentrated in a single or a few sites while the rest of the species is largely dispersed (for example, wildebeest distributions).
- Source populations where certain sites hold populations of species that make an inordinate contribution to recruitment of the species elsewhere (especially important for marine species)

Thresholds for Criterion 3 are the following:

(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.

(b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.

Criterion 4: Highly Threatened or Unique Ecosystems

The IUCN is developing a Red List of Ecosystems, following an approach similar to the Red List for Threatened Species. The client should use the Red List of Ecosystems where formal IUCN assessments have been performed. Where formal IUCN assessments have not been performed, the client may use assessments using systematic methods at the national/regional level, carried out by governmental bodies, recognised academic institutions and/or other relevant qualified organisations (including internationally recognised NGOs).

The thresholds for Criterion 4 are the following:

a) Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN.

b) Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

Criterion 5: Key Evolutionary Processes

The structural attributes of a region, such as its topography, geology, soil, temperature, and vegetation, and combinations of these variables, can influence the evolutionary processes that give rise to regional configurations of species and ecological properties. In some cases, spatial features that are unique or idiosyncratic of the landscape have been associated with genetically unique populations or subpopulations of

plant and animal species. Physical or spatial features have been described as surrogates or spatial catalysts for evolutionary and ecological processes, and such features are often associated with species diversification. Maintaining these key evolutionary processes inherent in a landscape as well as the resulting species (or subpopulations of species) has become a major focus of biodiversity conservation in recent decades, particularly the conservation of genetic diversity. By conserving species diversity within a landscape, the processes that drive speciation, as well as the genetic diversity within species, ensures the evolutionary flexibility in a system, which is especially important in a rapidly changing climate.

For illustrative purposes, some potential examples of spatial features associated with evolutionary processes are as follows:

- Landscapes with high spatial heterogeneity are a driving force in speciation, as species are naturally selected based on their ability to adapt and diversify.
- Environmental gradients, also known as ecotones, produce transitional habitat, which has been associated with the process of speciation and high species and genetic diversity.
- Edaphic interfaces are specific juxtapositions of soil types (for example, serpentine outcrops, limestone, and gypsum deposits), which have led to the formation of unique plant communities characterised by both rarity and endemism.
- Connectivity between habitats (for example, biological corridors) ensures species migration and gene flow, which is especially important in fragmented habitats and for the conservation of metapopulations. This also includes biological corridors across altitudinal and climatic gradients and from “crest to coast.”
- Sites of demonstrated importance to climate change adaptation for either species or ecosystems are also included within this criterion.

10.3 Screening

Screening of species which may meet the thresholds set out in Criterion 1 – 3 was conducted previously as part of the original IEE process. Additionally, that work concluded that there were no protected areas which would fall under the terms of SPS (2009) which automatically qualified the area as Critical Habitat. As noted, SPS does not include, *per s*e, IBA’s as qualifying areas.

10.4 Criterion 1 – 3

Species of Note

As already set out in earlier chapters, the only species identified as having a potential to qualify an area within or near to the project as Critical Habitat are two bird species, the Ma’oma’o and the Tooth-billed pigeon. These species are classed by the IUCN, in their Red List, as Endangered and Critically Endangered respectively. The remainder of this section of the assessment will focus on these two species.

10.5 Ecologically Appropriate Area of Analysis

The IFC guidance requires that for Criterion 1 – 3 an Ecologically Appropriate Area of Analysis (EAAA) is established for each species under consideration. The EAAA should not be based on the project area or likely impacts of the project, the guidance is clear that setting the area of analysis is separate from a project’s activities and potential impacts. In essence an area will or will not be Critical Habitat regardless of the status of a project.

Both these species are recorded within areas of the Apia Catchment IBA, they are one of the qualifying criteria for IBA designation. They are not however recorded as regularly occurring near to the road alignment, which at

this section does not provide suitable habitat for these species. It is noted that areas of known occurrence occur on both sides of the road, so it is likely that at times the species do cross the road.

On this basis it is considered that a suitable EAAA for the assessment for both species is the area encompassed by the IBA boundary. This was shown in Figure 3.2.

Determination of Critical Habitat – Criterion 1

No records of either of these two key species was made during the current field work. Extensive field work for the Alaoa Dam which is also situated within the Apia Catchments IBA showed varied results, with one extensive survey suggesting no records of the two species was made within that project area, while a second report stated that both species were regularly recorded on automated bird detection units.

Tooth-Billed Pigeon

The IUCN Red List suggest that there is an adult population of between 50 and 250 individuals of the Tooth-billed pigeon on the two main islands of Samoa. This value may have reduced in the period since the IUCN assessment was conducted in 2016. Using these values as the global population figure, a 0.5% value would equate to between 0.25 and 2.5 birds. Even using the higher end of this range, it is considered likely that the whole IBA supports more than three individuals of this species

Based on reported data from the Alaoa Dam project, it is likely that there are a minimum of five reproductive units within the IBA boundary.

Thus, it is concluded that the area of land within the IBA boundary is qualified as Critical Habitat through meeting the thresholds of Criterion 1 for the Tooth-billed pigeon.

Ma'oma'o

IUCN and Birdlife International both quote F.T. Tipamaa"s estimate of 500 individuals as a reasonable precautionary number for the global population of this species. This would place the 0.5% of population at 2.5, individuals. The IUCN assessment for this species was conducted in 2016 so the population may have further declined. A value of two individuals is used as the threshold for this species.

The Aloao Dam reports suggest that this species has higher numbers within the Apia Catchments IBA area and therefore meets the first part of Criterion 1 thresholds. It is also highly possible that the IBA supports more than 5 reproductive units,

Thus, it is concluded that the area of land within the IBA boundary is qualified as Critical Habitat through meeting the thresholds of Criterion 1 for the Ma'oma'o.

Determination of Critical Habitat – Criterion 2 and 3

As stated in Section 7.4, no other species of birds which may be endemic and therefore considered to be range restricted are considered likely to reach the 10% global population criteria and 10 breeding units within the IBA or other areas along the road alignment.

Further analysis of for Criterion 2 is considered unnecessary.

Samoa does not support significant numbers of migratory or congregatory bird species. During the survey period the only species observed to be present in groups were the White-rumped swiftlets which in the evenings could be seen in small groups. While Pacific Golden Plover were observed in small numbers during the study, they were low in number and are classed as Least Concern by the IUCN and have a high global population, estimated to be 190,000-250,000 in a 2006 account by Birdlife International. The numbers visiting Samoa will not approach the 10% threshold.

No species are considered likely to meet the thresholds established in Criterion 3.

Determination of Critical Habitat – Criterion 4 and 5

The area of the project is not considered to meet the thresholds of Criterion 4 a, an area of more than 5% of the global extent of an ecosystem type considered by IUCN as highly endangered.

For Criterion 4 b, areas of high regional or national conservation priority, the Apia Catchments IBA could in and of itself be considered as a potential qualifier for Critical Habitat. As noted, ADB SPS does not include IBA's within its definition of protected sites when speaking about Critical Habitat areas.

In some ways the issue is a moot point as the IBA area has already been determined to qualify as Critical Habitat for two species under Criterion 1.

For Criterion 5, while Samoa is an island, and geographically isolated areas may exhibit a tendency towards speciation through evolution, there is no indication that there are key evolutionary processes acting within the area of the road project.

10.6 Critical Habitat Assessment – Result

The assessment, which has built on previous work, indicates that the area within the Apia Catchments IBA meets at least one criterion for qualification as Critical Habitat as defined by IFC and ADB.

10.7 Implications for Project on Presence of Critical Habitat

ADB's SPS of 2009 is clear about the steps required if a project may affect an area determined to be Critical Habitat. The wording in SPS is as follows:

> *"No project activity will be implemented in areas of critical habitat unless the following requirements are met:*
>
> *(i) There are no measurable adverse impacts, or likelihood of such, on the critical habitat which could impair its high biodiversity value or the ability to function.*
>
> *(ii) The project is not anticipated to lead to a reduction in the population of any recognised endangered or critically endangered species or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.*
>
> *(iii) Any lesser impacts are mitigated in accordance with para. 27.*[5]*"*

For the current project, the location at which the road traverses the IBA is clearly highly modified habitat and not suitable for feeding or breeding of either of the species of importance.

An analysis of how the current project performs against the above requirements is set out in the following text.

No Measurable Adverse Impacts

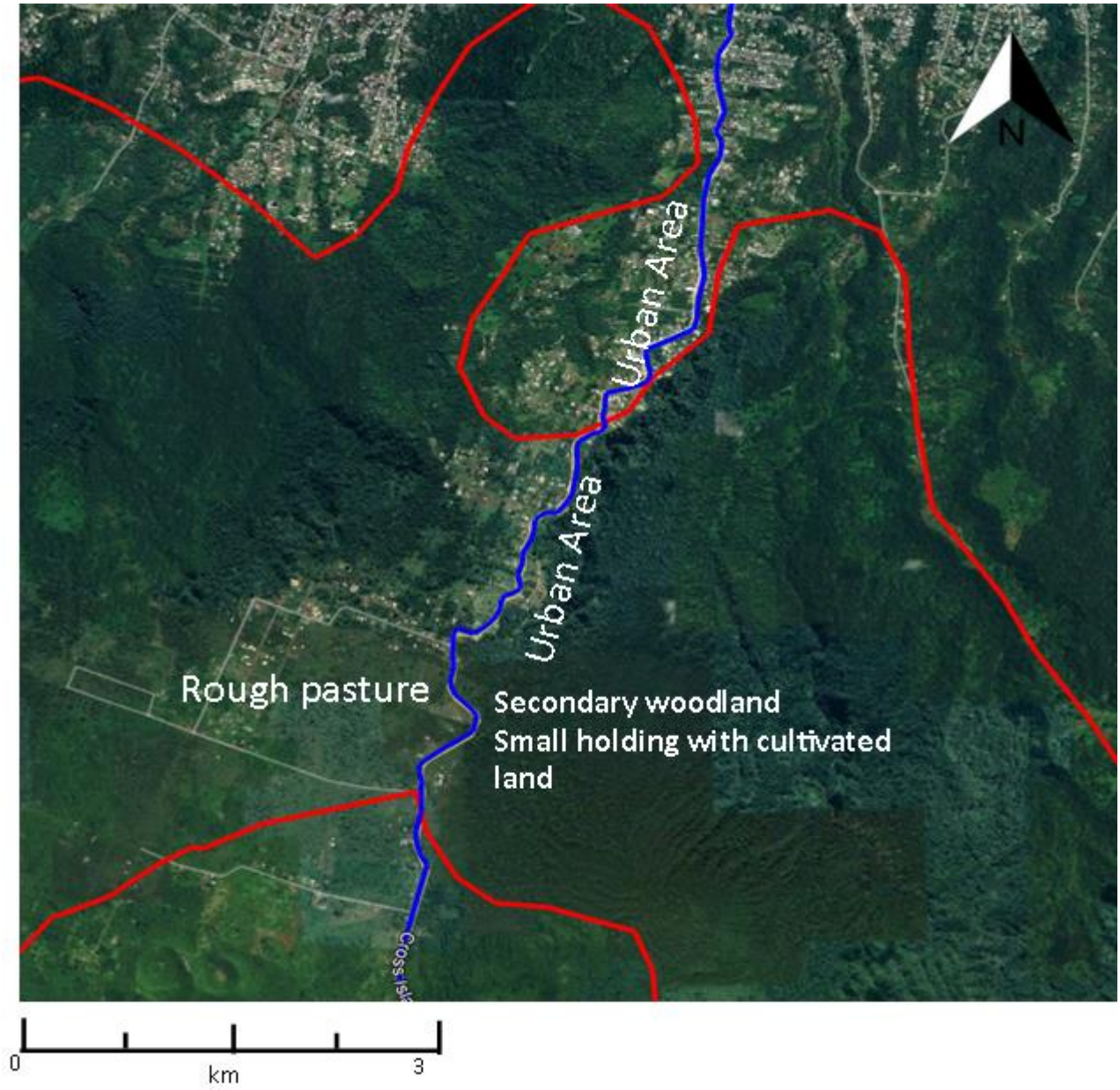
The project as proposed will have limited effect within the area which has been determined as Critical Habitat. As noted much of this section is urbanised with gardens and a managed road verge as the dominant land use. Figure 10.1 shows the mainland uses within the region where the road approaches and passes through the Critical Habitat area. The figure shows the urbanised area, further south the road passes into more open land which has scattered residences present but is dominated by open pasture with some scrub on the west side of the road. To the east side at this section is a strip of land which is used as residential and some small-scale farming with cultivated areas, this is backed by secondary, regenerating woodland.

[5] Where paragraph 27 refers to the adequate mitigation of effects so that a no nett loss of biodiversity of achieved

None of the habitats within this area are suitable for supporting Tooth-billed pigeon or Ma'oma'o.

There will be minor development within much of this section, with some drainage works and loss of existing verge vegetation. It is considered that such loss and the activities within this section during construction and the operation of the road will not impair the Critical Habitat integrity or functioning.

Figure 10.1 Main Land Uses Within and Adjacent to Critical Habitat and Road



Reduction in Species which Qualified the area as Critical Habitat

For the reasons set out in the previous two paragraphs, the habitat which will be affected in a minor way by the project is not suitable for the two key species under consideration.

It is likely that one or both species are likely to fly across the road, with reports of Ma'oma'o being present in the west and east of the IBA. Such overflights will be at a height which do not place the birds at risk of injury or death from traffic using the road.

There is no realistic scenario in which the proposed works and operation of the road, which is already existing, will cause a reduction in the population or survival rates of these two species.

Mitigation of Lesser Impacts

SPS requires demonstration of no nett loss of biodiversity interests of the Critical Habitat area. If adopting the full IFC approach, demonstration of Nett Gain in biodiversity interest relating to the qualifying factors for the Critical Habitat is required.

The project has already undertaken to mitigate lesser impacts on biodiversity, measures to achieve this are set out in Section 13.10.

Additionally, the project is recommending improvement of connectivity between areas suitable for feeding and breeding or Tooth-billed pigeon and Ma'oma'o. This is shown in Section 13.10.

The proposed planting of trees to replace those lost will include specimens of *Dysoxylum* spp. Tooth-billed pigeons specialise on feeding of fruits of these trees. Other fleshy fruiting species will be planted which will support sub-adult Tooth-billed pigeon and Ma'oma'o.

Such habitat connectivity and improvement for these species shall be conducted in collaboration with the MNRE and other bodies who active species recovery programs for both species of bird.

11 Invasive Species

11.1 Introduction

Samoa has a significant problem with invasive, non-native species, both flora and fauna. For fauna it is estimated that nearly 50% of plant species on Samoa are non-native, and that 25% of native species are threatened by non-native invasive species (Division of Environment and Conservation, 2019).

The MNRE has adopted a proactive approach to addressing the problem, with increases in bio-security measures and the publication and implementation of a National Invasive Species Strategy and Action Plan. The latest iteration of which covers 2019 – 2024 (Division of Environment and Conservation, 2019).

The following represents an account of notable invasive species observed during the field survey. For a full account of the problem and likely issues and approaches to control of risk of exacerbating invasive species issues the MNRE Invasive Species Plan should be reviewed.

11.2 Vegetation

In relation to flora the survey indicated several species which were common along the route alignment, either in the road verge or in the vegetation immediately along the right of way and which will be disturbed by the proposed works.

Two floral species of particular note are Koster's curse (*Clidemia hirta*) and *Impatiens balsamina*. The former was only found occasionally in the actual road verge but was more common in adjacent land, especially in pastures with occasional trees and heavy fern cover. This species is highly invasive of forest areas, preferring shaded conditions, although it was observed growing in open grassland during the survey. The MNRE reported that a biological control for this species had been identified, this is a thrip species (*Liothrips urichi*). MNRE state that this species will control the spread of Koster's curse. This ascertain appears to be overly simplistic and ambitious. Evidence from Fiji indicates that while the thrip can control Koster's curse in open field conditions (high light), the thrip does not reproduce in shaded areas, where the species is a significant problem (Rojas-Sandoval & Acevedo-Rodríguez, Clidemia hirta (Koster's curse) Datasheet, 2014).

Impatiens balsamina is believed to originate from Indian and Malay. It has been grown around the world as a garden plant and shown considerable invasive tendencies. It is a terrestrial species and appears to be able to grow and survive in a range of conditions including open ground and the shade of forest floor conditions. However, there is a preference for damper soils (Rojas-Sandoval, Impatiens balsamina (garden balsam) Datasheet, 2018). Given the wet and humid conditions of the project area, it is not surprising that this species is recorded throughout most of the rural section of the road. It is most notable along ditches and water courses but also found in drier road verges.

11.3 Mammals

An occasional rat body which had been killed on the road was observed during the survey period. It is known that Samoa has a problem with both rat and mice species. The former in particular can be very harmful to populations of nesting birds, predating on eggs and young.

11.4 Snails

Several species recorded are not native to Samoa, not all are invasive or necessary harmful. The African Land Snail (*Lissachatina* fulica) was commonly observed within the survey area. It was one of the most common species recorded, both live and dead shells. This species seemed particularly common within urban areas in gardens and landscaped areas. Other non-native species were recorded, there role in the ecosystem as

potential harmful species is less well documented. *Euglandina rosea* is a non-native predatory snail species, which feeds on other land snails. It has been introduced into Samoa either by accident or deliberately to control the spread of the African Land Snail. Unfortunately, this species also preys on native snails and is considered to be part of the reason for declining populations of native snails.

Related to the snail survey, the invasive New Guinea flatworm (*Platydemus manokwari*) has been introduced into Samoa, either accidentally or deliberately in an effort to control the African Land Snail. An individual of this species was recorded during the survey visit within the road corridor vegetation. This species is a snail predator and has caused significant declines in native population within specific islands, including Samoa. It is included within the IUCN's Invasive Species Group's list of the top 100 invasive species.

The species also has health implications for humans as it can be a carrier of rat lungworm which it can transfer into the human food chain via vegetables which are eaten raw.

12 Ecosystem Services and Ecosystem Functioning

12.1 Preamble

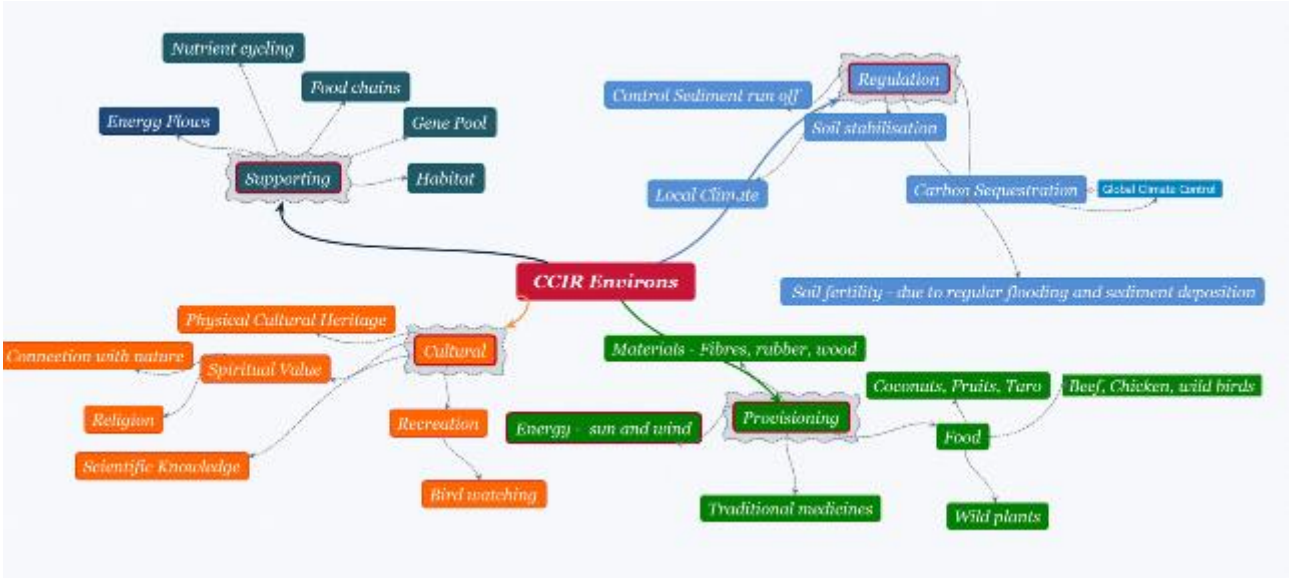
The following text provides an overview of the current ecosystem services provided by the habitats within the survey area and the functioning of the ecosystem. It is not intended to represent a full ecosystem analysis.

12.2 Ecosystem Services

Outside of the general Regulatory and Supporting Ecosystem Services, the surveyed project area and its surrounds provide significant Provisioning Services, along with, and to a lesser extent Cultural Services. As has been discussed in Section 4 much of the land use is utilised for food production. Either at an intensive level where there are some taro plantations, or less intensive in the form of coconut plantations and grazing land for meat/milk production. To a lesser extent some plant material such as the coconut fronds may be used for traditional basket making purposes.

A summary of the main ecosystem services exhibited along the CCIR is presented in Figure 12.1.

Figure 12.1 Simplified Ecosystem Services Diagram for CCIR



The landscaped areas and non-productive garden areas support cultural ecosystem services in the form of leisure opportunities and non-tangible enjoyment of managed garden systems.

All vegetated areas are contributing to regulating services such as carbon dioxide sequestration, reduction of soil erosion, micro-shading and microclimatic conditions.

Historically, the ecosystem services would have been more biased towards Supporting and Regulating services, but as human activities expanded into the primary forest areas and associated swiddening occurred, the shift has been towards more Provisioning Services and loss of Supporting and Regulatory Services (cf. with below discussion on Ecosystem Functioning).

The proposed project is not anticipated to lead to any further significant changes to the current ecosystem services. There will be minor reduction in areas under cultivation or available for grazing, but these are not considered to be significant. There is not likely to be any direct changes in the balance of ecosystem services provided. However, see Section 0 for a discussion about potential changes in land use which may be induced by the road upgrade across a wider area than the immediate road environs.

12.3 Ecosystem Functioning

As previously noted, it is clear that across most, if not all of the terrestrial areas of the island, the natural ecosystem has been significantly altered. This has been occurring for some time with clearance of primary forest even before the appearance and impacts of more recent settlers on the island. However, the settlement of the island and growth in population has accelerated this disruption of the natural ecosystem and created significant stress on remaining natural systems.

The existing road has played a role in this changing of ecosystem functioning, with access allowing conversion of primary forest to residential and agricultural uses.

The present ecosystem has several stresses outside of land use changes, primary among these is invasive species which are affecting natural vegetation communities, assemblages of birds and invertebrates and general interactions between species. This is resulting loss of endemic species and natural communities. This situation will continue to degrade Upolu's ecosystem functioning.

13 Impacts, Mitigation and Monitoring

13.1 Preamble

This section of the report provides the detailed Ecological Impact Assessment (EcIA) process conducted for the project design.

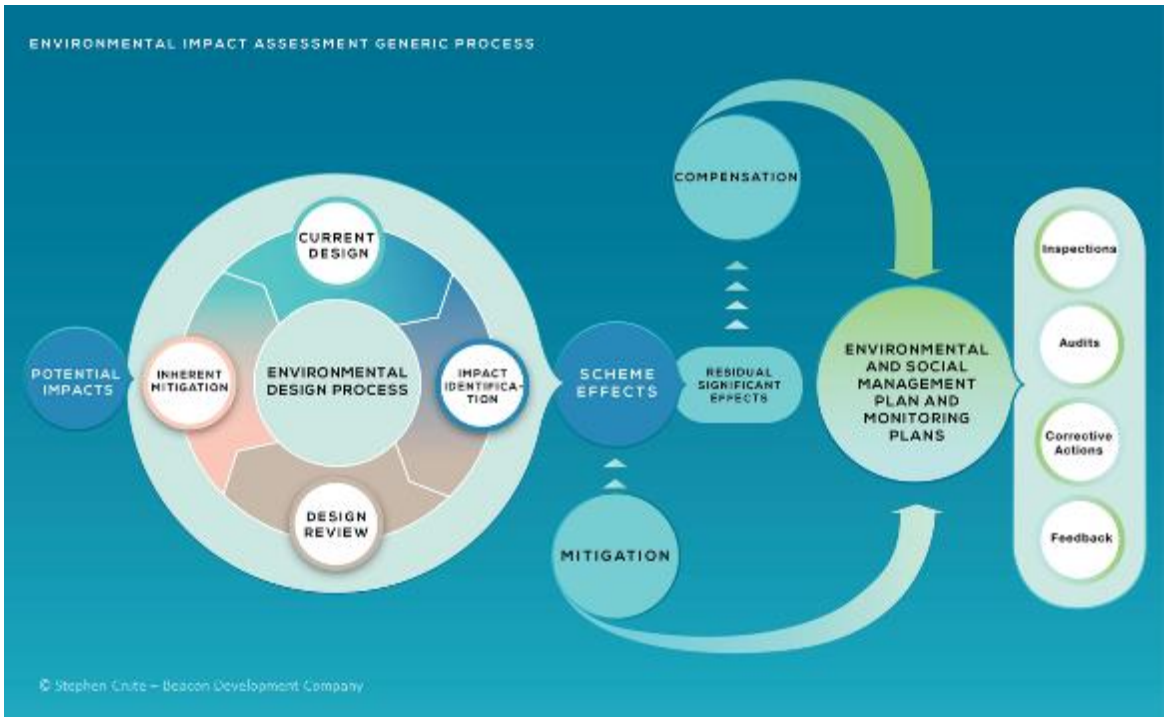
13.2 Generic Approach to Ecological Impact Assessment

Environmental Design Approach

The environmental design approach is intended to be used across all aspects of the project and in this case seeks to identify potential ecological/biodiversity impacts or risks at an early stage and remove or minimise the impacts or risks through modification of the design.

This is an iterative process, Figure 13.1 provides an overview of this process. An explanation of the process is provided below the figure.

Figure 13.1 Environmental Design Approach to EcIA



Source - Stephen Crute - not to be used without written permission

Any project will give rise to several potential impacts and risks to ecosystems and biodiversity components. Through the iterative process of identification of these potential impacts and risks and refinement of the design it can be seen that a number of the potential impacts and risks can be removed or 'designed out' of the project. This process can be referred to as 'design or inherent mitigation', which means the design has taken on board the possible impact or risk and mitigated it out of the Project.

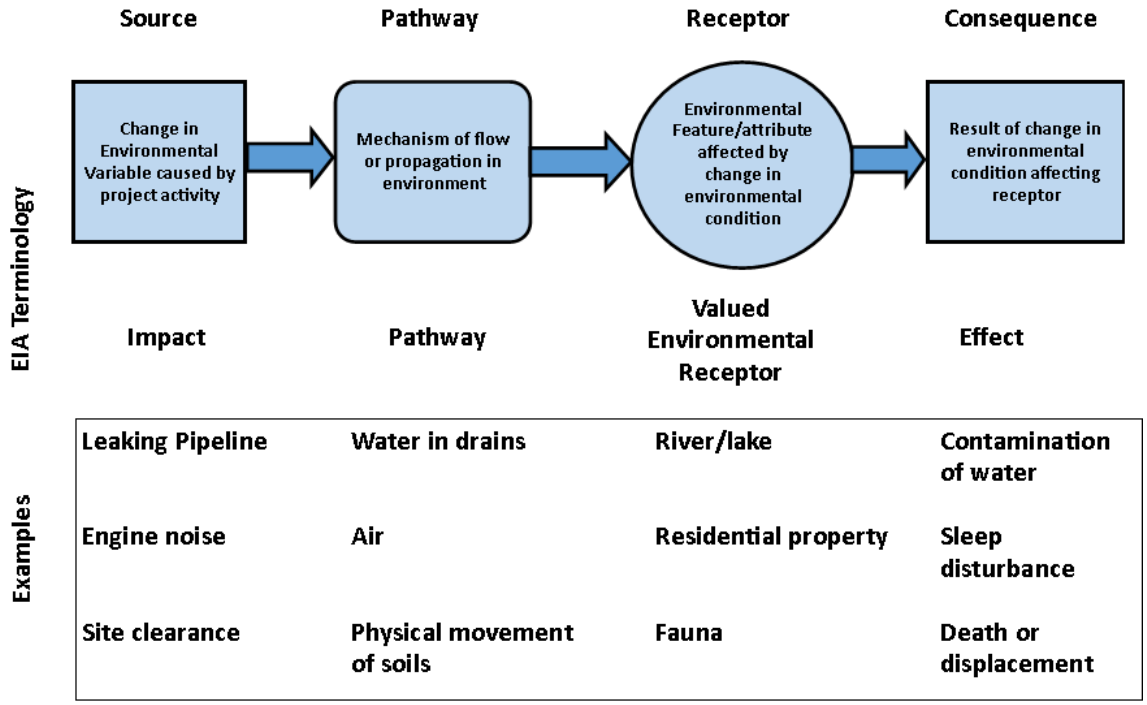
The iterative process should ideally take place through all stages of the design process, including site selection, project processes, alternative layouts etc. For the current project it is noted that a design has already been established and so implementing the good practice approach is limited.

13.3 Process of Determining Effects

A standardised approach has been based around standard terminology for the determination of impacts and determination of effects, their significance and mitigation or offsetting. The following sections provide an overview of the proposed process of impact assessment to be used for the current project. This Section provides the conceptual model to be used for determining effects.

The proposed approach for impact identification and assessment of effects relating to air land and water will be based on the Source - Pathway - Receptor - Consequence Model (SPRC). Such an approach is commonly used in contamination studies but is highly applicable for many of the elements considered in an EcIA process. The model is shown diagrammatically below in Figure 13.2.

Figure 13.2 Source - Pathway - Receptor - Consequence Model as Applied to EcIA



The model shows that to have an effect on a receptor you need all elements of the chain to be present. Therefore, an effect can only occur if there is a source (of change), a receptor upon which that change acts and a pathway between the source and receptor.

The SPRC conceptual model is less effective on intangible elements of the environment. These include potential exceedances of legislative standards and topics such where human perceptions and constructs are considered, for example landscape and visual impacts where individual perceptions of beauty, scenic value are important.

The SPRC model brings out some important aspects of terminology for the EcIA process. The first is that the terms impact and effect are not synonymous and cannot be used interchangeably. As can be seen, the **IMPACT** is the change in environmental variable. The size of change can be determined objectively in cases where change can be measured or predicted, for example increases in emissions to air.

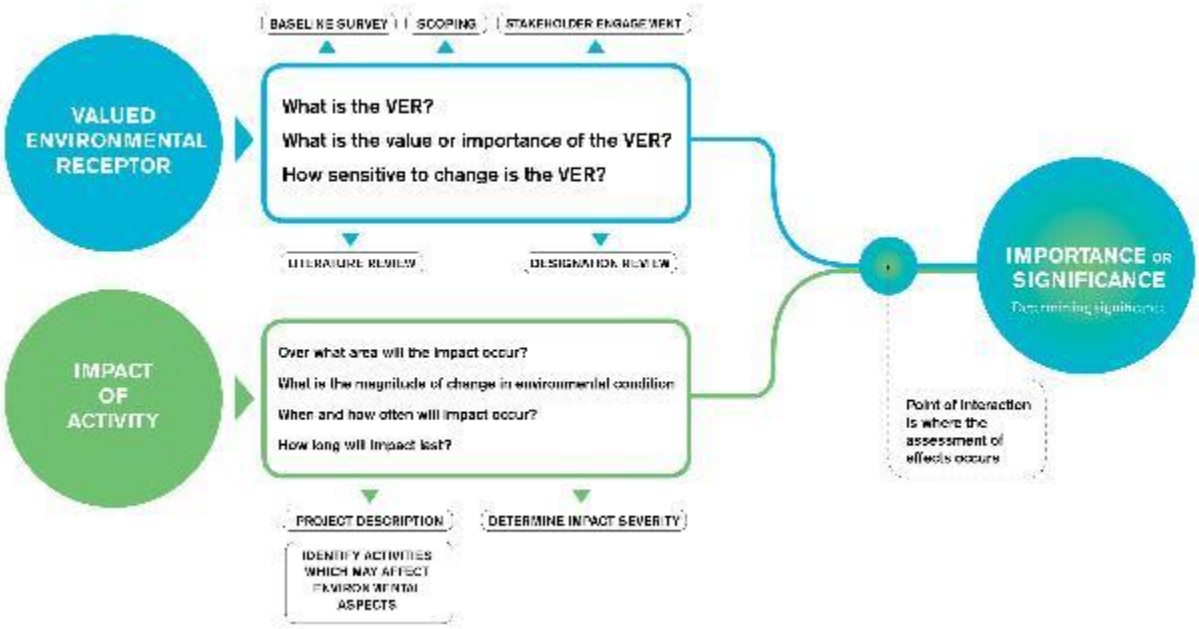
This **IMPACT** acting on the **VALUED ENVIRONMENTAL RECEPTOR** (**VER**) creates a consequence or **EFFECT** on that VER.

To determine the level or importance of the effects two key aspects need to be determined. These are:

- Characterisation of the magnitude and nature of the impact; and
- Identification of VERs and their level of importance and/or sensitivity to change.

This process is shown diagrammatically in Figure 13.3.

Figure 13.3 Overview of Process of Assessment



The following sections show how determination of VER's, and ascribing value/sensitivity was conducted for the CCRU.

13.4 Assessing Impacts

Valued Environmental Receptors

Based on the SPRC model it is necessary to identify ecological receptors which will be subject to the change due to the project.

VERs can be defined for the EcIA as:

- Elements of the biodiversity components of the project area and surrounding lands)
- Biodiversity Policies and designations
- Ecosystem functioning
- Ecosystem Services

The VERs are described in terms of their spatial importance and/or the sensitivity of that receptor to change due to potential impacts.

The ecological value (or sensitivity) of the receptors identified will be defined using the criteria in Table 13-1.

Table 13-1 Value and Sensitivity of Receptors used in the EcIA

Value / Sensitivity	Description of Value
International/ Extremely Sensitive	High importance and rarity, international scale, and limited potential for substitution (e.g., IUCN Endangered species) likely to include any areas of Critical Habitat - Extremely sensitive to change
National/ Highly sensitive	High importance and rarity, national scale, and limited potential for substitution, likely to include primary rain forest and areas of natural vegetation- very sensitive to change
Regional/ Moderately sensitive	High or medium importance and rarity, regional scale, limited potential for substitution (e.g., Functioning of wider ecosystems) - moderately sensitive to change
Local/ Low sensitivity	Low importance and rarity, local scale - insensitive to change (e.g., common species)

Establishing the VER's for the project is a fundamental building block of the EcIA process. Only VER's are referred to in the determination of significance of effect. VER identification and evaluation is the first step in the assessment process.

Characterising Impacts

Size of Impact

As noted above the impact is the change of state of the environment which is caused by a project activity. In general, this change can be measured or estimated in some manner. For some topics, the measure may be an area of land to be affected or number of trees to be lost etc., however other topics such as ecosystem functioning are less objective. Wherever possible the size of the impact should have a physical measurement.

For the established size of impact, the following values have been ascribed:

- Negligible see below text
- Low 3
- Medium 5
- High 8

For any impacts which do not exceed the threshold of significance then by definition, the impact severity must be negligible. A threshold of significance can be a physical measure, such as in the case of an air quality limit or may need to be based on judgement and first principles where such fixed measures are not available.

Other Aspects of an Impact

While the size of the change in environmental parameter is an important aspect of an impact, there are other aspects which will determine the severity of the impact when it acts on the receptor.

For this EcIA the following aspects are taken into consideration, in addition to the Size of Impact as set out above:

- Extent of impact
- Duration of Impact

- Frequency of Impact
- Probability of Impact Occurring
- Reversibility of Impact

The assessment process used in the EcIA process will use a bespoke scoring system to enable a systematic and transparent process to be undertaken to determine the impact magnitudes identified.

The following sections provide the scoring system used and its rationale.

Extent of Impact or Area of Influence (AoI)

This relates to the physical extent over which the impact will happen. A larger extent would tend to lead to increased risk of significant effects occurring than a highly localised AoI. The classification of this variable and the ascribed scores is shown in Table 13-2.

Table 13-2 Classification of Extent of Impact and Assigned Scores

Classification	Description	Example/s	Score
Very Local	The Area of Influence is highly limited, likely to take place only at the point of impact and not influencing receptors outside of this immediate area	Minor increases in noise levels during construction not extending from the work site	1
Local	The Area of Influence is contained within the project site or immediate surrounding area	Loss of local and common habitat within the site during clearance works	2
Regional	The Area of Influence extends to a regional scale, affecting areas outside the project site and into the wider environment	Loss of keystone native species from a region, or impacts on water catchment area	3
National	The Area of Influence extends to national scale	Loss or reduction of endemic species numbers or diversity	5
International	The Area of Influence will be cross boundary	Loss of species only found in affected location	7

Duration of Impact Effect

An impact's magnitude will be increased as its duration increases. It is important to note that the impact duration is not synonymous with the duration of the event causing the impact. The duration is defined as how long the impact will last. For example, a loss of containment event resulting in a chemical spill may last only 5 minutes but the impacts of the chemical entering the environment will last much longer depending upon the type of chemical, location and nature of spill and any remediation efforts.

The classification of this variable and the ascribed scores is shown in Table 13-3.

Table 13-3 Classification of Duration of Impact and Assigned Scores

Classification	Description	Example/s	Score
Transient	Less than 1 day	Noise disturbance during a heavy lift	1
Very Short Term	1 - 30 days	Localised construction noise affecting animal populations	2
Short term	1 - 12 months	Dust emissions from site clearance affecting nearby vegetation	3
Medium	1 - 5 years	Construction traffic effects on large projects	5
Long Term	Greater than 5 years	Loss of vegetation which can only slowly be regenerated	7
Permanent	Permanent	Clearance of natural vegetation which cannot be recreated	10

Frequency

An event, such as blasting during site preparation works, may be short term in nature but if the event is repeated many times during the course of the project, then the magnitude of the impact would be considered to be increased. The classification of this variable and the ascribed scores is shown in Table 13-4.

Table 13-4 Classification of Frequency of Impact and Assigned Scores

Classification	Description	Example/s	Score
One off	The event causing the impact occurs only once in the lifetime of the project	Clearance of soils and habitats at the start of the project	1/5*
Rare	A rare event in the lifetime of the project	Delivery of abnormal loads	2
Infrequent	An event which is expected to occur but not commonly as part of the normal project conditions	Release of pollutants into the natural environment	3
Frequent	An event will occur regularly throughout a phase of the project or the lifetime of the project	Daily construction activities	5
Continuous	An event which by the nature of the project is continuous	Noise emissions from operational facilities	7

*For one off events, a score of 1 is ascribed if the event does not lead to a permanent non-reversible impact, if the impact is permanent; a score of 5 is used.

Probability

Impact assessment for some issues is based on risk assessment. Not all predicted impacts will occur but should be considered in the assessment process. To account for this, a three-point probability scale and scores has been used as follows:

- Certain 5
- High 3
- Low 2

Reversibility

If an impact can be readily reversed, then its overall magnitude would be considered less than if it cannot be rectified. For example, the loss of natural habitats can never be fully reversed but the visual impact of a wind turbine will be reversed at the end of life when the turbine is dismantled and removed.

For this EcIA process a simple Yes or No scale is used with associated scores of 5 and 1, respectively.

Overall Impact Magnitude Scoring Model

The overall Impact score is obtained by summation of the ascribed values for each of the above variables. The cumulative scores will result in values across a range of 7 - 40. The impact assessment uses a four-point terminology to describe impact magnitude. This is presented in Table 13-5. The model ascribes the outcomes of the scoring of the variables as follows.

- 9 - 16 Negligible
- 17 - 25 Minor
- 26 - 34 Moderate
- 35 and above Major

As noted above, if the Size of The Impact

Table 13-5 Criteria for Magnitude of Impacts used in the EcIA

Magnitude	Description of Adverse Consequence	Description of Beneficial Consequence
Major	Loss of resource and/or quality and integrity, severe damage to key characteristics, features, or elements	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality
Moderate	Significant impact on the resource, but not adversely affecting the integrity, partial loss of/damage to key characteristics, features, or elements	Benefit to, or addition of, key characteristics, features, or elements; improvement of attribute quality
Minor	Some measurable change in attributes quality or vulnerability, minor loss of, or alteration to, one (maybe more) key characteristic, features, or element	Minor benefit to, or addition of, one (maybe more) key characteristic, features, or element; some beneficial impact on attribute or a reduced risk of negative impact occurring
Negligible	No loss, or very minor loss or detrimental alteration to one or more characteristic, feature or element	Very minor benefit to or positive addition of one or more characteristics, features, or elements

Assessment of Significance

A significant effect may be broadly defined as one which should be brought to the attention of those involved in the decision-making process. The determination of significance of an effect uses a two-dimensional matrix based on the above parameters of Impact magnitude and value/sensitivity of the receptor. The proposed assessment will use a matrix for determining the significance of an effect as presented in Table 13-6.

Significance is therefore a function of the value or sensitivity of the receptor being considered defined in Table 13-1 and the consequence of impacts defined in Table 13-5.

Table 13-6 Matrix for Determining the Significance of Ecological Impacts

	International/ Extreme	National/ High	Regional/ Moderate	Local/Low
Major	HIGH	HIGH	MEDIUM	LOW
Moderate	HIGH	MEDIUM	MEDIUM	LOW
Minor	MEDIUM	MEDIUM	LOW	NS
Negligible	NS	NS	NS	NS

The EcIA will utilise the following semantic definitions of the significance terms High, Moderate and Low. They are based on the terminology used in international principles and guidance and on the geographical context of the effect:

- High - An environmental effect that has importance at international or national level and is irreversible or unprecedented
- Medium - An environmental effect that has importance at a regional scale and/or one that can be readily reversed with intervention and is limited to the site boundary and immediate surrounding area
- Low - An environmental effect that is only important in a local context, which is readily mitigated, and it occurs only within the boundary of the project
- NS - An environmental effect that is considered Non-Significant

Significant adverse effects occur where valuable or sensitive receptors, or numerous receptors, are subject to impacts of considerable magnitude and duration. Some effects will be temporary, others are permanent in nature, and these will be stated in the assessment.

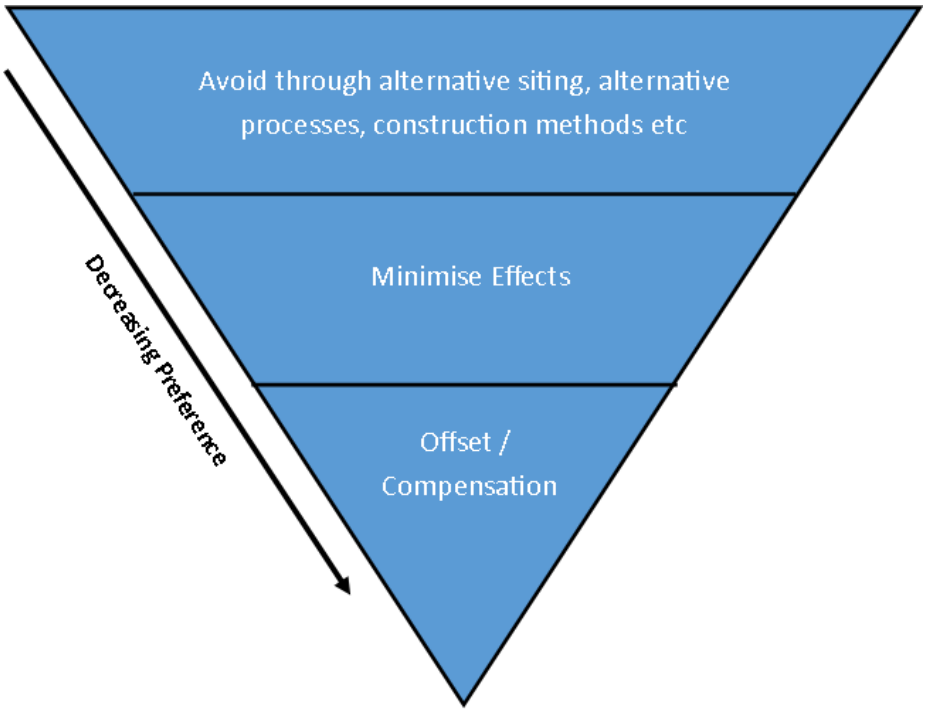
13.5 Hierarchy of Mitigation

One of the aims of the EcIA process is to design out or otherwise remove significant effects from the project. Those which cannot be removed completely should be minimised, and finally those which remain significant and cannot be reduced further have to be accepted. For significant residual effects it may be necessary to provide compensation or offsetting. This is where some other aspect of the environment is developed or managed in a manner which offsets unavoidable significant effect.

Offsetting is often used in managing biodiversity effects. As an example, loss of a wooded area can be offset; given time, by replanting similar species within the area, or by providing improved management and protection of other areas of similar habitat within the region of the project.

Figure 13.4 shows the Hierarchy of Mitigation as defined by the World Bank Group.

Figure 13.4 Hierarchy of Mitigation



The above hierarchy is implicit within the proposed approach to Ecological Assessment for the current project.

In theory mitigation would only be required for those effects which had been determined to be significant in an objective manner. However, within the EcIA, there is also a need to deal with human perceptions and emotions and so mitigation may be developed for reasons other than pure objective ones.

Defining appropriate mitigation is important in the process, but perhaps more important is recognising that any mitigation measures must be project commitments. Within the current EcIA process a register of commitments has been developed, these will be provided to the project proponent and the contractor for approval.

13.6 Impact Assessment

Preamble

The results of the impact assessment, for Terrestrial Ecology only, are shown in the following sections, mainly in tabular form. The tables provide a summary of the Impact and the assessment of significance based on the methodology set out above. Then the committed mitigation measures are set out and based on the assumption that these measures will be fully implemented by the project the post mitigation significance is set out.

The tables provide the summary assessment for each main phase of the project, namely Design and Land take, Construction and Operations and Maintenance.

The tables utilise a number of abbreviations in the assessment section. These are shown in Table 13-7.

Table 13-7 Abbreviations used in Impact Summary Tables

Impact (Im)	Impact Characteristic (C)
Extent (E)	Very Local (VL)
	Local (Lo)
	Regional (R)
	National (N)
	International (I)
Duration (D)	Transient (T)
	Very Short Term (VST)
	Short Term (ST)
	Medium (M)
	Long Term (LT)
	Permanent (P)
Frequency (F)	One off (OO)
	Rare (R)
	Infrequent (IF)
	Frequent (Fre)
	Continuous (C)
Probability (P)	Certain (Cer)
	High (H)
	Low (L)
Reversibility (R)	Yes (Y)
	No (N)
Size (S)	Low (L)
	Medium (M)
	High (H)
Score (SC)	-

The tables relate to project specific impacts and mitigation. In addition to these there is a risk of cumulative impacts across the whole route and potential impacts which may occur due to the increased ease of use and ability to travel from one side of the island to the other which may result in induced effects. These are discussed, along with mitigation and compensation at the end of this section on project specific effects.

Valued Environmental Receptors

In total 25 terrestrial ecology related VERs were identified for the project. These were identified at the early stages o the project. They included species which had been identified in the original IEE as potentially present and which have been the subject of the current survey work and assessment. Of the 25 original VERs, four were dropped from the full assessment as survey work showed that the species in question were not present within the project area, or that Supporting services for ecosystem services were not relevant to the assessment. The four excluded VER's were:

- Palm Species - *Balaka insularis*
- Fern species - *Clinostigma samoense*
- Snail - *Thaumatodon hystricelloides*
- Ecosystem services – Supporting.

The remaining 21 VERs (with their original numbering) used in the assessment are listed in Table 13-8.

Table 13-8 Terrestrial Ecology Valued Environmental Receptors

VER No.	Description of Valued Environmental Receptor	Value/ Sensitivity	Comments on VER
1	Tooth-billed pigeon (*Didunculus strigirostris*) and suitable habitat for nesting and feeding	International/ Extreme	IUCN Critically Endangered species
2	Bird - Ma'oma'o (*Gymnomyza samoensis*) and suitable feeding and nesting habitat	International/ Extreme	IUCN Endangered
3	Samoan Flycatcher (*Myiagra albiventris*) and suitable nesting and feeding habitat	National/High	IUCN Red List Near Threatened
4	Assemblage of Endemic Bird species	National/High	Range of species which are considered endemic to Samoa
5	Other native bird species	Local/Low	Assemblage of native species
6	Fruit bat Samoan flying fox (*Pteropus samoensis*)	National/High	IUCN Red List - Near Threatened
7	Pacific flying fox (*Pteropus tonganus*)	Local/Low	IUCN Red List - Least Concern
8	Pacific sheath-tailed bat (*Emballonura semicaudata*)	International/ Extreme	IUCN Red List - Endangered, considered to be Critically Endangered or likely extirpated from Samoa
9	*Emoia samoensis* - Tree skink	International/ Extreme	IUCN Red List - Endangered
10	Other reptiles	Local/Low	_____
14	Invasive species	National/High	Range of invasive species - including plants and fauna, - see Report description
15	Apia Catchments Important Bird Area	International/ Extreme	Non statutory designation of large central area including p[arts of the road alignment
16	Lake Lanotoo Wetland of International Importance designated under the Ramsar Convention	International/ Extreme	Included in assessment for secondary/indirect impacts only
17	O Le Pupu Pu'e Wetland of International Importance designated under the Ramsar Convention	International/ Extreme	Included in assessment for secondary/indirect impacts only
18	Hedgerows along route	Local/Low	Found in some locations where landowners/,managers have used timpber posts which have regenerated
19	Mature trees along route alignment	Local/Low	Mixed native and non native – includes some signficant Banyan trees

VER No.	Description of Valued Environmental Receptor	Value/ Sensitivity	Comments on VER
20	Existing roadside vegetation/habitats	Local/Low	Common road verge species
21	Modified habitats such as pasture and plantations	Local/Low	Common along route outside of urban area
22	Ecosystem services - Regulating	Local/Low	Range of services provided by existing road side vegetation Soil stability, run off protection, shading
23	Ecosystem Services - provisioning	Local/Low	Pasture and plantation land used for food production
25	Ecosystem functioning	Regional/Moderate	Functioning of overall ecosystem, primary production, shelter for fauna, food chains etc.

Design and Land Take Impacts

Table 13-9 shows the predicted impacts, their significance and committed mitigation measures relating to the design and required land take for the project.

The land take is relatively small and for the entire route is from modified habitats. Thus, effects are relatively low, even in areas which may affect the identified IBA and nearby Ramsar sites.

Key mitigation measures relate to minimisation of land take and importantly, adopting a design approach which allows for flexibility of the proposed widening. As proposed the project anticipates symmetrical widening, that is works will take place on both sides of the road, with more or less equal land take from both sides. It is recommended that the design be based on a asymmetrical widening approach, so that most land take, especially within the rural section of the route is from one side of the existing road only. This reduces disturbance and simplifies construction activities. The need for asymmetrical widening is particularly necessary where potential tree loss has been identified. As designed the road would result in loss of 65 mature trees, all these losses can be readily avoided by asymmetrical widening.

Many impacts of new roads, especially in rural areas, have already been realised by the existing road. The proposed works do not require any major realignment of the route, no new side roads or accesses. The design will therefore not increase the risk of access to areas which are currently undisturbed.

Construction

Table 13-10 shows the predicted impacts, their significance and committed mitigation measures relating to the construction period of the project.

It can be seen that this is the key period when impacts and risks may occur. In terms of committed mitigation, the main measures will be the implementation of an approved Construction Environmental Management Plan (CEMP) which includes the required mitigation measures set out within this report and assessment.

Operations and Maintenance

A summary of the impacts and mitigation measures for the Operational and Maintenance period of the project is presented in Table 13-11. There are three identified potential effects for this phase of the project, each was considered to be non-significant effects due to the relatively small impact magnitude.

This finding is not unexpected as the road is existing and the intent of the project is not to increase traffic volume, nor change the mix of vehicles using the road (for example increasing the percentage of heavy goods vehicles), or to change speed limits on the road. The operational impacts are already occurring.

No additional mitigation measures are required for this phase of the project.

Table 13-9 Summary of Impacts and Mitigation - Design and Land Take

Impact ID	Description	Impact Magnitude	Receptor No and Description	Receptor Value/ Sensitivity	Significance before Mitigation	Approved Mitigation Measures	Significance after Mitigation
TE001	Land take affecting Apia Catchments IBA- impact on actual footprint and policy requirements	**Im** **C** **S** S bT 1 E Lo 2 D Per 10 F One 1 P Cer 5 Rev N 5 Negligible* **29** **Permanent and One-off Impacts score five additional points**	15. Apia Catchments IBA	International/ Extreme	NS	Project to minimise required land take at this location. Consider use of footpaths over the drainage channels to restrict right of way width	NS
TE003	Land take from areas known to be over flown by Tooth-billed pigeon (*Didunculus strigirostris*)	**Im** **C** **S** S bT 1 E VL 1 D Per 10 F One 1 P Cer 5 Rev N 5 Negligible* **28** **Permanent and One-off Impacts score five additional points**	1. Tooth-billed pigeon (*Didunculus strigirostris*) and suitable habitat for nesting and feeding	International/ Extreme	NS	Project to minimise required land take at this location.	NS
TE006	Unnecessary loss of mature trees - mix of native (Banyan) and non-native teak species Total of 65 trees	**Im** **C** **S** S Med 5 E Lo 2 D Per 10 F One 1 P Cer 5 Rev N 5 Moderate* **33** **Permanent and One-off Impacts score five additional points**	19. Mature trees along route alignment	Local/Low	Low	Change footprint in each location to asymmetrical widening to avoid requirement to fell trees.	NS
TE009	Land take from areas known to be over flown by Ma'oma'o (*Gymnomyza*	**Im** **C** **S** S bT 1 E VL 1 D Per 10	2. Bird - Ma'oma'o (*Gymnomyza samoensis*) and	International/ Extreme	NS	Project to minimise required land take at this location.	NS

Impact ID	Description	Impact Magnitude	Receptor No and Description	Receptor Value/ Sensitivity	Significance before Mitigation	Approved Mitigation Measures	Significance after Mitigation
	samoensis)	F One 1 P Cer 5 Rev N 5 Negligible* **28** **Permanent and One-off Impacts score five additional points**	suitable feeding and nesting habitat				
TE012	Loss of habitat for Near Threatened Samoan Flycatcher	**Im C S** S Lo 3 E Lo 2 D Per 10 F One 1 P Cer 5 Rev Y 1 Moderate **27** **Permanent and One-off Impacts score five additional points**	3. Samoan Flycatcher (*Myiagra albiventris*) and suitable nesting and feeding habitat	National/High	Medium	Minimisation of loss of habitat within project boundary through effective design, place footpaths over drainage ditches to narrow land take Replacement of boundary hedges using traditional approach to use of native wood as fence posts which then regenerate to form hedge/boundary trees	NS
TE014	Loss of general feeding, roosting and nesting habitats for range of endemic bird species	**Im C S** S Lo 3 E Lo 2 D Per 10 F One 1 P Cer 5 Rev Y 1 Moderate **27** **Permanent and One-off Impacts score five additional points**	4. Assemblage of Endemic Bird species	National/High	Medium	Minimisation loss of trees and scrub through the use of asymmetrical widening at key locations (cf. Mitigation measure for TE006)	Low
TE015	General of habitat for local and non-endemic bird species	**Im C S** S Lo 3 E Lo 2 D Per 10 F One 1 P Cer 5	5. Other native bird species	Local/Low	Low	See TE014 Mitigation	NS

Impact ID	Description	Impact Magnitude	Receptor No and Description	Receptor Value/ Sensitivity	Significance before Mitigation	Approved Mitigation Measures	Significance after Mitigation
		Rev Y 1 Moderate **27** **Permanent and One-off Impacts score five additional points**					
TE017	Loss of habitat for tree skinks	**Im C S** S Lo 3 E Lo 2 D Per 10 F One 1 P Cer 5 Rev N 5 Moderate **31** **Permanent and One-off Impacts score five additional points**	9. *Emoia samoensis* - Tree skink	International/ Extreme	High	Avoid loss of trees along route through redesign of project and use of asymmetrical widening (cf mitigation for TE006)	NS
TE023	Loss of existing roadside vegetation, grassland and scrub	**Im C S** S Lo 3 E Lo 2 D Per 10 F One 1 P Cer 5 Rev Y 1 Moderate **27** **Permanent and One-off Impacts score five additional points**	20. Existing roadside vegetation/habitats	Local/Low	Low	Minimise footprint of project	Low

Table 13-10 Summary of Impacts and Mitigation - Construction

Impact ID	Description	Impact Magnitude	Receptor No and Description	Receptor Value/ Sensitivity	Significance before Mitigation	Approved Mitigation Measures	Significance after Mitigation
TE004	Secondary effects such as quarrying, disposal of waste materials during the construction period	**Im** **C** **S** S Med 5 E Lo 2 D LT 7 F Fre 5 P Lo 2 Rev N 5 Moderate **26**	15. Apia Catchments IBA	International/ Extreme	High	Contractor to develop quarrying/material sourcing plan, to be approved by LTA and ADB and fully implemented. Plan to exclude souring materials or waste deposition in sensitive areas, including IBA and the two Ramsar sites CEMP to prohibit quarrying or waste disposal within IBA area and buffer zone of 1 km.	NS
TE005	Loss of integrity of Ramsar site. Potential impacts on water regimes and status due to works.	**Im** **C** **S** S Lo 3 E VL 1 D Med 5 F Con 7 P Lo 2 Rev N 5 Minor **23**	16. Lake Lanotoo Wetland of International Importance designated under the Ramsar Convention	International/ Extreme	Medium	No depositing of liquid or solid waste within Ramsar site and 5 km buffer around site boundary. No water to be extracted within Ramsar site and within buffer zone of 5 km	NS
TE007	Secondary disturbance of Tooth-billed pigeon due to construction activities, incursion into areas of more natural habitat away from the route.	**Im** **C** **S** S Lo 3 E Lo 2 D ST 3 F Inf 3 P Lo 2 Rev Y 1 Negligible **14**	1. Tooth-billed pigeon (*Didunculus strigirostris*) and suitable habitat for nesting and feeding	International/ Extreme	NS	Ensure contractors camps are not located within IBA area or are in areas with modified habitats. CEMP to include clear delineation of areas which are off limits to contractor activities	NS
TE010	Secondary disturbance of Ma'oma'o due to construction activities,	**Im** **C** **S** S Lo 3 E Lo 2	2. Bird - Ma'oma'o (*Gymnomyza*	International/ Extreme	NS	Ensure contractors camps are not located within IBA area or	NS

Impact ID	Description	Impact Magnitude	Receptor No and Description	Receptor Value/ Sensitivity	Significance before Mitigation	Approved Mitigation Measures	Significance after Mitigation
	incursion into areas of more natural habitat away from the route.	D ST 3 F Inf 3 P Lo 2 Rev Y 1 Negligible **14**	*samoensis*) and suitable feeding and nesting habitat			are in areas with modified habitats. CEMP to include clear delineation of areas which are off limits to contractor activities	
TE013	Secondary disturbance due to construction activities	**Im C S** S Lo 3 E Lo 2 D ST 3 F Inf 3 P Hi 3 Rev Y 1 Negligible **15**	3. Samoan Flycatcher (*Myiagra albiventris*) and suitable nesting and feeding habitat	National/High	NS	Control of construction activities and off-site locations through CEMP	NS
TE016	Secondary impacts on fruit eating bats - disturbance due to construction activities and accidental/deliberate encroachment into mature woodland and plantations	**Im C S** S Lo 3 E Lo 2 D Med 5 F Inf 3 P Lo 2 Rev Y 1 Negligible **16**	6. Fruit bat Samoan flying fox (*Pteropus samoensis*)	National/High	NS	CEMP to set out access limits	NS
TE018	Indirect effects due to accidental or deliberate incursion and felling of trees by contractors	**Im C S** S Med 5 E Lo 2 D Med 5 F Inf 3 P Lo 2 Rev N 5 Minor **22**	9. *Emoia samoensis* - Tree skink	International/ Extreme	Medium	Restriction of contractor activities outside of project area	NS
TE019	Loss of habitats within road verge for reptiles, potential direct harm to	**Im C S** S Lo 3 E Lo 2	10. Other reptiles	Local/Low	NS	Contractor staff to be briefed as part of induction process	NS

Impact ID	Description	Impact Magnitude	Receptor No and Description	Receptor Value/ Sensitivity	Significance before Mitigation	Approved Mitigation Measures	Significance after Mitigation
	individuals during site clearance works	D Per 10 F Inf 3 P Lo 2 Rev N 5 Minor **25**				on potential presence of reptiles and instructed to stop work and seek advice from contract supervision staff	
TE020	Introduction and/or spreading of harmful invasive species. Such effects would be in contradiction to Samoa's Action Plans and intent on control of invasive species.	**Im C S** S Med 5 E Lo 2 D LT 7 F Fre 5 P Cer 5 Rev N 5 Moderate **29**	14. Invasive species	National/High	Medium	Soil and other materials excavated from existing road verge that is to be reused shall not be moved more than 100 m from its existing location. Stockpiles should be placed onto ground with a geotextile or hard surface ready for reuse. Hauling of such materials long distances shall not be permitted unless for legal disposal LTA shall implement a policy to control invasion of harmful invasive species into newly created road verges Contractors staff shall not feed birds or other animals within project-controlled areas or restricted areas Contractor shall utilise an integrated pest management system to manage risk of vermin	Low

Impact ID	Description	Impact Magnitude	Receptor No and Description	Receptor Value/ Sensitivity	Significance before Mitigation	Approved Mitigation Measures	Significance after Mitigation
						Contractor shall impose a strict policy on waste management to prevent attraction of vermin, rats and cats to work and camp areas. Contractors shall not be allowed to keep animals on site or within work camps, office sites etc. To include dogs and cats., All excess soils and material to be removed during the construction process to be taken to permitted land disposal area and buried deeper than 2 m with consolidated cover	
TE022	Loss of integrity of Ramsar site. Potential impacts on water regimes and status due to works.	**Im** **C** **S** S Lo 3 E VL 1 D Med 5 F Con 7 P Lo 2 Rev N 5 Minor **23**	17. O Le Pupu Pu'e Wetland of International Importance designated under the Ramsar Convention	International/ Extreme	Medium	No water to be extracted within Ramsar site and within buffer zone of 5 km No depositing of liquid or solid waste within Ramsar site and 5 km buffer around site boundary.	NS
TE024	Increased run off rates into stream from increased road area and improved drainage. Leading to potential soil erosion, changes in water turbidity and	**Im** **C** **S** S Med 5 E Lo 2 D Per 10 F Inf 3 P Hi 3	16. Lake Lanotoo Wetland of International Importance designated under	International/ Extreme	High	Include oil interceptors within areas where water drains into local stream network	Low

Impact ID	Description	Impact Magnitude	Receptor No and Description	Receptor Value/ Sensitivity	Significance before Mitigation	Approved Mitigation Measures	Significance after Mitigation
	localised flooding	Rev N 5 Moderate **28**	the Ramsar Convention			Include temporary holding ponds to reduce flow rates from drainage systems., Design drainage system using Sustainable Urban Drainage techniques and approach.	
TE025	Changes to ecosystem services due to loss of vegetation.	**Im C S** S Lo 3 E Lo 2 D Med 5 F One 1 P Hi 3 Rev Y 1 Negligible **15**	25. Ecosystem functioning	Regional/Moderate	NS	_____	NS

* Indicates Impacts which are considered to fall below the significance of Effect threshold as defined by the size of change - (See Section 13.4). Therefore, regardless of the Impact Magnitude score, if they are considered to fall below a significance threshold, then by definition they must be non-significant or negligible.

Table 13-11 Summary of Impacts and Mitigation - Operations and Maintenance

Impact ID	Description	Impact Magnitude	Receptor No and Description	Receptor Value/ Sensitivity	Significance before Mitigation	Approved Mitigation Measures	Significance after Mitigation
TE002	Potential impacts on birds which have qualified the area as an IBA - increased risk of collision, loss of feeding areas	**Im** **C** **S** S bT 1 E Lo 2 D Per 10 F Ra 2 P Lo 2 Rev N 5 Negligible* **22**	15. Apia Catchments IBA	International/ Extreme	NS	_____	NS
TE008	Increased risk of collision due to higher speeds and more traffic on route	**Im** **C** **S** S bT 1 E Lo 2 D Per 10 F Ra 2 P Lo 2 Rev N 5 Negligible* **22**	1. Tooth-billed pigeon (*Didunculus strigirostris*) and suitable habitat for nesting and feeding	International/ Extreme	NS	_____	NS
TE011	Increased risk of collision with Ma'oma'o due to higher speeds and more traffic on route	**Im** **C** **S** S bT 1 E Lo 2 D Per 10 F Ra 2 P Lo 2 Rev N 5 Negligible* **22**	2. Bird - Ma'oma'o (*Gymnomyza samoensis*) and suitable feeding and nesting habitat	International/ Extreme	NS	_____	NS

* Indicates Impacts which are considered to fall below the significance of Effect threshold as defined by the size of change - (See Section 13.4). Therefore, regardless of the Impact Magnitude score, if they are considered to fall below a significance threshold, then by definition they must be non-significant or negligible.

Summary of Ecological Impact Assessment Process

The total number of impacts identified during the EcIA process was twenty-four, a breakdown of which is provided in the following tables.

Table 13-12 provides a breakdown of the 24 identified impacts by significance level before and after mitigation is applied. Of the 24 identified impacts, 12 of them (50%) were scored as non-Significant without mitigation. This is considered to be an accurate reflection of the nature of the project and the receiving environment. The absence of any direct impacts on high value sites, the fact that the project is an upgrade of an existing road and with limited land take means that the risks to the identified VERs was considered to be negligible.

Of the 12 remaining impacts or risks, three were at Low Significance, seven of Medium Significance and two of High Significance.

Table 13-13 shows the effect of committed mitigation measures. The left-hand column shows the original significance level, with the following column giving the number of effects ascribed to that significance level before mitigation. Subsequent columns show how original significance levels without mitigation will be reduced through the effective implementation of the committed mitigation measures.

Of the 24 identified impacts, 20 are considered to be reduced to an acceptable level through the application of the mitigation measures set out in the impact summary tables. Of the four remaining impacts all are considered to be of Low Significance. It should be noted that within the ascribed approach to Ecological Impact Assessment, Low Significance still means that the effect is significant and should be taken into consideration by decision makers when determining the permitting of the project.

Table 13-12 Summary of Significance Before and After Mitigation

Significance	Before Mitigation	After Mitigation
NS	12	20
Low	3	4
Medium	6	0
High	3	0
Total	**24**	**24**

Table 13-13 Effect of Committed Mitigation

Original Significance	Original Number	Change to:			
		High	Medium	Low	NS
High	3	0	0	1	2
Medium	6		0	2	4
Low	3			1	2
NS	12				12

Residual Significant Effects

The remaining significant effects, after mitigation, are known as Residual Significant Effects. These are effects which shall be highlighted in the assessment process.

Table 13-14 provides a summary of the four residual effects of the project as determined by the conducted process (terrestrial ecology only).

Table 13-14 Residual Significant Effects

Impact ID	VER	Impact Description	Significance
TE024	Lake Lanotoo Wetland of International Importance designated under the Ramsar Convention	Increased run off rates into stream from increased road area and improved drainage. Leading to potential soil erosion, changes in water turbidity and localised flooding	Low
TE023	Existing roadside vegetation/habitats	Loss of existing roadside vegetation, grassland and scrub	Low
TE020	Invasive species	Introduction and/or spreading of harmful invasive species. Such effects would be in contradiction to Samoa's Action Plans and intent on control of invasive species	Low
TE014	Assemblage of Endemic Bird species	Loss of general feeding, roosting and nesting habitats for range of endemic bird species	Low

It can be seen that each of these are considered to be of Low; but still important, Significance.

13.7 Mitigation

The term mitigation refers to the removal of an impact or reduction in its severity. Where impacts cannot be further reduced in their severity or significance, any additional measures are referred to as compensation. For example, the loss of vegetation along the route for the road cannot be avoided – it is an intrinsic function of the project and cannot be reduced. Therefore, any measures taken to offset these losses are considered as compensation and not mitigation.

All mitigation set out in this EcIA has been committed to by ADB and the GoS and therefore forms part of the legal requirements of the project. Should any of the commitments be not able to be met, the assessment of significance should be reconsidered, and a new statement of impacts produced.

For clarity the detailed mitigation measures are set out in Table 13-15. These only include unique mitigation measures. Where similar or identical measures have been proposed but for different effects, they are not repeated.

Table 13-15 Committed Mitigation Measures - Unique Measures Only

Impactid	Description	Phase
TE001	Project to minimise required land take at this location. Consider use of footpaths over the drainage channels to restrict right of way width	Design Footprint
TE003	Project to minimise required land take at this location	Design Footprint
TE004	Construction Environmental Management Plan (CEMP) to prohibit quarrying or waste disposal within IBA area and buffer zone of 1 km.	Construction
TE004	Contractor to develop quarrying/material sourcing plan, to be approved by LTA and ADB and fully implemented. Plan to exclude souring materials or waste deposition in sensitive areas, including IBA and the two Ramsar sites	Construction
TE005	No water to be extracted within Ramsar site and within buffer zone of 5 km	Construction
TE005	No depositing of liquid or solid waste within Ramsar site and 5 km buffer around site boundary	Construction
TE006	Change footprint in each location to asymmetrical widening to avoid requirement to fell trees	Design Footprint
TE007	Ensure contractors camps are not located within IBA area or are in areas with modified habitats. CEMP to include clear delineation of areas which are off limits to contractor activities	Construction
TE009	Project to minimise required land take at this location	Design Footprint
TE010	Ensure contractors camps are not located within IBA area or are in areas with modified habitats. CEMP to include clear delineation of areas which are off limits to contractor activities	Construction
TE012	Replacement of boundary hedges using traditional approach to use of native wood as fence posts which then regenerate to form hedge/boundary trees	Design Footprint
TE012	Minimisation of loss of habitat within project boundary through effective design, place footpaths over drainage ditches to narrow land take	Design Footprint
TE013	Control of construction activities and off-site locations through CEMP	Construction
TE016	CEMP to set out access limits	Construction
TE017	Avoid loss of trees along route through redesign of project and use of asymmetrical widening (cf. mitigation for TE006)	Design Footprint
TE018	Restriction of contractor activities outside of project area	Construction

Impactid	Description	Phase
TE019	Contractor staff to be briefed as part of induction process on potential presence of reptiles and instructed to stop work and seek advice from contract supervision staff	Construction
TE020	All excess soils and material to be removed during the construction process to be taken to permitted land disposal area and buried deeper than 2 m with consolidated cover	Construction
TE020	Contractors shall not be allowed to keep animals on site or within work camps, office sites etc. To include dogs and cats	Construction
TE020	Contractor shall impose a strict policy on waste management to prevent attraction of vermin, rats, and cats to work and camp areas	Construction
TE020	Contractor shall utilise an integrated pest management system to manage risk of vermin	Construction
TE020	Contractors staff shall not feed birds or other animals within project-controlled areas or restricted areas	Construction
TE020	LTA shall implement a policy to control invasion of harmful invasive species into newly created road verges	Construction
TE020	Soil and other materials excavated from existing road verge that is to be reused shall not be moved more than 100 m from its existing location. Stockpiles should be placed onto ground with a geotextile or hard surface ready for reuse	Construction
TE022	No depositing of liquid or solid waste within Ramsar site and 5 km buffer around site boundary	Construction
TE022	No water to be extracted within Ramsar site and within buffer zone of 5 km	Construction
TE023	Minimise footprint of project	Design Footprint
TE024	Design drainage system using Sustainable Urban Drainage (SUDS) techniques and approach	Construction
TE024	Include temporary holding ponds to reduce flow rates from drainage systems	Construction
TE024	Include oil interceptors within areas where water drains into local stream network	Construction

The design and footprint impacts and associated mitigation need to be addressed through the developing design. Such measures were proposed to the Design Consultants at an early stage of the EclA process.

For construction mitigation, the main route to implementation will be through the development of a comprehensive CEMP. This will set out the processes, procedures, and requirements of the construction contractors as to how the environmental effects and risks will be managed, monitored and reported.

Part of the CEMP package will be a Topic Specific Environmental Management Plan for Biodiversity.

13.8 Monitoring

In order to ensure that the committed mitigation measures are implemented in full and are effective in controlling environmental impacts and risks, monitoring of the construction process and operational period is required. In addition, monitoring and reporting will identify if any unanticipated environmental effects, in this case on terrestrial ecology are occurring and need addressing.

For specified identified impacts, monitoring as set out in Table 13-16 will be adopted by the project and form part of the established environmental and social monitoring and reporting processes.

Table 13-16 Monitoring Requirements - Terrestrial Ecology

Impact ID	Monitoring Description	Frequency	Duration	No of Locations	Equipment Required
TE004	Physical inspection of sources of materials to ensure no activities within IBA boundary or protection buffer zone	Minimum of monthly inspections	Throughout construction period	N/A	No special equipment required - camera to record any non-conformances
	Review of implementation of resource source and waste management plans	Monthly reporting	Throughout construction period	N/A	None
	Review of waste manifest paperwork to check on source and final destination of all waste materials	Monthly reporting	Throughout the construction period	N/A	None required
TE007	Check environmental complaints/GRM register for any incidents reporting contractors, waste dumping etc outside of permitted areas.	At least monthly	Throughout construction period	N/A	Nonspecific
	Random checks to ensure that accidental or deliberate incursion into restricted areas as set out in the CEMP is not occurring	At least monthly	Throughout the construction period	N/A	Nonspecific
TE008	LTA to establish reporting process for bird strike along route for 12 months post completion works to include weekly drive along route to check for any dead birds on road. Images of any harmed species to be taken and species identified	Weekly	1 year post completion	Along Route	Vehicle and camera
TE013	Check on construction activities to ensure no incursion into restricted areas	Random checks at least once per month	Throughout construction period	N/A	Nonspecific
TE018	Regular and random checks on constructor activities to ensure no encroachment into restricted areas	Monthly minimum	Throughout construction period	N/A	Nonspecific
	Review of environmental complains/GRM for	Weekly	Throughout construction period	N/A	Nonspecific

Impact ID	Monitoring Description	Frequency	Duration	No of Locations	Equipment Required
	information on incidents relating to offsite tree felling, habitat loss etc				
TE020	Monitoring of excess soil and waste disposal shall be conducted via manifest system	Weekly during excavation works period	Throughout the project period	N/A	Nonspecific

Compensation

Where residual effects remain, and further reduction through mitigation cannot be achieved, it may be necessary to provide compensation for impacts. Compensation may be in the form of replacement of habitats or better management of existing vegetation and species for example. As a starting point the principle of non-Nett Loss of biodiversity interest shall be adopted. This means that compensation should be commensurate with the impacts identified and likely losses to biodiversity. While it may not be possible in the short term to provide a like for like replacement of lost habitats, the longer-term planning should seek to ensure that overall biodiversity interest of the area is not reduced due to the project.

The proposed compensation measures for specific impacts are shown in Table 13-17. This shows the impact Id which is being compensated for, a description of the VER and significance of effect followed by a description of the compensation measure. This is followed by the stated target or the compensation, with timescales for completion towards the target, based on Years 1, 3, 5 and 10 from completion of the construction of the upgraded road.

Table 13-17 Project Specific Compensation Measures

Impact ID	VER Description	Impact Significance	Compensation	Target	Yr 1	Yr 3	Yr 5	Yr 10
TE023	Existing roadside vegetation/habitats	Low	Newly created verges to be revegetated using native species only, grassed as early as possible after creation of bare soils to reduce soil erosion during storms. This will have the added benefit of restricting risk of non-native species establishing in the newly created verges	Revegetation of all newly created road verges	75	100		
TE023	Existing roadside vegetation/habitats	Low	In open rural areas, lost road boundary fencing shall be created using traditional technique of use of fresh cut tree branches, which frequently root and grow to form a hedge line	Installation of five linear km of such traditional fencing in appropriate locations	5	25	50	100

13.9 Non-Project Specific Risks and Cumulative Impacts

As previously noted, the fact that the project is an upgrade of an existing road means that many of the potential effects of a new road along a fresh alignment are removed from the project, the most significant of the effects of roads already having occurred historically, For the current project these relate to provision of access to areas of natural habitat which have been turned into agricultural uses or as residential land.

While it is anticipated that there will be no additional induced impacts of new habitat, change of land use etc from the proposed project, there is the potential that the improved connectivity between the north and south side of the island may lead to broader impacts.

At present, the south side of the island is less well developed. There is some development of new properties along the coastline near the southern end of the CCIR. These in some cases are second homes for people living and working in Apia.

It is likely that the improved access, safer and quicker journey from Apia to the south side using the upgraded road will induce land use changes on the southern side of the island. This may result in loss of habitats, severance and habitat fragmentation.

The induced impacts can be prevented by careful environmental planning for new developments, but there will be pressure for redevelopment within this area.

The nature of the project means that in any section of the route, land take from modified habitats is relatively low. So some residential land will be lost, some plantation land, some grazing land etc. However, these individual losses give rise to a cumulative loss of land and potential increased effects on biodiversity and ecosystem functioning.

13.10 General Compensation and Biodiversity Gain

Preamble

It is considered that while the risks to biodiversity within the project area are relatively low, the project can support considerable redress of the continuing decline of species and increased habitat fragmentation within the island. Essentially redressing some of the past impacts of the road and providing biodiversity and resilience benefits.

Such measures are set out below and are recommendations for implementation.

Power Line Along Road Route

At present the road corridor also, for a significant amount of its alignment within the rural areas also coincides with the power line wayleave. This means that the local power company spends time and budget, managing trees within the wayleave to prevent wind damage to trees affecting the power transmission system. During the survey period it was observed that contractors were felling or topping mature trees and cutting back hedges to protect the transmission cables.

The project offers an opportunity to underground the cabling. This would reduce the need for tree management and therefore benefit local biodiversity and improve ecosystem services through retaining ground water, reducing erosion and run off and providing shade.

Such an approach would have the additional benefit of providing climate change resilience by removing the risk of storm damage to the power lines and supporting structures.

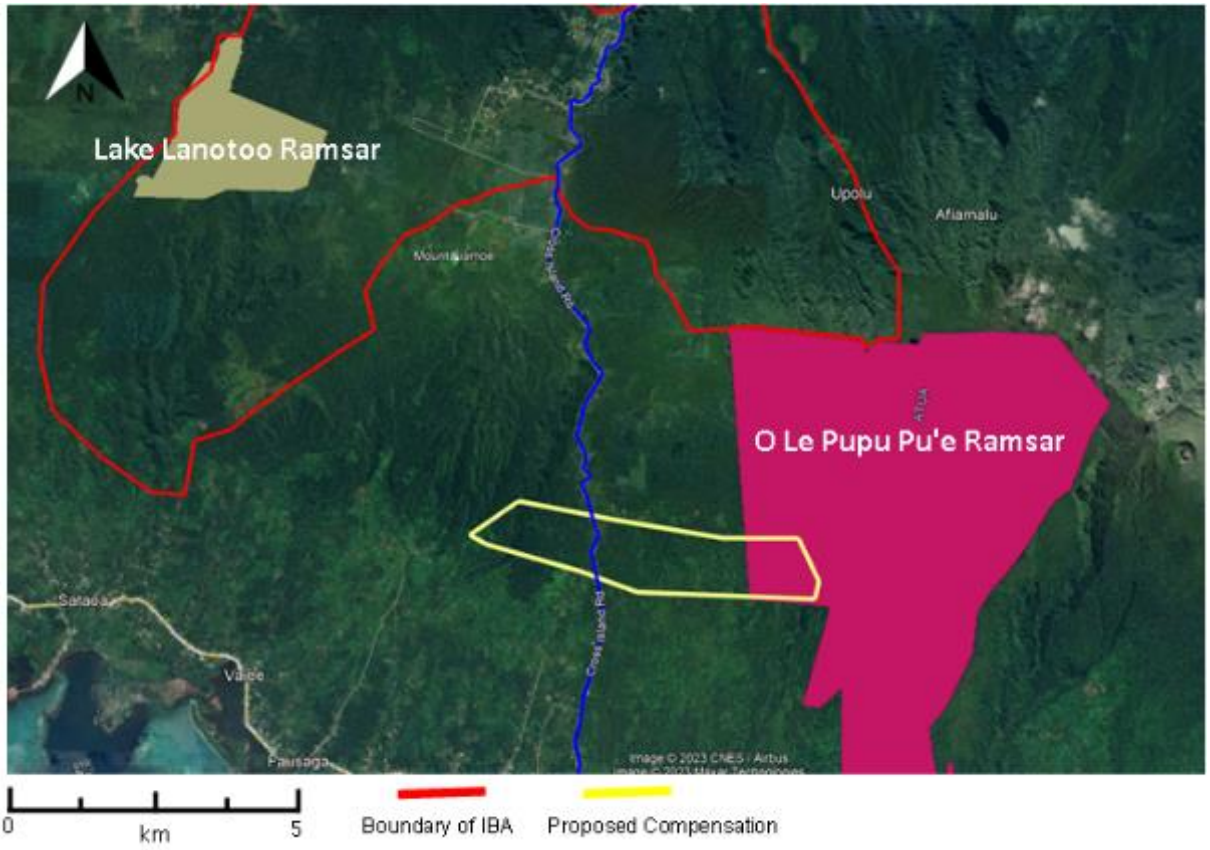
It is therefore recommended that the project make provision in rural areas for underground pipe routes for future cabling when the cables are at a natural end of life and need to be replaced.

Reduction in Habitat Fragmentation and Increase in Tree Cover

There is an opportunity to manage existing land to increase tree cover, using native species and link important areas of more natural habitats which are currently severed by the road and development of grazing areas and plantations.

It is recommended that compensation be developed in the form of a management plan for land which will connect the western edge of O Le Pupu Pu'e Ramsar site to land which has good mature tree cover on steep sloping valleys leading to Lake Lanotoo Ramsar Site. The proposed area is shown in Figure 13.5.

Figure 13.5 Suggested Location of Compensatory Management Area



LTA or the responsible authority for such a measure would need to enter into local land agreements with owners and/or tenants. The aim of the compensatory management plan would be to develop continuous tree cover across the area, linking the two sites identified above. This will be achieved using native tree species.

Much of the land in question has a scattering of mature trees present, including large examples of banyan trees. These would provide nurse crop cover for developing native tree species as well as a seed source for natural regeneration, which would take place in the absence of grazing cattle.

It is recommended that under the current project, budget is allocated for initial feasibility studies and preliminary consultations with relevant authorities and landowners.

14 Conclusions

14.1 Preamble

The objectives of the study were set out in Section 1.3 of this report, namely:

- Confirming; or otherwise, assumptions made in the original IEE
- Enable a more targeted and site-specific evaluation of habitats, species, and value of the AoI
- Determine if additional resources in terms of budget and manpower (species specialists) are required for the completion of the biodiversity assessment
- Provide data for an updated impact assessment relating to biodiversity
- Prepare mitigation, monitoring plans and produce a discipline specific environmental management plan relating to biodiversity

The following sections of text provide the conclusions reached following the assessment for each of these five objectives.

14.2 Confirming IEE Assumptions and Findings

The survey and assessment have furthered the data available to the project on the biodiversity context of the project and occurrence of habitats and species of potential interest.

It has confirmed that:

- There are no issues relating to Critical Habitat
- There is no significant plausible risk to IUCN Threatened species
- The habitats to be affected directly by the project land take are all modified
- The project can proceed with appropriate safeguards set out in a comprehensive CEMP for the construction period

The current work has defined additional mitigation requirements for the design stages which will remove potentially significant effects. Primary among these is the flexibility of design to allow for asymmetrical widening of the route, reducing disturbance and avoiding loss of trees.

14.3 Targeted and Specific Evaluation of Habitats Etc

The conducted work has indeed enabled a better evaluation of the biodiversity context of the project and the habitats and species present along the route. The work has enabled a better definition of potential effects and therefore a somewhat narrowed AoI of the project based on the existing modified habitat land uses.

14.4 Need for Additional Survey Resources

The conclusion from the work conducted for the current assessment is that additional detailed and specialist survey is not required.

14.5 Obtain Additional Data for Biodiversity Impact Assessment

The work conducted is considered to have collected adequate data for the assessment of realistic risks and impacts. The Ecological Impact Assessment has been conducted and is presented in this report.

14.6 Preparation of Mitigation and Monitoring Plans

The Ecological Impact Assessment presented in this report, includes the basis of the required mitigation measures and monitoring efforts required.

These shall be built into a standalone Biodiversity Construction Management Plan.

14.7 Overall Conclusion

The proposed project is considered to give rise to relatively minor impacts and risks to biodiversity. This is a function of the scale of the route widening and the absence of immediate sensitive or rare valued environmental receptors. This in turn is a function of the existing presence of the road and most of the negative direct and indirect (secondary) effects of a road into a previously undeveloped area.

Providing the mitigation measures set out in this assessment are fully and effectively implemented, it is considered that there is no basis for constraining the development due to terrestrial ecology impacts and risks.

As a potential net gain, proposals for compensation have been made which would produce greater ecological resilience of habitats around the road and offset some of the historical effects of the presence of the road.

15 References

Airey, R. C. (1921). Map Of Upolu. *Samojské ostrovy (Polynésie : souostroví)*. Marcus F. Marks.

Asian Development Bank. (2009). *Safeguard Policy Statement*.

Atherton, J. (2015). *{Predicted Changes to Vegetation Communities and Native Samoan Trees in Future Climate*. Apia: GEF/UNDP Integration of Climate Change Risks and Resilience into Forestry Management in Samoa Project (ICCRIFS) and the Forestry Division of the Ministry of Natural Resources and Environment (MNRE).

Beichle, U., & Baumann, S. (2016). *The Birds of Samoa*. Wardenburg: Ulf Beichle and Sabine Baumann.

Birdlife International . (2023). *BirdLife International (2023) Important Bird Areas factsheet: Apia Catchments. .* Retrieved from http://datazone.birdlife.org/site/factsheet/apia-catchments-iba-samoa/details

Brown, W. C. (1991). Lizards of the genus Emoia (Scincidae) with observations on thier evolution and biogeography. *Memoirs of teh Californian Academy of Sciences*, 1-94.

Cowie, R. H., & Robinson, A. C. (2003). The decline of native Pacific island faunas: changes in status of theland snails of Samoa through the 20th century. *Biological Conservation*, 55-65.

Cowie, R. H., Rundell, R. J., & Yeung, N. W. (2017). *Samoan land Snails and Slugs*. Department of Marine and Wildlife Resources, American Samoa Government.

Division of Environment and Conservation. (2019). *Samoa National Invasive Species Strategy and Action Plan (NISSAP) 2019 - 2024*. MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT.

Gill, B. J. (1993). The land reptiles of Western Samoa. *Journal of the Royal Society of New Zealand, 23*(2), 79-89.

Hodel, D. R. (2007). Unraveling Clinostigma in Samoa. *Palms, 51*(1), 11-29.

IFC. (2019). *Guidance Notes: Performance Standard No.6: Biodiversity Conservation and Sustainable Management of Living Natural Resources*. International Finance Corporation.

International Finance Corporation. (2012). *IFC Performance Standards on Environmental and Social Sustainability*. IFC.

Jackmond, G., Fonoti, D., & Tautunu, M. M. (2018). Samoas Hidden Past: LiDAR Confirms Inland Sttlement and Suggests Larger Populations in Pre-contact Samoa. *Journal of the Polynesian Society*, 73-90.

Kear, D. (1967). Geological notes on Western Samoa. *New Zealand Journal of Geology and Geophysics, 10*, 1446-1451.

Pearsall, S. H., & Whistler, W. A. (1991). *Terrestrial Ecosystem Mapping for Western Samoa*. Secretariat of the Pacific Regional Environment Programme (SPREP).

Rojas-Sandoval, J. (2018, February 15). *Impatiens balsamina (garden balsam) Datasheet*. Retrieved January 03, 2023, from CABI: https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.28765#sec-26

Rojas-Sandoval, J., & Acevedo-Rodríguez, P. (2014, June 27). *Clidemia hirta (Koster's curse) Datasheet*. Retrieved January 03, 2023, from CABI: https://www.cabidigitallibrary.org/doi/full/10.1079/cabicompendium.13934#sec-26

Whistler, W. A. (2002). *The Samoan Rainforest - A Guide to the Vegetation of the Samoan Archipelago*. Honolulu: Isle Botanica.

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