GOVERNMENT OF SAMOA

Land Transport Authority

Malie-Afega Bridge Crossing Replacement

Preliminary Environmental Assessment Report

February 2025

Prepared by Land Transport Authority

Executive Summary

The Project

The Samoa Land and Transport Authority (LTA) propose to replace the existing bridge that crosses Aleisa Stream with a new multi-cell box culvert (the Project). The Project is located on West Coast Road between the villages of Malie and Afega, Upolu. The Project will contribute to the Government of Samoa's objective to upgrade the full length of West Coast Road and improve the climate resilience of the road connections between Apia and Faleolo Airport.

The Key features of the Project include:

- Demolition and removal of the existing bridge across Aleisa Stream
- Construction of a new six cell box culvert with an overall length of 26.8m
- Raising the road crossing level by approximately 2m above the existing bridge deck level
- Installation of guardrail barriers along both sides of the easter and western approach
- Two 3.5m wide traffic lanes with 0.7m shoulders
- 1.5m wide footpaths on both sides of the new stream crossing and steel railings.
- Installation of erosion protection approximately 80m upstream and 50m downstream of the new crossing abutments.
- Installation of a box culvert at chainage 150 to allow stormwater to flow under the existing road embankment
- Upgrade and tie-in of the road embankment and surface each side of the new crossing. Approximately 180m on the eastern approach and 80m on the western approach.
- A temporary 6.5m wide two lane, sealed vehicle bypass located on the northern side of the new crossing placement. The bypass will include 3 culverts within the stream channel.

Need and justification

The Malie-Afega Bridge is deteriorating and requires significant repairs. It also experiences flooding during heavy rain. As part of ongoing efforts to enhance the climate resilience of Samoa's transport infrastructure, the West Coast Road (WCR) has undergone substantial upgrades. Package 1 Saina to Malua, was supported under the Samoa Climate Resilient Project (SCRTP) while, Package 2 of the WCR, from Malua to Faleolo, and was supported under the Climate Resilient West Coast Road Project (CRWCR), with Lot 2B funded through the Enhanced Road Access Project (ERAP). The Malie-Afega crossing builds on these initiatives to strengthen the road's resilience to climate impacts.

Options considered

The feasibility and options analysis phase considered nine crossing options all with various span and heights, inducing bridge and culvert structures were. Of these, five options were shortlisted based on costs and their design clearance under various storm flow events. Option 3c, a new 6-cell box culvert, was selected by the Land Transport Authority as the preferred crossing structure for Project. The option would significantly improve safety for the traveling public, and protection of residents and property assets in the vicinity of the stream outlet.

Statutory framework

This Preliminary Environmental Assessment Report has been prepared to identify and assess the potential environmental and social impacts associated with construction and operation of the Project. The PEAR also identifies appropriate mitigation and management measures to avoid and minimise the project's adverse impacts while maximising the Project benefits. Preparation of the PEAR has been undertaken in accordance with the *Planning and Urban Management Act 2004* (PUM Act) and the *Planning and Urban Management (Environmental Impact Assessment) Regulations 2007* (PUM Regulations). This PEAR will be submitted to the Planning and Urban Management Agency (PUMA) as part of a Development Consent Application. PUMA is the determining authority for the Project under the PUM Act and the national custodian of the EIA regulation as well as regulator for all developments.

The World Bank Safeguards Policies (Operational Policies) also apply to the project. This PEAR has been prepared to meet the requirements of Operational Policy 4.01 Environmental Assessment. The PEAR will be submitted to the WB for their No Objection in accordance with the SCRTP ESMF requirements. A separate Abbreviated Resettlement Action Plan (ARAP) has been prepared to meet the requirements of Operational Policy 4.12 Involuntary Resettlement.

Community and stakeholder engagement

Community and stakeholder consultation has been undertaken to inform design development and preparation of this PEAR. The purpose of public consultation and community engagement was to inform stakeholders about the proposed activities, gather feedback on the design and how the Project may affect them. Public community meetings were held in Afega and Malie villages in March 2024 (concept design) and October 2024 in addition to household-level consultations on specific matters including land acquisition. Please see appendix 2 Consultations in October.

A project specific GRM has been established for the Project and implemented by the LTA, its consultants and contractors. The GRM allows members of the public or directly affected parties to lodge a formal complaint or grievance and seek a resolution to their concerns. This PEAR will also be publicly notified, allowing persons who may be affected by the proposed Project to make a submission. Prior to construction commencing, the construction contractor will notify the communities of Afega and Malie of construction start dates and the duration of activities.

The process for identifying, assessing and compensating for land acquisition, loss of access, and/or removal of assets or access to assets is outlined in the Project's Land Acquisition and Resettlement Framework (LARF). An Abbreviated Resettlement Action Plan (ARAP) has also been prepared negotiation and agreements with directly affected persons will continue as per the Projects ARAP.

Land requirements and resettlement impacts

The new gabion wall will require the permanent taking of approximately 985m^2 customary land. The acquisition of customary land is governed by the land taking process for public purpose defined in the *Taking of Lands Act 1964.* Approximately 1,400 m^2 will be required for the temporary bypass during the construction phase. Loss of land and crops will be compensated upon reaching an agreement with the project affected people. Other non-land assets which include structures such as small buildings, fences/rock walls will either be reinstated in same or better condition or compensated. The project will not affect residential structures. The final resettlement impacts, and compensation will be based on the results of land cadastral survey of the final road alignment and approved cadastral surveys that were submitted to Ministry of Lands.

The process for identifying, assessing and compensating for land acquisition, loss of access, and/or removal of assets or access to assets is outlined in the SCRTP Land Acquisition and Resettlement

Framework (LARF). An ARAP has been prepared for the Project. Negotiation and agreements with directly affected persons will continue as per the Projects ARAP.

Potential environmental and other social impacts

The potential environmental and social impacts associated with the project have been assessed in accordance with a risk-based assessment methodology. The risk assessment considers the consequences, probability of occurrence, and relative significance of potential adverse environmental impacts associated with the Project.

Beneficial effects of the proposal would include:

- A safer, more client resilient vehicle crossing of Aleisa Stream
- A safer horizontal alignment for vehicles travelling along West Coast Road
- New, grade separated pedestrian crossings of Aleisa Stream
- Improved flood protection for properties located immediately upstream and downstream of the crossing.

Adverse environmental and social impacts are that likely to occur during construction and operation of the Project, include:

- Permanent loss of land (and associated impacts) required for channel widening and flood protection walls along Aleisa Stream
- Temporary land impacts (and associated impacts) for the road bypass during the construction
- Traffic delays on West Coast Road due to reduced speed limits and installation of a temporary vehicle bypass.
- Noise and vibration impact to properties adjacent to the Project site during construction
- Labour and working condition risks for the workforce
- Risk to health and safety of nearby communities and road users commuting within project site
- Disruptions to property access during construction
- Increased risk of degradation of water quality within Aleisa Stream
- Increased risk for spills and contamination during construction
- Potential temporary decline in air quality during construction
- Impacts to benthic habitat in areas where stream bed shaping will be undertaken
- Temporary visual amenity impacts for properties adjacent to Project.

Environmental management

A key feature in managing construction related impacts is the preparation and implementation of a Construction Environment and Social Management Plan (CESMP). The CEMP is the overarching management plan which sets out the methods and tools to be implemented by the Construction Contractor. It will be prepared to meet the Development Consent Conditions, the mitigation and management measures in this PEAR, the SCRTP ESMF, World Bank Safeguards Policies, and the Samoa Codes of Environmental Practice (COEP). The activity specific management plans that will accompany the CESMP will include:

- Occupational Health and Safety Management Plan
- Traffic Management Plan.

- Construction Waste Management Plan

A key aspect of the CESMP will be implementation of the Project's Grievance Redress Mechanism as well as ongoing community engagement.

Conclusion

The Samoa Land and Transport Authority propose to replace the existing bridge that crosses the Aleisa Stream with a new multi-cell box culvert. The Project will contribute to the Government of Samoa's objective to upgrade the full length of West Coast Road and improve the climate resilience of the road connections between Apia and Faleolo Airport.

This Preliminary Environmental Assessment Report has been prepared to identify and assess the potential environmental and social impacts associated with construction and operation of the Project. The PEAR also identifies appropriate mitigation and management measures to avoid and minimise the project's adverse impacts while maximising the Project benefits. This PEAR will be submitted to the Planning and Urban Management Agency as part of a Development Consent Application. The PEAR will also be submitted to the WB for their No Objection in accordance with the SCRTP ESMF requirements.

Several potential environmental and social impacts from the Project have been avoided or reduced during the concept design development and options assessment phase. However, the Project will still have impacts on water quality, biodiversity, traffic, visual and noise amenity, land, and social disruption. Given the mitigation and management measures outlined in this PEAR are implemented, it is anticipated that any adverse environmental or social impacts would be very low, low or medium in significance. The Project will also have a substantial positive effect on the climate-resilience, road safety and driving conditions of West Coast Road.

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Acronyms

CEAR	Comprehensive Environmental Assessment Report
CESMP	Construction Environmental and Social Management Plan
COEP	Codes of Environmental Practice
CRWCR	Climate Resilience of the West Coast Road
EIA	Environmental Impact Assessment
EHS	Environment, Health and Safety
ESMF	Environmental and Social Management
IA	Implementing Agency
LTA	Land Transport Authority
MNRE	Ministry of Natural Resources and Environment
MWTI	Ministry of Works and Transport Infrastructure
OP	World Bank Operational Policy
PEAR	Preliminary Environmental Assessment Report
PUMA	Planning and Urban Management Agency
SCRTP	Samoa Climate Resilient Transport Project
SEP	Stakeholder Engagement Plan
WB	World Bank

To:	Ministry of Works, Transport & Infrastructure (MWTI) – Planning and Urban Management Agency (PUMA)
Applicant's Name & Contacts:	Land Transport Authority Sagauga Leilani Galuvao Chief Executive Officer Land Transport Authority Contact Details: +685 26740 Address: Vaitele- Uta
Contact for EIA Service:	Land Transport Authority
Site Location:	Lano, Savaii Samoa
Land Tenure:	Customary
Legal Description:	
Proposed Land Use:	Road Transport Development
Proposed Activity:	River Crossing Replacement of Malie- Afega Bridge
Brief Description of Proposal:	Refer to Executive Summary
Proposed Start Date:	9th June 2025
Estimated Complete Date:	10th April 2026
Estimated Capital Value:	SAT$7,585,671.00
Contractor & Contacts	TBC
Other Types of Consents Required	

1. Introduction

1.1 Project background

The Samoa Land and Transport Authority (LTA) propose to replace the existing bridge that crosses Aleisa Stream with a new multi-cell box culvert (the Project). The Project is located on West Coast Road between the villages of Malie and Afega, Upolu (refer Figure 1-1). The Project will contribute to the Government of Samoa's objective to upgrade the full length of West Coast Road and improve the climate resilience of the road connections between Apia and Faleolo Airport.

The Key features of the Project are shown in Figure 1-2 and include:

- Demolition and removal of the existing bridge across Aleisa Stream
- Construction of a new six cell box culvert with an overall length of 26.8m
- Raising the road crossing level by approximately 2 above the existing bridge deck level
- Installation of guardrail barriers along both sides of the easter and western approach
- Two 3.5m wide traffic lanes with 0.7m shoulders
- 1.5m wide footpaths on both sides of the new stream crossing and steel railings.
- Installation of erosion protection approximately 50m upstream and 30m downstream of the new crossing abutments.
- Installation of a box culvert at chainage 150 to allow stormwater to flow under the existing road embankment
- Upgrade and tie-in of the road embankment and surface each side of the new crossing. Approximately 180m on the eastern approach and 80m on the western approach.
- A temporary 6.5m wide two lane, sealed vehicle bypass located on the northern side of the new crossing placement. The bypass will include 3 culverts within the stream channel.

The Project is being implemented under the World Bank financed Samoa Climate Resilient Transport Project (SCRTP). The Implementing Agency and Proponent for the Project is LTA. The contact details for the proponent are Tiumalu Malcom Esera, Manger, Project Management Division, Land Transport Authority. Phone: +685-24542 or Email: malcom.esera@lta.gov.ws.

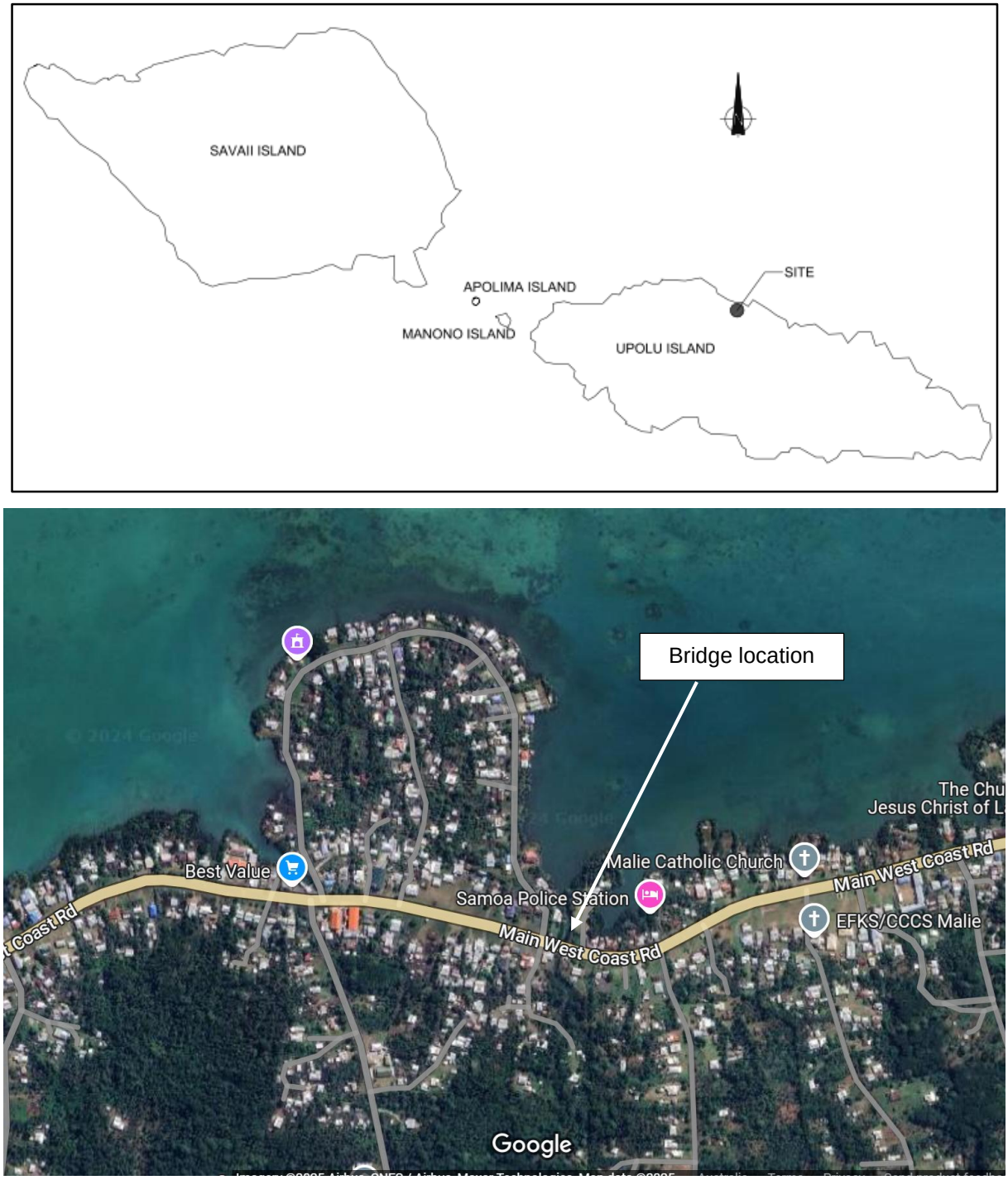

Figure 1-1 Project location

Figure 1-2 Key features of the Project

1.2 Purpose of this report

The purpose of this Preliminary Environmental Assessment Report (PEAR) is to identify and assess the potential environmental and social impacts associated with construction and operation of the Project. The PEAR also identifies appropriate mitigation and management measures to avoid and minimise the project's adverse impacts while maximising the Project benefits.

Preparation of the PEAR has been undertaken in accordance with the *Planning and Urban Management Act 2004* and *PUMA Environmental Impacts Assessment Regulations 2007.* This PEAR will be submitted to the Planning and Urban Management Agency (PUMA) as part of a Development Consent Application. PUMA is the determining authority for the Project.

The World Bank Safeguards Policies (Operational Policies) also apply to the project. This PEAR has been prepared to meet the requirements of Operational Policy 4.01 Environmental Assessment. The SCRTP Environmental and Social Management Framework (ESMF) provided principles, guidelines and procedures for assessing the potential environmental and social impacts within the PEAR. The PEAR will be submitted to the WB for their No Objection in accordance with the SCRTP ESMF requirements. A separate Abbreviated Resettlement Action Plan (ARAP) has been prepared to meet the requirements of Operational Policy 4.12 Involuntary Resettlement.

Further information on the Policy and Legal framework for the Project is provided in Section 3.

2. Project need and justification

2.1 Project need

In 2017, the Government of Samoa adopted the *Vulnerability Assessment and Climate Resilient Road Strategy 2017*. The Climate Resilience of the West Coast Road (CRWCR) project was subsequently funded to identify hazards and priority areas for investment in the transport sector. The CRWCR Design Completion Report 2017 identified the freeboard of the existing Aleisa Stream as inadequate, and that the bridge is deteriorating with substantial repairs required. In 2019, a heavy rainfall event resulted in the Aleisa Stream overtopping the existing bridge, closing this section of the nationally important West Coast Road.

Under the Samoa Climate Resilient Transport Project (SCRTP), the full length of West Coast Road was ungraded between Faleolo to Toamua. This included improving the roads resilience from flooding and sea level rise through culvert upgrades, sea walls, raised road levels and resurfacing. These works work completed in mid-2024. The Malie-Afega crossing is the continuation of these works needed to improve the Climate Resilience of the West Coast Road. The Malie-Afega Bridge is the only remaining low point of the road that is not designed to be at least 2.5m above mean sea level.

The Transport and Infrastructure Sector Plan 2023-2028 focuses on sustainable development, infrastructure resilience, and effective governance to support economic growth and improve quality of life. The Malie-Afega crossing replacement project aligns with these strategies by contributing to infrastructure development that supports economic opportunities while incorporating sustainable practices, maintaining and improving the quality of road networks by enhancing, regulating and strengthening national standards for road safety, climate resilient and sustainable road networks.

2.2 Existing road and infrastructure

The existing Malie-Afega Bridge is located approximately 10km west of Apia and is one of many stream crossings along the National important West Coast Road. The existing bridge is 15 metres long and crosses the Aleisa Stream. The bridge has been cited in several previous reports to be deficient and in need of replacement.

The existing Afega Bridge is located on a vertical sag curve along the West Coast Road and is over 50 years old. The bridge is single span and comprises 15 precast concrete beams with a concrete slab deck. The deck has an asphalt concrete overlay that was carried out as part of a major road reconstruction project in 2019, but there were no improvements made to the bridge at the time due to the pending replacement.

The Malie-Afega Bridge has a low flow capacity and is prone to overtopping from storms of strong intensity. Flooding in the vicinity of the bridge occurs frequently due to embankment breakouts immediately upstream from the existing structure. A photo of the existing bridge is shown in Figure 2-1.

Figure 2-1 Existing Malie-Afega Bridge

2.3 Project objectives

The primary objective of the Project is to replace the existing, deteriorating Malie-Afega Bridge, with a new, climate resilient crossing. The secondary objectives are as follows:

- Provide improved public safety due to high vulnerability from flash flooding and rising sea level hazards.
- Provide an all-weather crossing to an Annual Return of 1 in 50-year storm event
- Consider the upstream channel width, floodwall protection and potential erosion and land taking impacts.
- Minimise impacts to residents in the immediate vicinity of the new crossing structure.
- Provide for a 100-year design life.
- The Project construction budget is approximately USD 2.2 million.

2.4 Alternatives and options considered

A Feasibility and Options Analysis Report was prepared for the Malie-Afega Crossing (Tinai, Gordon and Associates, 2024). The results of this assessment are summarised in this section.

2.4.1 Do nothing

The ‘do nothing’ option would result in the existing Aleisa Stream remaining in place and continuing to deteriorate over time. The bridge would still be susceptible to overtopping and flooding making the entire West Coast Road network vulnerable during storm events.

The ‘do nothing’ option would not meet the objectives of the Project.

2.4.2 Bridge structure options

Nine crossing options were initially considered all with various span and heights. Both Single span bridges and culvert structures were considered. The nine options were:

- New single-span bridge, 24m long x 3.5m clearance
- New single-span bridge, 24m long x 4.1m clearance
- New 2-span bridge, 25m long x 3.5m clearance
- New multi-cell box culvert, 24.8m long x 2.4m clearance
- New 6-cell box culvert, 26m long x 2.65m clearance
- New 6-cell box culvert, 26m long x 3.2m clearance
- New 6-cell box culvert, 26m long x 4.5m clearance
- New 2-span bridge, 37m long x 3.5m clearance
- New single span steel truss bridge, 37m long x 3.5m clearance.

2.4.3 Options analysis

From the nine original options, three options were shortlisted based on cost and an additional two options were shortlisted due to their design clearance of the 1 in 100-year storm flow. The five shortlisted options, in order from lowest to highest cost, and listed in Table 2-1. A summary of the advantages and disadvantages is provided.

Table 2-1 Analysis of shortlisted options

Option	Cost (SAT)	Advantage	Disadvantage
Option 3a 9-cell Box Culvert	$6.8-10.2mil	Lowest cost. Pre-cast culvert allows offsite fabrication and rapid site installation.	Overtops for the 50-year storm. Inlet submerged for the 25-year storm. Multiple piers prone to snag from debris. Basecourse and subbase fills are prone to scour when overtopping occurs.
Option 3b 6-cell Box Culvert	$6.9-10.4mil	Cast-in-place piers provide a robust design. Cast-in-place deck slab provides a low maintenance and durable wearing surface. Low structure profile provides savings in length and height of the road approach embankments.	Overtops for the 50-year storm. Inlet submerged for the 25-year storm. Multiple piers prone to snag from debris.
Option 3c 6-cell Box Culvert	$7.2-10.9mil	Cast-in-place piers provide a robust design. Cast-in-place deck slab provides a low maintenance and durable wearing surface. Passes the 50-year storm – twice the ARI duration as the other two culvert options.	Overtops for the 100-year storm. Multiple piers prone to snag from debris.
Option 3d 6-cell Box Culvert	$7.9-11 mil	Cast-in-place piers provide a robust design. Cast-in-place deck slab provides a low maintenance and durable wearing surface. Passes the 100-year storm with 0.3 metre freeboard.	High embankment fills present access issues for adjacent driveway. Multiple piers prone to snag from debris

Option	Cost (SAT)	Advantage	Disadvantage
Option 1b Single-span bridge	$10.3-15.5 mil	The unobstructed, singe-span opening passes efficiently for high flow conditions. The bridge passes the 100-year storm with 0.36 metre freeboard. Lowest post-flood maintenance cost. The design provides an all-weather crossing.	High embankment fills present access issues for adjacent driveway. The bridge deck comprises pre-stressed concrete box girders which requires the involvement of overseas contractors with this expertise.

2.5 Preferred option

Following a review of the Feasibility / Options Report, Option 3c - a new 6-cell box culvert - was selected by the Land Transport Authority as the preferred crossing structure for Project. This decision was based on funding availability and Option 3c increased clearance and ability to passes the 50-year storm event. The option would significantly improve safety for the traveling public, and protection of residents and property assets in the vicinity of the stream outlet.

Although the single-span bridge design offers superior flood performance, the benefit / cost ratio of the 6-cell box culvert is higher which indicates a more balanced approach towards achieving improved road safety.

3. Policy and legal framework

This section outlines the relevant policies, guidelines and laws that apply to the Project and the approvals needed from different government agencies. The section also describes the applicable World Bank safeguard operational policies and requirements.

3.1 National laws, regulations and policy

3.1.1 Ministry of Works Act 2002

This *Ministry of Works Act 2002* provides for the Ministry of Works and Transport Infrastructure (MWTI) to create and administer the National Building Code via the Building Regulatory Division. Through the Act, MWTI are responsible for building code compliance, offences and liability, inspection, suspension or withdrawal of a Building Permit.

The Project must obtain a Building Permit from the Asset Management and Building Division of MWTI to ensure compliance with the National Building Code of Samoa before any construction activities can start on site.

3.1.2 Land Transport Authority Act 2007

The *Land Transport Authority Act 2007* establishes the Land Transport Authority (LTA). It mandates LTA functions which include the designation and management of national roads and road reserves; identification and acquisition of lands required for roads and infrastructure; regulation and enforcement of road use. The LTA are the proponent for this Project and will be responsible for maintenance of the completed new crossing.

3.1.3 Planning and Urban Management Act 2004

This *Planning and Urban Management Act 2004* (PUMA Act) sets out the framework for the planning, use, development, management and protection of land and resources in Samoa. The Planning and Urban Management Agency (PUMA) administers the Act and is the lead agency for development approvals and monitoring of developments.

Section 34 of the Act requires all developments to obtain consent, unless a sustainable management plan or regulation provides otherwise. The project site is not subject to any sustainable management plan. Where consent is required, the applicant must apply for a development consent in accordance with Section 37. Under Section 42 PUMA may require an environmental impact assessment be developed and submitted with the application. When awarding a Development Consent PUMA may include Conditions as per Section 48.

The Act also outlines the process for public notification of applications and the process for submissions and hearings on development applications.

3.1.4 Planning and Urban Management (Environmental Impact Assessment) Regulation 2007

Any environmental impact assessment required under the PUMA Act must be prepared in accordance with the *Planning and Urban Management (EIA) Regulation 2007* (EIA Regulation). The EIA Regulation specifies the format, structure, subject matter of the assessment.

The environmental impact assessment required under the PUMA Regulations could be in the form of either a Preliminary Environmental Assessment Report (PEAR), or a Comprehensive Environmental Assessment Report (CEAR) depending on the nature, scope and significance of potential impacts. PUMA considers the activities associated with the Project are unlikely to have a significant adverse impact on the environment and therefore a PEAR has been prepared.

The Regulations also outline: (i) baseline and compliance monitoring (Section 8); (ii) reviews of the EIA (Section 9 and 10); and (iii) public consultation (Section 11). Schedules attached to the Regulations detail the content of a PEAR and CEAR. An Environmental Management Plan (EMP) consisting of mitigating measures is further required to help minimize or avoid adverse environmental impacts resulting from the development.

This PEAR will be submitted to PUMA as part of the Development Consent Application along with all relevant documentation and supporting evidence and payment of the application fee. No works shall commence prior to the issuance of a development consent and works must be implemented in accordance with any Development Consent Conditions.

3.1.5 Samoa's National Building Code 2017

The Samoa National Building Code 2017 provides the standards of how a building and site should be constructed to achieve a structurally sound and sustainable built environment. It points to the Outcome of the Development rather than a step-by-step prescription of the Development or Construction method. The Code includes standards for the construction, maintenance and demolition of buildings, site servicing and amenities on site. The building code has been applied to all aspects of the design process and demolition planning. Of relevance to the Project are certain development aspects of the code's building sections (A, B, C, D, E, F, G and K) and the environment sections (H and J). A Building Permit is required from MWTI (Building Regulatory Division) to confirm the Project design complies with the Samoa Building Code.

3.1.6 Lands, Surveys and Environment Act 1989

This Act establishes the principal functions of the Ministry of Natural Resources and Environment (MNRE) and provides for the protection and proper management of the environment in Samoa and the promotion of sustainable development. The Act mandates the MNRE to administer and co-ordinate:

(i) Policies for influencing the management of natural and physical resources and ecosystems

(ii) The potential environmental impact of any public or private development proposal

(iii) Ways of ensuring that effective provision is made for public participation in environmental planning and policy formulation processes to assist decision making at the national and local level

(iv) Procedures for the assessment and monitoring of environmental impacts

(v) Pollution control and analysis of pollutants in the environment

(vi) Control and management of hazardous and potentially hazardous substances including the management of the manufacture, use, storage, transport and disposal of such substances

(vii) Investigations and research relevant to the protection and conservation of natural resources and the environment.

Division 5 Sections 119 and 120 specifically provide for the protection of the foreshore and coastal waters from human activities such as among others onsite construction. Division 6 Section 123 sets provisions for the pollution of seas and inland waters. Section 6 of this PEAR proposes mitigation measures to minimise and avoid potential adverse impacts on the foreshore, coastal waterways and inland waters.

The Act also provides for the alienation of government land and land administration. The Minister may approve purchase of any land for public purpose (s23) or lease of government land for up 20 years (s37). Section 6.4 of this REF discusses the land requirements of the Project.

3.1.7 The Taking of Land Act 1964

The Act establishes the taking of lands for "public purposes" (i.e. alienation of freehold or customary land). Once land is identified for acquisition reasonable notice is required to be given to the owner or

occupier of freehold land or the matai who has the rule over customary land. Public notice of 28 days is allowed for any objections. If no written objection is received, the Minister may then proceed to take the land by Proclamation.

Any land to be taken for the purpose of the Project must comply with the processes established by this law. Further information on the Project's land requirements is provided in Section 6.4.

3.1.8 Alienation of Customary Lands Act 1965

Customary land cannot be alienated except by the Minister of Lands in accordance with s4 of the Act which also appoints the Minister to act for and on behalf of all beneficial owners in signing a lease for registration. The Minister may grant a lease or license of customary land for authorized purposes (which are defined). The maximum lease in aggregate for a public, commercial, business or religious purpose is 40 years. Leases of public land and customary land are administered by MNRE and are based on standard terms.

3.1.9 Water Resources Management Act 2008

The *Water Resource Management Act 2008* which is administered by the MNRE brings together all the relevant laws in Samoa for the effective and sustainable management and utilisation of Samoa's water resources and covers pollution of water supplies such as rivers, lakes and boreholes. It provides for the regulation of taking water and pollution of water supplies.

The Project will use water from Samoa Water Authority network and does not require taking water or abstraction from natural water sources. The potential impacts of the Project on water quality are assessed in Section 0.

3.1.10 Waste Management Act 2010

The *Waste Management Act 2010* covers the collection, management, disposal, and recycling of solid waste. The Act provides for registration and licensing of waste operators, permits for dumping and incinerating wastes, and sets environmental standards for the management of waste. It provides for general offences related to wastes and involves any person who deposits or dumps wastes at a place other than an approved landfill.

The potential waste generated by the Project is assessed in Section 6.12. All waste will be disposed at Tafaigata Landfill.

3.1.11 Occupational Safety and Health Act 2002 and Occupational Safety and Health Regulations 2017

The *Occupational Safety and Health Act 2002* and Regulation 2017 mandate the duty of employers to take all reasonably practicable steps to protect the safety, health and welfare of employees and to provide and maintain a safe and healthy working environment.

The Construction contractor will be required to prepare and implement an Occupational, Health and Safety Management Plan during construction that applies to all construction work force and contractors.

3.1.12 Labour and Employment Relations Act 2013

The Labour and Employment Relations Act 2013 in Samoa is a significant piece of legislation that ensures fair and just working conditions for both national and foreign employees. It aligns Samoa's labor laws with International Labour Organization (ILO) standards, providing comprehensive regulations on wages, working hours, leave entitlements, and dispute resolution1. This Act plays a crucial role in protecting workers' rights, promoting gender equality, and fostering a harmonious work environment

In relation to the project initiatives and projects implemented by Land Transport Authority and ensuring a safe environment for workers and communities, It is the contractor's responsibility to ensure that all

the conditions of this act are adhered to and abided by the workers and employers to ensure that every practice during construction and after aligns with national and international legislations. Overall, the Labour and Employment Relations Act 2013 and ongoing development projects reflect Samoa's commitment to creating a fair and prosperous society for its people

3.1.13 Samoa Codes of Environmental Practice 2007

The Samoa Codes of Environmental Practice 2007 (COEP) provide guidelines for managing and minimising potential environmental and social impacts of development activities. The codes of practice that apply to the Project include:

- COEP 2 – Road Planning, Design and Construction.
- COEP 4 – Land Acquisition and Compensation
- COEP 6 – Road Construction Erosion Control
- COEP 11 – Drainage
- COEP 12 – Traffic Control during Construction
- COEP 13 – Earthworks

The COEPs have been considered and incorporated into the mitigation and management measures proposed in this PEAR. The COEPs will also be specified in the specifications for the construction of physical works (including relevant suggested specifications stated in the COEP being incorporated in the specifications).

3.2 World Bank safeguards policies

The World Bank's safeguard policies (also referred to as operational policies or OPs) cover environmental, social and legal aspects of proposed projects. Table 3-1 below contains a brief description of the aim of the safeguard policy, why the policy is triggered for the SCRTP, and the applicable safeguard instruments.

Table 3-1 Applicable World Bank policies

Operational Policy		**Required Measures and Actions**
Environmental Assessment OP/BP 4.01	Purpose	OP 4.01 Environmental Assessment requires an environmental assessment of WB financed projects to ensure they are environmentally and socially sound and sustainable. This is the umbrella policy for the Bank's environmental and social safeguard policies. The assessment needs to consider natural and social aspects in an integrated way.
	Justification of why this OP is triggered	The project is unlikely to cause any significant adverse environmental impacts and has been categorized as Category B under OP 4.01 (Environmental Assessment). Potential impacts are expected to be site-specific and few, if any, would be irreversible. Required mitigation measures are expected to be largely standardized.
	Safeguard Instrument	This SCRTP Environmental and Social Management Framework (ESMF) includes the principles, guidelines and procedures for screening and assessing environmental impacts of the Project.

Operational Policy		Required Measures and Actions
		This PEAR has been prepared to meet the requirements of OP 4.01.
Involuntary Resettlement OP/BP 4.12	Purpose	This policy aims to restrict the involuntary taking of land or any form of economic displacement of populations affected by World Bank financed activities; and where displacement is unavoidable, to assist persons to improve (or at least restore) their incomes and standards of living; and to identify and accommodate the needs of vulnerable groups.
	Justification of why this OP is triggered	Most Project activities will utilise the existing government owned road corridor for West Coast Road. However, some involuntary resettlement impacts will be required in the form of marginal loss of private and customary land as well as loss of some non-land assets (secondary structures, trees and crops).
	Safeguard Instrument	The Project has prepared a Land Acquisition and Resettlement Policy Framework (LARPF) to guide the process where land acquisition, loss of access, and/or removal of assets or access to assets will occur. An Abbreviated Resettlement Action Plan (ARAP) will also be prepared.
Physical Cultural Resources OP/BP 4.11	Purpose	To ensure physical cultural resources of local and national significance are protected and not permanently degraded or lost because of the Project.
	Justification	Tombs and gravesites are often located near the road reserve along West Coast Road. Excavation works associated with the river crossing may stumble upon culturally important resources requiring the activation of Chance Finds Procedures.
	Instrument	The CESMP to be prepared and implemented by the construction contractor will include mitigation measures for any potentially adverse impacts such as a Chance Find Procedure.

Country-level social analysis undertaken as part of preparation of the World Bank's Environmental and Social Safeguard Procedures and Instruments for Pacific Island Countries, determined that OP 4.10 is not typically triggered in Samoa. However, a precautionary approach has been applied for this project through employing culturally appropriate communication processes to ensure that traditional community structures are respected and incorporated.

3.2.1 Samoa Climate Resilience Transport Project instruments

To meet the requirements of the WB Safeguards Policies, the SCRTP Project was required to prepare and implement environmental and social risk management documents, including:

- Environmental and Social Management Framework
- Land and Resettlement Framework

The ESMF sets out the principles and procedures for the assessment and management of environmental and social risks and impacts associated with the Project. It intends to guide LTA, which is the Implementing Agency (IA), on the environmental and social screening and subsequent assessment during implementation, in accordance with the World Bank Safeguards Policies. The

LARF sets out the process for identifying, assessing and compensating for land acquisition, loss of access, and/or removal of assets or access to assets in accordance with OP 4.12.

3.2.2 Environmental, health and safety guidelines

Construction of the Project will use the WB Group's Environmental, Health, and Safety (EHS) Guidelines. The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). It contains the performance levels and measures that are normally acceptable to the WB Group and are generally considered to be achievable in new facilities at reasonable costs by existing technology. The EHS Guidelines are comprised of General Guidelines which are organised by themes (environmental; occupational health and safety; community health and safety; construction and decommissioning) and industry-specific guidelines.

3.3 Community Integrated Management Plans

The villages of Malie and Afega fall within the District Community Integrated Management Plan for Sagaga le Usoga. The aim of the Plan is to help communities and government improve climate resilience by identifying actions and solutions for sustainable development.

The CIM Plan identifies the absence of proper drainage along the sealed access roads as well as flooding and ponding along the main road where runoff is blocked by the West Coast Road.

The Project is consistent with the objectives of the Community Integrated Management Plan as it aims to improve the climate resilience of the bridge over Aleisa Stream as well as improving the capacity of the crossing to reduce potential flooding on adjacent areas during periods of high flow.

Upgrading of the Malie-Afega Bridge is specifically identified as a priority climate resilience intervention for Afega Village.

4. Project description

4.1 Project details

The Project involves removal of the existing bridge across Aleisa Stream and construction of a new multi-cell box culvert. The Key features of the Project are shown in Figure 1-2 and include:

- Demolition and removal of the existing bridge across Aleisa Stream
- Construction of a new six cell box culvert with an overall length of 26.8m
- Raising the road crossing level by approximately 2m above the existing bridge deck level
- Installation of guardrail barriers along both sides of the eastern and western approach
- Two 3.5m wide traffic lanes with 0.7m shoulders
- 1.5m wide footpaths on both sides of the new stream crossing and steel railings.
- Installation of erosion protection approximately 80m upstream and 50m downstream of the new crossing abutments.
- Installation of a box culvert at chainage 150 to allow stormwater to flow under the existing road embankment
- Upgrade and tie-in of the road embankment and surface each side of the new crossing. Approximately 180m on the eastern approach and 80m on the western approach.
- A temporary 6.5m wide two lane, sealed vehicle bypass located on the northern side of the new crossing placement. The bypass will include 3 culverts within the stream channel.

Construction of the Project would require a temporary vehicle bypass. The bypass would be located on the northern side of the West Coast Road, parallel to the existing alignment. Construction of the Project is anticipated to take 8-9 months to complete.

4.2 Design criteria

Specific design criteria that have been developed for the Project are summarised in Table 4-1.

Table 4-1 Design criteria

Item	Design criteria
Design speed	50km/hr
Posted speed	50km/hr
Number of traffic lanes	2
Minimum lane width	3.5m
Minimum shoulder width	0.6m
Footpath width	1.5m
Maximum gradient	5%
Minimum overhead clearance	6m

4.3 Major design features

4.3.1 Crossing structure

The new multi-cell box culvert would have an overall length of 26.8m. Each culvert will be approximately 4m wide and 3.2m high. The foundation will be a shallow concrete pad due to the near-surface basalt geology. Concrete cut-off walls at each side of the structure will extend to the hard subsurface rock. Angled wingwalls will intersect new rock revetments on the upstream and downstream sides of the structure. Concrete slabs and aggregate will be placed on top of the culverts to create the base for the new crossing road surface.

4.3.1 Road alignment and design

The existing horizontal alignment of West Coast Road will not be modified. The vertical alignment, however, will be affected since a primary objective for the Project is to raise the level of the crossing and roadway through this area. The proposed level of the new multi-cell box culvert is approximately 2m above the existing bridge deck. The approaches will be raised to tie-in with the crossing level giving this section of West Coast Road resilience from a 1 in 50-year flood event.

A 3 percent maximum approach gradient for the new roadway is proposed. Road embankment batters will be 3H:1V. Guardrails would be installed where the fill height exceeds 1m above adjacent ground levels. Rock filled gabions will be used to contain the imported fill along most of the approaches to minimise encroachment onto the roadside properties.

The roadway pavement design will be in accordance with the AUSTROADS Pavement Structural Design Standard.

4.3.2 Railings, Footpaths, Services and Lighting

The crossing railings will be fabricated overseas and made from galvanized steel. The railing sections will be bolted onsite with no welding required. The bridge railings will be designed in accordance with the Level 2 Barrier Design Loads of the AUSTROADS Bridge Design Code.

Footpaths will be located on both sides of the crossing and will have a width of 1.5m. The footpaths will be raised 150 mm above the adjacent road level. The approaches to the crossing footpaths will be designed to enable ease of disabled access.

There is currently a damaged water pipeline strapped to the side of the exterior upstream bridge beam. Service providers will be consulted during detailed design to confirm their requirements with respect to upgrading the damaged pipeline and re attaching it to the new crossing structure. Any upgrade works to the water pipeline will be undertaken with the assistance of Samoa Water Authority.

The Project includes the installation of new street lighting in the vicinity of the crossing site.

4.3.3 Erosion and flood protection

The topographic survey confirmed a flat streambed gradient and low, natural embankments in the vicinity of the Malie-Afega Bridge. This is the primary cause of the flooded stream to disperse as shallow, overland flow around the bridge crossing. This estuary condition extends approximately 100 metres upstream from the roadway centreline and 80 metres downstream to the lagoon outlet.

A new rock-filled gabion floodwall with a crest height of 2m will be constructed 50m upstream and 30 metres downstream of the new multi-cell box culvert. The floodwall will provide improved flood protection for properties immediately upstream and downstream of the crossing as well as erosion protection for the new crossing structure.

Erosion protection of the streambed has not been included based on the findings from the geotechnical investigation that confirmed a hard basalt rock mass at approximately 0.0m MSL.

4.3.4 Cross drainage

Following construction of the new floodwalls, the existing low ground east of the bridge and inland from the road embankment will not have a drainage path to the Aleisa Stream or lagoon. To enable drainage of this area, it is proposed to construct a new 1.8m wide x 1.2m high concrete box culvert under the new road embankment at Ch 150. This will connect to a concrete-lined open channel outfall to the nearby lagoon. The drainage culvert will be constructed from precast inverted U-type units for quick installation under the roadway to minimise traffic disruption of the West Coast Road.

4.4 Construction activities

4.4.1 Work methodology and construction staging

Detailed work methodologies would be determined during construction planning and detailed design. An indicative construction methodology for the Project is provided below:

- Pre-construction activities including notifying relevant authorities and the community of works commencing
- Site establishment and preliminary works including:
    - Commencing pre-construction mitigation measures outlined in the CESMP, such as installing erosion, sediment and water quality controls
    - Establish permanent and temporary fencing, work compounds and stockpile sites
    - Establish site access
    - Implement temporary traffic controls including construction speed limits and signs
    - Relocate and/or adjust affected utilities, services and signage (as required throughout construction staging)
    - Clearing activities including removal of vegetation and demolishing existing pavement and road structures
- Earthworks including:
    - Remove and demolish existing pavement
    - Excavate rock and unsuitable material to subgrade level
    - Haul, spread and compact earthworks materials that would be predominantly sourced from quarries off site
    - Progressively raise and stabilise the road embankment
- Construct cross drainage
- Construct crossing abutments and wingwalls, install six-box culverts, invert slabs and road deck
- Undertake streambed shaping and install flood protection walls
- Construct new road pavement
- Install railings, street lighting including trenching and utility connections
- Install signs and line marking
- Decommission stockpile and compound site and site clean up
- Topsoiling and landscaping
- Drainage structure.

Demolition

The Construction Contractor will be required to submit a demolition program for review and approval by LTA during the construction planning phase. The temporary detour road would be constructed prior to closing the existing bridge to vehicle traffic. The area would be fenced off, traffic and pedestrian barriers erected, and signage to divert traffic to detour the road and block the existing road. All works would be undertaken in accordance with the Traffic Management Plan and Construction Environmental and Social Management Plan (refer Section 7.4).

All demolished material would be removed completely from the site and trucked to the licensed landfill at Tafaigata.

Clearing and excavation

The clearing work involves cutting and removal of trees and brush, and stripping and cartage of rocks and topsoil in areas located within the Project boundaries as required. The basalt rock ground surface at both ends of the crossing structure will require bulk rock removal by tracked excavators fitted with rock breakers to prepare for foundation construction. It is also likely that some manual rock trimming may be necessary using an air compressor and jack hammer.

Abutments and wingwalls

The 6-cell box culvert will be formed and poured in place. The 250mm concrete invert slabs will be constructed after the walls are complete. 150mm precast concrete planks will be placed over the box culverts. They will be manufactured off-site and set in place using a small mobile crane

Streambed shaping and riprap floodwalls

Shaping will be required to widen the natural channel to prepare an average of 24m crest to crest width between the gabion floodwalls. The equipment required to do this will be excavators, rock breaks and bulldozers fitted with rippers.

4.4.2 Workforce and working hours

Construction is anticipated to take approximately 8-9 months to complete. It is estimated that up to 50 construction and site management personnel would be required on site each day. This number is indicative and would be confirmed by the appointed construction contractor during construction planning. It is expected that the works will be undertaken by a Samoa-based contractor, hence there will be no need for a worker accommodation camp.

It is anticipated that most construction works would be undertaken during recommended standard hours. The recommended standard hours for construction are:

- Monday to Friday: 7am to 6pm
- Saturday: 7am to 6pm
- No work on Sundays and public holidays.

Some construction works may be required outside of standard working hours to minimise traffic impacts. These works would include:

- Installation/removal of traffic control measures
- Pavement reconstruction

Work undertaken outside of standard working hours (if required) would be in accordance with the mitigation measures outlined in Section 6.8.2. This would include notifying the local community in advance of any works planned to be undertaken outside of standard construction hours.

4.4.3 Plant and equipment

The plant and equipment required for construction of the Project would be determined during construction phase planning. However, the equipment outlined in Table 4-2 are likely to be used.

Table 4-2 Construction plant and equipment

Plant and equipment	Plant and equipment
Excavator	Crane
Front-end loader	Concrete saw
Grader and roller	Backhoes
Compactor	Trenching machines
Bulldozer	Milling machine
Concrete vibrator	Hand tools
Jack hammer	Haulage trucks
Bitumen and asphalt paving machine	Rock breakers
Concrete truck	Water trucks
Concrete pump	Road sweepers
Line-marking plant	Passenger vehicles

4.4.4 Source and quantity of materials

Table 4-3 outlines the indicative quantities of material associated with earthworks for the Project.

Table 4-3 Indicative earthworks and materials quantities

Material	Cubic metres
Excavation under existing road	294
Excavation of rock for crossing footings	207
Base fill material – Temp detour	549
Base fill material – Main alignment	3,586
Rock flood protection gabion walls	600

The bulk fill materials for the road approach embankment will be sourced from local quarries. Crushed rock subbase, basecourse and asphalt will be sourced from local suppliers.

4.4.5 Construction site compound and laydown

A temporary construction compound and laydown area will be needed during construction for site offices, machinery parking, material stockpiles and storage. The size and location of these areas will be determined by the construction contractor during the construction planning phase. They will be subject to a separate development consent and building permit application.

No worker accommodation camp is expected to be required.

4.4.6 Public utility adjustment

Existing overhead power lines pass along the downstream side of the existing bridge. The lines will be unaffected by the new multi-cell box culvert. The route of the proposed temporary detour road, however, passes under the wires. A 6m minimum clearance of power lines above the roadway is required. To maintain safety clearance zones within the horizontal alignment of the new roadway, two existing power poles will be relocated with the assistance of Samoa Electric Power Corporation.

Three existing underground service lines currently follow the downstream side of the West Coast Road. New conduits will be allowed for on the downstream side of the new culvert structure.

The construction contractor will be responsible for locating and protecting all utilities during construction. All works will be undertaken in accordance with the utility owners' requirements and site teams. Any potential disruptions to utility services will be communicated with affected property owners.

4.5 Temporary detour

Temporary land taking will be required for the detour bypass to allow for traffic flow before and during construction, this process often requires the approval of relevant stakeholders and coordination with affected families/landowners and affected communities.

This include obtaining and signing of agreements with landowners to ensure they give consent to use their land temporarily before project begins. The conditions in this agreement depends upon the discussions between LTA, consultant and family (AP) agree upon.

This agreement will be confirmed through the ARAP process and after consultations have been conducted.

During construction a temporary detour of traffic would be required around the work areas (refer Figure 4-1). This would include a temporary crossing over the Aleisa Stream. It is proposed to provide a 2-lane, temporary detour route north (ocean side) of the existing bridge. The stream crossing will comprise a triple set of 2.4m wide x 1.8m high concrete culverts constructed from precast, inverted U-type crown units for ease of installation and eventual removal (refer Figure 4-2). There is adequate space for a run-out ramp at the west approach; the east approach will be routed to avoid the removal of 2 existing buildings, and an existing power pole.

The detour roadway will be constructed with chip sealing of the surface to minimise dust and muddy conditions. A 6.5-metre-wide sealed carriageway is appropriate. Warning and directional signage, reduced speeds and full-time traffic management measures will be implemented throughout construction.

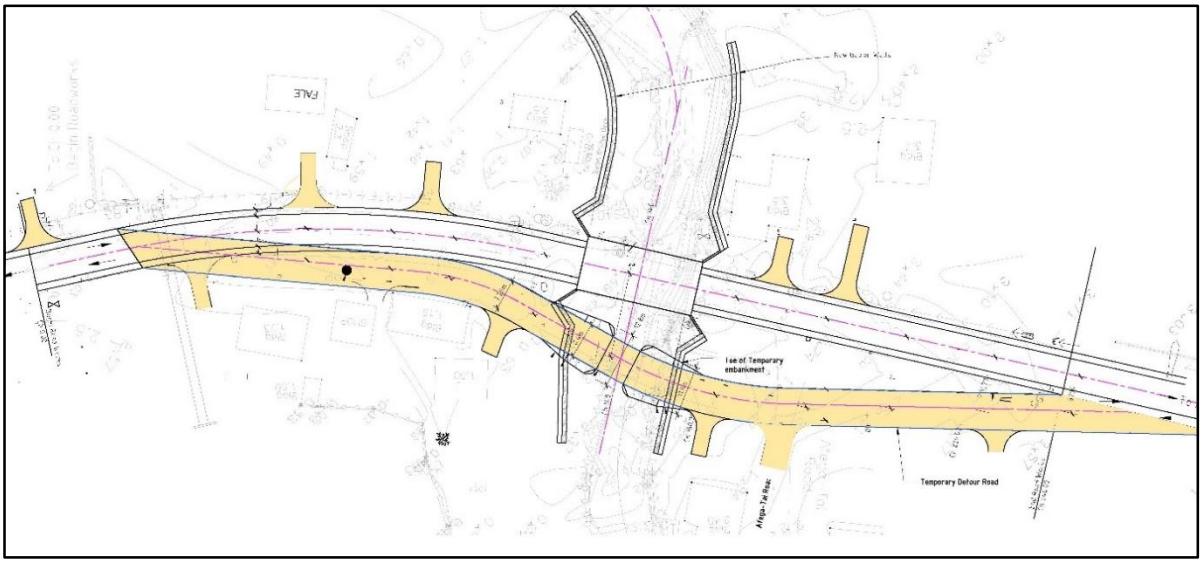

Figure 4-1 Temporary detour

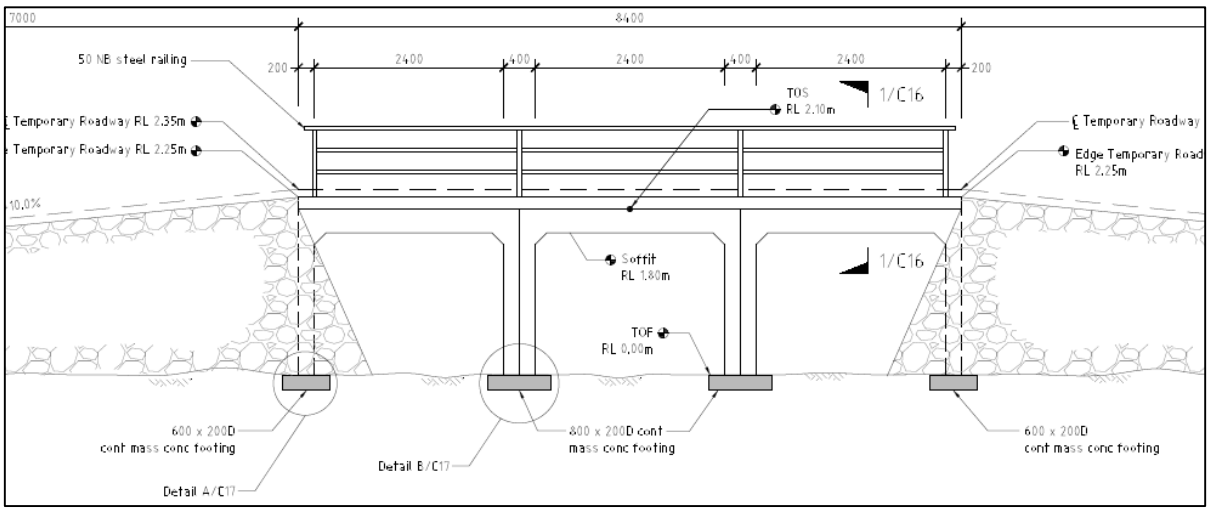

Figure 4-2 Temporary stream crossing elevation

A Traffic Management Plan would be prepared and implemented by the Construction Contractor. Further detail regarding the traffic management measures is provided in Section 6.1.

4.6 Land requirements

4.6.1 Temporary land requirements

The temporary vehicle bypass will require the temporary use of approximately 1,400m^2 of customary land within Malie and Afega Villages (refer Figure 4-1) and a summary is provided in table 4-4. Note that an easement will be built at Malie on a government leased land (refer Figure 4-2) approximately 72m^2 required but not acquired.

Table 4-4 Lands affected by the temporary detour and easement

Village	Coordinates	Land use	Occupier / User	Customary Authority (Matai Sao)
Afega	-13.800056 -171.850833	Residential	[redacted]	[redacted]
Afega	-13.800083 -171.850611	Residential	[redacted]	[redacted]
Afega	-13.800083 -171.850611	Residential	[redacted]	[redacted]
Malie	-13.800528 -171.849972	Landscape	[redacted]	[redacted]
Malie	-13.800528 -171.849806	Residential	[redacted]	[redacted]
Malie	-13.800639 -171.849722	Shop (closed)	[redacted]	[redacted]
Malie	-13.800611 -171.849556	Residential	[redacted]	[redacted]
Malie	-13.800611 -171.849389	Residential(easement)	[redacted]	[redacted]

4.6.2 Permanent land requirements

The newgabion walls will require the permanent taking of approximately 985m^2 customary land in Afega and Malie villages. This is necessary to support the new transport resilient crossing of Aleisa Stream. The acquisition of customary land is governed by the land taking process for public purpose defined in the *Taking of Lands Act 1964*.

Further detail on the land acquisition and compensation of customary land will be address in an Abbreviated Resettlement Action Plan (ARAP) for the project. Damage to, or loss of assets, fences, garden hedges, trees, crops because of the project activities will also be addressed in the ARAP.

As summary of the permanent land requirements are provided in Table 4-5. A map showing the location of permanent land take requirements is provided in Figure 4-3

Table 4-5 Permanent land requirements

Village	Coordinates	Land use	Occupier / User	Customary Authority (Matai Sao)	Affected area (m^2)
Afega	-13.800806, -171.850444	Residential	[redacted]	[redacted]	124
Afega	-13.801222, -171.850667	Residential	[redacted]	[redacted]	35
Afega	-13.800083, -171.850611	Residential	[redacted]	[redacted]	31
Malie	-13.801028, -171.849972	Residential	[redacted]	[redacted]	512
Malie	-13.800528, -171.849972	Landscape	[redacted]	[redacted]	242
Malie	-13.799917, -171.849972	Landscape	[redacted]	[redacted]	41
			Total area of land to be acquired		**985m^2**

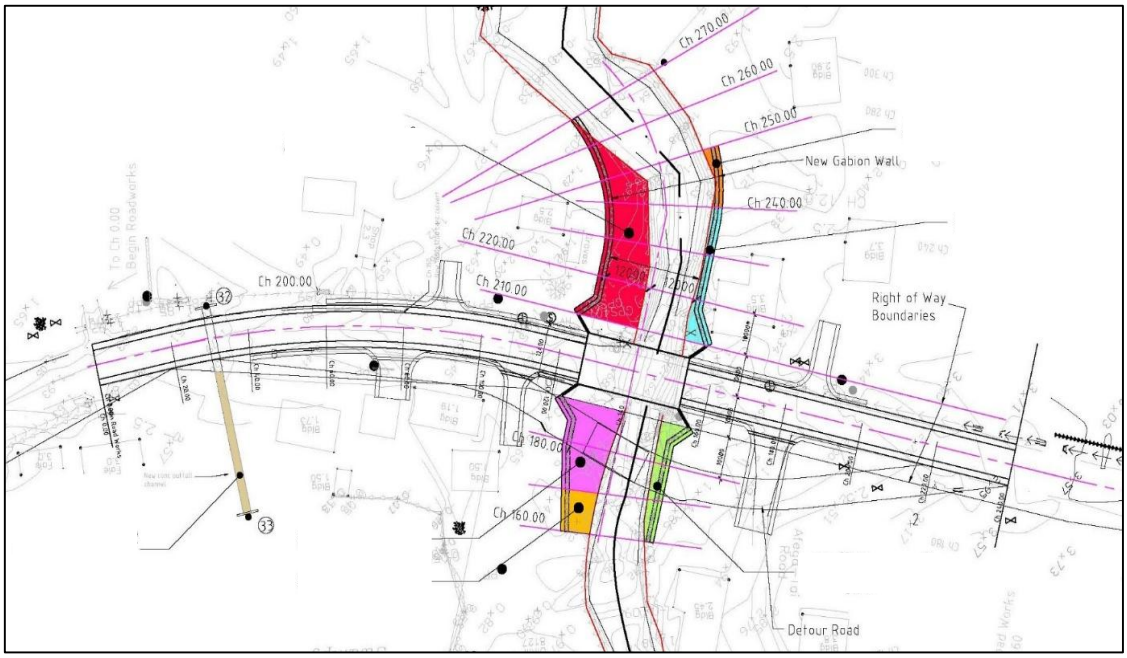

Figure 4-3 Areas of land permanently required

5. Stakeholder and community consultation

5.1 Consultation strategy

Community and stakeholder consultation is required throughout the life of the project. Samoa has a well-developed and culturally embedded system of consultation guided by informal and formal guidelines. Public participation is one of the key principles underlying the *Planning and Urban Management Act 2004* and LTA must comply with the requirements of the *Planning and Urban Management (Environment Impact Assessment) Regulations 2007* as they pertain to consultation during the environmental impact assessment process. In addition, the Samoa Codes of Environmental Practice (COEP) (MNRE 2007) prescribes procedures for carrying out consultations during the EIA process.

The purpose of public consultation and community engagement is to inform stakeholders about the proposed activities, gather feedback on the design and how the Project may affect them, provide notification prior to construction activities, and to gauge the effectiveness of mitigation measures once implemented.

The Consultation process for Malie-Afega bridge replacement has involved four key stages:

(i) Awareness-raising with broader community

(ii) Identification of affected persons, households, and villages

(iii) Detailed consultation sessions with affected villages and persons

(iv) Formal notification of works commencement.

The process for identifying, assessing and compensating for land acquisition, loss of access, and/or removal of assets or access to assets is outlined in the Project's Land Acquisition and Resettlement Framework (LARF). An Abbreviated Resettlement Action Plan (ARAP) has also been prepared. Further consultations will be conducted with affected landholders/assets holders through the implementation of the ARAP.

PUMA Affected Persons form listing affected persons and their signatures indicating they have been consulted will be required.

5.2 Community involvement

To promote inclusive participation, village engagement was originally designed to target four village stakeholder groups:

- Village council/executive and judicial authority of the village (village chiefs)
- Village married/titled women's group (faletua ma tausi)
- Village unmarried/untitled women's group (tamaitai male aualuma)
- Village unmarried/untitled men's group (taulelea male aumaga).

The Ministry of Woman Community and Social Development (MWCSD) is responsible to promote the well-being of villages, village authority, social development, and other matters concerning culture and traditions of Samoa. The MWCSD appoints Sui-o-le-Nuu (village mayor) and Sui-o-Tamaitai (women's and girl's representative) as the government focal points in the village. Notification of the village community consultations was through an official letter from the MWCSD addressed to the Sui-o-le-Nuu outlining the dates, times, and venue for the four village stakeholder groups.

This approach was revised based on the outcome of village community consultations for Afega Village. In was evident that there was a low level of engagement from married/titled and unmarried/untitled women participants during the question-and-answer sessions. This can be attributed to the Samoan culture where matters concerning customary land rests with customary owners/authority (Sao) and the head of the household makes decisions for the household. To ensure an efficient use of resources, a decision was agreed between the Design team and LTA to combine the village stakeholder groups into one village community consultation for the village of Malie.

Affected people were identified as households and customary landowners of areas of customary land adjoining the project site who are likely to experience change because of the project. The official letter from MWCSD was also distributed directly to affected people to encourage their participation in the village community consultations.

A community meeting was convened using a formal format that allows community members to join and to promote open participation. The meeting was chaired by LTA who provided introductory remarks and overall information about the project. The design consultant team provided a PowerPoint Presentation that include:

- A description of project
- A description of the benefits of the project
- A display of the design using graphics, images, maps
- A display of the proposed temporary detour to ensure the flow of traffic during construction works
- A description of the environmental and social assessment and issues to be covered
- Planned consultations with affected people/households and customary landowners.

The first round of public community meetings on the preliminary design was held with Afega Village on 25 and 26 March 2024 at Fale Komiti, Afega and with Malie Village on 27 March 2024 at EFKS Hall in Malie. The second round of consultation on the final design was held for both Malie and Afega on the 10 October 2024.

The issues raised by the community during all consultation is summarised in **Error! Reference ource not found.**. A summary of how each issue has been considered is also provided.

Table 5-2 Summary of issues raised by the local community for Malie and Afega during March and October 2024

Issue	Response
Participants raised concern about involuntary customary land taking since the PowerPoint presentation clearly show that customary land would be affected from the construction of the riprap flood walls.	Final land requirements will be confirmed during detailed design and negotiations with affected landowners, including freehold and customary owners. The necessary areas will be surveyed, and applications submitted to the Ministry of Lands for gazetting. Additional consultations with individual households were conducted concerning the footprint required for the originally-proposed riprap flood levees to explain potential land impacts. As a result of these consultations the design was modified to replace levees with

Issue	Response
	gabion walls significantly reducing the land acquisition required.
Participants wanted to know more details about social and cultural impacts as a result of surveying works for involuntary customary land taking.	The gravesite located on the eastern stream bank immediately upstream of the crossing would not be physically impacted by the Project. During construction, an exclusion zone would be set up around the site to prevent potential physical impacts from machinery. Further mitigation measures to avoid potential impacts on cultural heritage sites are discussed in Section 6.9.
Participants were concern about the impacts of the temporary detour and wanted to know whether there would be compensation since customary land would be affected during construction. One participant stated that if there is compensation for the temporary use of customary land affected then there is support for the Project.	The detour is a temporary land requirement. No compensation will be provided by LTA given no permanent land is required. Construction contractors will be required to negotiate and sign an agreement with the affect landowner/families for the temporary use of land. [Subsequently clarified through the ARAP process that LTA will secure in agreement for temporary land access before project begins]
A participant raised concern that there is a village spring pool that needs to be protected and ask whether the Project would consider these additional works as compensation for involuntary customary land taking.	The Afega Village Pool, 500m from the Aleisa Stream crossing, will remain unaffected by project activities. Compensation for any land taken will go directly to the affected landowners.
Participants declare their support for the Project because the construction of the riprap flood walls would provide protection from inland flooding and praised the Government for the good initiative. Participants highlighted that the proposed riprap flood walls would protect the households adjoining the proposed riprap flood walls and not the rest of the household located further inland.	The Project will include gabion baskets that extend 80m upstream and 50m downstream of the new crossing. These will provide erosion protection to the crossing structure and flood protection for properties adjacent to the gabion baskets.
Participants were particularly concern about the impact of inland flooding and acknowledge that this has been an on-going issue. A question was raised whether the riprap flood walls could be extended to about 2km upstream to protect households located further inland.	The primary objective of the Project is providing a climate resilient transport crossing across the Aleisa Stream. An additional benefit of the Project is improved flood protection for properties upstream and downstream of the crossing. Extending the flood protection by an additional 2km would involve substantial land acquisition

Issue	Response
	and costs, which are not aligned with LTA's primary objectives related to road transport.
Participants wanted to know more about the impact of the approach road works particularly if the existing road seal will be removed and would there be road widening that would require involuntary customary land taking.	Excavation works would include removing the existing seal, land filling, and new seal. These works would be limited to within the existing legal road reserve boundary and would not affect customary land. The horizontal alignment of West Coast Road would not be changed.
Participants raised their disapproval of the Project name being "Afega Bridge" which does not include A request was made to change the name of the project to "Malie-Afega Bridge" for future references to the project and for any future village community consultations. The project design must acknowledge that Malie households and customary land are affected by the Project.	Noted. The Project is now referred to the Malie-Afega Crossing.
Participants raised concern about the impact of customary land and households from the construction of the temporary detour and the proposed additional drainage. The main concern is that works proposed outside of the legal road reserve boundary should be compensated and consent from affected households and customary landowners should be obtained.	The detour is a temporary land requirement. No compensation will be provided by LTA given no permanent land is required. Construction contractors will be required to negotiate and sign an agreement with the affect landowner/families for the temporary use of land.
Participants raised concern about impacts such as noise and works carried out during sensitive hours and days.	Construction will be restricted to standard working hours. Assessment of the potential noise impacts are discussed in Section 6.8.
Participants declare their support for the project and that the village council will provide assistance where needed, however consultations with affected households and customary landowners must be carried out.	Noted.
Participants ask whether the construction of the riprap flood walls could be extended further inland about 200m to protect other households of the village. Also, a comparison was made to the Vaisigano concrete flood walls and a request was made to consider this kind of flood protection instead of riprap flood walls.	The primary objective of the Project is providing a climate resilient transport crossing across the Aleisa Stream. An additional benefit of the Project is improved flood protection for properties upstream and downstream of the crossing. Extending the flood protection would involve substantial land acquisition and costs, which are not aligned with LTA's primary objectives related to road transport.

The community meeting notification letter and attendance list is provided in Appendix A.

5.3 Government agency and stakeholder involvement

During concept design development and preparation of this PEAR, a number of government agencies and stakeholders were consulted. Consultation was conducted to help identify key issues and opportunities as part of the concept design as well as to discuss potential management options and assessment requirements for environmental and social issues. A summary of the stakeholder meetings is provided in Table 5-1.

Table 5-1 Stakeholder meetings

Meeting date, venue	Stakeholder	Issues discussed
31 July 2024, MNRE Lvl 3 TATTE	Ministry of Lands and Surveys (MLS) LTA	Discussions on issues regarding the initial design (riprap walls and distinguishing the 5-meter reserve.)
14 August 2024, On site at Malie and Afega	MNRE- water division, LTA	On site visit with MNRE to discuss the extent of the river reserve, hydrology and how MNRE fits in the bigger picture.
22 August 2024, CBS level 7	MNRE, MOF, MWTI-PMD, LTA	During World Bank SCRTP mission discussion were held on the design and E&S components of Afega & Lano Crossing.
16 September 2024, PUMA Lvl 5 TATTE Building	PMD-MWTI, MOF-CTSSU specialist, LTA, PUMA	Discussions with PUMA Principal Sustainable Development officer regarding the DCA that will be submitted and LTA ongoing projects including Male & Afega bridge.
10 October 2024, Malie and Afega	Community reps, MWTI-PMD	Discussions on the change in design and land take estimates for affected communities

5.4 Grievance Redress Mechanism

A Project specific GRM has been established for the Project and implemented by the LTA, its consultants and contractors. The GRM allows members of the public or directly affected parties to lodge a formal complaint or grievance and seek a resolution to their concerns. Throughout project engagement activities, stakeholders and affected communities have been made aware of the GRM, including:

- How to lodge a complaint or raise a concern
- Anticipated timeframes for response
- Their rights to confidentiality, responsiveness and transparency
- Alternative avenues where conflicts of interest occur.

The grievance process is based upon the premise that it imposes no cost to those raising the grievances (i.e., Complainants); that concerns arising from project implementation are adequately addressed in a timely manner; and that participation in the grievance process does not preclude pursuit of legal remedies under Samoan law. Local communities and other interested stakeholders may raise a grievance at any time to the IA/EA in Samoa or the World Bank's Inspection Panel.

Some project related grievances experienced by villagers can be dealt with effectively at the village level and need not be referred to the Project Manager/IA unless village level redress mechanisms fail.

The traditional mechanism for grievance redress requires the aggrieved party to take his/her grievance to his/her extended family matai, who will assume responsibility for a resolution on their behalf. The aggrieved party's matai may seek redress directly with the Contractor or the other/opposing party and would do his/her utmost to secure a satisfactory outcome. Failing this, the 'matai' will then take the grievance to the Village Council of Chiefs, through the Pulenuu/Sui o le Malo. Usually this is discussed during the monthly meeting of the Council of Chiefs. The Council of Chiefs will decide on how best to address the grievance including conveying the concern to the Contractor on behalf of the aggrieved party or alternatively recommending that the aggrieved party seek a resolution directly with the responsible Government agency (i.e. LTA) and failing that, seeking redress with the Court.

In the case of local disputes over customary land boundaries, and ownership and use of non-land assets, the Council's decisions are final with the disputing parties well aware of the risk of noncompliance. Such decisions of the Village Council are now recognized by the Courts by virtue of the *Village Fono Act 2000*.

5.5 Ongoing or future consultation

In accordance with the *Planning and Urban Management (Environment Impact Assessment) Regulations 2007* PUMA will circulate this PEAR to all agencies known to have, or to be likely to have, a statutory or functional interest in the application, for their written comment and approval.

This PEAR will also be publicly notified, allowing persons who may be affected by the proposed Project to make a submission, by way of objection or otherwise, to PUMA in the manner and form prescribed by the regulations. PUMA will then consider any submissions when determining whether to grant a development consent for the Project and if any, development consent conditions.

Prior to construction commencing, the construction contractor will notify the communities of Afega and Malie of construction start dates and the duration of activities. The communities will also be reminded of the GRM where they will lodge their complaints, and LTA will ensure they are resolved. Continuous consultations by the project team are required throughout construction phase if or when needed. LTA will also work closely with community representatives to notify and relay any information regarding project construction including potential impacts expected from its day to day works. LTA's Facebook page will also be used to further inform broader audience regarding upcoming and ongoing works. The contractor will be required to plan and have in place consultation schedules.

Negotiation and agreements with directly affected persons will continue as per the Projects ARAP.

6. Environmental and social assessment

6.1 Assessment methodology

The potential environmental and social impacts associated with the project have been assessed in accordance with the SPREP (2016)[1] risk assessment methodology. The environmental and social risk assessment examines the consequences, probability of occurrence, and relative significance of potential adverse impacts associated with the Project. The risk assessment uses defined criteria and rating methodology to examine and classify impacts and to prioritise their management. Given the inherent uncertainty in assessing potential impacts, the risk assessment provides structure when considering qualitative and quantitative information. The risk assessment method involves the following steps:

6.1.1 Step 1 – Assign rating

Assign a rating and score for each of the three criteria (A-C) listed in the table below, and then adding the scores to determine the consequence rating for an impact.

Rating	Definition of rating	Score
A. Extent – the area over which the impact will be experienced		
Local	Confined to the project site or study area.	1
Wider catchment	Extends beyond the project site to the wider, surrounding area.	2
National	Extends to the whole nation.	3
Regional or global	Extends beyond country borders	4
B. Intensity – the magnitude of the impact i.e. whether the impact will result in minor, moderate or major environmental, economic and social changes		
Low	Minor or negligible changes, disturbances, damages, injuries or health effects. Likely to generate minimal interest or concern amongst the local community/affected stakeholders.	1
Medium	Moderate changes, disturbances, damages, injuries or health effects. Likely to generate more prolonged interest or concern amongst the local community/stakeholders.	2
High	Major or severe changes, disturbances, damages, injuries or health effects. Likely to generate widespread and intense interest or controversy amongst local, national and regional communities/ stakeholders.	3
C. Duration – the timeframe over which the impact will be experienced and its reversibility		
Short-term	Up to 2 years – impact is reversible or limited to when development activities or environmental events are taking place. Remediation or recovery is possible.	1

[1] SPREP (2016) *Strengthening Environmental Impact Assessment: Guidelines for Pacific Island Countries and Territories*. Apia, Samoa.

Rating	Definition of rating	Score
Medium-term	2 to 15 years – impact is reversible or limited to when development activities or environmental events are taking place. Remediation or recovery is possible.	2
Long-term	More than 15 years – impact is permanent or gradually reversible with sustained remediation and recovery efforts.	3

The combined score of the three criteria (extent, intensity, duration) corresponds to a consequence rating, as follows:

Combined score (A+B+C)	3 – 4	5 – 6	7 – 8	9 – 10
Consequence rating	Minor	Moderate	Major	Massive

6.1.2 Step 2 – Assign probability

Assess the probability of the impact occurring according to the following definitions:

Probability – the likelihood of the impact occurring	
Improbable	Unlikely to occur during project lifetime < 20% chance of occurring
Possible	May occur during project lifetime 20%–60% chance of occurring
Probable	Likely to occur during project lifetime > 60%–90% chance of occurring
Highly probable	Highly likely to occur, or likely to occur multiple times during project lifetime > 90% chance of occurring

6.1.3 Step 3 – Determine significance

Determine the overall significance of the impact as a combination of the consequence and probability ratings, as set out in the matrix below:

		Probability of Occurrence			
		Improbable	**Possible**	**Probable**	**Highly Probable**
Consequence of Impact	**Minor**	Very low	Very Low	Low	Low
	Moderate	Low	Low	Medium	Medium
	Major	Medium	Medium	High	High
	Massive	High	High	Very High	Very High

6.1.4 Step 4 – Level of confidence

State the level of confidence in the assessment of the impact as high, medium or low. The level of confidence will depend on the extent and type of information available, whether it is qualitative or quantitative, and whether it is based on direct measurements, extrapolated data, estimations or expert opinion.

6.1.5 Step 5 – Assign mitigation measures

Identify and describe practical mitigation measures that can be effectively implemented to reduce the impact and reassess the impact. This second assessment examines how impact extent, intensity, duration and/or probability are likely to change, after mitigation measures have been put in place.

6.2 Traffic and access

6.2.1 Existing environment

The Afega Bridge is on the West Coast Road which is the main road along the north-western coast of Upolu connecting Apia with Faleolo International Airport and Mulifanua Wharf (providing ferry connections to Savai'i), and providing the main access for the large population and industry situated along the road and in the hinterland.

Traffic count data from the vicinity of the Malie-Afega crossing was collected next to the Methodist Church at Afega over a seven-day period between 16 and 23 August 2021. The results provided an Average Annual Daily Traffic count of 8,791 vehicles in both directions with heavy vehicles comprising 9.3 percent of the total. An average annual growth rate of 5 percent is estimated for West Coast Road.

6.2.2 Potential impacts and mitigation

Construction

During the construction phase it will be necessary to completely close the existing bridge and the approach roads to allow demolition and bridge reconstruction. To maintain access along the West Coast Road a temporary detour will be constructed north of the existing road as shown on Figure 4-1. The detour will include provision for two vehicle lanes (each 3.3 metres in width) and a pedestrian footpath on the north side of the carriageway. The carriageway will be constructed on a gravel base and will be topped with bitumen chip seal. Figure 4-2 shows the detour cross section at the crossing which comprises three concrete box culverts and riprap embankments on both stream banks.

Temporary driveways will be provided for all properties north of the detour and the detour will connect to Afega-tai Road. Residences to the south of the existing carriageway will need to traverse the construction zone to access the detour and West Coast Road. These movements will be undertaken under traffic control to ensure the worksite is safe to traverse. Residents will be provided with the phone contact information for the contractor's superintendent to coordinate these movements and in case of emergency.

The detour arrangement will allow unrestricted traffic flow around the construction zone, albeit at a lower speed (i.e. 30 km/hr).

The detour does not avoid the full works extent as it needs to tie back into West Coast Road. Pavement works at the eastern and western extent of the works zone will therefore need to be undertaken under traffic control. A traffic management plan similar to that shown in Figure 6.-6-1 will be developed and managed by the contractor to allow works to be completed while maintaining two-way traffic along WCR.

Operation

Operation of the Project would result am improved horizontal alignment through this section of West Coast Road resulting in improved road safety conditions. Additionally, the new crossing would be less susceptible to flooding and potential traffic disruptions during high rainfall.

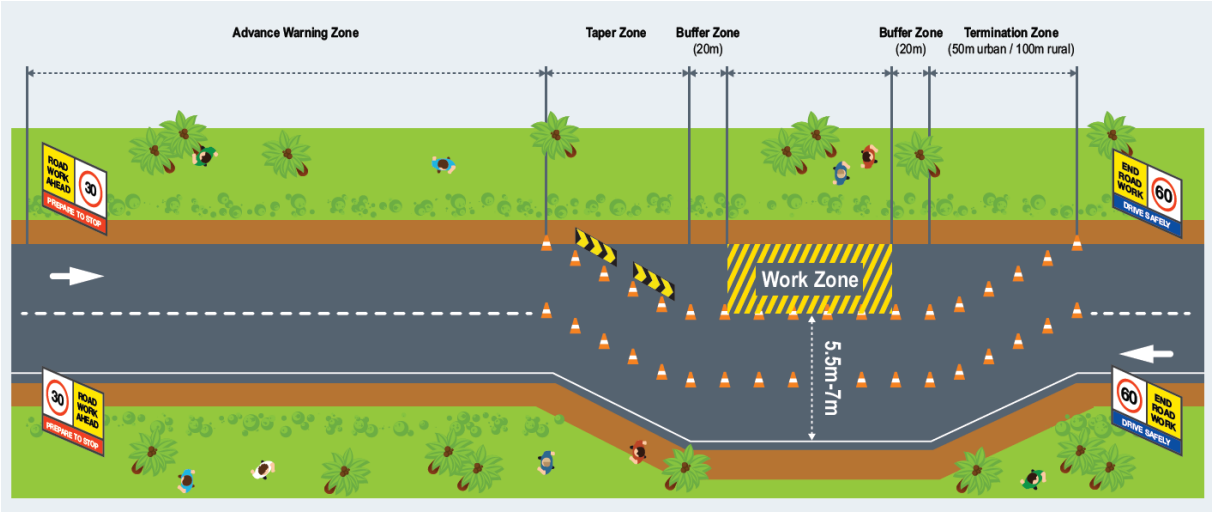

Figure 6.-6-1 Indicative traffic management arrangement

6.3 Hydrology, flooding and water quality

6.3.1 Existing environment

Hydrology and flooding

Hydrological analysis and flood modelling for Aleisa Stream was undertaken as part of the feasibility assessment for the Project (Tinai, Gordan Associates, 2024). Aleisa Stream is a low land stream that does not flow all year round. The hydrological catchment is approximately 32.9km^2. The stream bed is shallow and almost non-existent about 400m upstream of the existing Malie-Afega Bridge.

Flooding in the vicinity of the Malie-Afega Bridge occurs frequently during heavy rain due to embankment breakouts immediately upstream from the existing structure. Overtopping of the existing bridge was assessed as occurring during a one in five-year flood event. The one in 25-year flood event would have a 0.75 metre depth above the bridge deck with a velocity of 2.06 metres per second, a very hazardous situation.

Runoff flow and duration withing the Aleisa Stream catchment is reduced due to the highly permeable Mulifanua Volcanic geology. Consequently, the likelihood of a prolonged heavy rain event resulting in a prolonged flood event is low. Intense storm events are likely to result in short duration flood events.

Anecdotal evidence from Malie and Afega residents indicate that during heavy rain, flooding starts about 400m inland from the existing bridge adjacent to the Sagaga Primary School. Buildings and households situated upstream on the east side of the existing bridge are most affected by flooding.

The flow velocities are typically low (1.5m per second and less) except around the bridge at Ch 200 where a weir effect takes place when overtopping occurs.

The topographic survey confirmed a flat streambed gradient and low as well natural embankments in the vicinity of the existing bridge. This would primarily cause the flooded stream to disperse as shallow, overland flow around the bridge crossing. The ‘estuary’ condition extends approximately 100 metres upstream from the roadway centreline and 80 metres downstream to the lagoon outlet.

A 2.3m MSL cyclone storm surge level would submerge the bridge and culvert openings however widespread shoreline inundation would occur in all low-lying coastal areas of Malie and Afega.

Water quality

Water quality sampling was undertaken at four locations along Aleisa Stream on 24 May and 16 September 2024 (Tinai, Gordan Associates, 2024) the four water quality sampling sites are shown in Figure 6-2. Two samples were collected from each site. Selected physical, chemical, and microbiological parameters were assessed by Samoa Water Authority. The results are provided in Appendix B

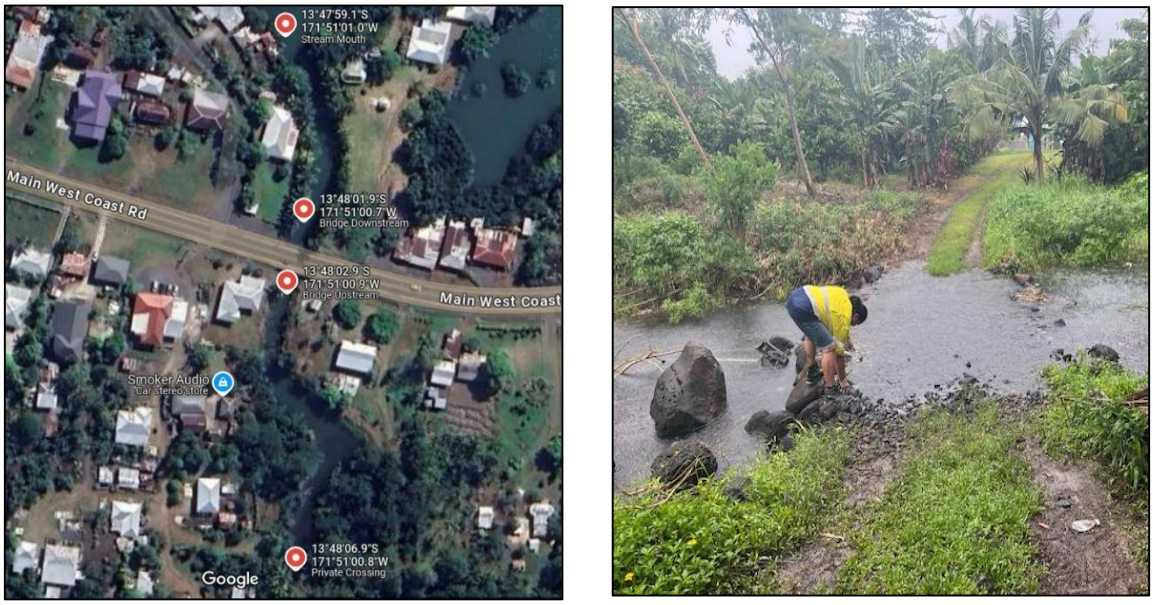

Figure 6-2 Water quality sampling locations at Malie-Afega

The following observations can be made from the water quality sampling undertaken:

- Ph levels were between 6.5 and 9 which is within a typical range required to support aquatic health.
- Very high levels of E.coli present indicating human or animal waste is entering the stream
- Very high levels of salinity present indicating Aleisa Stream is highly influenced by marine tidal flows.
- Very high levels of Dissolved Oxygen indicating a healthy environment for aquatic life
- Biological oxygen demand was very good indicating low levels of organic matter present within Aleisa Stream
- Low turbidity

The Aleisa Stream catchment is not registered for conservation or management purpose. This suggests limited or no involvement of the local villages in conservation and management measures, including requirements or restrictions relating to activities they may affect water quality within Aleisa Stream. This includes:

- Grazing of pigs and cattle in a manner that may impact on a water quality
- Disposing wastes in areas near the stream
- Clearing and earthworks on the stream banks and riparian margin.

6.3.2 Potential impacts and mitigation

Construction

During construction, activities are required within, around and above Aleisa Stream, potentially having adverse impacts water quality. This includes:

- Demolition and removal the existing bridge structure
- Constructing the temporary bypass including temporary instream culverts
- Excavation of headwalls for the new six box culverts
- Installation of the new six box culverts
- Installing flood protection walls upstream and downstream of the crossing
- Stream bed shaping downstream of the crossing.

- Earthworks associated with raising the road embankment Installation.

Site establishment and preliminary works including vegetation removal, topsoil stripping and pavement demolition would destabilise the ground surface and expose large areas of soil. Short-duration, heavy rainfall events that occur from time to time within the study area have the potential to erode exposed areas and cause sedimentation and water quality impacts within Aleisa Stream.

Excavation of the crossing headwalls is likely to encounter ground water. This will result in groundwater intrusion into excavated areas needing regularly pumping to avoid flooding of excavated areas. Pumped groundwater will be including high sediment loads which is directed into Aleisa Stream without mitigation will cause water quality impacts. If uncontrolled, sedimentation from the Project could increase the sediment load within Aleisa Stream and within downstream marine areas, affecting aquatic ecology.

Prior to the commencement of construction activities, erosion and sedimentation control measures should be established to minimise sediment laden surface runoff and pumped groundwater entering Aleisa Stream. Site specific erosion and sedimentation control mitigation measures would be investigated during detailed design and construction planning and would be included within the CESMP.

Construction of the Project could impact water quality through the introduction of pollutants into Aleisa Stream. Activities adjacent to Aleisa Stream have the greatest potential to impact water quality. Pollutants may include accidental leakage or spillage of fuels, lubricating and hydraulic oils from construction equipment, and run-off from equipment and vehicle wash downs. Slurry generated from excavation works should be contained and disposed of appropriately to avoid contamination of surface water on site. Waste from concrete works also be contained to avoid contamination of Afega Creek.

Stream bed shaping activities would only occur during no flow or low flow conditions however the dust in debris would result in minor temporary impacts to water quality downstream during the first flush after heavy rain.

The construction compounds and stockpile site would not be located within the 1 in 100-year flood level and therefore potential inundation of stockpiles and materials/liquids storage areas is unlikely.

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Wider 2	Medium 2	Short 1	Moderate 5	Highly Probable	Medium	High

Mitigation measures:

1. Location and activity specific erosion and sedimentation control mitigation measures should be investigated during detailed design and included within CESMP. This should include the use of sediment fences, earth bunds, diversion drains. The use of coffer dams should be considered for in stream works during times of high flow.

2. Erosion and Sediment Control measures should be established prior to earthworks commencing and regularly inspected and maintained over the duration of the Project

3. Works within Aleisa Stream should only occur during ‘low flow’ or ‘no flow’ conditions

4. Disturbed areas and/or uncompacted soil should be stabilised progressively during the works and excavations should be minimised during periods of wet weather.

5. Groundwater pumped from excavated abutments should be transferred to sediment retention basins before being released into Aleisa Stream.

6. All stockpiles of earth materials should be located at least 20m from Aleisa Stream

7. All hazardous chemicals (e.g. fuels) should be stored in appropriate containers and on the back of vehicles or on impervious surfaces that would contain a spill. A spill kit should be kept onsite at all times.

8. Vehicle and equipment washdown areas should occur in a designated area at least 20m from Aleisa Stream.							
With mitigation	Wider 2	Medium 2	Short 1	Moderate 5	Probable	Medium	High

Operation

The Project will raise the road level crossing Aleisa Stream thereby providing increased flow passage. Construction of new flood walls above and below the new structure will also reduce erosion and flooding in the vicinity of the crossing. The purpose of the walls is to channelize the flows and minimise flooding of properties in the vicinity of the existing bridge.

Following construction of the new floodwalls, the existing low ground east of the bridge and inland from the road embankment will not have a drainage path to the stream course. To enable drainage of this area, a new cross culvert will be placed under the road embankment, minimising the potential for flooding to occur in this area because of the Project. This will connect to a concrete-lined open channel outfall to the nearby lagoon.

The effect of increased channelling of floodwaters would not compromise the hydraulic efficiency of the crossing due to the flat gradient and low flow velocities within Aleisa Stream.

In general, operation of the Project will have a moderate positive impact on properties adjacent to the new crossing by reducing the frequency and intensity of localised flooding events.

6.4 Land and resettlement

6.4.1 Assessment framework

The SCRTP Land Acquisition and Resettlement Framework (LARF) provides the framework for assessing and managing impacts caused by involuntary land acquisition, such as economic or physical displacement, loss of assets or access to assets. The LARF has been developed in accordance with the principles, objectives, procedures set out in the World Bank Operational Policy OP4.12 Involuntary Resettlement. It provides guidance for preparing Abbreviated Resettlement Action Plans (ARAP) and associated documentation. It outlines the procedures and information requirements for ARAPs in accordance with policy requirements and national legislation.

An Abbreviated Resettlement Action Plan will be prepared for the Project that details the assessment and management of resettlement impacts.

6.4.2 Existing land tenure

Land tenure in Samoa comprises of freehold, public and customary land. Customary lands are generally not surveyed therefore most do not have legal descriptions. They are under the overall control of Village Councils of Chiefs, who allocate land to different extended families for dwellings and plantations, and for community facilities such as churches, schools and other development purposes. In most cases, boundaries between extended family parcels or sections are informally marked by physical features such as a stream, gully, a prominent rock formation, planted hedges or trees. Village lands thus generally consist of land allocated for communal purposes such as schools, churches etc., and (iii) land that have not been allocated and remaining under the direct control of the Council of Chiefs. Customary land allocated to extended families for their houses and crops falls under the authority of the extended family chief Matai, or Sa'o. He/She is responsible for its apportioning to all the households of his/her family. For each household, often headed by a matai or chief of lower ranking, this allotted land becomes quasi-freehold in nature, especially where there is continuous occupation and use over several generations. Village land not allocated to extended families remain under the authority and control of the Council of Chiefs. These lands are allocated to extended families as the need arises, such as for newly anointed Matai. Over the years, however, novel mechanisms have evolved that have enabled individuals and households to acquire the use and occupation rights over these lands, with the ownership rights retained still by the Council of Chiefs.

Customary land is inalienable under Samoa's Constitution, therefore cannot be sold. Recent changes in the Constitution now allow the leasing of land for development purposes.

A 22m wide road reserve for West Coast Road is designated Government land as per the *Transport Act 2007*. Outside of the designated road reserve boundary, land tenure is entirely customary land. Customary land belonging to the village of Afega is situated on the west side of the existing bridge and extends inland on both east and west sides of the Aleisa Stream. Land on the eastern side of Afega also includes customary land belonging to the village of Malie.

Under the *Survey Act 2010*, the Aleisa Stream is designated River Reserve and is defined as the riverbed and all the areas to the top of the riverbank.

6.4.3 Project land requirements

Permanent land requirements

A total area of approximately 985m^2 will be permanently acquired by the GoS to accommodate the new Aleisa Stream crossing. A map showing the location of the permanent land requirements is provided in

Figure 4-.

Temporary land requirements

In addition to the Permanent Land Requirements, it is anticipated that land will be required for the temporary crossing bypass during construction. The temporary vehicle bypass will require the temporary use of approximately 1,400m^2 of customary land within Malie and Afega Villages. Consultations regarding the temporary use of land of the proposed bypass will be undertaken by LTA with landowners and land residents. A drainage easement totalling approximately 72m^2 (refer Figure 4-1) and resulting in restricted land use will be secured via an easement agreement and therefore, land remains under government land ownership. A map showing the location of the temporary land requirements is provided in Figure 4-1.

6.4.4 Resettlement impacts

The resettlement impacts of the project have been substantially minimized through numerous adjustments to the final design, taking into account both environmental and social considerations. For example, the Project footprint was reduced limiting the permanent and temporary impacts to family lands, structures and access to family lands during construction phase.

Throughout project design phase, LTA with assistance from the supervision team have consulted PAPs to highlight project design features and its associated impacts to their assets and structures. Following project design change, a second round of community consultation led by the LTA with assistance from the supervision team was conducted to notify families and communities of; i) change in project scope ii) reduced permanent impacts to land and structures iii) temporary associate impacts from the new design to community environment and livelihood during construction stage iv) mitigation measures that will be in place during construction works and v) compensation entitlements and process along with available options for relocation assistance. Follow up consultations have been done with families to complete and sign agreements for affected crops and structure registry for compensation payment prior to construction.

LTA will conduct its last round of community consultation and ensure all resettlement matters are completed prior to works commencing. Continuous consultation will continue to be done by LTA and the supervision team throughout construction phase and post construction when and if needed. Other resettlement mitigations are listed in the table below.

Contractors will be required to conduct continuous consultations with APs from the early stages of mobilization where communities are notified in advance prior to setup activities i.e. survey set-up, relocation assistance etc. until demobilization stages where rehabilitation and tidying works are done to both the client and family's satisfaction. Contractors will be required to ensure all approved

mitigation measures are setup and regularly maintained along with any required family agreements prior to commencement onsite.

No permanent residential structure will be impacted however, acquisition of family lands has been identified to meet project design features. Permanent impacts to lands have been limited following design review and is now considered minor. Consultations with landowners will be spearheaded by MLS with boundaries based on approved survey plans from MLS.

Shops or roadside market stalls will be relocated by the contractor at an equal or better condition to continue operations safely during construction. Market stalls will be relocated to a safe or unaffected area by construction activates and done in a timely manner prior to works starting to prevent any prolonged and discontinued operations. These structures require relocation to allow temporary detour route construction, flood protection wall construction and widening of river channel. Impacted crops such as taro, coconut was considered minor with family consultations completed. LTA with assistance from MoF will ensure any resettlement compensation payments will be disbursed prior to construction.

The full implementation of the resettlement plan (ARAP) is overseen by the LTA, which will coordinate with Ministry of Lands and Survey to conduct consultations for land acquisition and compensation. All land acquisition, leasing, and compensation processes will be completed before civil works begin. In cases where unforeseen impacts on crops or structures occur during construction, the contractor will provide compensation or replacement as necessary.

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Wider 1	Medium 2	Short 1	Moderate 5	Probable	Medium	High
Mitigation measures: 1. Physical displacement or economic displacement should be avoided, when unavoidable minimise involuntary land acquisition and resettlement by exploring project design alternative. 2. Ensure that all consultations are carried out prior to construction to avoid any issues regarding land acquisition and resettlements if any from arising later in the project. 3. Design criteria should be to avoid or minimize involuntary land acquisition and resettlement. 4. Measures to avoid or minimize involuntary land acquisition and resettlement to be clearly shown in preliminary design drawings. 5. Prepare LARP for land acquisition of the project prior to finalizing project design. 6. Compensation to be in accordance with requirements of the WB and GOS and shall be paid prior to commence of construction works and activities. 8. Restriction on access to customary and or use of customary land include water resources should be avoided in the preliminary design. 9. All involuntary land acquisition and resettlement requirement should be completed during the design stage or pre-construction stage.							
With mitigation	Wider 1	Medium 2	Short 1	Moderate 5	Probable	Medium	High

6.5 Socio-economic

6.5.1 Existing socio-economic context

The Project is located within the Sagaga Le Usoga District, approximately 10 kilometres west of Apia. The district contains the coastal village of Afega located on a large headland and the low-lying coastal villages of Tuana'i and Malie on either side of Afega. The Sagaga Le Usoga District currently has a population of 5652 persons (2016 Census Preliminary). District development is mostly near the coast although some families are settled further inland which is largely agricultural land.

The West Coast Road is an important part of the district's infrastructure. It is the main access route to Apia for employment, hospitals and schools as well as the airport, wharf and other districts. From West Coast Road, side roads to village plantations extend inland. They are generally in good condition and are sealed for the first kilometre. Services such as water, power and telephone follow the West Coast Road and generally extend inland along secondary roads for 1km.

The district supports a secondary school, several primary schools, several churches and a medical facility that operates as a Community Health Care Centre. The economy of the district is dominated by traditional work in plantations, agriculture and fishing. A large portion of the working age population travel to Apia daily for paid employment. Many families sell fresh produce and fish from roadside stalls along West Coast Road. There are no commercial shops located within 500m of the Project site.

The Aleisa Stream is not used by the villages of Afega and Malie for any domestic purpose. Some individual buildings and houses are located on the riverbank and sanitation practices and facilities are likely to impact on the quality of the stream. An informal temporary crossing of Aleisa Stream is located approximately 100m upstream of the bridge.

6.5.2 Potential impacts and mitigation

Construction

During construction, families located within 200 metres of construction works have the potential to be adversely impacted by noise and dust from construction activities. These families would also experience a change in visual amenity that would last for the 8-9months duration of construction. Approximately 20 houses are located within 200 metres of construction activities.

Access to properties would also be disrupted. Approximately 17 private driveways used by families to access their properties from West Coast Road are located within the construction footprint. The construction contractor will ensure vehicle access to every property is maintained during construction however this may be through temporary alternative access arrangements.

Increased traffic congestion and delays will be experienced by drivers using West Coast Road as speed limits will be reduced through construction areas, lane widths will be reduced and the temporary bypasses established. This may pose a safety risk for children and pedestrians as road crossings and pedestrian pathways will be temporary altered to allow construction activities. A Traffic Management Plan will be prepared that includes consideration of how pedestrian will move safety around construction zones.

Issues such as air quality, dust, traffic and access, noise, vibration and visual amenity are assessed further in the following sections:

- Noise and vibration (refer Section 6.8)
- Visual impacts (refer Section 6.10)
- Traffic and access (refer Section 6.2)
- Air quality (refer Section 6.11).

Land requirements and resettlement impacts are discussed in Section 6.4.

The temporary bypass would be in very close proximity to several houses on the northern side of West Coast Road (less than 2m). These houses are currently unoccupied however could become inhabited before or during construction. While these houses are already highly exposed to traffic noise on West Coast Road, the temporary bypass would increase the current noise impacts experienced. The properties would also be highly suspectable to air quality, health and amenity impacts from dust if not appropriately managed by the Construction Contractor. Safety road barriers would also need to be installed between the bypass and houses to minimise the potential risk of vehicles hitting the buildings.

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Wider 2	Medium 2	Short 1	Moderate 5	Highly Probable	Medium	High
Mitigation measures: 1. Local communities and directly affected landowners should be notified prior to works commencing and should be kept regularly informed of progress during construction. 2. A Grievance Redress Mechanisms/Complaints process should be implemented during construction for receiving, investigating, recording and resolving complaints received from the community. 3. The Construction Contractor should have a nominated community liaison person(s) in place who is available to work with community members on any concerns raised during construction. 4. A Traffic Management Plan should be prepared and implemented that includes measures for safe pedestrian movements along West Coast Road. The risk of vehicles impacting the houses located near the temporary bypass should be considered. 5. Vehicle access to properties should always be maintained during construction. 6. Residents should be informed prior to any interruptions to utility services that may be experienced. 7. Landscaping should be considered along the road embankment and flood protection wall to soften the visual impact on adjacent residents from these structures. 8. PAPs should be given priority for local labour opportunities to ensure inclusive economic benefits and community participation. 9. Vendors will be receive relocation assistance from the contractors (relocation) and LTA (via compensation) to relocate and ensure that affected families that have market stalls to safety continue trade and to ensure the livelihood of these communities are not disrupted by the project.							
With mitigation	Wider 2	Medium 2	Short 1	Moderate 5	Probable	Medium	High

Operation

Operation of the Project would result in a significant net Benefit for the local Villages of Malie and Afega as well as the wider District communities. The new climate resilient crossings would enhance road safety along this section of West Coast Road and improve network resilience. Pedestrian access across Aleisa Stream would be improved by the construction of grade separated pedestrian footpaths on both sides of the new crossing, with new safety rails.

Flood protection walls would reduce the frequency and extent of flooding on properties immediately upstream and downstream of the crossing. However, approximately 985m^2 of customary land would be permanently required for gabion walls along the Aleisa Stream bank. This is not anticipated to impact the livelihoods of families living on the land given the small percentage of land required compared the remaining available areas.

6.6 Biodiversity

6.6.1 Existing environment

The landscape surrounding the Project site is characterized by low-lying, intensively developed, coastal plains and gently sloping inland planes extensively used for agricultural purposes.

The terrestrial biodiversity is made up of mostly non-forest areas, mixed rotational crops (taro), fruit trees, plantations (coconuts, bananas), grazing pasture, ornamental shrubs and trees, private gardens, grassed residential compounds and disturbed mixed regrowth. Common plant species are coconut, breadfruit, taro, banana, papaya, vi, kuava, cocoa, pineapple, mango, timber trees, flowering trees, house plants and medicinal trees like talie. Invasive weed species are widespread and abundant. Land is continually cleared by farmers and families creating a landscape that is highly disturbed by human activities. The district is not within a Key Biodiversity Area (Priority Sites for Conservation in Samoa: KBAs, 2010).

The coastal foreshore is approximately 50 metres downstream from the Malie-Afega Bridge. The reef system is between 2km and 3km offshore and provides a barrier from wave action, creating a low energy coastal environment. Siltation from inland clearing and the clearance of mangroves along the coast have had a direct impact on the reef health as fine sediments suffocate most of the coral reefs within the lagoon. Substrate cover within the lagoon would comprises of mud and silt, sand, coral rubble and dead corals with algae and stones. The impacts of land-based human activities such as land clearing, coastal reclamation and surface runoff would contribute to the muddy and silty substrate. It is expected that there would be low occurrence of biotic features, and low diversity of corals and invertebrate which is indicative of severely degraded habitats.

The riparian margin of Aleisa Stream is highly disturbed with little to no original vegetation or bank profile. Invasive weeds, bank erosion and large boulders dominate. Aleisa Stream is intermittent, and stream flow is highly influenced by short-period rain events within the upstream catchment. Water sampling indicated a brackish environment which is tidally influenced (refer Section 6.3.1). Water quality sampling indicated a relatively healthy stream environment however sampling was taken during low flow conditions. Water quality would be expected to severely deteriorate during heavy rain with the flushing of contaminates from the catchment. Even during low flow conditions facial coliform counts were very high. It can be assumed water quality of the stream is highly disturbed from upstream land practices and this in turn would impacting the quality of freshwater habitat within Aleisa Stream. Low biological diversity is expected, and any fish species would be dominated by opportunistic invasive species.

6.6.2 Potential impacts and mitigation

Construction

Construction of the Project will require disturbance of approximately 2000m^2 of terrestrial land outside of the existing road corridor. The majority of area is cleared land containing exotic pasture species or environmental weeds. However, some ornamental trees, ornamental shrubs and fruit trees will require clearing. Approximately 1,400m^2 of land would be cleared for the temporary road bypass. Only ornamental shrubs and planted trees would require clearing.

The Project would directly affect the riparian margin of Aleisa Stream approximately 50 upstream and 30m downstream of the Stream crossing. The placement of rock boulders would permanently change the riparian habitat that currently exists. This would alter the hydrology experienced within Aleisa Stream as well as removing any potential for rehabilitation to a natural riparian habitat. The current riparian habitat also already highly disturbed from human activities and offers little value to instream water quality or aquatic habitat.

Construction of the temporary crossing would directly impact approximately 26m of the Aleisa Stream bed habitat. Stream bed shaping downstream of the crossing would direct impact approximately 50m^2 of Aleisa Stream benthic habitat. The ecological value of these areas would be lost due to the physical

disturbance however it would be expected that they would gradually recover overtime to become consistent with adjacent in stream benthic habitat areas.

The potential impacts of the Project on hydrology water quality, as well as proposed mitigation measures are discussed in Section 0.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Confidence
Without mitigation	Local 1	Medium 2	Short 1	Minor	Highly Probable	Low	Low
Mitigation measures: 1.The final design level of the multi-box culvert outlet should not create a barrier to fish passage during periods of high flow. 2. Prior to construction commencing, areas to be disturbed should be delineated to avoid unnecessary clearing of vegetation and topsoil. 3. Detailed design should minimise the area required for streambed shaping. 4. Heavy machinery should be limited to the minimal area required.							
With mitigation	Local 1	Medium 2	Short 1	Minor	Highly Probable	Low	Low

Operation

Culverts within streams can become barriers to fish passage potentially impacting the ability of native fish species to migrate upstream for breeding. The final design level of the new six box culverts should not create a barrier for fish passage. This will require consideration of the outfall height in relation to the stream bed level. During periods of high flow, the culvert should not create a physical barrier for fish passage.

6.7 Soils

6.7.1 Existing environment

The Project is located within low lying coastal plans that gradual slope towards the coast. The soil characteristics are influenced by the Aleisa Stream, with a rocky stream bed and immediately adjacent flood plans containing deep topsoil. A geotechnical investigation at the crossing location was completed in September 2023. The investigation included drilling 2 boreholes, one on each side of the stream and in the vicinity of the proposed foundations for the new bridge. The preliminary findings from the boreholes indicated hard basaltic rock from the ground surface to the bottom of the bores at both locations.

6.7.2 Potential impacts and mitigation

During construction, site establishment, vegetation clearing and earthworks would expose soils which have the potential to be washed away during heavy rain. The potential for Project activities to cause erosion of soils would be minimised through the implementation of an erosion and sediment measures.

There is potential for chemical, and fuel spills or leaks to occur during construction, which may result in localised contamination of soils. The potential for these leaks and spills would be minimised through the implementation of safeguards and management measures outlined in the table below.

Samoa does experience seismic activity and earthquakes however given the low lying, undulating topography surrounding the site there is a low risk of landslides or rock fall.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Confidence
Without mitigation	Local 1	Low 1	Short term	Minor	Possible	Very Low	High
Mitigation measures: 1.Site clearance and/or levelling should be limited to the minimum area of exposed soil surface needed at any given time 2. Construction work areas should be visual monitored for signs of erosion during and after heavy rainfall. Aleisa Stream should also be visually monitored for signs of excessive sedimentation. If sigs of erosion are observed appropriate erosions and sediment control measures should be implemented to reduce erosion. 3. COEP 11 (Drainage) and COEP 13 (Earthworks) should be used as a guide for erosion and sediment control onsite. 4. Where appropriate, allow grass to regrow as soon as construction is completed. 5. Undertake weekly inspections of all machinery and equipment to check for leakages when in use. 6. Designate storage areas for oils and solvents that are bunded and on impervious services to minimise any impact from spillages. Where needed, refuelling or lubrication of machineries and vehicles on site must be done away from drainages and/or where the hazardous liquids are restrained from reaching the ground. 7. Take precautions when handling and mixing concrete on site - watch dripping into surface water drains 9. Spill kits will be kept onsite. Training on their use is to be provided, and regular content checks undertaken.							
With mitigation	Local 1	Low 1	Short term	Minor	Possible	Very Low	High

Operation of the Project is not expected to have adverse impacts on soil.

6.8 Noise and vibration

6.8.1 Existing environment

The external background noise environment in the vicinity of Afega Bridge is characterised by natural noise sources including wind and waves and traffic noise which is most pronounced at morning and afternoon peak hours. While background noise monitoring was not undertaken it is reasonable to characterise Afega and Malie villages as having a moderate noise environment with few, if any, intrusive noise sources that may be considered unreasonable. There are no industrial noise sources in the vicinity. Existing vibration sources are limited and associated with heavy vehicles passing on West Coast Road.

The nearest residences to the construction site are shown on Figure 6-3 (marked). These are sensitive land uses[2].

[2] Sensitive land uses include residential housing, educational institutions, hospitals, parklands and recreation areas, and tourism accommodation

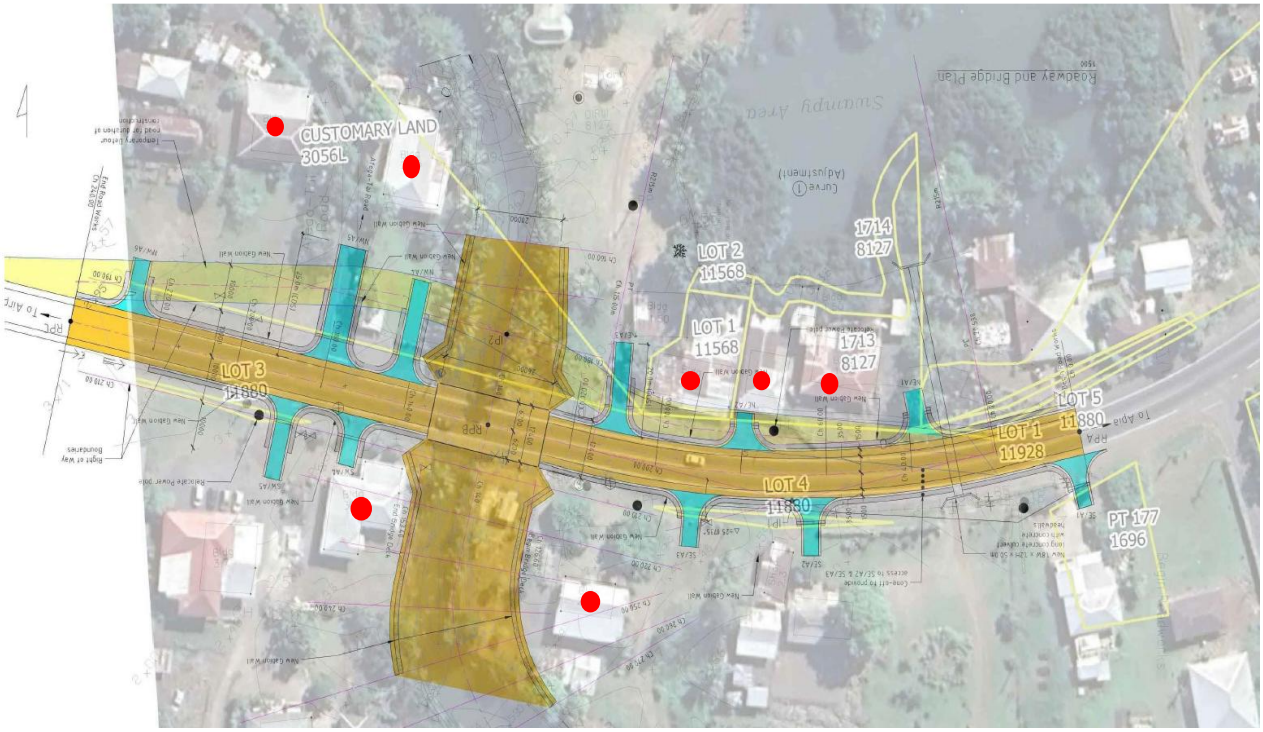

Figure 6-3 Residences near construction works

Noise is an inherent part of many activities but may become annoying if it intrudes into people's awareness, disturbs sleep or is heard against their wishes. Noise may disturb a person's everyday life or working/learning environment and may cause adverse health effects if sleep is disturbed[3]. When considering potential noise impacts from an activity a standard approach is to consider whether the noise is unreasonable[4]. Many activities in everyday life create noise as does the environment (e.g. wind noise) but most of this noise is considered reasonable or tolerable and often is unavoidable. Various factors contribute to making a noise source unreasonable including:

- Volume - how far the noise spreads throughout the affected location
- Intensity – how loud the noise is, including noise that is intrusive over background sounds
- Duration – how long the noise continues
- Character – including tonal noise (e.g. truck reversing alarms) and impulsive noise (a sudden burst of sound that can be described as banging, hammering or thudding)
- The time (e.g. at night) and place (e.g. near a sensitive receptor such as a school that is not normally exposed to elevated noise levels)
- How often the noise is emitted or recurs.

When assessing whether a noise source is unreasonable consideration needs to be given to how the various factors work together. For example, a crashing sound from dropping metal may be so loud (its intensity) that it disturbs sleep. If this happens rarely, the noise may not be unreasonable noise (how often it is emitted). But if the crashing noise is emitted frequently - such as a few times each night and it disturbs sleep - it may be considered unreasonable noise. In the Project context any noise from construction that is audible at nearby residences has the potential to be unreasonable or cause disturbance.

Noise is measured on decibels (dB) with Figure 6-4 showing typical noise levels from some common activities, noting that an individual's perception of noise is strongly influenced by their environment, particularly the existing background noise levels and characteristics. A noise level that is perceived as

[3] South Australia Environment Protection Authority (2017) *Land Use Planning Position Statement: Interface Between Land Uses*. EPA1106/17

[4] For example, Environment Protection Authority Victoria (2023) *Unreasonable Noise Guidelines*. https://www.epa.vic.gov.au/for-business/find-a-topic/noise-guidance-for-businesses/unreasonable-noise-guidelines?p=1

loud in one situation may appear quiet in another. Below table shows acceptable noise level for works in accordance to local policy which contractor will need to abide by

"Noise Source" (Average dBA, L_{10mins})	"Receiving Property" (LAeq, 10 minutes)											
	Residential Use			Commercial Use			Religious use			Industrial Use		
	Day	Even[n]	Night	Day	Even[n]	Night	Day	Even[n]	Night	Day	Even[n]	Night
Residential use	55	50	45	60	55	50	60	55	50	60	55	50
Commercial use	60	55	50	60	55	50	60	55	50	65	60	55
Religious use	65	55	50	70	60	50	70	60	50	70	65	60
Industrial use	65	60	55	70	65	60	70	65	60	75	70	65
Construction Works	75	70	-	75	70	-	75	70	-	75	70	-

*Note: Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

Figure 6-4 Typical noise level from various activities from PUMA noise policy 2011.

Vibration can result from various construction activities, but in this case the main sources of potentially disturbing vibration at residences will be from vibratory rollers (for compacting road base) and rock breaking (for streambed shaping). Construction vibrations are a known nuisance and can cause damage to nearby structures. Humans will sense vibration at much lower levels than that which is required to damage a structure. The potential for damage to structures from rollers and rock breakers is largely related to masonry and concrete building components which are more rigid than flexible components such as wood and steel.

Direct vibration damage is caused by vibration energy transmitted to the foundation through direct contact with the bearing soils. Ground vibrations travel most often, in construction, as surface waves. This type of wave decreases in magnitude, or attenuates, with greater distance from the source of the vibrations. This attenuation is the result of energy loss due to friction within the material, soil particles in this case, through which the wave must travel. For comparison, building impact vibration levels are often noted as a single number quantifying the peak particle velocity (PPV, in in/sec or mm/sec)[5].

The construction phase will last for approximately 8 -9 months during which construction noise and vibration levels and durations will vary considerably depending on the activity taking place. Potential noise impacts will mostly be related to operation of equipment (e.g. excavators), truck movements and loading and unloading of materials. The specific noise-generating activities and their characteristics include:

- Truck movements – engine noise and reversing/movement alarms (tonal noise)
- Excavators with rock-breakers to remove rock for the streambed shaping (impulsive noise from rock-breaking)
- Truck loading by excavator (including excavated rock) and unloading and placement of materials such as sub-base (tonal noise from excavator movement alarms)
- Concrete pouring from agitator trucks (tonal noise from movement alarms and engine noise).

The noise generation scenarios for each of these activities are described below.

Truck movements

Truck movements will be intermittent during a typical workday with no more than six movements per hour expected at a maximum (a movement comprises a truck entering and leaving the site). Peak truck movements will likely occur during placement of road base, asphalt and other road building activities (temporary detour and bridge approaches).

[5] J S Held (2022) *The Impact of Construction Vibration on Adjacent Structures* (https://www.jsheld.com/uploads/Perspectives_The-Impact-of-Construction-Vibration-on-Adjacent-Structures.pdf)

Excavators with rock breaker attachments

An excavator fitted with a rock breaker (see example in Figure 6 5) will be required to excavate rock along the eastern bank of Aleisa Stream for the streambed shaping. Use of a rock breaker creates impulsive noise which can be disturbing at nearby receptors and may also cause vibration. Impulsive noise is often considered intrusive noise as its frequency and volume characteristics mean it is distinctive when compared with other construction noise sources. This activity will be undertaken very close to the residences coloured purple in Figure 6-3.

Noise Mitigation

There are multiple strategies to mitigate noise from construction activities including:

- Universal work practices - such as using equipment in ways to minimise noise, avoiding shouting and other unnecessary noise on site (e.g. two-way radios), designated haul routes
- Consultation and notification – such as regular meeting with sensitive receptors (e.g. nearby residents) to discuss forthcoming works and noisy activities
- Plant and equipment – using quieter methods and quieter equipment, operating plant in a quiet and efficient manner (e.g. turning off engines when not in use), maintaining equipment in good working order (e.g. engine enclosures)
- On site measures – such as avoiding use of reversing/movement alarms (e.g. limit reversing movements) and replacing tonal with broadband alarms; maximise shielding by reusing existing structures; using materials stockpiles or natural landforms as noise barriers
- Work scheduling - provide respite from high noise activities (e.g. rock breaking limited to 1000-1200 and 1400-1600 each day)
- Noise transmission path - reduce the line-of-sight noise transmission to residences using temporary noise barriers.

Specific mitigation measures for the various noise sources are described below:

- Engine noise from trucks and excavators – Ensuring that equipment is in good working order and that all acoustic covers, mufflers etc. are in place. Installation of noise barriers around the worksite
- Movement alarms – establish one way truck movement to, through and from site to minimise reversing movements. A turning circle at the site's northern end will allow forward movement for most vehicles. Replace tonal movement alarms on excavators with broadband alarms
- Rock breaking - the noise impacts from this activity at the school facilities will be mitigated by the location of the works at the base of the existing coastal scarp meaning that the noise transmission path is blocked by the topography. Additional measures include the installation of a portable plywood noise barrier close to the excavation site and respite periods (e.g. only allowing rock-breaking between 1000-1200 and 1400-1600).

The main mitigation measure for vibration impacts is inspection of nearby buildings prior to, during and after construction. The contractor and engineer should carry out joint preconstruction surveys of all buildings near the construction zone that, in the opinion of the Engineer, might be affected by vibration resulting from construction activities. The surveys should be conducted in the presence of and with the permission of the property owners. The survey reports should also be verified by the property owners. There are various methods that can be used to conduct preconstruction surveys, but all must meet the primary purpose of documenting the pre-construction condition of the structures, including all the defects and existing damage.

Noise impacts from construction activities

	Extent	Intensity	Duration	Consequence	Probability	Significance	Confidence

Without mitigation	Local 1	high 3	Short-term	Moderate	Highly probable	Medium	High
Mitigation measures could include: 1. Ensure that plant is in good working order and that all engine panels are in place 2. Instruct drivers and machine operators to operate equipment in a quiet manner 3. Strictly adhere to standard working hours 4. Installation of acoustic barriers around construction zone 5. Respite periods for intrusive noise sources such as rock breaking (e.g. activity allowed only between 1000-1200 and 1400-1600) 6. Replacement of tonal movement alarms on excavators with broadband alarms 7. Regular meetings with residents to discuss forthcoming work program and potential noise issues							
With mitigation	Local 1	Moderate 2	Short-term	Minor	Possible	Very Low	Medium

Vibration impacts from construction activities:

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Local 1	high 3	Short 1	Moderate	Highly probable	Medium	High
Mitigation measures could include: 1. Pre-construction and post-construction condition surveys of nearby residences 2. Respite periods for vibration-generating noise sources such as rock breaking (e.g. activity allowed only between 1000-1200 and 1400-1600)							
With mitigation	Local 1	Moderate 2	Short 1	Minor	Possible	Very Low	Medium

6.9 Cultural heritage

6.9.1 Existing environment

No known cultural heritage sites were identified during site inspections and no sites were identified during community consultations with the Malie and Afega Villages. However, a spring pool is located 500m away from project site and would not be affected by project works refer to Figure 6-5. The majority of Project works would occur within or near the existing road corridor which is heavily modified from past human activities. Mitigation measures for any identified and nearby cultural heritage has been included in the ESMP.

A family grave site is located on the eastern stream bank approximately 20 metres upstream of the crossing. This grave would not be physically impacted be the stream flood protection wall. An

additional grave site is located on the eastern side, approximately at Ch 40.00 on the seaside. This grave site would not be physically impacted by easement works. During construction, an exclusion zone would be set up around the site to prevent potential physical impacts from machinery.

The design was altered also to minimise impacts on cultural heritage in both Malie – Afega villages this includes also the gravesite of the Toelupe family that is now avoided after alterations to the initial design, however a grave also is located near the cross drainage will be located please refer to fig.12 and will not be affected by the works. It is important to ensure that the existing environment is kept as it is before, during and after construction and operation phases.

Figure 6-5 Spring pool location about 500m from the project site.

6.9.2 Potential impacts

No impacts on cultural heritage are anticipated as a result of the Project activities. However, a chance find procedure should be implemented during Construction. During construction, an exclusion zone would be set up around the grave sites to prevent potential physical impacts from machinery.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Confidence
Without mitigation	Local 1	Low 2	Short term	Minor	Highly Possible	Medium	High
Mitigation measures: 1. A physical exclusion zone should be set up around graves sites to prevent machinery or work activities from physically disturbing the sites 2. In the event of an unexpected find of a cultural heritage item (or suspected item) work would cease in the affected area, LTA would be notified and the unexpected finds procedure followed 3. A chance find procedure for the unexpected discovery of potential cultural heritage items should be included in the CESMP and implemented by the Construction Constructor. 4. Spring pool located 500m away from project site shall be considered during all the project activities and shall be maintained at any cost.							
With mitigation	Local 1	Low 1	Short term	Minor	Possible	Low	High

6.10 Visual amenity

6.10.1 Existing environment

The Aleisa Stream crossing sits within an existing road corridor. The surrounding landscape is and urban environment that has been highly modified by human activities. In some locations, distant views of the inland mountain range can be seen. Views northward towards the lagoon are generally blocked by houses and large trees. The houses located along West Coast Road where the Project is located have their views dominated by the existing road corridor, surrounding village houses and landscaped gardens.

6.10.2 Potential impacts and mitigation

Construction

During construction, the positioning of plant and equipment along the alignment and the presence of construction compounds within the view of neighbouring properties would result in minor, temporary visual impacts. Earthworks would also expose subsoil during the construction period that would be visible in the landscape. Potential increased traffic delays would result in minor, temporary visual impacts immediately in front or properties. The temporary, road bypass would also result in a temporary visual impact to properties, particularly those located within proximity to the bypass. Two houses will be located less than 2m.

Construction impacts on visual amenity

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Local 1	Low 1	Short term	Minor	Possible	Very Low	High
Mitigation measures 1. The footprint for construction works would be kept to a minimum to ensure existing stands of vegetation remain intact wherever possible and to screen adjoining sensitive receivers. 2. The work site would be left in a tidy manner at the end of each workday.							
With mitigation	Local 1	Low 1	Short term	Minor	Possible	Very Low	High

Operation

The horizontal alignment of the new crossing would remain unchanged and generally follow the existing road corridor. The vertical alignment would be increased by approximately 2 metres in height which has the potential to cause a minor permanent visual impact. The flood protection riprap along the banks of Aleisa Stream would be approximately 2m high and will have a minor impact on views when standing immediately adjacent to the rock. However, this would be softened once grass re-grows on areas disturbed during construction.

Operation impacts on visual amenity

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Local 1	Low 1	Short term	Minor	Possible	Very Low	High
Mitigation measures 1.Where vegetation loss reduces the amount of screening between residences and the Aleisa Stream crossing or new flood protection wall, the following would be considered:							

• Tree protection measures at the base of the fill embankment to maintain as much mature vegetation as possible • Plant shrubs along the base of the new flood wall embankment • Plant shrubs along the base of the road embankment and the road corridor boundary							
With mitigation	Local 1	Low 1	Short term	Minor	Possible	Very Low	High

6.11 Air quality

6.11.1 Existing environment

Background air quality in the Afega locality is generally good with sources of potential air pollutants mainly related to motor vehicle emissions (particularly diesel vehicles) and the burning of garden waste. Prevailing regular winds from the ocean rapidly disperse any pollutants.

6.11.2 Potential impacts and mitigation

Construction

Potential sources of air pollution from the construction phase include exhaust emissions from construction equipment (e.g. excavators and trucks) and dust generation from earthworks.

Exhaust emissions from construction equipment and delivery vehicles are unavoidable as all equipment uses hydrocarbon-based fuels (i.e. diesel). Prolonged exposure to diesel exhaust can lead to serious health conditions like asthma and respiratory illnesses and can worsen existing heart and lung disease, especially in children and the elderly. Emissions from diesel engines may also contribute to the production of ground-level ozone which damages crops, trees and other vegetation[6]. Diesel-powered engines may also emit excess smoke (containing pollutants) if not properly maintained or operated[7].

Diesel emissions in the Project context are a low risk to human health and the environment given the small numbers of diesel vehicles in operation, the intermittent exposure and the characteristics of the airshed which allow rapid dispersion of emissions. However, in the Project context diesel-powered equipment will be operating in very close proximity to residents over a prolonged period. While pollutant concentrations are unlikely to pose significant health risks, good practice is to ensure that emissions are minimised at source.

Construction impacts on air quality

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Local 1	Low 1	Short 1	Minor 4	Probable	Low	High
Mitigation measures 1. All plant items to be used on site to be inspected prior to use by the supervision engineer to ensure they are in good working order and do not have excessive emissions[1]. 2. Equipment with excessive emissions will need to be serviced or replaced.							

[6] US EPA (2024) *Learn About Impacts of Diesel Exhaust and the Diesel Emissions Reduction Act (DERA)* https://www.epa.gov/dera/learn-about-impacts-diesel-exhaust-and-diesel-emissions-reduction-act-dera. Accessed 24 November 2024.

[7] New South Wales Environment Protection Authority (2021) *Causes of smoky vehicles* https://www.epa.nsw.gov.au/your-environment/air/reducing-motor-vehicle-emissions/causes-smoky-vehicles. Accessed 24 November 2024

3. Equipment to be powered down when not in use or when queueing for extended periods.							
With mitigation	Local 1	Low 1	Short term	Minor	Improbable	Very Low	High

1. A motor vehicle is considered to be emitting excessive air impurities if, when in operation, smoke is visible for a continuous period of more than 10 seconds (New South Wales *Protection of the Environment Operations Act 1997*). In the absence of air quality regulations in RMI, this measure is proposed as good international industry practice.

Operation

Air quality during the operational phase is expected to be very similar to existing conditions. The roadway at the bridge and approaches will be elevated above its existing level which may increase pollution dispersion away from nearby residents. There will be no dust emissions during operation.

6.12 Waste management

6.12.1 Potential impacts and mitigation

Construction

LTA is committed to ensuring the responsible management of unavoidable waste and promotes the reuse of such waste in accordance with the resource management hierarchy principles outlined in the *Waste Management Act 2008*. The resource management hierarchy principles are:

- Avoidance of unnecessary resource consumption
- Resource recovery (including reuse, reprocessing and recycling)
- Disposal.

Construction of the new Aleisa Stream crossing will require demolition of the existing bridge structure. This will produce moderate amounts of waste including concrete rubble, steal rebar, road asphalt, concrete blocks and steal guard rails. All waste material from demolition will be loaded on to trucks and transported to Tafaigata landfill for disposal as general waste. No waste from demolition will be reused onsite.

Earthworks for site preparation will require removal of some subbase material as well as excavation of rock for the culvert piers, abutments and wingwalls. Approximately 294m^3 and 207m^3 respectively. All material that is not suitable for reuse onsite will be loaded onto trucks and transported to Tafaigata landfill for disposal.

Construction activities will also generate general waste including packaging, offcuts, plastics, timber framing, asphalt drums, used oils, contaminated soil and lubricants. Rubbish bins will be provided at the construction site compound and dedicated storage areas for waste provided. Moderate amounts of green waste will also be produced during the site establishment phase. Dumping of any waste would have an adverse impact on the receiving environment therefore, this practice is highly prohibited on site. Establishing of any kind of waste site will be prohibited.

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Local 1	Low 1	Short term	Minor	Highly Probable	Low	High
Mitigation measures							

1. A dedicated waste storage area should be provided at the construction contractor's site compound area. Bins should be provided for small general waste like packaging and plastics. Waste should be collected from site on a regular basis and disposed at the Tafaigata landfill. 2. Construction areas should be kept tidy and generally free from waste 3. No waste should be burnt on site or dumped on neighbouring lands 4. Consider on-site segregation of all demolition waste materials into appropriate categories including (i) topsoil, sub-soil bedrock; (ii) concrete (iii) iron and metal. Consider any potential opportunities for reuse or repurposing with the local village before disposal at Tafaigata landfill. 5. Portable toilets would be provided for construction workers and would be managed by the service provider to ensure the appropriate disposal of sewage							
With mitigation	Local 1	Low 1	Short term	Minor	Possible	Very Low	High

Operation

No waste is anticipated during operation.

6.13 Demand on resources

6.13.1 Potential impacts

Construction of the Project will require the use of resources, including:

- Resources associated with the operation of construction machinery and motor vehicles (this includes the use of diesel and petrol)
- Material required for road surface and pavements (road base, paints, solvents, asphalt, spray seal, sand, concrete, aggregate etc)
- Fill required to meet design levels
- Materials required for road signage
- Construction water (for concrete mixing and dust suppression)
- Electricity for the site office.

The final estimated quantities of these materials would be determined during detailed design.

The materials required for construction are not currently limited in availability. Materials required for construction would be sourced from licensed facilities.

The amount of water required for construction is currently unknown. Water is likely to be sourced from the Samoa Water Authority network. Extraction of water from natural sources is not anticipated however any approvals under relevant legislation would be obtained if required. Power supply will come from the EPC network.

The Project will not require the opening of any new quarry or borrow pit.

Demand on resources

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Wide 2	Low 1	Short term	Minor	Probable	Low	High
Mitigation measures							

1. All aggregates or imported fill material must be sourced from a licensed quarry supplier. The Construction Contractor must obtain a required of the Quarry Operator's Quarry License before purchasing materials. 2. Ensure the Contractors use electricity at the site in a responsible and efficient manner. All workers must be encouraged to conserve electricity by switching off electrical equipment or appliances when they are not being used.							
With mitigation	Wide 2	Low 1	Short term	Minor	Probable	Low	High

6.14 Climate and natural hazards

6.14.1 Existing environment

Samoa has a distinct dry season from April to September and a rainy/wet season from October to March. Temperatures are generally high throughout the year. The south-easterly trade-winds dominate the wind pattern during the dry season. During the wet season, the wind direction becomes more variable, with high energy, localised storm cells common. This time of the year Samoa generally experience heavy rainfall, often causing flooding. Tropical cyclones are also common between November to April.

Climate change projections for the Pacific region, including Samoa, anticipate more frequent, intense tropical cyclones and heavy rainfall events. Tropical cyclones and tropical storms can cause high winds, potential storm surges, heaving rain and flooding

Heavy rainfall events in the upstream catchment exceeding the flow capacity of Aleisa Stream and stormwater network causes flooding of adjacent properties. Flooding within Aleisa Stream is discussed in Section 0.

Other natural hazards may bushfire in the surrounding vegetation, seismic activity and tsunami.

Natural hazards represent a risk to the health and safety of construction workers as well as a risk to assets and infrastructure.

These existing hazards and risks are managed through established National emergency systems and procedures implemented by NEOC and FESA. This includes emergency fire and rescue services as well early warning systems and monitoring.

6.14.2 Potential impacts and mitigation

Construction

The Project is located within and immediately adjacent to a flood prone area. The stream is also influenced by tidal process and has the potential to be impacted by king high tides or storm surges.

Prior to construction commencing, the construction contractor will prepare and implement an emergency response plane for hazards and risks during construction. The requirements for this emergency response plan should include monitoring of weather and potential storm events as well as measures for securing construction areas and evacuating construction personal.

An increase in greenhouse gas emissions would occur during construction of the Project associated with the transport of materials to site (vehicle emissions), fuel use and energy consumption associated with construction machinery and plant. Emissions would also include those embodied or generated during the manufacture of construction materials, particularly steel and concrete. Due to the small scale of the Project and the short term and temporary nature of the construction activities however, their contribution to overall greenhouse gas emissions from the transport sector would be negligible.

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**

Without mitigation	National 3	High 3	Short 1	Major	Possible	Medium	High
Mitigation measures: 1. Prior to construction commencing, the construction contractor will prepare and implement an emergency response plane for hazards and risks during construction							
With mitigation	National 3	High 3	Short 1	Major	Possible	Medium	High

Operation

During operation of the Project, no new hazards or risks would be created in addition to the existing hazards and risks and therefore they would be managed in accordance with the existing community emergency and evacuation procedures. The design of the new crossing raises the road level by 2m and increases the flow capacity of Aleisa Stream, reducing the vulnerability of West Coast Road from fooding during storm events.

6.15 Working Condition's/ Occupational health and safety

The Labour and Employment Relations Act 2013 of Samoa outlines key provisions for working conditions, including fair wages, working hours, leave entitlements, and occupational health and safety (OHS) standards. In the project phase, these conditions can be enforced through strict adherence to OHS regulations, ensuring that contractors and workers operate in a safe environment. Employers must conduct risk assessments, provide protective equipment, and implement safety training to minimize hazards. Regular workplace inspections and compliance monitoring by relevant authorities, such as the Ministry of Commerce, Industry, and Labour (MCIL), help uphold these standards and prevent work-related accidents or exploitation.

Occupational safety and health standards and regulation in the construction sector in Samoa is often below good international standards, particularly in relation to certain hazards such as working near traffic and mobile plant, and electrical safety (including work near overhead powerlines). MCIL has developed a series of Occupational Safety and Health Guides (including for electrical risks and plant/equipment operation), however development and implementation of project-specific safety plans are often substandard.

6.15.1 Potential impacts and mitigation

Construction

The construction phase includes a number of activities that pose a high occupational safety and health hazard due to their inherently dangerous nature and the potential for serious injury or deaths. The following activities are considered to be high risk:

- Demolition of a load bearing structure (e.g. bridge deck and abutments)
- Work inside an excavation greater than 1.5 metres deep (e.g. bridge abutment installation)
- Work on or near energised electrical installations (e.g. overhead powerlines)
- Work that involves pre-cast concrete (e.g. bridge deck planks)
- Work next to a traffic corridor (e.g. traffic control)
- Work involving mobile plant.

In accordance with the MCIL Occupational Safety and Health (OSH) Guides high risk activities require that safe work procedures or a safe work method statement (SWMS) is prepared. Additionally, the OSH Act (Part III) details the general duties of care of employers to employees requiring employers to (Part 11) *"…take all reasonably practicable steps to protect the safety, health and welfare at work of*

employees and to provide and maintain a safe and healthy working environment including substances, systems of work and any building or public or private area in which work takes place."

The OHS Guides describe a five-step process to managing OSH hazards, which reflects the OSH Act requirements:

- Step 1: Identify the hazards – determine the tasks or situations which could cause workers harm and identify the workers at risk from these tasks
- Step 2: Assess the risks – this involves considering what could happen if someone is exposed to a hazard (consequence) and the likelihood of it happening. A risk assessment can help determine how severe a risk is; whether existing control measures are effective; what action you should take to control the risk, and how urgently the action needs to be taken
- Step 3: Determine control measures – based on the hierarchy of control (in order of decreasing effectiveness): eliminating the hazard; substituting with a lower hazard work process; isolation of the work process from the worker; physical/engineering control measures (e.g. barriers); administrative controls; and personal protective equipment
- Step 4: Implement control measures – putting control measures into action; and
- Step 5: Monitor and review - control measures must be maintained so they remain fit for purpose, suitable for the nature and duration of the work and installed, set up and used correctly.

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Wide 2	High 3	Long-term 3	Major	Probable	High	High
Mitigation: 1. An Occupational Health and Safety Plan should be prepared by the Construction Contactor and implemented through the duration of construction. 2. Contractors must provide fair wages and timely payment for all employees. 3. Health and Safety training should be provided for all employees. 4. A first aid-kit should be kept on site and in trucks at all times. 5. Ensure that all works (local or foreigner) should not be subjected to unfair dismissal, harassment or discrimination. 6. Additional safety protocols for tasks involving heavy machinery, chemicals or construction works. 7. Workers must comply with environmental regulations to prevent harm to surrounding communities. 8. Contractors must NOT employ workers under the age of 18 on a dangerous machine or any occupation under working conditions injurious or likely to be injurious the physical or moral health of a child.							
With mitigation	Local 1	Low 1	Short-term 1	Minor	Improbable	Very low	High

8. "Reasonably practicable" is not defined in the Samoa OSH Act, however it is a legal requirement. It can be defined as an employer doing what it is reasonably able to do to ensure the health and safety of workers and others like visitors. When determining what is reasonable the following should be considered: the likelihood of the hazard or risk occurring; the degree of harm from the hazard or risk; what the person concerned knows, or ought reasonably to know, about the hazard or risk, and ways of eliminating or minimising the risk; the availability and suitability of ways to eliminate or minimise the risk; and the cost associated with available ways of eliminating or minimising the risk and whether the cost is grossly disproportionate to the risk.

6.16 Community Health and Safety

The Project has the potential to cause adverse impacts to community health and safety. These potential risks are assessed in a number of locations throughout this report, including:

- Traffic and vehicle related risks in Section 6.2
- Air quality in Section 6.11
- Water quality in Section 6.3
- Noise in Section 6.8

The prevention of health risks, the promotion of safety standards, and the reduction of hazards that may impact individuals' lives and livelihoods is a key consideration of the Project. Without adequate measures, communities can face challenges such as disease outbreaks, traffic-related accidents, or environmental hazards that disrupt daily life.

The World Bank has mandatory prevention measures towards sexual exploitation and abuse & sexual harassment (SEA/SH) that will be enforced to minimise community exposure to these risks. Awareness trainings will be provided to contractors including expected behaviours and how to respond to SH/SEA issues. Contractor's will report regularly on any ESHS incidents including any fatalities and SH/SEA complaints issues that may be received from the public. A code of conduct will be signed by all personnel working onsite, agreeing to their roles and responsibilities along with consequences of misconduct.

Consultations with communities included relaying project GRM process to lodge any complaints and SH/SEA incidents. Prior to Construction starting, consultations will reiterate contractor requirements to have approved safety measures and management plans in place to minimize any risks and to ensure public and community safety is prioritized during construction. The Contractors community liaison officer will ensure community and/or families are notified in advance regarding anticipated day to day impacts and ensure any community and public complaints are lodged, addressed and resolved in a timely manner. The construction site will be sealed off from the public with fences, barriers and hazard signs.

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Local 1	Low 1	Short 1	Minor	Improbable	Very low	Moderate
Mitigation: 1. Enforce code of conduct that explicitly prohibits SEA/SH with the adherence of all staff and contractors. 2. Conduct community awareness programs in educating individuals on rights and reporting mechanisms. 3. Establish specialized grievance redress mechanism (GRM) on SEA/SH incidents for responsible implementing agency to address in a timely and sensitive manner. 4. Engage and inform the community about project timelines and potential risks. 5. Restrict public access to hazardous areas using barriers and fencing. 6. Set up a community feedback system for ongoing health and safety concerns 7. Tight fencing of project site to prevent public from entering worksite 8. Installation of hazard and TMP signs throughout project site 9. Forbidden zone for swimming downstream of worksite							
With mitigation	Local 1	Low 1	Short 1	Minor	Improbable	Very low	Moderate

6.17 Cumulative environmental impacts

Cumulative impacts have the potential to arise from the interaction of individual elements within the Project and the additive effects of other external projects.

The Project is part of a much larger program of works to upgrade West Coast Road and improve the climate resilience of the regions transport network. As construction of the other sections of West Coast Road have been completed there would be no risk of cumulative impacts occurring with the Aleisa Stream crossing works. No other major project along West Coast Road is known to be scheduled within the time of construction for the Project.

The potential for adverse cumulative impacts would be addressed through the application of individual project specific environmental safeguards and management measures as summarised in Table 7-1.

The long-term effect of replacing the Malie-Afega Bridge would have a positive cumulative benefit when considered in the context of the other West Coast Road upgrade works that have already been completed.

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Confidence**
Without mitigation	Local 1	Low 1	Short 1	Minor	Improbable	Very low	Moderate
Mitigation: No specific mitigation measures recommended.							
With mitigation	Local 1	Low 1	Short 1	Minor	Improbable	Very low	Moderate

7. Environmental management and monitoring

The Preliminary Environmental Assessment Report has assessed the potential environmental and social impacts associated with construction and operation of the Project (refer Section 6). It also identified mitigation and management measures that should be implemented to avoid and minimise the potential adverse impacts.

In accordance with the *Planning and Urban Management (EIA) Regulation 2007*, this section provides a draft Environmental Management Plan (EMP) that outlines how the environmental and social management measures will be implemented before, during and after construction, to avoid, minimise and mitigate the potential adverse impacts identified.

7.1 Roles and responsibilities

The roles and responsibilities for the implementation of the EMP throughout construction and operation are as follows:

Land Transport Authority: LTA is the Implementing Agency responsible for the Samoa Climate Resilient Transport Project and therefore responsible for proposed replacement of the Aleisa Stream crossing. The LTA Project Management division are responsible ensuring environmental and social requirements implemented on every phase of the Project. This includes ensuring Safeguards requirements are included in the bidding documents for contractors, reviewing and approving the CESMP, monitoring construction progress and operation and maintenance of the new crossing.

Design and Supervision Consultant: The design and supervision consultant will be responsible for ensuring all environmental and social mitigation measures and consent conditions relevant to design are incorporated into the detailed design of the Project. The Supervision Consultant will also be responsible for monitoring the implementation of the CESMP.

Construction Contractor: The construction contractor will be responsible for all construction activities onsite. They will be obligated under their contractor to complete works in accordance with this PEAR/ESMP and any relevant Conditions of Consent. The construction will be responsible for preparation and implementation of the CESMP, including compliance monitoring and reporting of DC conditions. They will also have primary responsibility for the health and safety of all workers and visitors onsite.

Environmental Social Health and Safety Manager: is required for the project and is responsible in producing the relevant CESMP sub plans as outlined in the PEAR and Bidding documents.

He/she is also responsible for Preparation and submission of an approved Contractor's Environmental and Social Management Plan (C-ESMP) as per Specifications and Conditions of Contract (excluding detailed Quality, Safety and Traffic Plans which are billed separately) and implementation of the Contractor's Environmental and Social Management Plan (C-ESMP) throughout the construction period

PUMA: PUMA is responsible primarily for the administration and enforcement of the PUMA Act 2004 and Environmental Assessment Regulations 2007. PUMA will be responsible for issuing the DC and any conditions for the development by way of review and approval of this PEAR/ESMP. PUMA also have a role of compliance monitoring during construction.

7.2 Detailed design and construction planning

The concept design for the Project (as reflected in this PEAR and the design drawings submitted with the DCA) has sought to avoid or mitigate adverse effects through design refinement. This process will

continue during detailed design and development of the construction methodology in the next phase of the Project development.

7.3 Bidding documents

The bidding documents for the Construction Contractor will include specific work requirements that will contractually bind the successful bidder to environmental and social tasks and outcomes. The bidding documents will stipulate the minimum requirements for the nominated ESHS Construction Manager, including a minimum number of years of relevant experience in similar roles and qualification requirements.

The 'Bill of Quantities' will itemize the specific Environment, Social, Health, and Safety tasks that need to be completed and will ensure the budget is included within the contractor's overall fee estimate. This will include lump sum costs for the preparation of the CESMP, estimates for CESMP implementation, and provisional sums for environmental remediation. Workforce training and community engagement are all included.

The bidding documents will also outline specific hold points in the contract where works cannot commence without certain approvals being obtained. For example, construction cannot start before the DCA has been granted and the land acquisition/compensation process has been completed.

This PEAR will be attached to the bidding documents so that the mitigation and management measures become contractual requirements and are adequately incorporated into construction pricing and planning.

7.4 Construction Environmental and Social Management Plan

A key feature in managing construction related impacts is the preparation and implementation of a CESMP. A Construction Environment and Social Management Plan (CESMP) will be prepared by the Construction Contractor before any works commence onsite. The CEMP is the overarching management plan which sets out the methods and tools to be implemented by the LTA and the Construction Contractor will manage impacts during construction. It is prepared to meet the Development Consent Conditions, the mitigation and management measures in this PEAR, the SCRTP ESMF, World Bank Safeguards Policies, the Samoa Codes of Environmental Practice and relevant guidelines. Its purpose is to ensure that construction related impacts effects are appropriately managed during all stages of construction.

If required, the final CESMP will be provided to PUMA and WB for approval prior to construction, to allow PUMA and WB to confirm that the CESMP meets the applicable requirements of the consent conditions and WB Policies. The LTA require that contractors undertake all construction activities on site in accordance with the provisions of the relevant consent conditions and management plans as part of their contractual arrangements. The CESMP will provide details of:

- Environmental policy
- Staff and contractors' responsibilities
- Training requirements for employees, sub-contractors and visitors
- Environmental incident and emergency management
- Complaints grievance management
- Compliance monitoring
- Reporting (including detail on the frequency of reporting)
- Mitigation measures
- Corrective action.

The CEMP provides an overarching framework for the specific environmental management plans which will outline the methodology for delivering more detailed site or activity specific management plans. The activity specific management plans that will be prepare for the Project will include:

- Occupational Health and Safety Management Plan
- Traffic Management Plan

A key aspect of the CESMP will be implementation of the Project's Grievance Redress Mechanism (GRM) as well as ongoing community engagement. The GRM sets out the process for managing and responding to community concerns or complaints. The GRM is discussed further in Section 5.4.

7.5 Summary of mitigation and management measures

Key to the delivery of the Project, including the management of impacts, is the development, implementation and monitoring of a suite of measures covering detailed design, construction and operation. Table 7-1 provides a summary of the mitigation and managements proposed in this PEAR and outlines the responsibility and timing for implementation.

Table 7-1 Summary of mitigation and management measures

Ref	Impact	Measure	Responsibility	Timing
1.	General	1.1 Prepare and implement a Construction Environmental and Social Management and Monitoring Plan (CESMP) prior to works commencing onsite. The CESMP should include: • The mitigation and management measures that will be implemented to minimise and avoid adverse impacts during construction, including any specific measures imposed by Conditions of Approval. • Monitoring parameters for each mitigation measure • The Roles and responsibilities for construction personnel implementing the CESMP. • Corrective actions procedures. • A monitoring and audit schedule including any monitoring imposed by Conditions of Approval. • A communications plan including complaints register. • Training and induction information for construction personnel regarding their roles and responsibilities.	Construction contractor	Pre-construction
2.	Traffic and access	2.1 Prepare and implement a Traffic Management Plan in accordance with the Ministry of Works, Transport and Infrastructure's *Safer Road Works – A Field Guide for Use on Samoan Roads 2021.* 2.2 The Traffic Management Plan must allow works to be completed while maintaining two-way traffic along WCR 2.3 A Traffic Management Plan should be prepared and implemented that includes measures for safe pedestrian movements along West Coast Road. The risk of vehicles impacting the houses located near the temporary bypass should be considered.	Construction contractor	Pre-construction

Ref	Impact	Measure	Responsibility	Timing
		2.4 Temporary driveways must be provided for all properties affected by the traffic detour and vehicle access to properties must be maintained at all times.		Construction
3.	Hydrology and flooding	3.1 Location and activity specific erosion and sedimentation control mitigation measures must be investigated and included within CESMP. This should include the use of sediment fences, earth bunds, diversion drains. The use of coffer dams should be considered for in stream works during times of high flow. 3.2 Erosion and Sediment Control measures must be established prior to earthworks commencing and regularly inspected and maintained over the duration of the Project 3.3 Works within the Stream should only occur during 'low flow' or 'no flow' conditions 3.4 Disturbed areas and/or uncompact soil should be stabilised progressively during the works and excavations should be minimised during periods of wet weather. 3.5 Groundwater pumped from excavated abutments should be transferred to sediment retention basins before being released into the Stream. 3.6 All stockpiles of earth materials should be located at least 20m from the Stream 3.7 All hazardous chemicals (e.g. fuels) must be stored in appropriate containers and on the back of vehicles or on impervious surfaces that would contain a spill. A spill kit must be always kept onsite. 3.8 Vehicle and equipment wash-down areas should occur in a designated area at least 20m from the Stream.	Construction contractor	Construction
4.	Land and resettlement	LTA has overall responsibility for the full implementation of the ARAP and will work closely with MLS in conducting consultations for land-taking and compensation for required land. All land acquisition, leasing and transfer processes, as well as compensation for affected assets within easement areas will be completed prior to the commencement of civil works. Compensation for affected assets located within the road alignment will be identified and compensated once the awarded contractor has mobilized and completed surveying the new proposed alignment. Clearing and grubbing works will not commence until this has been completed.	LTA	Pre-construction
5.	Socio-economic	5.1 Local communities and directly affected landowners should be notified prior to works commencing and should be kept regularly informed of progress during construction. 5.2 A Grievance Redress Mechanisms/Complaints process should be implemented during construction for	Construction contractor	Construction

Ref	Impact	Measure	Responsibility	Timing
		receiving, investigating, recording and resolving complaints received from the community. 5.3 The Construction Contractor should have a nominated community liaison person(s) in place who is available to work with community members on any concerns raised during construction. 5.4 The Traffic Management Plan should include measures for safe pedestrian movements along West Coast Road. The risk of vehicles impacting the houses located near the temporary bypass should be considered. 5.5 Vehicle access to properties should be always maintained during construction. 5.6 Residents should be informed prior to any interruptions to utility services that may be experienced. 5.7 Landscaping should be considered along the road embankment and flood protection wall to soften the visual impact on adjacent residents from these structures.		
6.	Biodiversity	6.1 The final design level of the multi-box culvert outlet should not create a barrier to fish passage during periods of high flow. 6.2 Prior to construction commencing, areas to be disturbed should be delineated to avoid unnecessary clearing of vegetation and topsoil. 6.3 Detailed design should minimise the area required for streambed shaping. 6.4 Heavy machinery should be limited to the minimal area required.	Construction contractor	Construction
7.	Soils / Erosion Control Measures	7.1 Site clearance and/or levelling must be limited to the minimum area of exposed soil surface needed at any given time 7.2 Construction work areas should be visual monitored for signs of erosion during and after heavy rainfall. The Stream should also be visually monitored for signs of excessive sedimentation. If sigs of erosion are observed appropriate erosions and sediment control measures should be implemented to reduce erosion. 7.3 COEP 11 (Drainage) and COEP 13 (Earthworks) should be used as a guide for erosion and sediment control onsite. 7.4 Where appropriate, allow grass to regrow as soon as construction is completed. 7.5 Undertake weekly inspections of all machinery and equipment to check for leakages when in use. 7.6 Designate storage areas for oils and solvents that are bunded and on impervious services to minimise any impact from spillages. Where needed, refuelling or	Construction contractor	Construction

Ref	Impact	Measure	Responsibility	Timing
		lubrication of machineries and vehicles on site must be done away from drainages and/or where the hazardous liquids are restrained from reaching the ground		
		7.7 Take precautions when handling and mixing concrete on site - watch dripping into surface water drains		
		7.8 Spill kits will be kept onsite. Training on their use is to be provided, and regular content checks undertaken.		
		7.9 Location and activity specific erosion and sedimentation control measures should be investigated during construction planning and describe within the CESMP.		
		7.10 All sedimentation resulting from earthwork activities shall be contained, confined and restricted in such a manner that turbidity in Alesia Stream will be kept to a minimum.		
		7.11 Runoff from a project area shall not be discharged into water without effective means to prevent sedimentation.		
		7.12 Sedimentation retention booms, containment areas, sedimentation basins, or any combination of these, shall be used to restrict accelerated sedimentation around earthworks or earth disturbing activities on reefs or in lagoons.		
		7.13 Ensure that stockpiles of topsoil, fill, waste materials, and aggregates are not located within 10m of a watercourse and comply with COEP 2 Stockpiles.		
		7.14 Ensure that refuelling and maintenance facilities are not located, or activities do not take place, within 30 m of a watercourse.		
		7.15 Temporary Silt Control to comply with COEP2		
		7.16 Temporary stormwater devices and associated cut off drains/bunds shall be installed prior to any earthworks commencing on site.		
8.	Noise and vibration	8.1 Ensure that plant is in good working order and that all engine panels are in place	Construction contractor	Construction
		8.2 Instruct drivers and machine operators to operate equipment in a quiet manner		
		8.3 Strictly adhere to standard working hours		
		8.4 Respite periods for intrusive noise sources such as rock breaking (e.g. activity allowed only between 1000-1200 and 1400-1600)		
		8.5 Replacement of tonal movement alarms on excavators with broadband alarms		
		8.6 Regular meetings with residents to discuss forthcoming work program and potential noise issues		
		8.7 Pre-construction and post-construction condition surveys of nearby residences		

Ref	Impact	Measure	Responsibility	Timing
		8.8 Respite periods for vibration-generating noise sources such as rock breaking (e.g. activity allowed only between 1000-1200 and 1400-1600).		
9.	Cultural heritage	9.1 A physical exclusion zone should be set up around graves sites to prevent machinery or work activities from physically disturbing the sites 9.2 A chance find procedure for the unexpected discovery of potential cultural heritage items should be included in the CESMP and implemented by the Construction Constructor. 9.3 In the event of an unexpected find of a cultural heritage item (or suspected item) work would cease in the affected area, LTA would be notified and the unexpected finds procedure followed 9.4 Spring pool located 500m away from project site shall be considered during all the project activities and shall be maintained at any cost.	Construction contractor	Construction
10.	Visual amenity	10.1 Where vegetation loss reduces the amount of screening between residences and the Stream crossing or new flood protection wall, the following would be considered: • Tree protection measures at the base of the fill embankment to maintain as much mature vegetation as possible • Plant shrubs along the base of the new flood wall embankment • Plant shrubs along the base of the road embankment and the road corridor boundary	LTA and design team	Detailed design
		10.2 The footprint for construction works would be kept to a minimum to ensure existing stands of vegetation remain intact wherever possible and to screen adjoining sensitive receivers. 10.3 The work site would be left in a tidy manner at the end of each workday.	Construction Contractor	Construction
11.	Air quality	11.1 All plant items to be used on site to be inspected prior to use by the supervision engineer to ensure they are in good working order and do not have excessive emissions1. 11.2 Equipment with excessive emissions will need to be serviced or replaced. 11.3 Equipment to be powered down when not in use or when queueing for extended periods.	Construction contractor	Construction
12.	Waste Management	12.1 A dedicated waste storage area should be provided at the construction contractor's site compound area. Bins should be provided for small general waste like packaging and plastics. Waste should be collected from site on a regular basis and disposed at the Tafaigata landfill.	Construction contractor	Construction

Ref	Impact	Measure	Responsibility	Timing
		12.2 Construction areas should be kept tidy and generally free from waste 12.3 No waste should be burnt on site or dumped on neighbouring lands 12.4 Consider on-site segregation of all demolition waste materials into appropriate categories including (i) top-soil, sub-soil bedrock; (ii) concrete (iii) iron and metal. Consider any potential opportunities for reuse or repurposing with the local village before disposal at designated landfill. 12.5 Portable toilets would be provided for construction workers and would be managed by the service provider to ensure the appropriate disposal of sewage.		
13.	Resource use	13.1 All aggregates or imported fill material must be sourced from a licensed quarry supplier. The Construction Contractor must obtain a copy of the Quarry Operator's Quarry License before purchasing materials. 13.2 Ensure the Contractors use electricity at the site in a responsible and efficient manner. All workers must be encouraged to conserve electricity by switching off electrical equipment or appliances when they are not being used.	Construction contractor	Construction
14.	Climate and natural hazards	14.1 Prior to construction commencing, the construction contractor will prepare and implement an emergency response plane for hazards and risks during construction.	Construction contractor	Pre-construction
15.	Working Conditions/ Occupational health and safety	15.1 An Occupational Health and Safety Plan must be prepared by the Construction Contactor and implemented through the duration of construction. 15.2 . Contractors must provide fair wages and timely payment for all employees. 15.3 .Health and Safety training should be provided for all employees. 15.4 .A first aid-kit should be kept on site and in trucks at all times. 15.5 .Ensure that all works (local or foreigner) should not be subjected to unfair dismissal, harassment or discrimination. 15.6 .Additional safety protocols for tasks involving heavy machinery, chemicals or construction works. 15.7 .Workers must comply with environmental regulations to prevent harm to surrounding communities. 15.8 .Contractors must **NOT** employ workers under the age of 18 on a dangerous machine or any occupation under working conditions injurious or likely to be injurious the physical or moral health of a child.	Construction contractor, ESHS manager	Pre-construction

Ref	Impact	Measure	Responsibility	Timing
16.	Community Health and Safety	16.1 Enforce code of conduct that explicitly prohibits SEA/SH with the adherence of all staff and contractors. 16.2 Conduct community awareness programs in educating individuals on rights and reporting mechanisms. 16.3 Establish specialized grievance redress mechanism (GRM) on SEA/SH incidents for responsible implementing agency to address in a timely and sensitive manner. 16.4 Engage and inform the community about project timelines and potential risks. 16.5 Restrict public access to hazardous areas using barriers and fencing. 16.6 Set up a community feedback system for ongoing health and safety concerns.	Construction contractor, ESHS manager	Pre-Construction and throughout project construction phase

7.6 Licensing and approvals

Table 7-2 list all relevant licenses, permits and/or approvals needed to construct/operate the Project

Table 7-2 Licences and approvals required

Requirement	Timing
PUMA Development consent for Construction Compound	Prior to Construction mobilisation
PUMA Development consent for Main Works	Prior to Construction mobilisation
World Bank no-objection to PEAR and CESMP	Prior to Construction mobilisation
World Bank no-objection to ARAP	Prior to Construction mobilisation
World Bank no-objection to ARAP implementation completion report	Prior to Construction mobilisation
MWTI Building Permit for crossing structure	Prior to Construction mobilisation

8. Conclusion and recommendations

The Samoa Land and Transport Authority propose to replace the existing bridge that crosses the Aleisa Stream with a new multi-cell box culvert. The Project will contribute to the Government of Samoa's objective to upgrade the full length of West Coast Road and improve the climate resilience of the road connections between Apia and Faleolo Airport.

The existing Malie-Afega Bridge has been identified as requiring substantial repairs as well as been susceptible to over topping during periods of high rainfall. The Malie-Afega crossing is the remaining section required to complete the Climate Resilience upgrades of the West Coast Road.

This Preliminary Environmental Assessment Report has been prepared to identify and assess the potential environmental and social impacts associated with construction and operation of the Project. The PEAR also identifies appropriate mitigation and management measures to avoid and minimise the project's adverse impacts while maximising the Project benefits. Preparation of the PEAR has been undertaken in accordance with the *Planning and Urban Management Act 2004* and *PUMA Environmental Impacts Assessment Regulations 2007.* This PEAR will be submitted to the Planning and Urban Management Agency (PUMA) as part of a Development Consent Application. PUMA is the determining authority for the Project.

The World Bank Safeguards Policies (Operational Policies) also apply to the Project. This PEAR has been prepared to meet the requirements of Operational Policy 4.01 Environmental Assessment. The SCRTP Environmental and Social Management Framework (ESMF) provided principles, guidelines and procedures for assessing the potential environmental and social impacts within the PEAR. The PEAR will be submitted to the WB for their No Objection in accordance with the SCRTP ESMF requirements.

A number of potential environmental and social impacts from the Project have been avoided or reduced during the concept design development and options assessment phase. However, the Project will still result in impacts on water quality, biodiversity, traffic, visual and noise amenity, land and social disruption. Mitigation measures as detailed in this PEAR would ameliorate or minimise these expected impacts. The Project would also result in positive impacts climate resilient transport network, road safety and driving conditions. On balance the Project is considered justified.

9. References

Tinai, Gordon and Associates, 2024, *Feasibility and Options Analysis Report for Crossing at Afega*, Upolu

Appendix A – Community consultation invitation letter and attendance list

Appendix A Removed for Disclosure

Appendix B – Water quality results

Samoa Water Authority

Pulega o le Suavai

Customer name:	Margaret Rimoni		
Sample number:	24PS56-59	**Invoice number:**	1011
Date of report:	24th May 2024	**Pages:**	2 of 2

Detail of samples

Samples reference number	Description of sample
24PS56	Bridge downstream
24PS57	Stream mouth
24PS58	Crossing
24PS59	Bridge upstream

Sampled by: provided
Date sampled received and analyzed: Wednesday 15th May 2024
Tests performed by: SWA staff

Abbreviations

BOD_5	Biological Oxygen Demand
DO	Dissolved Oxygen
E. coli	*Escherichia Coli*
mg/L	Milligrams per liter
MPN	Most Probable Number
NTU	Nephelometric Turbidity Unit
PS	Private Sample
SS	Suspended Solids
°C	Degree Celsius

Methods used

Test	Analytical Method[1]
Escherichia coli	9223 B
Salinity	In-house
Turbidity	2130 B
Temperature	4500 – H+ B
SS	HACH 8006
DO	In-house
pH	4500 – H+ B
BOD_5	5210B

Reference

APHA	APHA standard methods for the examination of Water and Waste Water (24th Edition)

[1] Analytical Method Number stated refers to 'APHA Standard Methods for Examination of Water and Waste Water (24th Edition)' unless stated otherwise.

PO Box 245, Apia Samoa, Phone (685) 20409

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Fax: (685) 21298, e-mail: info@swa.gov.ws

Results

Table 1: Results for the various tests performed

Microbiological Parameters					
Tests	**Unit**	**24PS56**	**24PS57**	**24PS58**	**24PS59**
Escherichia coli	MPN/100ml	>2419.6	>2419.6	>2419.6	>2419.6
Physical Parameters					
Salinity	mg/l	14450	19990	304	11930
Turbidity	NTU	11.0	19.1	5.49	8.40
Temperature	°C	22.3	22.5	21.3	23.4
SS	mg/l	8	19	5	13
DO	mg/l	8.49	8.50	8.30	8.24
pH	No units	6.51	6.74	7.69	6.90
Chemical Parameter					
BOD_5	mg/l	2	2	1	1

Comments

The results relate only to the samples as received.

Please do not hesitate to contact us for any further queries on telephone number +685 21267 extension: 210

Soteria Matatia
Senior Laboratory Technician
Water Quality Unit
Samoa Water Authorit

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PO Box 245, Apia Samoa. Phone (685) 20409

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Fax: (685) 21298, e-mail: info@swa.gov.ws

Samoa Water Authority

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Customer name:	Margaret Rimoni		
Sample number:	25PS33-36	**Invoice numbers:**	1036
Date of report:	16th September 2024	**Pages:**	2 of 2

Detail of samples

Samples reference number	Description
25PS33	Private crossing
25PS34	Stream mouth
25PS35	Bridge downstream
25PS36	Bridge upstream

Sample by: provided

Date sampled analyzed: 11th September 2024 **Tests performed by:** SWA staff

Abbreviations

COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
mg/L	Milligrams per liter
NTU	Nephelometric Turbidity Unit
SS	Suspended Solids
TDS	Total Dissolved Solids
°C	Degree Celsius

Methods used

Test	Analytical Method[1]
Salinity	In-house
Suspended Solids	HACH 8006
Turbidity	2130 B
Temperature	4500 – H+ B
DO	In-house
BOD_5	HACH Method 8043
pH	4500 – H+ B
Escherichia coli	9223 B

Notes	
1	Analytical Method Number stated refers to 'APHA Standard Methods for the Examination of Water & Waste Water (24th Edition)' unless stated otherwise.
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RESULTS

Table 1. Results for the various tests performed

Physical and Chemical Parameters					
Analytes	**Units**	**25PS33**	**25PS34**	**25PS35**	**25PS36**
Salinity	mg/L	1,733	25,600	30,500	39,625
Turbidity	NTU	4.18	16.5	12.8	13.8
Temperature	°C	19.6	12.4	13.2	19.8
SS	mg/L	6	22	21	13
DO	mg/L	8.21	9.02	8.51	8.02
pH	pH units	7.42	7.75	7.93	7.88
BOD_5	mg/L	< 1	2	< 1	2
Microbiological Parameter					
E. coli	MPN/100ml	1,263	4,332.3	5,525.8	5,885.4

Comments

The results relate only to the samples as received.

Please do not hesitate to contact us for further queries on telephone number 21267 extension 210.

Pafuti Miller
Environmental Scientist
Water Quality Unit
Samoa Water Authority

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