Feasibility Report Vanuatu

Scoping study for Landfill Rehabilitation and/or Climate Proofing in Vanuatu

30 SPREP PROE

Sustainable, transformative and resilient for a Blue Pacific

Feasibility Report Vanuatu

Scoping Study for Landfill Rehabilitation and/or Climate Proofing in Vanuatu

Secretariat of the Pacific Regional Environment Programme

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→ **The Power of Commitment**

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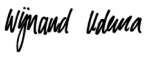
S4	0	F Mills	S Chirgwin		W Udema		21/4/23

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Acronyms

Acronym	Description
AFD	*Agence Française de Développement*
ADB	Asian Development Bank
DDT	Dichlorodiphenyltrichloroethane (insecticide used in agriculture)
DEPC	Department of Environmental Protection and Conservation
DFAT	Australian Department of Foreign Affairs and Trade
EU	European Union
FASEP	Fonds d'Etude et d'Aide au Secteur Privé (Study Fund and Private Sector Assistance)
JICA	Japan International Cooperation Agency
J-PRISM	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries
LMC	Luganville Municipal Council
m	Metres
MCA	Multi-criteria analysis
MoCCA	Ministry of Climate Change and Adaptation, Meteorology and Geo-hazards, Energy, Environment and Disaster Management
MSW	Municipal Solid Waste
NGOs	Non-governmental Organisations
Ni- **Vanuatu**	A native or inhabitant of Vanuatu
NWMS	National Waste Management Strategy
PacWaste	Pacific Waste Management Programme
PET	Polyethylene terephthalate
PICTs	Pacific Island Countries and Territories
PSS	Product Stewardship Scheme
PVCC	Port Vila City Council
PVMC	Port Vila Municipality Council

PWD	Public Works Department
RfQ	Request for Quotation
SPREP	Secretariat of the Pacific Regional Environment Programme
SWAP	Committing to Sustainable Waste Actions in the Pacific
t	Tonne
UNEP	United Nations Environment Programme
USD	United States Dollars
uPOPs	Unintentional Persistent Organic Pollutants
VAT	Value Added Tax
VUV	Currency of Vanuatu - Vatu
$**m**	Dollars million (1,000,000) in USD

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1. Introduction

1.1. Background

“Committing to Sustainable Waste Actions in the Pacific (SWAP)”, aims to improve environmental, social, and economic conditions in Pacific Island countries and territories through proper waste management. Funded by the *Agence française de développement* (AFD), this work stemmed from an awareness of the increased pressure from development and population growth, and the impact of increasing and changing waste streams for Pacific Island Countries and Territories (PICTs).

SWAP has a focus on four key areas:

– used oil
– marine debris
– disaster waste
– sustainable financing mechanisms.

This targeted approach for three key problematic waste streams, and the over-arching enabling mechanism of sustainable financing, provides the beneficiary countries with support to improve local waste management systems and infrastructure.

Six countries and territories will benefit from this project - Fiji, Samoa, Solomon Islands, Tonga, Vanuatu, and Wallis and Futuna. The SWAP implementation pathways include:

- regional vocational training
- pilot projects
- tools for sharing successes and challenges through a Community of Practice.

In collaborating with partner governments, support is targeted to meet the needs on the ground. In both Vanuatu and the Solomon Islands, there is an identified need to improve waste disposal sites, with a focus on rehabilitation and/or climate proofing to reduce environmental and social impacts.

SWAP has funded this Project to scope the most appropriate interventions in both Vanuatu and the Solomon Islands. Working with in-country focal points, GHD has selected priority sites, and then assessed the needs on the ground. The funding available for works is USD110,000 per country, including USD100,000 to implement the selected activity/activities plus USD10,000 to hire a consultant to oversee the implementation. The budget allocation can be revised if there is less need to recruit a consultant to oversee the field works or if the need for supervision is greater due to work complexity.

After options for the works were selected in collaboration with local focal points, broad technical specifications, costs and work planning were undertaken to enable the works component to be undertaken in 2023 / 2024. This report relates to the proposed works in Vanuatu.

1.2. Purpose of this report

The purpose of this report is to support SWAP and the Vanuatu government agencies with decision making on the allocation of funds available for waste disposal site rehabilitation and climate resilience in Port Vila and Santo. The report provides the recommendations on the selected waste disposal sites and a definition of the specific activities to be implemented within the budget allocation. The report provides a summary of current and planned activities at the sites, technical assessment of current operations and the site infrastructure, analysis of options for interventions, and selection or recommended works, including high level costs, equipment and work requirements, specifications, a workplan and recommended timeline.

1.3. Limitations

This report: has been prepared by GHD for Secretariat of the Pacific Regional Environment Programme and may only be used and relied on by Secretariat of the Pacific Regional Environment Programme for the purpose agreed between GHD and Secretariat of the Pacific Regional Environment Programme as set out in section 1.2 of this report.

This document has been produced with the financial assistance of the Agence Française de Développement (AFD). The views expressed herein can in no way be taken to reflect the official opinion of the AFD

GHD otherwise disclaims responsibility to any person other than Secretariat of the Pacific Regional Environment Programme arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Secretariat of the Pacific Regional Environment Programme and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the preliminary cost estimates set out in sections 6.7.4 and 7.7.4 of this report and Appendix A, using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD.

The Cost Estimate has been prepared for the purpose of evaluating interventions and providing high level budgeting, and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the works can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

The opinions, conclusions and any recommendations in this report are based on information obtained from site visits and interviews conducted with stakeholders. No testing has been undertaken at or in connection with, specific sample points.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

1.4. Assumptions

This report has been prepared upon the following assumptions:

- USD$110,000 is available in capital works for the project, inclusive of an estimate of USD$10,000 for supervision costs. The focus of this Feasibility Report is to explore potential infrastructure improvement projects, and where necessary identify capacity development initiatives that could be included in the cost of the project.

- Information provided by third parties, and during stakeholder interviews was, true, correct and information complete.
- As advised by SWAP, the donor funds cannot be utilised for day-to-day operations.

For costings, this was based on discussions with contractors and suppliers with sound understanding of Vanuatu context. Whilst best efforts have been made for realistic pricing, final pricing from the quotation process may differ from these estimates.

2. Methodology

2.1. Scope and Methodology

The methodology for this assessment included:

– Desktop review of available published literature and reports
– Legislative and policy framework review to contextualise potential interventions
– Engagement with key Vanuatu Government agencies relevant for the waste disposal sites governance, management and operations
– Through engagements, evaluation of capacity development needs at the central government, and provincial government level.
– Field site inspection of shortlisted waste disposal locations (Bouffa Waste Disposal site located in Port Vila, Efate Island and Luganville Waste Disposal site located in Luganville, Santo Island)
– Review of existing national, provincial, and local initiatives by government agencies or other donors related to waste management, or climate change that are relevant for consideration.
– Develop a multicriteria ranked priority list of interventions for each location for potential rehabilitation or climate resilience initiatives.
– Workshop discussion of long listed potential interventions and draft recommendations with SWAP in Samoa, SWAP focal points in Vanuatu, relevant Council representatives, and other donor partners working to improve waste management in the region.
– Written feedback from stakeholders after considering long-listed potential interventions.
– Compilation of summary report and recommendations
– High level costings, technical requirements and proposed timeframe for implementation.

2.2. Stakeholder engagement

Stakeholder engagement was largely focused on government agencies that would likely be involved in the project, should it proceed. No engagement was undertaken with community groups, Non-governmental Organisations (NGOs) or women's groups. The key stakeholders for the Vanuatu Feasibility Study are included in Table 1

Table 1 Stakeholders interviewed to date

Name	Organisation	Role / Function
Julie Pillet	SWAP	Technical Waste Project Coordinator
Tooa Brown	SWAP	Project Technical Assistant
Ionie Bolenga	Vanuatu Department of Environmental Protection and Conservation. (Waste Management and Pollution Control).	Director Waste management and Pollution Control

Name	Organisation	Role / Function
	Ministry of Climate Change and Adaptation, Meteorology and Geo-hazards, Energy, Environment and Disaster Management	
Roselyn Bue	Ministry of Climate Change and Adaptation, Meteorology and Geo-hazards, Energy, Environment and Disaster Management	Senior Officer (Chemical and Ozone)
Jason Andrews	PVMC Waste Management and Environment and Health Office	Manager
Serge Sandy Mwetu 'Sandy	PVMC Waste Management and Environment and Health Office	Municipal Waste Management Officer
Chief Seule	Local chief of community who neighbours the Bouffa waste disposal site	Local chief of community who neighbours the Bouffa waste disposal site
Ms. Touasi Tiwok	Department of Environmental Protection and Conservation Ministry of Climate Change Adaptation, Meteorology and Geo-Hazards, Environment, Energy and Disaster Management	Director – in charge of environmental
Solomon Jimmy	Shefa Provincial Council	Environmental Waste Management Officer – In charge of wider region, waste management officer for provincial council / landowners.
Lolo Tambe	Luganville Municipal Council	Waste Management Officer
Tommy	Luganville Municipal Council	Town Planner
Kuber Naicker	LCM (large local chain store in Luganville)	Operations Manager
Chief Sandy Sur	Local Chief in a community located nearby to the Luganville Municipal Council waste disposal site	Local Chief in a community located nearby to the Luganville Municipal Council waste disposal site who also runs a tourism village.

2.3. Intervention prioritisation

2.3.1. Site Prioritisation

The site prioritisation process was largely undertaken by Ministry of Climate Change and Adaptation, Meteorology and Geo-hazards, Energy, Environment and Disaster Management (MoCCA) staff from the Department of Environmental Protection and Conservation (DEPC), where high priority sites were shared with the project team. It is understood that this prioritisation was primarily based upon perceived need, and whether other donor resources had been allocated to these waste disposal sites, seeking to avoid duplication of efforts in sites that had received recent donor attention. Three locations were chosen for discussions, including Bouffa, Luganville and Tanna. The site prioritisation is described in further detail in Section 4 .

2.3.2. Review of existing or planned interventions

The purpose of this assessment was to identify existing or planned interventions for waste management, and where relevant, climate change (only considered where it relates or may impact waste management) – in order to

avoid duplication of other efforts, and also to potentially identify where there may be opportunities to augment existing projects or programmes of work being executed by government, donor agencies or third parties such as NGOs.

This review was largely a desk top exercise, reviewing publicly available sources of information. This was supplemented with information gathered during stakeholder engagement sessions. This information was collated into a summary table, and this was reviewed in consideration of intervention options.

2.3.3. Multi-Criteria Analysis of Potential Interventions

By applying a multi-criteria analysis to interventions, it provides a standardised method to assess criteria that are considered important when prioritizing interventions. The criteria provide a weighting, based upon importance, and also based upon feedback from stakeholders.

Three main categories, and sub-categories of criteria are included

- Social criteria:
  - Adverse human health (contact, drinking water)
  - Local nuisance (odours, vectors, traffic, noise, dust)
  - Capacity building potential
  - Improvement in waste transport cost/effort
  - Local ownership constraint
  - Adverse tourism effects
- Environmental:
  - Surface water / marine effects
  - Level of climate resilience improvement (coastal vulnerability / inundation / flooding / storm surge)
  - Complexity of permitting and approvals
- Operational / Implementation complexity:
  - Available waste disposal site operational resources
  - Ability of provincial government to support (in kind contribution of plant and/or people)
  - Available third party contractor on island
  - Maintenance requirement
  - Delivery timeframe for intervention
  - Ability to augment with other donor funding
  - Local technical capacity for maintenance
  - Capital cost

MCA Evaluation

Each criterion is assigned a rating of low, medium or high (high being positive and low being negative), and descriptions for each of the criterion. These include both semi quantitative, and subjective criteria that are evaluated on the findings of this scoping study, stakeholder engagement, field inspections and professional judgement.

The tallies for each category are added up to provide a cumulative ranking from high (most desirable), to low (least desirable. This helps bring focus to the shortlist of interventions that should be considered for funding. Further consultation with key stakeholders was undertaken on the shortlist, to ensure alignment for funding priorities. A summary of this discussion is provided in Appendix A.

3. Legislative and Policy Context

A summary of legislation and policy relevant to Vanuatu is provided in Table 2.

Table 2 Relevant legislation

Legislation/ Policy/ International Convention	Relevant Clauses	Relevance to rehabilitation/climate resilience improvements of waste disposal sites	Consideration/ comments	Project Relevance
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention)	4.1a 4.2b	Parties exercising their right to prohibit the import of hazardous wastes or other wastes for disposal shall inform the other Parties of their decision. Each Party shall take the appropriate measures to ensure the availability of adequate disposal facilities, for the environmentally sound management of hazardous wastes and other wastes.	**-Basel Convention on the Control of Transboundary Movements of Hazardous Wastes - 20113644.pdf (unep.org)** In effect in country since 14 January 2019. No specific implanting legislation.	Limited relevance
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam Convention)	1	The objective of this Convention is to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties.	**Rotterdam Convention Home Page (pic.int)** In effect in country since 14 January 2019. No specific implementing legislation.	Limited relevance
Minamata Convention on Mercury (Minamata Convention)	1 10.3	The objective of this Convention is to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. Sound interim storage of mercury and mercury compounds, considering any relevant guidelines developed under the Basel Convention on the Control of	**Minamata Convention on Mercury | UNEP - UN Environment Programme**	Limited relevance

Legislation/ Policy/ International Convention	Relevant Clauses	Relevance to rehabilitation/climate resilience improvements of waste disposal sites	Consideration/ comments	Project Relevance
		Transboundary Movements of Hazardous Wastes and Their Disposal and other relevant guidance.	In effect in country since 14 January 2019. No specific implementing legislation.	
Convention to ban the Importation of Hazardous and Radioactive Wastes into Forum Island Countries and to Control the Transboundary Movement and Management of Hazardous Waste within the South Pacific Region (Waigani Convention) (2001)	15	The Waigani Convention is modeled on the Basel Convention and constitutes the regional implementation of the international hazardous waste control regime (Basel, Rotterdam, and Stockholm Conventions). The objective is to reduce and eliminate transboundary movements of hazardous and radioactive waste, to minimize the production of hazardous and toxic wastes in the Pacific region and to ensure that disposal of wastes in the Convention area is completed in an environmentally sound manner. The Conference of the Parties shall consider the establishment of a revolving fund to assist on an interim basis in case of emergency situations to minimize damage from disasters or accidents arising from transboundary movement or disposal of hazardous wastes within the Convention Area.	**Waigani Convention | Pacific Environment (sprep.org)** In effect in country since 17 February 2008. Implementing legislation – Waste Management Act (2014).	Limited relevance
Waste Management Act (2014)	1.1 1.3 2.3.3 2.3.4 2.3.5 2.3.6 2.3.7 2.4.4 3.2.1 3.2.4	An environmentally sustainable Vanuatu in which all types of generated wastes are collected, reused, recycled, and treated by environmentally sound technologies suited to local conditions and waste going to landfill is minimized to the lowest amount possible. Objectives to reduce waste landfilled, upgrade waste systems to be well-managed, efficient, and self-sustaining, and to better coordinate national waste management activities.	**https://www.sprep.org/attachments/j-prism/Vanuatu/Annex21_Vanuatu_FINAL_NWMS_APRIL_2011.pdf**	Improving the main waste disposal site and facilitating improved operational efficiencies are directly relevant to Waste Management Act.

Legislation/ Policy/ International Convention	Relevant Clauses	Relevance to rehabilitation/climate resilience improvements of waste disposal sites	Consideration/ comments	Project Relevance
Vanuatu Waste Management Policy (2001)	All	Policy objectives: to minimize and ensure proper waste management through methods accepted by the Ni-Vanuatu that: protect the environment by reducing adverse impacts, promote human health, and facilitate socio-economic developments; and to increase public knowledge and understanding on waste minimization and management issues to ensure their active participation in programmes and initiatives developed to achieve the goal. Vanuatu also identified three high priority issues as being (1) Integrated Solid Waste Management, (2) Legislation, and (3) Awareness, Communication and Education. The actions identified in the Regional Strategy (Cleaner Pacific) are closely aligned with the actions identified in this Vanuatu National Waste Management Strategy.		Improving landfill operational and environmental performance directly relevant to Policy
Pollution Control Act (2013)	8	The owner or occupier of any premises must comply with any prescribed standard for the discharge of pollution, wastewater and the emission of noise, odour, or electromagnetic radiation from the premises.	**http://www.paclii.org/cgi-bin/sinodisp/vu/legis/num_act/pa2013236/pa2013236.html?stem=&synonyms=&query=pollution%20control%20act**	Improving operations may reduce pollution risk
Environmental Management and Conservation Act (2006)	6 18 19	Establishment of Environmental Registry and Environmental Impact Assessment guidelines.	SPREP (2020). Stocktake of Existing and Pipeline Waste Legislation.	Not directly relvant
Water Resources Management Act (2002) and Water Resources Management (Amendment) Act (2016)	37 27A	While the current provisions of the Act do not specify wastewater in terms of the PacWastePlus definition, there appears to be scope under the legislation to create regulations that may cover water impacted by solid waste. Regulations may be made for 'the control, regulation or prohibition of any matter or thing in connection with the diversion, taking, collection, storage, supply, disposal, or discharge of any wastewater'. Section 27A(2)(d) prohibits filing or dumping of waste in buffer zones.	SPREP (2020). Stocktake of Existing and Pipeline Waste Legislation.	Improving operations may reduce pollution risk

Legislation/ Policy/ International Convention	Relevant Clauses	Relevance to rehabilitation/climate resilience improvements of waste disposal sites	Consideration/ comments	Project Relevance
Public Health Act (1994) and Public Health (Amendment Act (2018)	8 – 65, 66, 72 8 – 73	Makes general provisions for public health, including through regulating waste management, sanitation, and prohibiting water pollution. Part 8 of the 2006 consolidation dealt with sanitation and waste disposal, with specific provisions on littering and inappropriate waste disposal (sub-sections 65, 66 and 72). Part 8 was substantially amended by the 2018 amending legislation and the provisions on littering repealed. Many provisions now relate to sewage sanitation systems. More relevant are sub-sections 73H, 73I and 73J on the provision of rubbish bins and interference with rubbish bins and tips. Healthcare waste is not specifically identified in the legislation. Other provisions relating to inappropriate waste disposal and litter management now fall under the Waste Management Act 2014.	SPREP (2020). Stocktake of Existing and Pipeline Waste Legislation.	Improving operations may reduce health risk, particularly reducing disease vectors through proper operational procedures
Pipeline		Oceans Initiative Vanuatu National Statistics Office National Disaster Waste Management Action Plan	SPREP (2020). Stocktake of Existing and Pipeline Waste Legislation.	Highly relevant to management of disaster waste given the need to be able to clear areas of existing waste stockpiles and separate and manage disaster waste on arrival

4. Site Prioritisation

4.1. Site Shortlisting

Engagement and discussions with key Vanuatu Government Stakeholders identified a number of waste disposal sites that are in need of rehabilitation and/ or climate related resilience works. The locations that were identified included:

– Lenakel, Tanna Island
– Luganville, Santo Island
– Port Vila, Efate Island

4.2. Location selected

The Bouffa Landfill in Port Vila (Section 6) and the Luganville Landfill (Section 7) were selected for analysis.

In Vanuatu, there are only three formalised waste disposal sites identified: Bouffa Landfill at Port Vila, and the two provincial waste disposal sites known as Luganville dumpsite and Lenakel dumpsite. Whilst there are disposal areas in all Provinces, these are essentially local arrangements with no official standing. They are tolerated given there are no alternatives available. However, undertaking works to improve these sites is challenging given the Government has no official jurisdiction to operate on this land.

In discussion with the Government, it was agreed that the focus sites need to be those that are located on land where there is clarity on ownership and that the sites are regulated by Government.

The Bouffa Landfill in Port Vila was selected as this waste disposal site is estimated to process half of the waste within Vanuatu. This site is well established and has a well understood governance structure. This disposal site is prioritised as a site to assess.

The Luganville Municipal Council waste disposal site was also selected as a high priority from the Government perspective. One of the key issues in the Luganville is access to land for waste disposal as the land at this existing site has a number of claimants and is used by the council with permission from the leaser. This leads to complex negotiations to allow works on site. However, this site is recognised by the government enabling some jurisdiction for intervention from the government.

5. Capacity Review

An in-depth review of institutional capacity was not undertaken as part of this scoping study, as such the commentary herein is based upon observations noted during engagement with government agencies and contractors.

5.1. Ministry of Climate Change and Adaption, Meteorology and Geo-hazards, Energy, Environment and Disaster Management

GHD consulted with staff from the Ministry of Climate Change and Adaption, Meteorology and Geo-hazards, Energy, Environment and Disaster Management (MoCCA) including management and technical staff (Waste Management and Climate Change). MoCCA demonstrated a high level of competence and professionalism and interactions were a positive experience. Staff members have been supported technically and undertaken capacity development initiatives through the two phases of JPRISM (Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries). This programme has included short training programmes in Japan, to allow firsthand understanding of waste management, landfill operation and engineering in a different context. Phase Three of the JPRISM programme will commence in March 2023 and run through to March 2028 and will continue to focus on capacity development within MoCCA and relevant council staff, utilizing a similar modality of delivery.

As with many central government agencies across the Pacific, within MoCCA it appears that the capacity is constrained through lack of financial resources, inadequate staffing numbers, lack of equipment and lack of financial support for waste management and climate change activities to be undertaken in an effective manner. There may be some opportunity to strengthen financial sustainability through financial instruments such as waste levies, advanced disposal fees, or user pays bag systems (such as improving the financial model for the red and yellow bag system). Strengthening financial mechanisms is being supported by both PacWaste Plus and SWAP, with the intention to strengthen revenue streams for the Ministry, potentially building broader resources to adequate levels.

The PacWastePlus Programme, funded by the European Union (EU), is supporting the Department of Environment and Conservation under MoCCA, to implement an investment to draft regulations for a Product Stewardship Scheme. It is hoped that this will provide a means to strengthen the financing of waste management and resource recovery initiatives. PacWastePlus is also providing training as per the Vanuatu Implementation Plan, with the first one aimed at increasing the capacity of Vanuatu government staff to undertake effective and inclusive consultations. Other planned trainings include topics such as storage, treatment and disposal solutions for health care waste management, organic facility design and operation, and training resources on a range of waste management challenges such as bulky waste, disaster waste and asbestos.

The ongoing support through regional programmes such as SWAP, PacWaste Plus and J-PRISM are critical for ongoing capacity development across the region, encouraging Governments to consider a range of sustainable financing mechanisms for waste management service delivery and infrastructure. In addition, standalone programmes through institutions such as the World Bank or Asian Development Bank (ADB) include measures to build capacity alongside infrastructure delivery. MoCCA are the lead agency in Vanuatu for waste management, and as the focal point for waste management nationally, receive opportunities for capacity development.

5.2. Provincial Government & Town Council – Port Vila

The engagements in Port Vila included meetings with the Director and Senior Officer of Vanuatu Department of Environmental Protection and Conservation, members of PVMC (Port Vila Municipal Council) Waste Management and Environment and Health Office and a member of Shefa Provincial Government Council.

In Port Vila the staff members directly responsible for the landfill site are the PVMC Waste Management and Environment and Health Office. All staff members were well motivated and proactive in improving waste management, with Sandy, one of the more senior staff members having been involved in trainings with JPRISM in person in Japan and virtually. There is a risk that if the current landfill manager resigns from his position, that there will be no staff with the required level of knowledge to operate the landfill appropriately. Subsequently, additional training and capacity development for site managers as well as site workers is required. Further to this, it is also understood that the Phase 3 of the JPRISM project will continue to focus on technical development of staff at the levels of MoCCA, Provincial Government, and Municipal Council which is also likely to strengthen capacity.

Most training activities were focused on planning and there appears to be a lack of technical understanding of the following areas:

– Environmental risks and compounding impact of contaminant and litter release into the environment
– Risk posed by waste dumps on water courses and groundwater
– Human health and environmental hazards posed by medical waste burning and inappropriate disposal

Currently, no known water samples are collected from groundwater or surface water around the site. It is understood that a number of departments including the Shefa Provincial Government Council and Vanuatu Department of Environmental Protection and Conservation, and the Vanuatu Department of Water are looking into undertaking surface water sampling. This is discussed further in the recommendations section of this report.

Currently, both Port Vila and Santo use bag systems for their user-pay waste collection service. There may be further opportunity to strengthen financial sustainability through instruments such as waste levies or increased user fees for bags. Given the constraints in operations due to lack of adequate financial and human resources, seeking revenue opportunities is an important component of strengthening waste management in Port Vila.

5.3. Provincial Government & Town Council – Luganville

The engagements in Luganville included meetings with the Luganville Municipal Council Waste Management Officer Lolo Tambe, Luganville Municipal Council Town Planner (Tommy) and local Chief Sandy Sur.

Engagement with the Waste Management Officer demonstrated that he has a good understanding of the key issues around waste management and a desire to improve waste management in the Luganville area, however there was lack of institutional support to enable these improvements. There is a lack of planning and development for the landfill. The Luganville Municipal Council would benefit from preparation of management documents for the site such as a landfill management plan.

The Luganville Waste Management Officer participated in an extensive waste management training programme in Japan as part of JPRISM II in 2015. The training was broad and has provided an excellent understanding of good waste management practice and landfill operations and maintenance. In addition to Lolo completing this training the gatekeeper has also benefited from the JPRISM Phase 2 programme. Overall, there appears to be a reduced need for capacity development – as the site management is primarily constrained by resources and financial constraints. However, it is important that technical training does reach staff who are working on the ground, and Lolo is very interested to stay up to date with practices relevant to the site at Luganville.

5.4. Implementation capacity

An in-depth capacity assessment was not undertaken for Vanuatu (Port Vila or Luganville) government agencies in terms of ability to support project implementation, and as such the following commentary is based upon engagement and discussions. Overall, the ability for town council officers to resource and support the project is limited as they all have their day-to-day duties to fulfill in their current roles, meaning that there is limited spare capacity to support additional workload with project implementation. It is recommended that council officers' involvement is limited to liaison, and engagement with stakeholders and community. This is part of their normal functions, however the intensity of this would be heightened through the project implementation cycle.

6. Bouffa Waste Disposal Site (Port Vila)

6.1. Site overview

6.1.1. Location

The Bouffa Landfill is located approximately 6 km east of town in the suburb of Montmartre. The site is located approximately 900 m west of the Teouma River and 350 m west of the Lololima River. The site is located 5km from the coast (see Figure 1).

6.1.2. Waste disposal site description

The Bouffa Landfill (see Figure 1) is the main waste disposal site for Port Vila, which is the capital city of Vanuatu. The landfill was opened to receive waste in 1995 and was subsequently upgraded to a semi-aerobic design in 2006. The site accepts domestic, commercial and industrial waste collected by the Port Vila Municipal Council (PVMC) and waste brought in by individual customers. In addition, the Sefa Provincial Council (SPC) utilises the Bouffa Landfill for waste disposal. According to the Waste Audit report undertaken in 2020 through SPREP, the site receives approximately 13,100 tonnes of waste per annum.

The underlying geology of the Efate Island and in particular of the city of Port Vila is a large Plio-Quaternary volcano-sedimentary island. The composition is primarily volcanic eruptive rocks and ashes deposits however volcanic substratum does not outcrop in Port Vila area and is probably lying at great depth beneath the city. [1] The city of Port Vila is located on raised lime stone terraces of different ages, the areas formation has been controlled by tectonic uplifts and it is now bounded by large quaternary limestone and sedimentary terraces.

The landfill site has a surface water divide on its' western boundary and where waster shed is to the eastern Lololima river that discharges southwards to the Teouma River and ultimately to Teouma Bay. Customary residential properties exist immediately to the west of the western site boundary. On the eastern catchment to the Teouma River are few if any residences down gradient of the landfill. The land is predominantly horticultural with small areas of residential.

[1] https://horizon.documentation.ird.fr/exl-doc/pleins_textes/pleins_textes_7/b_fdi_55-56/010023682.pdf

Legend

Port Vila Site

Paper Size ISO A4

0 75 150 225 300

Meters

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Figure 1 Port Vila waste disposal site

Project No. 12587989
Revision No. -
Date 24/03/2023

Data source: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community. Created by: fmills2

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Print date: 28 Mar 2023 - 15:20

6.1.3. Climate

Port Vila has a mean annual temperature of 24.5 °C with a mean annual precipitation of 2700 mm (2.7 m) (1991 – 2020)[2]. Port Vila experiences the majority of its' wet season between November to April, this is also the hot season. The landfill is located on elevated ground about 100 m ASL. This causes rainfall to fall more than at the coast.

6.2. Site management and oversight

The Bouffa landfill is operated by the Port Vila Municipal Council (PVMC) on land leased from custom land and Shefa Provincial Council. The management and operation of the landfill is solely undertaken by PVCC (Port Vila City Council).

There are currently nine staff on site operating the landfill, overseen by the Municipal Waste Management Officer (Serge Sandy Mwetu) reporting to the Manager, Waste Management and Environment and Health Department (Jason Andrews). The waste management and landfill disposal charges are legislated through the Port Vila City Council bylaw number 6, 2021.

Day-to-day management of the landfill and waste collection operations is by the Municipal Waste Management Officer who is formally trained in landfill management through the J-PRISM initiative.

The on-site staff include a gate keeper who receives waste disposal tickets (pre-paid at the PVCC office) and an onsite supervisor to direct end tipping of incoming vehicles and monitoring waste delivered and placed. The Waste Management Officer attends the site daily to direct waste placement progression and maintenance duties undertaken by the site staff.

6.3. Waste disposal site operations

The Bouffa landfill is a semi aerobic landfill which is owned by PVMC.

The landfill development plan prepared by JICA provides for the development of five separate waste cells based on the semi aerobic Fukuoka method. To date Cell 1 is operational and near capacity.

[2] https://climateknowledgeportal.worldbank.org/country/vanuatu/climate-data-historical

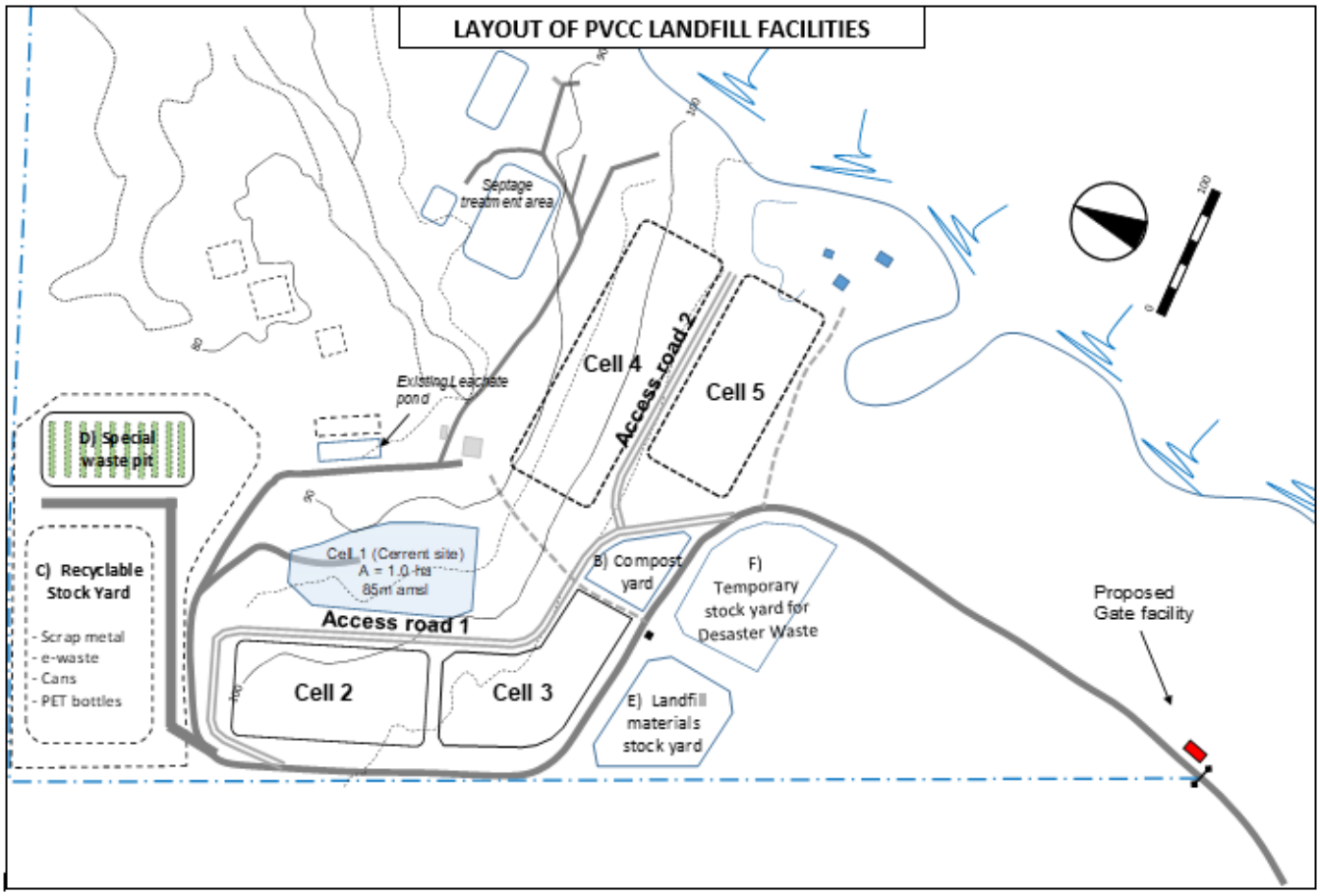


Figure 2 JICA landfill development plan

An historical waste cell for the period prior to preparation of the JICA development plan exists on the site. This historical cell has been capped and was proposed to be used for the placement of scrap metals, E-waste, cans and bottles. It has however been used for the placement of construction and demolition waste (co-mingled with soil) as well as tyres and scrap metals (see Plate 1). The quantity of waste over the historical waste cell is significant. Relocation to Cell 1 is not possible (due to the quantity) and it would consume a significant portion of Cell 2 when developed.

Plate 1 View of entrance to historical landfill with C&D waste end dumped on cell and also approach road

The JICA development plan provides for 4 further waste cells with capacities and life span set out in the following extract from the *Preliminary Design Report for Development of Cell – 1 &2 of Bouffa Landfill Site* (JICA March 2020)

Table 3 Expansion schedule of cells in Bouffa Disposal Site (JICA 2020)

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Disposal amount	m3/year	17,613	18,659	19,254	20,143	21,080	22,066	22,950	23,869	24,826	25,821	26,855
Accumulated volume	m3		18,659	37,913	58,057	79,137	101,203	124,153	148,022	172,848	198,668	225,524
Cell 1		Cell 1										
Cell 2			Cell 2									
Cell 3						Cell-3						
Cell 4										Cell 4		

Cell 5 is not included in the previous table. This cell has additional capacity for about 4 years of waste

There are large expanses of exposed waste over Cell 1, temporary stockpiles of MSW over the undeveloped future cells 2, 3 and 4, and demolition waste placed over the historical cell. Previous operations to place daily cover ceased when the wet weather prevented access of waste delivery trucks to the current waste cell and the available equipment was fully utilised in managing temporary waste stockpiles. The current 4-wheel tip truck assigned to the landfill is considered too small to effectively cart the required volumes of cover soils.

6.3.1. Onsite infrastructure

There is currently a small and roughly constructed gatehouse located on the main access road some 450 m in the site from the entrance gate. There is no water, electricity, or toilets at this gate house. Staff facilities including rain harvested water and a composting toilet are located at the staff shed close to the septage ponds, about 1km further into the site (see Plate 2). Landfill staff drive to the area for lunch, leaving the waste disposal area unattended. If the gate keeper needs to leave the gatehouse, there is no supervision of site users at the point of entry.

Plate 2 Staff facilities near sludge ponds

There exists a plant maintenance shed and lockable sheds for the bulldozer and excavator part way between the landfill operations and the staff facilities (Plate 3). There is a toilet and water tanks (taking for water from the maintenance shed) however neither of these facilities are working. The fuel tank is in disrepair and not used.

Plate 3 Equipment storage shed

Plate 4 Equipment maintenance shed

Plate 5 One of 2 sludge ponds

Although there is no electricity to the site, the local electricity supplier has recently installed an 11kV overhead power line to service the local residential community. This line terminates prior to the landfill main gate.

There were 2 significant historical fires, including one fire in the old landfill area that took approximately four years to extinguish through covering with soil. There is no water supply for firefighting other than the leachate pond. There was also a fire in the tyre stockpile that was adjacent to the disaster waste area. All tyres were consumed in the fire. Tyres are now co-mingled in the demolition waste heaps.

6.3.2. Staff resources

There are currently 9 staff employed at the Bouffa Landfill. The staff work approximate hours from 8.00 – 16:30 Monday – Friday and 8:00 – 12:00 Saturday.

The roles at the landfill include:

– Landfill Gatekeeper – Invoicing of accepted waste or checking of receipts and ensuring that the wastes received are accepted at the site.
– Traffic Controller – Ensuring traffic is moving at the tipping face
– Municipal Waste Officer – Directs operations on a regular basis
– Machinery operators – Operates the bulldozer on site
– General labourers

6.3.3. Site operating life

There is 30 to 40 years of expected life remaining at the site with most of the remaining capacity in undeveloped Cells 2 to 5. Plans for the post closure of the landfill is rehabilitation to a grassed area. There is discussion of developing a composting facility at the site – however this requires a reasonably flat area and the completed cells will have inclined capping making composting on the slope impractical.

6.3.4. Site access

The site is open for waste disposal Monday – Friday 8:00 – 15:00 and Saturday 8:00 – 12:00. The staff are on site for a further hour past closing times to clear the built-up waste from the day. There is a gate which is used to close off the site to public vehicles during periods when the site is not open however pedestrians could access the site at any time because there is no fence (see Plate 6, and note poor signage to the right).

Plate 6 Main gate to site

There is reasonably good road access to the site which can be accessed during all weather conditions, however the internal access to Cell 1 is only available during dry periods. The public road leading to the landfill is a gravel road with some potholes, but generally in reasonable condition. The Public Works roading division is constructing a section of concrete pavement on the steeper section of the public road and this has been a start stop

construction and not yet completed. The gravel road over this section of public road has never prevented access to the landfill.

Plate 7 Legal road approach to landfill showing party constructed concrete pavement on incline

Onsite roads are a mixture of gravel and soil roads. Generally, roads to the waste areas are well formed but there are potholes throughout the roads. There is a section of access road over the flat area between the leachate ponds and the maintenance sheds where the road formation is below the surrounding ground and this section ponds in heavy rains. Beyond the extent of onsite roads that service the waste cells, there is little or no road aggregate and during rains, this prevents trucks accessing the septage ponds

Plate 8 Poorly drained access to sludge ponds

6.3.5. Waste acceptance

Waste can be delivered to the site via pre-paid landfill bags collected by waste service trucks or delivered by private trucks (or smaller vehicles). Both methodologies have an associated fee set by legislation and are generally pre-paid at the PVCC offices.

Waste is collected from residences in yellow landfill bags and green landfill bags depending on the provincial area of waste collection. It is understood that the prepaid bags in the PVMC region start from 70 VUV for a 45 Litre bag. The specially marked bags are imported by a distributor, who then sells to a network of retailers and direct to consumers. The pricing includes a small amount for the service fee, with the rest of the margin retained by the importer and retailer.

The PVMC collects kerbside waste in bags which are delivered to the landfill in flatbed trucks. The three specialised waste compactor trucks are all currently out of service and needing significant repairs. Compactor trucks are viewed as inappropriate for use in Vanuatu where replacement parts are expensive and slow to arrive in country.

The waste bags are off loaded from the flatbed trucks by hand and it is considered that tipper trucks would reduce off-load time at the landfill and physical effort – allowing more trips to the landfill for the single tipper truck.

Other municipal councils on Efate undertake their own waste bag collection system and bring that waste to Bouffa landfill. Payment for this bagged waste at the landfill is per truck and not per bag. The site team suggest that PVMC may be undercharging for this out of city bagged waste.

Gate charges range from 2,500 VUV for a small truck (Bongo) and 8,500 VUV for a dump truck. There is currently no weighbridge, electricity or mains water connection at the site. There is however a ‘Landfill Gatekeeper’ who reviews waste entering the site and monitors that only allowable waste is accepted. The landfill operations manager highlighted that although it would be good to separate waste types between organics and recyclables at source, this would have to be led by the Council to enable selling separate waste collection bags to enable easier separation of wastes onsite.

Materials accepted on site include plastic and metals, compostable material and septic sludge. There is limited steel, copper and aluminium recycling offered to the Port Vila region by a single recycler in Port Vila (RecycleCorp). Plastic is not currently recycled, however there is a program initiating to collect plastic bottles. Historical bailing of plastic bottles previously occurred in a pilot programme that is no longer operating. The bailed plastic is stockpiled behind the landfill waste acceptance booth.

Metals are also accepted by the third-party recycling centre, which pays the supplier 200 VUV / kg for copper and 10 VUV / kg for recyclable ferrous metal (eg cans).

Medical waste is currently incinerated off-site, and the ash and remnants of the incineration disposed to the landfill (this aspect is poorly managed and syringe needles and vials were seen in surface end dump piles). Medical waste is generally not accepted at the site, other than when the incinerator at the hospital is damaged. When the incinerator has been damaged in the past, the site has accepted this waste and burnt it on site. The site inspection team observed a pile of partially incinerated medical waste left in an end tipped heap (see Plate 10). Syringe needles and intact vials were visible. The plan is to bury this waste in the abattoir pits. The hospital was fined for dumping the waste in this area.

The PVCC also collects septic sludge to dispose to the septic lagoons. The lagoons have substantial unused capacity, however the formed but dirt road to the sludge lagoons requires that during rain periods, sludges are tipped into one-off pits close to the metalled access road at the upper level. The location of these ad hoc pits is currently not surveyed. The sludge lagoons are appropriately designed, constructed and operated – it is the lack of all-weather access that is the constraint.

Animal products are accepted in the abattoir area of the site and buried upon acceptance. This area is near the septage receival facility. There is also a separate area for the disposal of asbestos waste, which needs to be buried on arrival. Asbestos is placed in a designated area with separate pits for burial.

All waste is marshalled at the gatehouse, waste payment tickets received, and the vehicles directed to the appropriate disposal location. Dangerous goods are not accepted however the occasional battery may be included

in the general waste. Liquid paint is not accepted – however dried paint cans are accepted. In theory, loads can be rejected and trucks required to return the waste back to the supplier. However, this is not common.

Plate 9 Bailed plastic bottles stored near the gatehouse of the Bouffa Landfill.

Plate 10 Partly incinerated medical waste dumped next to the abattoir pit

Plate 11 Abattoir waste pit

A key challenge in waste acceptance is that during wet weather when the road to Cell 1 is inaccessible, waste is placed in temporary areas, creating site operational problems and inefficient double handling of the waste to move it into the correct area.

6.3.6. Landfilling methods

The current landfilling method is one where significant improvement can be made. Presently, there is double handling of the waste material in a number of instances, leading to inefficiency.

Plate 12 Waste acceptance area and temporary stockpiles of waste

Plate 13 Temporary stockpiles of waste (over future cells 3 and 4)

With improvements to the road infrastructure on site, the acceptance and placement of waste can be changed. When there is significant and regular rain, the waste vehicles cannot traverse the muddy roads that do not have aggregate, and the waste is dumped adjacent to the upper portions of the access road that do have an all-weather aggregate surface. The excavator and bulldozer then pull this waste aside to make room for more incoming waste and divert these machines from more efficient, permanent and/or maintenance works. In addition, the existing site truck is too small to effectively transport the waste from the temporary area to Cell 1.

It is recommended that with road improvements, waste loads are placed adjacent to the active cell and pushed with the bulldozer up onto the waste cell. The regular passage of the bulldozer will result in some compaction, however not sufficient to produce the density of 0.9 t/m3 suggested in the JICA 2020 design report.

Placement of daily cover soils over the MSW on Cell 1 had occurred in the past, however due to machines being diverted to temporary waste stockpiling, there was no availability for the soils to be sourced at the borrow area and placed. As a result, most waste areas have waste exposed. This allows access by waste pickers to aged and putrid waste which is deemed unacceptable. An additional problem is that the borrow area is located over 500m from the waste cell and time is required for the excavator to track to this location. Further to this, the only truck at the landfill is a 5 tonne four-wheel truck and the 24 tonne excavator would be sitting idle for most of the time waiting for the small truck to return, making regular cover of the landfill inefficient.

The excavation required to develop the future Cell 2 location is immediately adjacent to Cell 1. This work will create cover soils more efficiently with less transport time. The complication in this proposal is that the extent of Cell 2 has a significant layer of waste to be removed to expose the soil below.

In addition to the placement of MSW, the same process occurs in different locations for separate waste streams such as demolition waste, white goods and tyres. The result is that there are waste piles all over the landfill adjacent to accessible roads. This is also true for the portion of the site designated for disaster waste near the entrance to the landfill, where demolition waste is inefficiently dumped close to the main access, preventing future access for disaster waste trucks to dispose to this stockpile area.

There are three machines operating at the landfill, all owned by PVMC. There is no budget to hire in additional equipment. There is no landfill compactor for the site, which limits the ability to compact the waste and thus maximise the site life.

The existing equipment is as follows:

- 1 x 13t Bulldozer with compound blade and rippers – 2 years old

- 1 x 24t Excavator - 2 years old
- 1 x 4-wheel tip truck (approximate 5t capacity)

6.3.7. Site water management

Cell 1 is an engineered semi aerobic landfill with clay lining, an imbedded leachate pipe collection system and gas/air wells. The leachate drainage system/aeration pipework is concrete pipes.

Leachate is transported from the landfill into drains to a series of three ponds. The primary pond is full and relatively deep and overflows directly to the shallow water tertiary pond. Water in the final pond is brown indicating a reasonable level of treatment of the leachate. Flows follow ephemeral streams to the Lololima River and then to the Teouma River.

The primary pond is designed to attenuate leachate flows and provide storage for pumping as recirculated leachate into the waste cell. The pump has been removed, and an estimate of 300,000 VUV was provided for its' replacement. The pond is always full and leachate immediately overflows to the tertiary ponds during rainfall. There is therefore no flow attenuation afforded by the pond. Options to remediate the system is to reinstate the pump and install a drainage gallery in the waste, or to allow the leachate to flow through the tertiary ponds. If the latter is adopted, a low flow discharge pipe should be installed to reduce the lower operating level of the leachate in the pond and thereby attenuate storm flows. The reduced flow rate would allow the vegetation in the tertiary ponds to more effectively treat the flows.

There is evidence of leachate ponding in temporary waste stockpiles (outside the formal Cell 1 area). There is however there is no evidence of leachate breakout – primarily as there is little final cover associated with Cell 1 and leachate could easily escape without being concentrated.

The local customary community have developed horticulture gardens on the landfill land to which there is unimpeded access and gardens were in some cases directly adjacent to the leachate ponds. In terms of surface water management, there are interception trenches installed along many of the access roads however there is no cut-off drain immediately up slope of Cell 1. Flooding potential is low due to the landfill being at the ridge and that the site has a moderate slope.

The sensitivity of the receiving water environment is unknown. Groundwater interception and monitoring is not occurring, and the groundwater level is not disclosed to the site team. Previous monitoring wells are blocked and re-drilling of the bores is recommended. There is no monitoring of water quality by the landfill team or the Shefa Provincial Government, and no environmental reporting. When talking to Solomon Jimmy, the Shefa Environmental Waste Management Officer, he was not aware of any concerns with water quality or downstream effects but did not know of any monitoring being undertaken. Mr Jimmy did however say that monitoring of the watercourses downstream of the landfill may commence in 2023.

6.3.8. Landfill gas management

There is no landfill gas monitoring or collection. As the landfill is a semi-aerobic landfill the landfill gas production is considered low. Cell 1 is an engineered semi aerobic landfill with clay base lining, with an imbedded leachate collection system and gas/air wells in accordance with the design guide SPREP, (2005): *Practical_Guide_Semi Aerobic LFM_practices*.

6.4. Site impacts

6.4.1. Environmental and health impacts

The following discussion is based upon site visual inspection. No intrusive investigations, testing or analysis has been undertaken to verify impacts to the environment.

A summary of key environmental risks with current site infrastructure and operating constraints, and any environmental impacts that were observed include:

- Waste stockpiles and uncovered waste in cells creates potential for windblown litter, odour emissions, breeding areas for insects and vermin (both potential disease vectors), ponding water within stockpiles, and a loss of amenity.
- Possible leachate discharge into the local streams, rivers and ultimately coastal marine area associated with placement of waste outside the landfill cell(s)
- Pollution of Lololima River and Teouma River in the event of leachate overflow
- Human health and environmental hazards associated with contact with hazardous waste
- Human health and environmental hazards associated with improper medical waste disposal (sharps, bandages and medical vials apparent)
- Human health and environmental hazards associated with growing produce for consumption adjacent to leachate ponds, where overflow or seepage may contaminate the soil
- Risk of contamination of food crops in vicinity of leachate ponds and associated potential health impacts
- Human health risk from waste picking activities (injury, disease)
- Surface water seepage from saturated soils through waste materials
- Fire risk from uncompacted and uncovered waste cells and stockpiles

6.4.2. Social impacts

The site is located at the end of a public road and is not visible to people who do not live adjacent to the waste disposal site. The site is bordered on the west of the site by a community of approximately 3000 people who reside on customary land. This population resides less than 100 metres from the active tipping area. Although there is a small fence between the landfill and the residences, this fence does not prevent access to the site from the community. The same community access the landfill to pick recyclable materials from the waste and grow food on landfill land.

While on site GHD spoke to a local chief Seule who stated that the local community found the most concerning issue was the number of flies from the waste disposal site, and on occasion the community experiences odour emissions from the landfill site. The chief did not mention any annoyance from dust emissions related to the site and made no further comment to other vectors such as vermin. Complaints could be made to the PVCC however PVCC stated there was no complaints register and were not aware of significant complaints through the formal channel. The landfill management meets with the local community chief(s) on an as-required basis where such complaints can be voiced.

Waste pickers are common at this site, with collectors taking aluminium cans and other metals for sale to the metal recycler and food scraps to feed household pigs. Although in general, the income generated through waste picking is not the sole income for these families, in some cases it is understood that waste pickers rely on this as their only income stream. The community who undertake waste picking include adults and youth, both men and women. Waste picking at the site is tolerated but not encouraged. The landfill workers have not highlighted any events of injury and none were reported by the local community chief.

Plate 14 Community dwellings adjacent to the landfill western boundary and access road

A portion of the neighbouring community are involved in waste picking activities and in growing produce around the landfill site. While local custom community Chief Seule stated that he did not believe people were getting sick from the food produced or proximity to the leachate ponds, there is clearly a risk of contamination.

GHD discussed with the PVCC Waste Management team about ensuring that only fresh waste is open to waste picking and that gardening and planting practices occur only in an area of the site which is away from landfill leachate and heavy vehicles. This will help protect the health and safety of the community where the activity cannot be prevented.

There are vermin in the area, with workers at the landfill stating that there are large numbers of rats and flies. There are also less prominent populations of mosquitos and a lesser population of birds within the waste. GHD observed that there was odour associated with the site however it was not excessive given the activities undertaken on the site and extent of exposed municipal solid waste (MSW). There are small amounts of waste in the area close to the access roads, however this is likely due to illegal dumping rather than the waste being wind blown away from the landfill site. There was no notable smoke near the site however fires have previously occurred at the site and one major fire in the historical waste area burnt for a number of years.

6.5. Summary of ongoing and planned work

6.5.1. Planned investment in the site

Landfill operations, maintenance and capital works as well as waste collection, is solely funded from waste disposal charges through the sale of pre-paid rubbish bags, or disposal fees based on vehicle size. The charges are set by legislation and an increase in fees can only occur if the legislation changes. Without regular user fee increases, the effective income for landfill management is diminished through inflation. Capital works design and construction as well as equipment has been donated by aid agencies.

The waste collection and operational costs to place waste at the landfill consume the available budget providing no additional funds for planned capital works. Creation of new waste cells therefore needs to be funded by Council or national government grants, or overseas aid donations. There are no such investments planned and therefore there is no planned investment for the development of the next landfill waste cell.

The *Vanuatu Infrastructure Strategic Investment Plan (2015-2024)* provides for capital expenditure for waste collection vehicles as set out in the table below, however there is no planned investment for development of the Bouffa landfill.

Table 4 Pipeline investments in the Vanuatu Infrastructure Strategic Investment Plan

Project No.	Project	Type	Island	Province	Est. Value (b VUV)	Est. Value ($m)	Development partner(s) Interest	Status	Timing (if known)
	Urban Solid Waste								
SW1	Port Vila Solid Waste Collection Trucks		Efate	Shefa	0.093	1.00	Undefined	P	
SW2	Luganville Solid Waste Management		Santo	Sanma	0.140	1.50	NZMFAT?[1]	P	
SW3	Lenakel Town Dumpsite		Tanna	Tafea	0.093	1.00	Undefined	P	
	Total MIPU				**1.008**	**10.80**			

JICA developed a landfill development plan with five waste cells proposed and ancillary infrastructure as well as sludge ponds. The Bouffa landfill manager is attempting to follow the details of this plan within the financial constraints. To date, Cell 1 and the associated leachate system was installed, along with the sludge lagoons. Bulk earthworks for the waste haulage route to Cell 1 is partially completed however lack of funds has prevented this from being completed along with an all-weather aggregate surface to this access. Lack of all-weather access is the cause for temporary stockpiling of waste that creates health and environmental problems discussed below.

The temporary stockpiling and relocation of waste is grossly inefficient and consumes the available resources and funds, leaving insufficient budget to operate the landfill as intended.

6.5.2. Other relevant donor activities in Port Vila

Relevant work is being undertaken by the company SCE Amenagement and Environnement, with funding from the French Government through Fonds d'Etude et d'Aide au Secteur Privé (Study Fund and Private Sector Assistance) – FASEP. The project is being undertaken across Vanuatu, delivered over two phases. The first phase is focussed on diagnosis of current issues and the selection of a preferred resource recovery solution. Phase two covers design studies and project preparation to deliver the work, including concept notes and applications seeking donor support for implementation. In May 2022 at a Steering Committee meeting, three options were presented –

- a local based approach for all locations,
- a decentralised model of four resource recovery hubs in Port Vila, Luganville, and at two other locations to be confirmed, and

- a centralised model of a national resource recovery hub based at Port Vila.

It was determined that the centralised approach is the most feasible as a first step given that it is technically achievable, and easier to finance and operate. However, this is viewed as a pilot with the potential to expand to other locations.

Resource recovery systems rely on improved waste segregation and collection, and it is anticipated that the work will improve waste management at a systems level, along with the capacity of PVCC to deliver waste services.

The PacWastePlus programme supporting waste management in Pacific Islands is a 72 month project funded by the EU and implemented by SPREP. It aims to sustainably and cost effectively improve regional management of waste and pollution. The focus of the support in Vanuatu is to develop and implement a Product Stewardship Scheme (PSS) as a means to implement recovery of recyclables, and potentially to fund proper waste management. The project will focus on aluminium cans and PET plastic bottles as a starting point but is seeking to extend this to items such as bulky waste and electronic waste in the future.

The first stage is to seek community and business buy-in through conducting consultation for the draft PSS regulation. Developing administrative resources to steer the operations, and conducting legacy waste buy-back events will be the next step. Whilst this project is not immediately linked to landfill operations, any waste minimisation that keeps resources out of the landfill will prolong the landfill life. There is further potential to seek ways to improve the funding resources for proper waste management. For example, an import duty on electronic items or white goods and tyres could potentially fund the management of these materials at the end of life. It is important that the funds can be directed to where they are needed operationally, rather than being absorbed into general government revenue.

The National Plastics Strategy (2020-2030) in one of the four objectives aims for “solid waste management systems and programmes to be financially self sustaining. Sustainable financing mechanisms are key to improving the management of the Bouffa site.

6.6. Analysis of Options for Bouffa Site

6.6.1. Description of Potential Interventions

The Study Team compiled a full list of intervention options to improve the operation, public health, environmental impacts and from this developed a long-list of potential interventions as a starting point, with different options presented along with high level cost estimates. Potential interventions to improve climate resilience of the Port Vila (Bouffa) landfill (ranked in order of cost (low to high) are presented below in Table 5.

Table 5 Summary of intervention options for Bouffa site

Area	Key Issue	Potential Interventions
Water monitoring	Environmental impact Health risk Resilience	Surface water monitoring *Proposed to be undertaken by Shefa PC*
Improving operational capacity of staff	Resilience	Update training of staff - for supervisors and field workers *Proposed for potential funding by J-PRISM*

Maintain existing surface water swale drains	Environmental impact	Improving drainage *Existing maintenance activity*
Improve waste covering	Environmental impact Health risk	Progressively cover Cell 1 waste *Existing maintenance activity*
Drain ponding leachate (associated with temporary stockpiles)	Environmental impact Health risk	Improve site water management through improved drainage near stockpiles *Existing maintenance activity*
Machinery spares for continued operations	Resilience	Provide store of spare parts for bulldozer
Improve safety and information	Health risk	Provide additional signage stating safety requirements, operating hours, unpermitted wastes and disposal fees
Manage garden crops on the site	Health risk	Relocate horticulture away from leachate system
Improve surface water drainage	Environmental impact Health risk	Install surface water channel up-slope of Cell 1
Improve C&D waste area	Resilience Resource recovery	Blade C&D waste in disaster waste area into concise piles, clear vegetation and provide access to area
Improve operational and site planning	Resilience	Review landfill management plan and provide design for tyre pits and special waste *Proposed to be funded by J-PRISM*
Improve operational and site planning	Resilience	Survey all stockpiles for location and volume and location of special waste pits
Improve leachate discharge	Environmental impact	Amend first leachate pond to have low flow outlet
Improve receiving capacity for special wastes	Environmental impact Health risk	Provide 500m2 formal area for special waste pits (e.g. medical waste, tyres, Ewaste and abattoir waste)
Improve waste compaction to extend landfill life	Environmental impact Resilience	Provide towed compactor for waste compaction (lower cost option)

All weather access improvements to site	Environmental impact Resilience	Earthworks to secure 200 m long access to Cell 1 (all weather). Add single lane access between cells 2 and 3. Single lane one way truck route and turning circle.
Address waste stockpiles and commence preparations for cell 2	Environmental impact Resilience	Remove waste from Cell 2 area and compact on cell 1 to permit excavation of cover soils for Cell 1 and partial clearance for cell 2 construction
Relocation of waste stockpiles at site	Environmental impact Resilience	Relocate as much waste from stockpiles and cell 2 as budget allows
Improve fuel infrastructure	Environmental impact Resilience	Install on site Diesel tank (and containment) for machinery re-fuelling
Improve water management from C&D area	Environmental impact	Construct water quality pond for leachate exiting C&D area
Improve access and drainage	Environmental impact Resilience	Apply 300 mm of coral agregate to surface 300 m access road
Improve site waste data and resource recovery infrastructure	Resource recovery Resilience	Supply and install weighbridge
Improve staff amenities	Health risk	Provide gate house with water tank and toilet
Improve utilisation of historic landfill for C&D waste	Resilience	Prepare C&D cell over historical landfill and move existing waste (cover under normal operations)
Improve access and address double-handling of waste	Environmental impact Resilience	Provide all weather access to Cell 1 only
Increase efficiency of moving materials on the site	Resilience	Replace 4 wheel truck with 6 wheel (2 driven axle) tip truck
Improve waste compaction to extend landfill life	Environmental impact Resilience	Provide self propelled compactor for waste compaction (higher cost option than tow-behind but more capital outlay)
Improve site security	Health risk	Install fence along western boundary (abutting dwellings)

Improve site access	Resilience	Construct full cell access as per JICA design (additional to above)
Improve efficiency and sustainability of waste collection fleet	Resilience	Replace 5x existing flat bed rubbish collection trucks with tippers
Landfill plant and equipment	Resilience	Budget to replace Bulldozer and excavator in 5 years
Landfill asset development	Environmental impact Health risk Resilience	Construct Cell 2 and place waste in as appropriate

6.6.2. Basis for prioritisation

The process of analysis and criteria are described in further detail in section 2.3 of this report. The multi-criteria analysis prioritises the projects from most favourable, to least favourable as ranked against the performance criteria (Appendix A).

This shows that the highest-ranking options include:

- Provision of all-weather access to allow ongoing delivery of waste directly to the waste cells without the need for temporary stockpiling of waste during wet weather
- Relocation of as much waste from the temporary stockpiles to Cell 1 as the budget permits

Following this narrowing of options, broad costings were explored to understand what was possible within the funding allocation for the works.

6.6.3. Discussion of options at stakeholder workshop

Once the interventions were assessed, this information was provided to a stakeholder workshop for discussion on 13 February 2023. See Appendix B for a copy of the presentation.

A number of issues were discussed at the forum, summarised below in Table 6

Table 6 Intervention options workshop - discussion summary

Issue	Discussion points	Actions
Donor and Government coordination	Discussion of work to date on the FASEP project and recommendations to implement a system of waste segregation and resource reprocessing. One of the challenges is that at the current landfill site with its poor roading and waste stockpiles, starting a new facility would be challenging. If this work could be undertaken to bring the site to a better standard, this would be an important foundation for implementing more complex resource recovery infrastructure. Where this	GHD to further consider ways of aligning with FASEP project more strongly.

Issue	Discussion points	Actions
	facility is planned will not be impacted by the proposed interventions under SWAP. Discussion of the weighbridge installation and the team's identification of a weighbridge which will be available for sale after a current ports project has completed. However, this timing will not align with the SWAP funding window, as the weighbridge will not become available for approximately two years. J-PRISM III – no funds allocated to physical investment, with focus on capacity building and training. National projects to be finalised in September 2023.	
Funding limitations	It was stressed by SWAP that the budget ceiling is 110,000 USD, with 10,000 allocated to hire a consultant to oversee the implementation. It is important to ensure the selected activities do not exceed the works budget or the oversight budget.	GHD team to ensure works do not exceed budget, and that it is structured for some flexibility to absorb unanticipated costs.
Allocation of funds between Port Vila and Luganville	Workshop participants discussed a preference to focus the funding on Bouffa site given the high proportion of waste received, and the need to make a difference here. After the workshop, this decision was also supported by the MoCCA Minister.	GHD team to prioritise spending at Port Vila site.

At the conclusion of the workshop, it was agreed that the presentation would be shared, and stakeholders were to provide feedback on recommended interventions. It was on the basis of the feedback provided via email that the recommendations were finalised. Feedback was received from the Government participants, and from SWAP in Samoa.

6.6.4. Selected works for SWAP investment in Port Villa

The landfill commenced as an open tip and that historical landfill cell was closed off and capped. A new cell was developed using the Fukuoka semi aerobic landfill design, along with leachate treatment ponds and sludge pits. The design of these recent works prepared by the Japanese International Cooperation Agency (JICA) is considered appropriate for waste disposal for the region.

The operation of the landfill at the commencement of the operation of Cell 1 was considered best practice for the region. However, over time, waste has been placed inappropriately and the current state of the landfill is deemed unsatisfactory and a hazard predominantly to human health and to a lesser extent to the environment.

The root cause of the degradation in the landfill is lack of funds to provide all weather access that would permit the landfill managers and staff to avoid double handling waste and undertake the works to the required standard. This is not a criticism of the landfill staff. Funding is restricted with the waste disposal fees set by legislation and unable to increase with inflation. It is also understood in setting these fees, that the rates were reduced from those applied prior to this legislation. There is little or no additional funding from the city or Provincial councils or the Vanuatu government.

The build-up of waste on areas outside the current operating cell (Cell 1) is due to the lack of all-weather access to the landfill cell and waste accumulates on the edge of the aggregate access. When weather conditions improve, new waste is trucked directly to Cell 1 with the temporarily stockpiled waste loaded on a small truck to transport to Cell 1. This double handling consumes the use of the excavator and truck at the expense of other landfill maintenance operations.

The temporary stockpiles of waste are on areas of the landfill where leachate is not managed and the waste attracts flies and rats and emits foul odours. Unmanaged stockpiles create a health hazard to the landfill staff and the waste pickers, as well as residents of nearby dwellings.

There are many works that are required to bring the Bouffa to the standard envisaged in the JICA design. There is an opportunity with the funding offered in the SWAP programme to address the fundamental problem that consumes resources and funds available to the landfill operator. Once this fundamental problem is addressed – the landfill operational resources can progressively address other maintenance issues.

In discussion with the landfill operator and stakeholders, this feasibility report identifies the single most critical work that can be afforded by the donated funds, is to provide all weather vehicle access to Cell 1 and to assist in the relocation of the temporary stockpiles of waste to Cell 1. This requires Cell 1 to be increased in height beyond that previously designed.

Once the limited resources of the landfill operator are not consumed in double handling waste and reacting to weather events, those same resources can be more effectively utilised in undertaking the functions they were designed for and keep ahead of landfill infrastructure maintenance.

It should be noted that in placing these temporary stockpiles of waste into Cell 1, that the cell will be filled beyond design capacity quickly and Cell 2 is required to be operational as soon as possible. Additional funding is likely to be required for the development of Cell 2. Excavation of soils to prepare for the establishment of Cell 2 will provide cover soils for Cell 1.JICA plan.

Additional activities considered but beyond the current SWAP funding includes management of the placement of demolition waste over the pre-existing and closed cell at the north of the landfill. This work should be designed and allow for appropriate compaction of the waste, final cover and leachate treatment. Leachate from demolition waste is less concentrated that that from municipal waste.

Following the multi-criteria assessment process (see Appendix A), and discussion at the workshop, the recommended expenditure of the current SWAP funds was a grouping of investments that would improve the all weather access, site drainage, and relocation of waste stockpiles. Grouping the works into the one contract would enable cost efficiencies, and would be structured to provide the following:

- Finalise the earthworks over previously worked access over 200m long access to Cell 1 to provide for a single lane access and associated truck turning area. Additionally undertake buld earthworks and subgrade preparation for a single lane access between proposed cells 2 and 3. This will provide for a single lane one-way truck route for the offloading of incoming waste.
- Install 600mm stormwater culvert utilising on site pipes and provide surface water swale drains to the access road and upslope of Cell 1 (the latter by the landfill operator)
- Apply 300mm of coral aggregate to surface the 300m long single lane access road
- Relocate as much waste from the temporary stockpiled areas and cell 2 area as budget allows and place in cell 1 to extended height. It is envisaged that third party excavator, bulldozer and trucks will be brought on site to move this waste in a short period and allow the landfill operator's equipment to place fresh waste and undertake other maintenance. Amend landfill operations to prohibit tracking from soil areas to the aggregate access road to prevent degradation of the all weather access due to soils making the aggregate surface slippery in wet weather.

Table 7 provides an overview of the detailed rationale and high-level cost estimates.

Table 7 Detailed rationale and costs for proposed interventions

Investment Option	Benefit	Current state	Proposed action	Cost (USD)
Install 600 mm stormwater culvert and surface water swale drains to improved road and upslope of Cell 1	Improved site drainage will reduce the risk of road becoming impassable in wet weather. Better water management will reduce the requirement of road maintenance at the site. Installation of drains will enable more controlled water movement around the site which will improve environmental and operational conditions at the site.	Current surface water ponds throughout the landfill causing rapid degradation and potholes on roads and increasing the amount of contaminated water running through the waste.	The installation of the culvert pipes that are currently on site, is proposed to be undertaken by the third party contractor, however the swale drain development to be undertaken by the landfill operators excavator.	3060
Finalise the earthworks over previously worked area over 200m long access to Cell 1 to provide for a single lane access and associated truck turning area. Additionally undertake build earthworks and subgrade preparation for a single lane access between proposed cells 2 and 3. This will provide for a single lane one-way truck route for the offloading of incoming waste.	Increase in efficiency of landfill operations and vehicles. Enabling all weather access will allow for further development of the site through reduced commitments to the existing equipment. After reviewing a number of options, this provides the most cost effective means of improving access.	There are two access roads to Cell 1, however during wet weather neither access road can be utilised as one access road is too slippery and steep and the other is developed with inappropriate material.	The landfill already has an established road which is a mixture of dirt and gravel. It is proposed that a contractor be engaged to provide the equipment, material and labour.	19,622
Apply 300 mm of coral aggregate to surface 300 m length of access road	As above. Applying the aggregate will provide a lasting road surface	As above	Part of contractor works package will be to supply and install aggregate	34,234
Hiring third-party machinery to relocate waste from the temporary stockpiles and Cell 2 as budget allows, moving waste into Cell 1 area	Clearance of waste from the temporary stockpiles will enable maintenance of the site in line with the landfill report established by J-PRISM. This will enable the site to be used more effectively, and have space available for events such as natural disasters.	During the period where waste could not be transported down the hill to cell 1 waste was left in a temporary stockpile which has built up over 4 months. Current build-up of 4 months of waste are requiring significant time investment of both of the heavy vehicles, resulting in a lack of time for vehicles to undertake further development of the site. Other stockpiles are also in place, reducing opportunities to utilise the	Hiring of two third-party excavator, bulldozer and tipper trucks to relocate waste from the temporary stockpile to Cell 1. Tipper trucks would be loaded with the landfill excavator and therefore multiple trucks are required to keep the excavator fully utilised over a short period.	23,205

Investment Option	Benefit	Current state	Proposed action	Cost (USD)
		site more effectively, and creating more environmental impact.		

6.6.5. Works suitable for additional funding or other donor projects

The following works are recommended for additional donor support. An indicative budget in USD has been provided for the purpose of early planning, with further refinement needed through project feasibility work:

1. Remove any remaining waste from the Cell 2 area (shaping and compacting into Cell 1). Excavate soil from the Cell 2 area in preparation for development of the new cell, stockpiling the soil to use as cover material on-site. USD 22,000
2. Review landfill site management plan and provide design for pits for special waste such as asbestos, abattoir waste and tyres. It is recommended that this be considered by JPRISM-III as part of their ongoing technical support. *This option is not costed, as this is the type of technical support offered by J-PRISM to date, and they would have costings for resourcing with technical inputs from Japan.*
3. Amend first leachate pond to have a low flow outlet rather than rely on replacement and maintenance of a pump. USD 13,000
4. Supply and install a weighbridge, which would provide improved waste data to inform ongoing planning. This infrastructure will also be important for the proposed resource recovery facility. The existing weighbridge in country currently utilised for the port upgrade project will become available in approximately two years, thus providing a cost effective means to purchase this infrastructure. USD 40,000
5. Development of Construction and Demolition (C&D) waste area over the historical landfill once existing waste stockpiles are removed. This would be of benefit as a part of improving waste management in the event of natural disasters. USD 57,500
6. Develop an area of approximately 500 m2 for the ongoing installation of pits to receive special waste such as asbestos or abattoir waste. USD 15,500

A larger package of works suitable for consideration as a component of a more significant investment would combine some of the above works with the design and construction of cell 2 of the site. At this time additional works such as site fencing, staff amenities, improved fuel storage and upgraded landfill and waste collection operating equipment could be considered. A preliminary budget estimate to construct cell 2 is in the vicinity of USD 2 million. An important aspect learned from other PICs in these types of investments in improved waste infrastructure and systems is the need for capacity building, particularly for maintenance systems.

6.7. Proposed Works at Bouffa Site

6.7.1. Description of Works

There a number of works identified in in the list of potential interventions in Table 5 that require no funding. These works are not discussed as part of the proposed interventions to be funded by this project.

The proposed interventions can be broadly categorised as:

- Provision of all weather access to Cell 1
- Relocation of temporary stockpiled waste (as much as the budget permits)

For the construction of the all-weather access, the initial proposal was to complete the partially completed access that approaches cell 1 from the north. This access has bulk earthworks completed and aggregate placed over portions of the access. However, this access requires a width of at least 7m to allow for two way traffic to and from the tip off location adjacent to Cell 1. It is identified that in some portions of this access, the existing formation is 5.0m wide with a steep drop off beyond the formation width. In discussion with a reputable contractor based in Port Vila, the preferred (and more cost effective) all weather access would be a one-way system comprising a single

lane with aggregate surfacing. This proposed access route generally follows the J-PRISM design as identified in Figure 3:

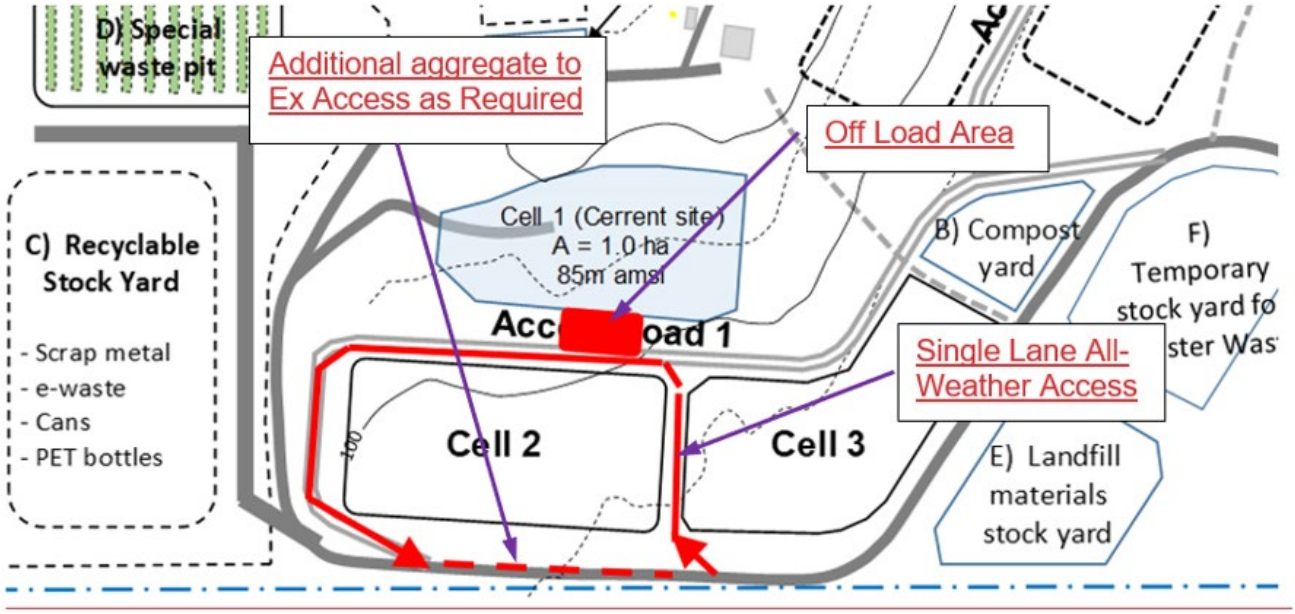


Figure 3 Overview of proposed road upgrade

In addition to the single lane access, it is proposed that an all weather staging area be provided to drop off the waste from the urban delivery trucks, adjacent to Cell 1.

For the relocation of the temporary waste stockpiles, it is proposed that a third party contractor provide the machinery necessary to relocate as much waste as possible, within the limits of the budget. The use of third party equipment avoids the use of the on site landfill machinery and allows that same equipment to place incoming waste immediately once the access road is completed.

In considering the equipment needed to relocate the temporary stockpiles, consideration is required to undertake the waste relocation in a dry weather window to prevent unsafe truck movements over wet clay soils and otherwise degrade the existing track formations. Also to be considered is the efficient use of the machinery so that the trucks proposed meet the production capacity of the excavator loading the trucks and the bulldozer placing and compacting the waste.

It is recommended that a contractor be engaged to agree with the landfill operator the extent of roading required, measure that roading and for the contractor to provide a lump sum for the roading element. This then allows the determination of the remaining budget available to relocate the waste to Cell 1. This relocation work is to be completed before the all weather access is constructed.

6.7.2. Technical specifications

The extent of works and quantities are subject to a measure on site and direction by the landfill site manager. It is assumed that the landfill operator will direct the contractor to undertake the works specified below. The contractor appointed will be responsible for the supply of all plant, labour fuel and consumables, establishment and dis-establishment of equipment and support facilities for staff and plant, for preparation and implementation of health and safety plans and provision of full time site supervision.

The works are weather dependant and although extensions of time will be made in the event that works are delayed due to wet weather, there will be no additional payment made to the contractor for stand-by or stand down time of plant or equipment.

The following works have been described, however detailed plans and specifications are required to be prepared. There is provision in the SWAP budget for the development of formal works orders and contracts to be prepared and oversight of implementation.

The following provide the broad specifications, to be finalised once on site measurements can be achieved.

Provision of all weather access to Cell 1

1. Undertake bulk earthworks. Prepare, trim and roll road and off load pad subgrade and supply and installation of 300mm compacted thickness of general all passing coral aggregate.
2. The single access road to be 5.0m wide with provision of a 2.0m wide swale drain to be installed on the up-slope side of the access road by the landfill operator.
3. The off load pad dimensions are subject to confirmation on site, however it should have an area of no less than 100m^2 in addition to the adjacent 5m wide access road
4. All aggregate all weather surfaces to have a cross fall of between 3% and 5%
5. The extent of road works to be determined and agreed with the third party contractor prior to commencement, at which time the cost of the works will be determined as a lump sum to determine the available budget for the waste relocation works
6. Stormwater culvert to be installed to provide drainage from the upslope swale drain, under the 5m wide access road to the existing pipework adjacent to Cell 1. Existing concrete pipes are located on site and are to be used for this work.
7. Prior to installation of the concrete pipes, the required number and sizes of pipes on site to be identified
8. Concrete pipes to be installed in a trench 200mm to 300mm wider than the outside dimension of the pipes. The trench subgrade to be 100mm lower than the bottom of the pipe. The full extent of the trench bedding, pipe surround and backfill to subdrainage level to be 40mm coral aggregate compacted in 200mm layers. Pipes to have a minimum gradient of 2%. Pipe ends to be exposed to open and free draining trenches. The top of the culvert to be 300mm below the road subgrade.
9. All soil spoil to be placed in stockpiles where directed by the landfill manager.

Relocation of temporary stockpiled waste

Waste is to be relocated from the temporary stockpiles to Cell 1 as much as the budget permits such that all the available budget is consumed. It is important that the machinery supplied is efficient in that all machinery is working and not idle waiting for trucks to be refilled. To this end, an estimate of the equipment required is for a 30 tonne excavator to load two 6 wheeler trucks on runs between the stockpiles and Cell 1, and for the waste to be pushed and compacted over Cell 1 by a D7 bulldozer (or equivalent). The size of the bulldozer will allow compaction of the existing waste in Cell 1 as well as compaction of the freshly placed waste.

The landfill will be receiving waste while the stockpiled waste is being relocated. To avoid a clash of standard landfill operations and waste relocation, it is important that there is separation of the two activities. It is proposed that fresh waste will utilise the uncompleted dirt road entering to Cell 1 from the North, and the stockpile relocation operation will use the construction access road to the south of Cell 1. It follows that for this work to be separated, the site access roads must be dry and a suitable weather window identified to prevent down time due to wet weather.

Also of consideration is that there are existing landfill gas vents in Cell 1. The stockpile relocation contractor is requited to work around these vents, but also to place waste up to the vents. The landfill operator may also need to extend these pipes and as such coordination between the third party contractor and the landfill operator is essential.

The following waste relocation site works are identified:

1. Provide equipment to load, cart, place and compact waste from temporary stockpiles to Cell 1. It is envisaged that plant will include one 30t tracked excavator with wide bucket, one 7t bulldozer with pushing blade, two 6 wheeler tipper trucks with 2 drive axles.
2. Lack of supply or operation of any of the specified plant will required the contractor to stand down at its' cost
3. Waste relocation trucks shall not traffic over existing or new aggregate access roads
4. Waste to be transported to Cell 1 to be pushed over the full extent of Cell 1 as directed by the landfill manager.
5. All new waste placed on Cell 1 will be in lifts not exceeding 1.0m and be track rolled with 7t bulldozer with a minimum of 4 passes in each track width.
6. On completion of the work, the surface of Cell 1 shall be on a flat plane with a cross fall of 6%in 2 directions from the centre line of the cell (or as directed by the landfill manager)
7. The volume of waste relocated shall be loose measured based on truck capacity and the number of truck movements.

6.7.3. Personnel and equipment requirements

The on site landfill operator is required to undertake its' normal work operations during the period that these additional site works are implemented so that fresh incoming waste is deposited directly to Cell 1 and not temporarily stockpiled (exacerbating the issue being remedied). Accordingly, a third party contractor is required to undertake the proposed roading and waste relocation works.

It is important that the third party contractor that undertakes the specified works, has the required equipment, resources and experience to undertake the works in a timely manner.

7. Luganville Waste Disposal Site

7.1. Site Overview

7.1.1. Location

The Luganville site is the only waste disposal site for the Luganville region and is located 4m north of the Luganville CBD immediately off the sealed road leading to the beaches to the north and Port Orly (see Figure 4).

The Luganville disposal site is a historical deep coral quarry excavated in WWII. The location is in a rural undeveloped area that now has cattle farming to the west and a custom residential village 1.5km to the south. The Santo international airport is 1.7km to the southeast.

7.1.2. Waste disposal site description

The waste disposal site accepts kerbside domestic and commercial rubbish, demolition waste, end of life tyres, white goods, incinerated medical waste, abattoir waste and septic sludge. The landfill is operated by the Luganville Municipal Council (LMC) on land leased by a third party from multiple customary owners. There is no lease arrangement between the council and either the landowners or the third party lessee.

The landfill commended operation during WWII as an open dump with no liner or leachate management and continues with this operation. The area of the landfill site is 4.2ha

Down gradient ground water receptors may include unrecorded and unlicenced water extraction bores at individual properties. The LMC health officer advised the groundwater flow path generally avoids known water bores as depicted in .

Figure 5 shows the extent of the landfill and the sealed public road from Luganville to Port Orly. Note that there are no formal lease arrangements or boundaries relating to the landfill and the extent shown is the perimeter road around the landfill operations. Also note that immediately to the south of the landfill, there is land allocated to the placement of disaster waste, however this same land is proposed for use in an Australian Department of Foreign Affairs and Trade (DFAT) project for the development of septic sludge ponds,

Legend

Luganville Site

Paper Size ISO A4

0 150 300 450 600

Meters

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Figure 4 Luganville waste disposal site

Project No. 12587989
Revision No. -
Date 24/03/2023

Data source: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community. Created by: fmills2

C:\Users\Fmills2\Desktop\2023\SI\Gizo_GHD.mxd
Print date: 28 Mar 2023 - 15:27

Figure 5 Extent of waste disposal operations in Luganville

The geology of the site is a soil layer of less than 2m thickness overlying coronous rock. The underlying geology is coral bedrock. The waste disposal pit was excavated to provide aggregate for roads and runways during WWII. There is no soil liner below the waste and rainfall drains directly into the porous bedrock. There is about 2m of soils overlying the basement rock (where stripping to expose the rock has not occurred).

The local terrain is flat. Site vulnerabilities include unrestricted access to the site by the local community waste pickers, flies, odour and potential contamination of the groundwater. There is no surface water from the waste disposal site to down gradient streams.

The Luganville Municipal town drinking water supply is obtained from a spring close to the Sarakata River to the west of the waste disposal site pumped from an open well from where it is pumped uphill into the storage tanks and then piped into the urban area (Ref: *Improvement schedule for Luganville water supply*, SOPAC: (2009).

The disposal site is an unlined open pit with no management, no collection or treatment of leachate, which flows directly to the groundwater table some 70m BGL. It is assumed that leachate permeates the coronous rock vertically until reaching the ground water where it will combine and flow to the Palikula Bay some 3 km east of the landfill. The area of exposed waste is signficant. The extent of the exposed waste could be reduced to half by placement of waste in the pit rather than in the pit and around the perimeter rim of the pit.

7.1.3. Climate

Luganville has a mean annual temperature around 26°C with 2500 mm (2.5 m) annual rainfall. The warmer season runs between November and March and the wetter season between November and April. The waste disposal site is located on elevated ground about 70 m ASL.

Where the access roads are provided with aggregate surfacing, rainfall does not affect the waste placement operations. Earthworks (if these were to occur and currently do not) would be affected by rainfall.

7.2. Site management and oversight

7.2.1. Onsite infrastructure

There are no facilities for staff at the waste disposal site other than a rudimentary gate house where incoming loads are directed to the appropriate disposal location and where the disposal fees are collected. There is no toilet, no water and no electricity on site. Where necessary, water and toilet facilities are located at the nearby cemetery (300m distance from the waste disposal site).

The bulldozer currently parks close to the gate house where it is open to the elements. This equipment, which is two years old, is critical to the operation of the site and needs protection and regular use to prevent deterioration and rust. There is little maintenance to the bulldozer which regularly has broken hydraulic hoses and no spares to immediately replace such hoses. The hydraulic hoses to the push blade are regularly damaged with protruding waste and there are long delays to obtain replacement hoses, thereby exacerbating the placement and compaction of waste into the pit.

7.2.2. Staff resources

In addition to the waste manager based in the Luganville Council offices, the number of people employed on-site is limited to one being the gatekeeper. The inspection team consider that a second person is required to operate the bulldozer and supervise waste tipping at the tip face. Requests by the waste manager for additional disposal site staff have been submitted to the council clerk, however the request has been denied.

Currently the driver of the rubbish collection compactor truck operates the bulldozer when there is no road space to tip waste from the trucks. The bulldozer operator pushes the waste into the pit to create that space. This can be as infrequent as 3 monthly and is clearly inadequate to confine waste to the waste pit and prevent the indiscriminate tipping that currently occurs.

7.2.3. Site operating life

The void at the disposal site is expected to be filled to existing ground level in approximately 20 years.

7.2.4. Site access

The main road from the Luganville town to the disposal site entrance is sealed and in good condition. On-site access is constructed from coral aggregate and is generally in good condition. There is a 50m section of the aggregate access road from the gatehouse to the pit that requires additional aggregate as it is slippery when wet. In wet weather conditions, lack of access to the pit creates the need to tip waste loads outside the main waste pit.

There is cattle fencing on the road frontage although the rest of the site is unfenced. There is a lockable gate at the entry. The site is open for waste deliveries from 8:00 to 16:00. There are no site operations undertaken outside of these hours and the site is unstaffed after 16:00. The site is open for half a day on Saturday and closed Sundays and public holidays

The waste disposal site manager had suggested the installation of additional fencing to prevent tipping in areas other than the main pit. Once the fly tipping at the perimeter of the waste disposal site is stopped and the vegetation grows up to 2m high, there would be no visibility of the waste pit from the public road. It is the opinion of

GHD site inspectors that employing a dedicated person to direct waste placement at the tip face, and to operate the existing bulldozer, would remove the need for such fencing.

Plate 15 Landfill gate, "office" and gate barrier

Plate 16 Short section of access to pit where no aggregate exists

Plate 17 Perimeter road showing fly tipping

7.2.5. Waste acceptance

The site operating hours are from 8:00 to 16:00 with the site staffed by a single gatekeeper with no staff on site to supervise operations. The gate keeper on occasion leaves the gate unattended.

There is no weighbridge. A daily record of deliveries is provided to the council office.

The gate keeper directs waste to certain places in the site – however the distance from the gate house to the landfill is 100m for waste disposal areas and delivery drivers often offload where they deem appropriate.

Fees for the disposal of waste are collected at the gate house on site. There are no additional fees collected at the site for pre-paid disposable rubbish bags collected by LMC and disposed to the landfill. In some cases, the gate is unstaffed with tipping of waste unsupervised and no collection of disposal fees.

The gate keeper generally inspects incoming waste and allocates the location where the waste is to be tipped. All wastes are accepted at the site as there is no other disposal location. (batteries, paints, asbestos, healthcare waste),

MSW from households is largely collected in 40 litre waste bags and contain all general waste including kitchen food scraps (unless fed to animals). Cardboard from local shops is generally brought on trucks from the shops – and separate from the bagged waste. Some businesses bale the cardboard before taking to the disposal site. Some recycling of cardboard exists where it is used to suppress weeds in kava plots.

Metal recycling is undertaken directly by the recycler (RecycleCorp), or through pickers on the disposal site accessing the resources after the landfill closes. Recyclecorp pay cash for certain metals recovered. Plastics are not actively recycled.

Abattoir waste is supposed to be buried on farms by the farmers. However, some meat waste is illegally dumped at the site.

Septic tank sludges are collected by a plantation owner who treats the sludges in a 5 stage process and uses the compost to fertilise the plantation. Charges to remove sludge is approximately 20,000Vt per septic tank. The septic pump truck is privately owned and operated by Mr Wong Zhi Sing.

There are no dedicated locations at the disposal site for special waste disposal. Asbestos disposal is not actively managed. However asbestos waste was not observed during the site inspection.

There are no waste separation activities at the waste disposal site. However, small scale composting initiatives using green waste from the town market are in a trial phase.

7.2.6. Landfilling methods

Waste is delivered as a Council waste service for pre-paid bags only. All other wastes are delivered mainly in 5 to 10t trucks by third parties and local councils outside the LMC area limits. Waste is dumped next to accessible roads in the main pit and above the upper rim of the pit. The bulldozer then pushes the waste into the pit every 2 to 3 months. Compaction is by the bulldozer only.

No cover soils are applied

There is a separate area where EWaste is placed – mainly to be remote from waste pickers.

Abattoir waste is dumped amongst the MSW and lies exposed for weeks/months

Out of date convenience foods (e.g. potato crisps past the expiry date) are placed into pits excavated in the waste and covered by waste to prevent pickers from reclaiming these products to eat or re-sell. The cost of the excavator is paid by the waste supplier. Anecdotal evidence suggests in some cases food waste (packaged or otherwise) has on occasion be reclaimed from the waste.

Waste is pushed to the formal pit with the 13t bulldozer with combination blade and then the waste is track rolled to achieve some level of compaction. There is no excavator on site. One is hired locally when required (at 18,000vt/hr)

The Public Works Department (PWD) has excavators, however the relationship between council and PWD is poor and often the required plant is not provided. When provided there is no charge to the landfill budget

Soil cover is not applied, and the waste is 100% exposed, A limited stockpile of cover soil is on site adjacent to the waste disposal pit, but there is insufficient quantity to use for daily cover or final cover. Other soils overlying the bedrock would need to be scalped to provide such resources. The current stockpile would be limited to fire suppression and to cover hazardous wastes.

Plate 18 Waste disposal pit (Note height of original ground in the distance)

Plate 19 View from upper level in previous picture. Waste pit in the centre and "convenience tipping left and right

Plate 20 Illegal tipping of abattoir waste (also in blue bags) around perimeter of waste pit

7.2.7. Site water management

The waste disposal site is flat on porous ground and no rainfall flow is expected to enter the pit from the surrounds. Accordingly, there are no cut off trenches installed or required. The sensitivity of the receiving water environment is unknown. Groundwater interception and monitoring is not occurring, and the groundwater level was not disclosed to the site team.

7.2.8. Waste disposal gas management

There is no landfill gas management installed and given the low waste volumes, this is not a priority at the site.

7.3. Site Impacts

7.3.1. Environmental and health impacts

The following discussion is based upon site visual inspection. No intrusive investigations, testing or analysis has been undertaken to verify impacts to the environment. A summary of key environmental risks with current site infrastructure and operating constraints, and any environmental impacts that were observed include:

- Aviation risk due to landfill proximity (particularly with proposed runway extension). Does not meet buffer standards. Landfills provide foraging habitat for birds, creating a significant aviation hazard.
- Waste stockpiles and uncovered waste in cells creates potential for windblown litter, odour emissions, breeding areas for insects and vermin (both potential disease vectors), ponding water within stockpiles, and a loss of amenity.
- Visual loss of amenity when using public roading around the waste disposal site.
- Possible leachate discharge into the local groundwater, streams, rivers and ultimately coastal marine area associated with placement of waste.
- Human health and environmental hazards associated with contact with hazardous waste
- Human health and environmental hazards associated with improper medical waste disposal (sharps, bandages and medical vials apparent)
- Surface water seepage from saturated soils through waste materials
- Fire risk from uncompacted and uncovered waste cells and stockpiles

7.3.2. Social impacts

Neighbouring land use is beef farming to the west and sparse residential to the east. A significant issue of competing land use relates to the airport. There is a proposal to extend the existing airport runway by 600m towards the waste disposal site. This will decrease the separation distance from the current buffer of 1.7km down to 1.1km. The reason there needs to be a buffer between landfills and airports is the risk of bird strike through increased bird activity generated from a landfill. The proposed runway extension is a significant concern with the proximity of the waste disposal site to the extended runway unviable.

The waste pit itself is below road level and combined with vegetation between the pit and the road is not visible to the road users. However, waste is often placed at the convenience of the incoming truck drivers and is regularly visible to the driving public and impacting on amenity. The principal route north from Luganville to the eastern beaches (a tourist destination), passes the landfill entry. Waste piles visible from the road detract from the visitor experience.

Site access roads are in reasonable condition with coral aggregate surface. The exception is to the main pit where about 50 m requires supply and application of additional aggregate. This is officially the reason waste is often placed around the rim of the pit; however it is the opinion of the observer that the latter is more convenient for the

waste dumpers and there is no supervision at the tip face to amend that process. There used to be signs directing what waste goes where – however these are now gone. Our opinion is that a pit manager who directs waste and regularly moves the waste with the bulldozer is required.

Wind-blown rubbish does occur, however there is sufficient vegetation around the waste disposal site and if the waste is placed into the pit (not dumped around the rim) and covered on a regular basis there would be little wind-blown waste.

In discussion with the site manager and the community chief, they raised that the waste-pickers remove cans with some food remaining in them from the waste pit, and this waste is then dropped on the access tracks used by the pickers. This is thought to be major source of scattering of rubbish, with the cans also creating water traps that increase mosquito breeding.

The surrounding land use contain a mixture of sparsely vegetated farmland used for beef stock and forested (rainforest) areas. Further from the site there are also sparsely distributed properties. Odour emissions from the bagged putrescible waste and the uncovered carcasses create social impact. This could be controlled with improved waste disposal site operational practices. Containing the active tipping face to a smaller area of exposed waste, regular covering of the waste, and placing abattoir waste in a designated pit with immediate soil covering are actions that would address odour emissions.

Flies are a major concern for the local residential community. Flies impact on village amenity, the tourism experience, and can have health impacts through the spreading of disease. The actions to reduce impacts from flies are the same as those described above to reduce odour emissions.

7.4. Planned activities at the Luganville Site

7.4.1. Planned investment in the site

There is no planned cell development and there is no landfill management plan for the site, and no plan for site development over the longer term, including areas for separated materials, hazardous waste areas (e.g., asbestos or abattoir waste disposal pits), or a sequenced plan to develop new cells and close old disposal areas. Investing in the site has not been a priority for budgeting to date.

7.4.2. Other relevant donor activities in Luganville

The Luganville Urban Water Supply and Sanitation Project funded by the ADB is under the preparatory phase. The aim is to improve access to integrated and resilient urban water supply and sanitation services in Luganville. There is currently no centralised collection or treatment of wastewater, with most households and businesses serviced by septic tanks that in many instances are poorly constructed and/or operated. Private septage tanker trucks empty septage waste into unlined, unmanaged and unlicenced pits on private land. A septage treatment facility is proposed under this Project, with concept designs completed for the construction of a septage facility on a portion of the flat area of the waste disposal site set aside for disaster waste. To date the location has been surveyed and concept designs completed, with detailed design work and procurement documentation planned for 2023.

The Project Implementation Unit for improved sanitation will be the LMC, who will benefit from the support based at the waste disposal site. This is an opportunity to review cost recovery mechanisms for septage treatment, and potentially this could encapsulate a broader review of waste management charges or financing mechanisms.

Sustainable financing for waste is a clearly recognised constraint across the Pacific and is an underlying barrier to improved site management at Luganville. Under PacWastePlus, the efforts to address financing mechanisms will have flow through benefits to Luganville if successful. This will include reductions in waste to landfill, and potentially using innovative funding mechanisms to cover end of life disposal costs for problematic wastes such as white goods and tyres.

7.5. Analysis of options for Luganville site

7.5.1. Description of potential interventions

The operation of the waste disposal site is considered poor due to lack of staff and resources. Deposition of waste is largely unsupervised and waste trucks tend to dispose where is convenient for them. Placing and compaction of the waste with the bulldozer is infrequent and both aspects lead to a wide expanse of uncovered waste that attracts flies and vermin.

The waste disposal site commenced operation during WWII and is an open dump with no liner or leachate management. Down gradient ground water receptors include unrecorded and unlicenced water extraction bores at individual properties.

The root cause of the poor management and operations of the waste disposal site is lack of funds to employ additional staff to supervise waste placement and operate the bulldozer to compact and cover the waste to permit the site managers and staff to undertake the works to the required standard. There is no budget for site maintenance and capital works and little or no additional funding from the city or provincial councils or the Vanuatu government.

The current build-up of waste on areas other than the base of the pit is stated to be due to a section of the access road being un-metalled.

The waste disposal site is close to the Santo international airport to which the runway is proposed to be extended 600m closer to the landfill. Although there are not excessive numbers of birds (mainly Minas), the proximity of the runway to the waste disposal site exceeds aviation guidelines. This suggests that the waste disposal site should be relocated. The cost of relocation could be considered the responsibility of the airport. Studies have been undertaken by the VSA and others as to alternative sites. Copies of these studies has been requested and not viewed at the date of this report.

According to the research on current waste management systems undertaken by SCE, the LMC plans to move the site to an alternative location in the vicinity of the current site, but further from the airport. A site of 11ha of government land has been identified but has not been surveyed or had appropriate feasibility and environmental studies undertaken. There is no funding allocated to address these issues.

Given the uncertainties related to the waste disposal site location (airport proximity, groundwater contamination and proximity to residential areas) upgrading the landfill does not appear to be appropriate and relocation may be necessary. However, there are immediate works that could reduce the adverse environmental, human health and social effects. This would include the application of aggregate to a 50m length of access to the main pit, employment of an additional site worker to operate the bulldozer regularly to push perimeter waste into the pit and to place and compact waste appropriately going forward. Additionally servicing of the bulldozer and supply of spare parts and fuel to undertake the increased use of the bulldozer is required.

Once the waste disposal site is tidied up and waste moved to the main pit, ongoing operation of the landfill will be more efficient.

The suggested expenditure of the current SWAP funds would be structured to provide the following:

- Supply and place aggregate for 50m of the pit access road
- Hire a bulldozer operator to place the waste and control the tipping of waste (confined to the landfill pit). (suggest payment of wages for the first 3 months)
- Maintain the 2 year old bulldozer and provide spares to reduce down time if further breakage occurs, and provide a budget for fuel for 3 months

The full list of interventions to improve the operation, public health, environmental impacts and climate resistance of the Luganville waste disposal site (ranked in order of cost (low to high) are presented in Table 8.

Table 8 Summary of intervention options for Luganville

Area	Key Issue	Potential Interventions
Improve capacity of staff at site	Environmental impact Health risk Resilience	Update training of staff - for supervisors and field workers (J-PRISM)
Improve management of septage waste	Resilience	Construct sludge lagoon (other aid agency providing)
Improve disaster waste preparedness	Resilience	Clear area for disaster waste disposal
Reduce illegal dumping	Environmental impact Health risk Resilience	Install barriers on ring road to prevent fly tipping
Improve staff amenities at site	Health risk Resilience	Provide staff facilities (toilet, water, rain shelter)
Provide all weather access to prevent poor placement of waste	Environmental impact Health risk Resilience	Provide additional roading aggregate to landfill pit access
Improve site planning and operations	Environmental impact Health risk Resilience	Review landfill management plan and provide design for tyre pits and special waste
Improve capacity for repairs and maintenance	Resilience	Provide spare parts for bulldozer
Reduce visual impact from site	Environmental impact	Provide screening of waste disposal site from tourist road

Improve management of special waste	Environmental impact Health risk Resilience	Install special waste pits for abattoir and medical waste
Reduce exposed waste	Environmental impact Health risk	Place cover soil over completed portion of the landfill pit
Increase life expectancy of bulldozer	Resilience	Provide shelter building for bulldozer
Improve site operations	Environmental impact Resilience	Provide additional staff and fuel to use bulldozer daily
Resolve conflict of use with proposed runway expansion	Safety Resilience	Relocate waste disposal site to alternative location

7.5.2. Basis for prioritisation

The process of analysis and criteria are described in further detail in section 2.3.3 of this report. The multi-criteria analysis prioritises the projects from most favourable, to least favourable as ranked against the performance criteria (Appendix A).

This shows that the highest-ranking options include:

- Provision of additional roading aggregate for the staff to utilise in improving the access road into the waste drop-off area
- The next five ranked interventions were viewed as operational expenses, and therefore ineligible for the SWAP funding

7.5.3. Stakeholder discussion workshop

At the stakeholder discussion workshop, there was concern expressed about investing funds into the site given its land use conflict with the airport, particularly given the plans to extend the runway to be closer to the waste disposal site.

There was some follow-up communication from the Waste Management Officer from LMC, who was hoping to get some of the funding allocation given that Luganville has received limited support to date, and also has pressing needs.

In the list of proposed interventions, it would be most cost effective to utilise LMC staff and equipment to implement various site works. However, provision of items such as fuel and wages is viewed as an operational expense and therefore ineligible for funding from SWAP.

7.5.4. Selected works for SWAP investment

Although there was general consensus with stakeholders that the SWAP funds should be concentrated on the Bouffa site, it is recommended that a small allocation be assigned to the provision of gravel to improve the access to the waste disposal pit. This funding would cover the aggregate only, with the work to spread, shape and compact being undertaken with the staff and machinery on site. All other intervention options are either operational in nature or require significant investment levels.

7.5.5. Works suitable for additional funding or other donor projects

Relocation of the waste disposal site to an area away from the runway is the highest priority, with the need to identify alternative locations with minimal risk to the environment and surrounding communities. This project requires significant funding, with a preliminary estimate of USD 2 million for feasibility, approvals, design, and construction.

Other capacity initiatives such as updated training and capacity building for staff are suitable for funding through the JPRISM-III. The same applies for technical support for waste disposal site planning. The following capital works for immediate improvement with preliminary cost estimates are recommended for consideration:

– Installation of pits for special waste (e.g., abattoir waste and medical waste) USD 7,500
– installation of barriers on the ring road to prevent fly tipping USD 13,000
– Provision of staff facilities USD 3,250
– Provide screening of landfill from tourist road (tree planting) USD 6,500
– Provide shelter for bulldozer USD 13,000

However, prior to further investments for short term improvements, it is important to develop a longer term plan for the site closure given the context of the airport runway extension.

7.6. Proposed Site Works

7.6.1. Description of Works

MoCCA has decided that because of the possibility that the Luganville waste disposal site will be relocated due to proximity to the airport, that little or no funds will be made available to improve the site from the SWAP funding. Such relocation of the waste disposal site will take considerable time to assess options, consult the stakeholders, gain environmental approvals, design, arrange funding and construct. Closure of the existing waste disposal site will also need to be factored into planning and implementation.

It is the recommendation of GHD that although funds for capital works to the disposal site is not available, that limited funds should be made available for the supply of roading aggregate to be placed on the main pit access road. The lack of all-weather access to the pit is the reason waste is spread around the upper portions of the disposal site and this is the cause of the adverse environmental impacts observed during the December 2022 site assessment.

The quantity of roading requiring aggregate is not large and it is estimated a 50m length of road requires aggregate to be supplied. The on-site bulldozer can spread and track roll the aggregate supplied by a third party to reduce costs to the project. we recommend the amount of USD5,000 be provided to supply this aggregate.

7.6.2. Technical specifications

The work to the access road required the supply and placement of a 200mm compacted thickness of coral aggregate graded to be all passing 65mm. The extent of the proposed pavement is 50m long and 4.0m wide with a compacted height of 200mm. The end dumped aggregate requires spreading with the on-site bulldozer and track rolling with 8 passes of the same bulldozer over the full width of the placed aggregate. The bulldozer will need to shift side to side to provide 8 passes of the tracks over the full width of the placed aggregate. However, the contract itself will be only for supply and delivery, depositing the aggregate in an area designated by the site manager.

7.6.3. Personnel and equipment requirements

Graded aggregate will need to be supplied by the third party quarry located near to the waste disposal site. This can be arranged by the landfill operator Lolo Tambae who could also be available to direct the placement, spreading and compaction of the aggregate. The existing 3 tonne bulldozer located at the site and operated by the disposal site staff, can be used to spread and compact the roading aggregate.

8. Vanuatu SWAP Interventions

8.1. Projected costs

The project budget to implement the improvements to both the Bouffa and Luganville waste disposal sites is USD100,000 with a further allowance of USD10,000 for administration and supervision activities. As GHD recommends a budget allowance of USD5,000 be allocated to improvements for access to the Luganville waste disposal site, there is a remaining budget of USD95,000 to expend on improvements to the Bouffa landfill.

If SWAP focal points in country prefer to maintain all funding for the Bouffa site, the adjustment can be made to the budget ceiling for moving waste stockpiles.

Estimates have been prepared for the works proposed to Bouffa waste disposal site. The roading works can be fully estimated at the time of tender when the extent of road works is agreed onsite and measured with the contractor and landfill manager. Once this work is fully defined, the roading works can be negotiated with the third party contractor as a lump sum. This then allows the determination of the available budget for the waste relocation works. The waste to be relocated is not quantified, however it is likely that there is more waste than the available budget can relocate.

Accordingly, it is important to define the critical road works as a lump sum to define the budget remaining to relocate the waste. It is also important that the relocation of the waste does not traffic over the new access roads where the latter would be severely damaged by truck movements.

Another consideration is that many aid projects apply for and obtain approval for the Government of Vanuatu for relaxation of the requirement to pay VAT on the aid works. If this was successful for this aid project, the quantity of waste to be relocated could be increased from 1,400m^3 t0 2,150 m^3. However, for this report, we have assumed that VAT is payable.

As part of the work undertaken in this report, the MCA tool utilised estimates prepared by GHD. To assist with this costing, in country discussions were held with local contractors to understand current price structures. However, final costings will be determined by the RFQ process.

The estimate of costs are presented in Table 9.

Table 9 Cost Estimates

Item for Procurement	USD
Port Vila – Bouffa Site	
Works package to improve site access roads	
Mobilisation to site. Allowance for insurances, establishment and de-mobilisation of all equipment. Supervision, temporary services and staff facilities, management and health and safety. Note that client direction of works will be provided at commencement and on site daily	10,625
Trim subgrade - access road and turning area Trim and roll the existing clay surface to provide 4% - 6% crossfall and compacted subgrade	6,800
Pavement aggregate - access and turning area 5M wide only Supply, place and compact coral roading aggregate - 300mm compacted thickness of 100mm. True to line and grade to 90%MDD	34,234
Culvert Pipes	
Uplift existing client supplied, 600mm diameter concrete pipes (currently on site). Trench, supply and compact 40mm bedding and surround and backfill with hardfill to subgrade level	3060
Unloading zone 10m x 10m Make a platform of 10m x 10m next to cell 1 for the truck to unload the waste with 30cm thick road base, compacted and watered.	2,197

Item for Procurement	USD
Moving existing waste stockpiles Relocate waste from existing stockpiles and place and compact on Cell 1 for 82 trips: 1 excavator 30T, 1 dozer D7 and 2 dump trucks 17m3 will be used for this item. **It is noted that this budget item may be increased or decreased, depending on budget availability**	23,205
TOTAL ESTIMATE	**$ 80,121**
VAT @ 15% Note that there may be an opportunity to have VAT exemption/waiver, given that it is foreign aid expenditure. VAT has been included, but if it was not payable, this funding could be reallocated to moving more of the waste stockpiles, particularly in the Cell 2 area.	**$12,018**
TOTAL	**$92,139**
Luganville	
Supply and delivery of coral aggregate suitable for upgrading the access road to the waste disposal pit. The material will be deposited in an area designated by the site manager.	$5000
TOTAL ESTIMATE	**$5,000**
VAT @ 15%	**$750**
	$5,750
TOTAL INTERVENTION ESTIMATE	**$97,889**

8.2. Implementation mode

The total funding package for Vanuatu is 110,000 USD. Of this budget, 10,000 USD has been allocated to implementation and oversight.

The interventions would include the procurement of two packages:

- Contract for the provision of material and works to upgrade roads to provide all weather access at the site. The works will also include scope to relocate temporary stockpiled waste (up to a budget ceiling that is set following on site measurements for the road upgrade).
- Contract for the supply of coral aggregate to be delivered to the Luganville waste disposal site

The additional budget of approximately $10,000 would be provided to hire an independent consultant to supervise the works in Bouffa and provide quality oversight. The consultant will be responsible for the activities stated in this report. They will also supply SWAP in Samoa with a report detailing all expenditure, and documenting the arrival and acceptance of the completed works packages. The use of an independent consultant will minimise the demands on DEPC resources.

It is advised that the RFQ documents contain separate line item costs to improve flexibility. For example, the road works at the Bouffa site may be lower than the estimates, with excess funds able to then be allocated to the waste stockpile removal work. Similarly, if there are budget shortfalls, the contractor can reduce the scope of the works for relocating waste stockpiles. Providing flexibility during the procurement process is an important means to gain full utilisation of the funding.

The cost estimates for the works at the Bouffa site were provided in discussion with local contractors to reflect realistic costs. To implement the project, a competitive tender process will be required in accordance with the SPREP Procurement Policy. As part of developing the RfQ and undertaking the bid assessment, it is important that the bidder demonstrates their capacity to supply the appropriate level of equivalent in terms of machinery, expertise, safety systems, and quality oversight. To maximise the works that can be achieved within the budget, it

is recommended the contractor can supply adequate tipper truck capacity to ensure the excavator is not left idle waiting for truck return.

At the Luganville site, the landfill operator can supervise the works and arrange the on-site bulldozer use under the existing landfill operational budget.

8.3. Workplan and timeline

The contractual period to undertake the works at the Bouffa site will be negotiated with the contractor appointed. It is anticipated that the roading would take two to three weeks and waste relocation two weeks. This is based on the contractor providing adequate machinery and equipment to undertake the works cost effectively.

It is recommended that the proposed works are undertaken in the drier period of the year, but this may not be practical.

Time allowance will be required to prepare the Request for Quotation (RFQ), provide bidders with adequate response period and undertake the bid assessment. This is likely to require approximately two months. Following the contract award, the process to agree to the extent of roading works will be required with the supplier. There is also a need to allow approximately one week for site mobilisation.

The proposed works at Luganville are minor and although there has been no collaboration with local aggregate supply contractors or the landfill operator to undertake the works, it is envisaged that the works can be completed in less than one month.

Consideration for the application to waive the requirement for VAT to be applied to this aid project may also affect the project timeline.

A workplan and time line is presented in Figure 6.

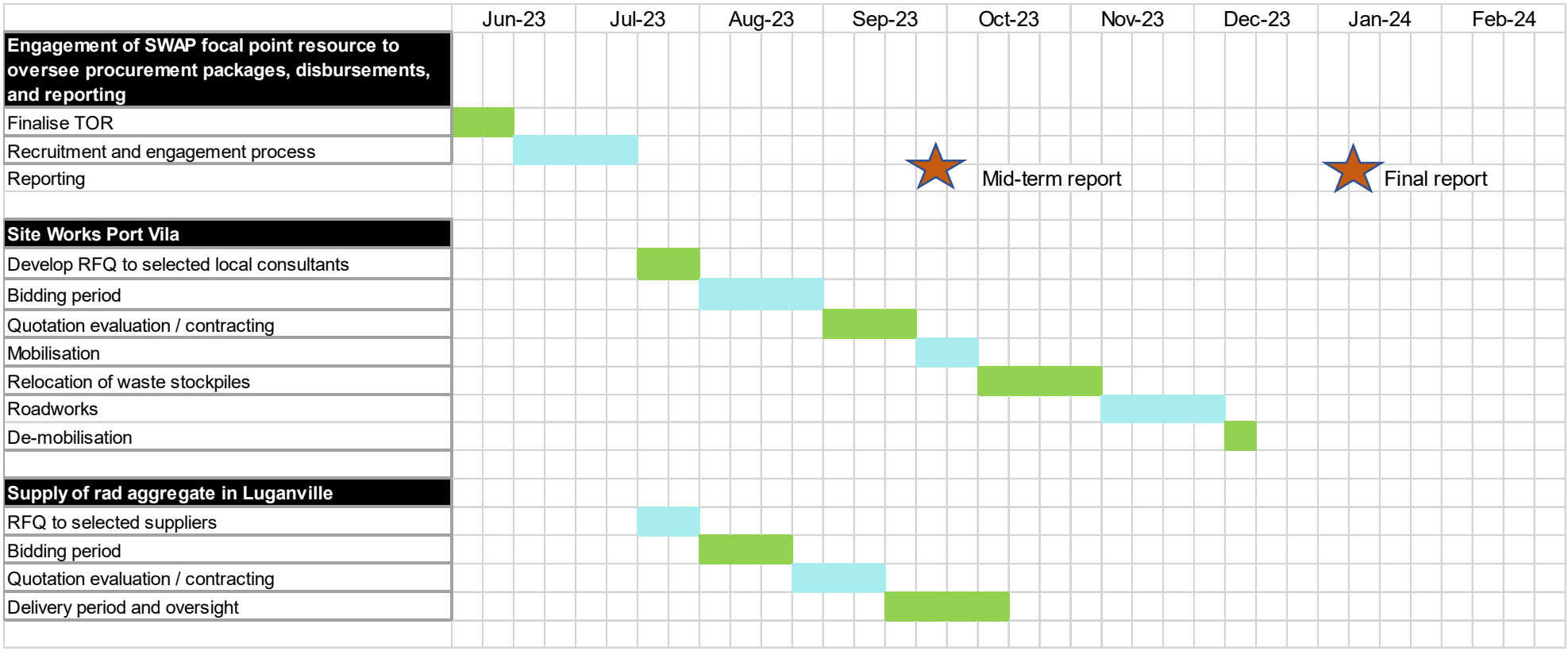


Figure 6 Proposed work steps and timeline for implementation

8.4. Risks and mitigation measures

There are a number of risks and associated mitigation measures outlined below in Table 10, covering both the implementation of the proposed packages, and the longer-term risks in terms of sustainability of the interventions. This provides an indicative analysis of risks, with unforeseen events possible.

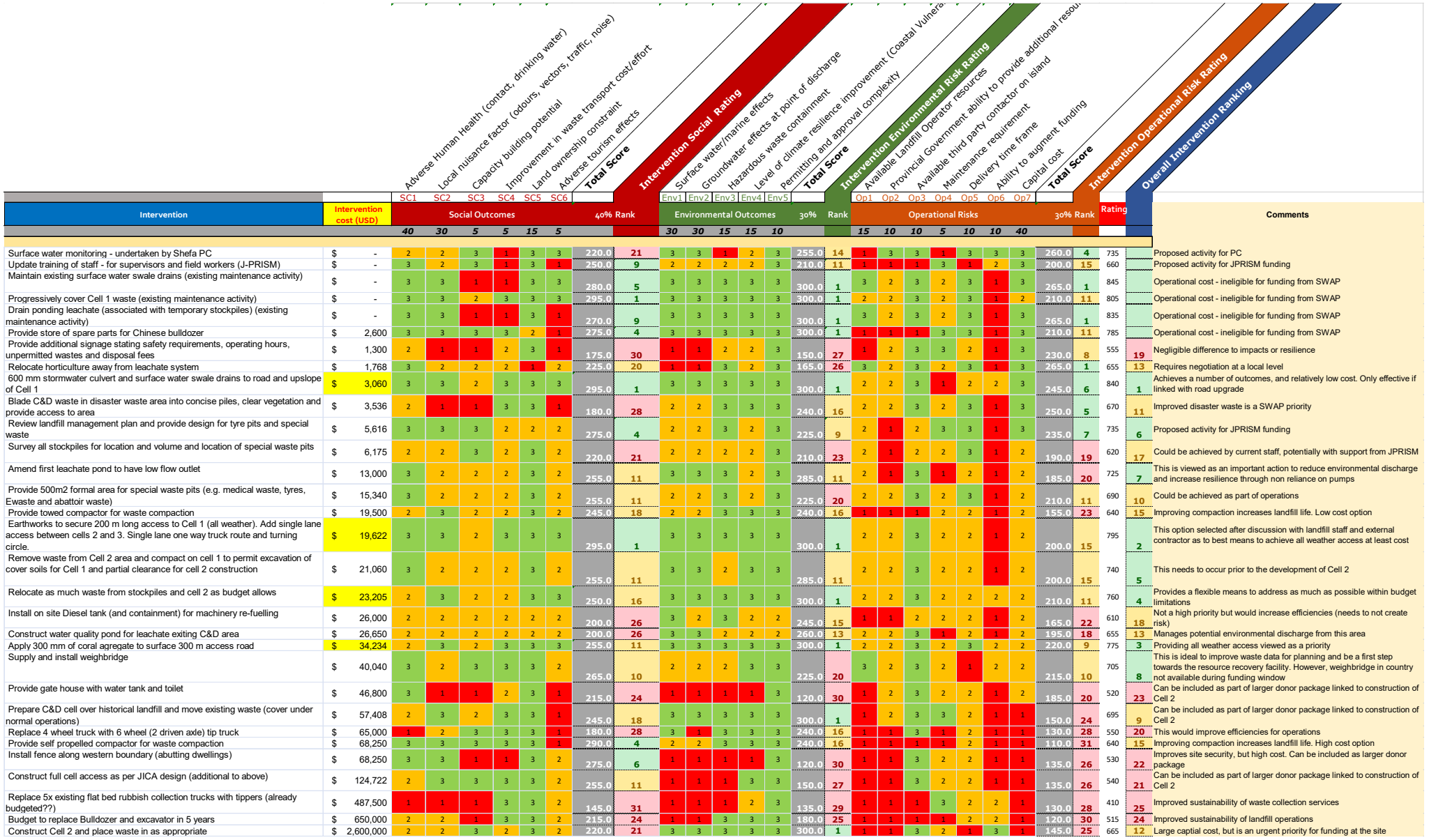
Table 10 Risk matrix for implementation and sustainability

Risk Description	Potential Impact	Likelihood	Consequence	Risk Profile	Proposed Mitigation
Sourcing person to provide oversight / management of project	Project delays. Poor oversight compromising outcomes	Possible	Significant	High	SWAP focal point to seek candidates early and discuss with SWAP in Samoa who will provide support for selection process. Mid term report to provide SWAP with update, but regular informal communication prior to this to identify and resolve issues.
Unknown waste volume in stockpiles, with SWAP funds unable to relocate ***all* the waste.**	Disappointment that needed works aren't completed	Possible	Moderate	Medium	Contract to provide a lump sum for the fundamentally necessary roading works. Remaining budget for relocation of waste can be defined and works undertaken accordingly to fully utilise the available budget. Any savings (e.g., through waiver/exemption of VAT) can be allocated to this component of the contract.
Waste relocation damaging road works	Wasted resources and further remedial works required	Possible	Significant	High	The use of aggregate access roads for the large number of heavily loaded trucks to relocate waste would severely damage the new roads. This can be avoided by the relocation of the waste before the roads are constructed.
Cost over-runs for project oversight due to complexity of open bidding process	Less funding available for works	Unlikely	Moderate	Low	Competitive tendering provides surety that the price accepted is best value for the client. However to create a level platform for tenderers that does not leave room for unreasonable variations and therefore price uncertainty, this requires detailed tender

					documentation and contract administration. Provision of these services costs time and money. If there is uncertainty about capacity to provide this oversight, the alternative is to obtain fixed pricing from a sole sourced and quality local contractor
Lack of resources to operate the Bouffa site leads to rapid deterioration of the access road, or reintroduction of waste stockpiles	Ongoing impacts from the site within a short timeframe	Unlikely	Signficant	Medium	Ongoing discussions with PVTC about their operational resourcing. Technical support under J-PRISM III to support ongoing operational planning
Lack of resources to operate the Luganville site leads to gravel not being spread and compacted appropriately	Rapid degradation of road	Possible	Moderate	Medium	Contractor who is overseeing the implementation of SWAP interventions to work with site operators at Luganville to ensure the works are undertaken effectively as part of the condition of receiving the support from SWAP.
Natural disasters having impact on site operations, inundating the disposal sites with excess materials beyond the space allocations	Less project impact, as works 'undone' through excess material loadings	Unlikely	Moderate	Low	This risk is relevant given the two cyclone events experienced in Vanuatu in February and March 2023. Whilst the waste impacts were considerable, SWAP focal points reported the majority of waste was organic was managed on-site or at the organics facility. Roofing iron and metals were managed by RecycleCorp. Excess waste materials were received at the waste disposal sites, but did not overwhelm the capacity of the sites to manage the materials. However, the volume of stockpiled waste to be moved may have increased.

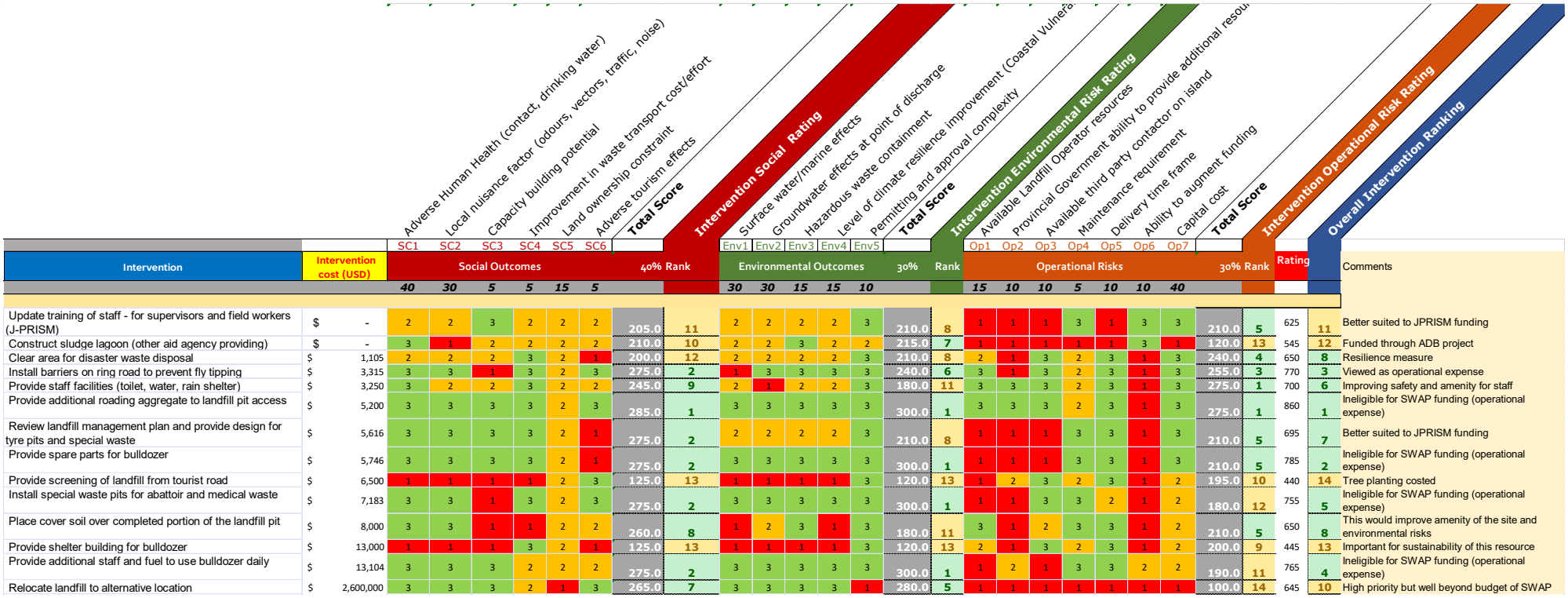
Appendix A

Multi-criteria assessment for investment options



Intervention	Intervention cost (USD)	Social Outcomes							40% Rank	Environmental Outcomes						30% Rank	Operational Risks								30% Rank	Rating		Comments
		SC1	SC2	SC3	SC4	SC5	SC6			Env1	Env2	Env3	Env4	Env5			Op1	Op2	Op3	Op4	Op5	Op6	Op7					
		40	30	5	5	15	5			30	30	15	15	10			15	10	10	5	10	10	40					
Surface water monitoring - undertaken by Shefa PC	$ -	2	2	3	1	3	3	220.0	21	3	3	1	2	3	255.0	14	1	3	3	1	3	3	3	260.0	4	735		Proposed activity for PC
Update training of staff - for supervisors and field workers (J-PRISM)	$ -	3	2	3	1	3	1	250.0	9	2	2	2	2	3	210.0	11	1	1	1	3	1	2	3	200.0	15	660		Proposed activity for JPRISM funding
Maintain existing surface water swale drains (existing maintenance activity)	$ -	3	3	1	1	3	3	280.0	5	3	3	3	3	3	300.0	1	3	2	3	2	3	1	3	265.0	1	845		Operational cost - ineligible for funding from SWAP
Progressively cover Cell 1 waste (existing maintenance activity)	$ -	3	3	2	3	3	3	295.0	1	3	3	3	3	3	300.0	1	2	2	3	2	3	1	2	210.0	11	805		Operational cost - ineligible for funding from SWAP
Drain ponding leachate (associated with temporary stockpiles) (existing maintenance activity)	$ -	3	3	1	1	3	1	270.0	9	3	3	3	3	3	300.0	1	3	2	3	2	3	1	3	265.0	1	835		Operational cost - ineligible for funding from SWAP
Provide store of spare parts for Chinese bulldozer	$ 2,600	3	3	3	3	2	1	275.0	4	3	3	3	3	3	300.0	1	1	1	1	3	3	1	3	210.0	11	785		Operational cost - ineligible for funding from SWAP
Provide additional signage stating safety requirements, operating hours, unpermitted wastes and disposal fees	$ 1,300	2	1	1	2	3	1	175.0	30	1	1	2	2	3	150.0	27	1	2	3	3	2	1	3	230.0	8	555	19	Negligible difference to impacts or resilience
Relocate horticulture away from leachate system	$ 1,768	3	2	2	2	1	2	225.0	20	1	1	3	2	3	165.0	26	3	2	3	2	3	1	3	265.0	1	655	13	Requires negotiation at a local level
600 mm stormwater culvert and surface water swale drains to road and upslope of Cell 1	$ 3,060	3	3	2	3	3	3	295.0	1	3	3	3	3	3	300.0	1	2	2	3	1	2	2	3	245.0	6	840	1	Achieves a number of outcomes, and relatively low cost. Only effective if linked with road upgrade
Blade C&D waste in disaster waste area into concise piles, clear vegetation and provide access to area	$ 3,536	2	1	1	3	3	1	180.0	28	2	2	3	3	3	240.0	16	2	2	3	2	3	1	3	250.0	5	670	11	Improved disaster waste is a SWAP priority
Review landfill management plan and provide design for tyre pits and special waste	$ 5,616	3	3	3	2	2	2	275.0	4	2	2	3	2	3	225.0	9	2	1	2	3	3	1	3	235.0	7	735	6	Proposed activity for JPRISM funding
Survey all stockpiles for location and volume and location of special waste pits	$ 6,175	2	2	3	2	3	2	220.0	21	2	2	2	2	3	210.0	23	2	1	2	2	3	1	2	190.0	19	620	17	Could be achieved by current staff, potentially with support from JPRISM
Amend first leachate pond to have low flow outlet	$ 13,000	3	2	2	2	3	2	255.0	11	3	3	3	2	3	285.0	11	2	1	3	1	2	1	2	185.0	20	725	7	This is viewed as an important action to reduce environmental discharge and increase resilience through non reliance on pumps
Provide 500m2 formal area for special waste pits (e.g. medical waste, tyres, Ewaste and abattoir waste)	$ 15,340	3	2	2	2	3	2	255.0	11	2	2	3	2	3	225.0	20	2	2	3	2	3	1	2	210.0	11	690	10	Could be achieved as part of operations
Provide towed compactor for waste compaction	$ 19,500	2	3	2	2	3	2	245.0	18	2	2	3	3	3	240.0	16	1	1	1	2	2	1	2	155.0	23	640	15	Improving compaction increases landfill life. Low cost option
Earthworks to secure 200 m long access to Cell 1 (all weather). Add single lane access between cells 2 and 3. Single lane one way truck route and turning circle.	$ 19,622	3	3	2	3	3	3	295.0	1	3	3	3	3	3	300.0	1	2	2	3	2	2	1	2	200.0	15	795	2	This option selected after discussion with landfill staff and external contractor as to best means to achieve all weather access at least cost
Remove waste from Cell 2 area and compact on cell 1 to permit excavation of cover soils for Cell 1 and partial clearance for cell 2 construction	$ 21,060	3	2	2	2	3	2	255.0	11	3	3	2	3	3	285.0	11	2	2	3	2	2	1	2	200.0	15	740	5	This needs to occur prior to the development of Cell 2
Relocate as much waste from stockpiles and cell 2 as budget allows	$ 23,205	2	3	2	2	3	3	250.0	16	3	3	3	3	3	300.0	1	2	2	3	2	2	2	2	210.0	11	760	4	Provides a flexible means to address as much as possible within budget limitations
Install on site Diesel tank (and containment) for machinery re-fuelling	$ 26,000	2	2	2	2	2	2	200.0	26	3	2	3	2	2	245.0	15	1	1	2	2	2	1	2	165.0	22	610	18	Not a high priority but would increase efficiencies (needs to not create risk)
Construct water quality pond for leachate exiting C&D area	$ 26,650	2	2	2	2	2	2	200.0	26	3	3	2	2	2	260.0	13	2	2	3	1	2	1	2	195.0	18	655	13	Manages potential environmental discharge from this area
Apply 300 mm of coral agregate to surface 300 m access road	$ 34,234	2	3	2	3	3	3	255.0	11	3	3	3	3	3	300.0	1	2	2	3	2	3	2	2	220.0	9	775	3	Providing all weather access viewed as a priority
Supply and install weighbridge	$ 40,040	3	2	3	3	3	2	265.0	10	2	2	2	3	3	225.0	20	3	2	3	2	1	2	2	215.0	10	705	8	This is ideal to improve waste data for planning and be a first step towards the resource recovery facility. However, weighbridge in country not available during funding window
Provide gate house with water tank and toilet	$ 46,800	3	1	1	2	3	1	215.0	24	1	1	1	1	3	120.0	30	1	2	3	2	2	1	2	185.0	20	520	23	Can be included as part of larger donor package linked to construction of Cell 2
Prepare C&D cell over historical landfill and move existing waste (cover under normal operations)	$ 57,408	2	3	2	3	3	1	245.0	18	3	3	3	3	3	300.0	1	1	2	3	3	2	1	1	150.0	24	695	9	Can be included as part of larger donor package linked to construction of Cell 2
Replace 4 wheel truck with 6 wheel (2 driven axle) tip truck	$ 65,000	1	2	3	3	3	1	180.0	28	3	1	3	3	3	240.0	16	1	1	3	1	2	1	1	130.0	28	550	20	This would improve efficiencies for operations
Provide self propelled compactor for waste compaction	$ 68,250	3	3	3	3	3	1	290.0	4	2	2	3	3	3	240.0	16	1	1	1	1	2	1	1	110.0	31	640	15	Improving compaction increases landfill life. High cost option
Install fence along western boundary (abutting dwellings)	$ 68,250	3	3	1	1	3	2	275.0	6	1	1	1	1	3	120.0	30	1	1	3	2	2	1	1	135.0	26	530	22	Improves site security, but high cost. Can be included as larger donor package
Construct full cell access as per JICA design (additional to above)	$ 124,722	2	3	3	3	3	2	255.0	11	1	1	1	3	3	150.0	27	1	1	3	2	2	1	1	135.0	26	540	21	Can be included as part of larger donor package linked to construction of Cell 2
Replace 5x existing flat bed rubbish collection trucks with tippers (already budgeted??)	$ 487,500	1	1	1	3	3	2	145.0	31	1	1	1	2	3	135.0	29	1	1	1	3	2	2	1	130.0	28	410	25	Improved sustainability of waste collection services
Budget to replace Bulldozer and excavator in 5 years	$ 650,000	2	2	1	3	3	2	215.0	24	1	1	3	3	3	180.0	25	1	1	1	1	2	2	1	120.0	30	515	24	Improved sustainability of landfill operations
Construct Cell 2 and place waste in as appropriate	$ 2,600,000	2	2	3	2	3	2	220.0	21	3	3	3	3	3	300.0	1	1	1	3	2	1	3	1	145.0	25	665	12	Large captial cost, but is an urgent priority for funding at the site

Figure 7 Outcome of MCA for Port Vila intervention options



Intervention	Intervention cost (USD)	SC1	SC2	SC3	SC4	SC5	SC6	Total Score	Intervention Social Rating	Env1	Env2	Env3	Env4	Env5	Total Score	Intervention Environmental Risk Rating	Op1	Op2	Op3	Op4	Op5	Op6	Op7	Total Score	Intervention Operational Risk Rating	Overall Intervention Ranking	Comments
		Social Outcomes						40%	Rank	Environmental Outcomes					30%	Rank	Operational Risks							30%	Rank	Rating	
		40	30	5	5	15	5			30	30	15	15	10			15	10	10	5	10	10	40				
Update training of staff - for supervisors and field workers (J-PRISM)	$ -	2	2	3	2	2	2	205.0	11	2	2	2	2	3	210.0	8	1	1	1	3	1	3	3	210.0	5	625	11	Better suited to JPRISM funding
Construct sludge lagoon (other aid agency providing)	$ -	3	1	2	2	2	2	210.0	10	2	2	3	2	2	215.0	7	1	1	1	1	1	3	1	120.0	13	545	12	Funded through ADB project
Clear area for disaster waste disposal	$ 1,105	2	2	2	3	2	1	200.0	12	2	2	2	2	3	210.0	8	2	1	3	2	3	1	3	240.0	4	650	8	Resilience measure
Install barriers on ring road to prevent fly tipping	$ 3,315	3	3	1	3	2	3	275.0	2	1	3	3	3	3	240.0	6	3	1	3	2	3	1	3	255.0	3	770	3	Viewed as operational expense
Provide staff facilities (toilet, water, rain shelter)	$ 3,250	3	2	2	3	2	2	245.0	9	2	1	2	2	3	180.0	11	3	3	3	2	3	1	3	275.0	1	700	6	Improving safety and amenity for staff
Provide additional roading aggregate to landfill pit access	$ 5,200	3	3	3	3	2	3	285.0	1	3	3	3	3	3	300.0	1	3	3	3	2	3	1	3	275.0	1	860	1	Ineligible for SWAP funding (operational expense)
Review landfill management plan and provide design for tyre pits and special waste	$ 5,616	3	3	3	3	2	1	275.0	2	2	2	2	2	3	210.0	8	1	1	1	3	3	1	3	210.0	5	695	7	Better suited to JPRISM funding
Provide spare parts for bulldozer	$ 5,746	3	3	3	3	2	1	275.0	2	3	3	3	3	3	300.0	1	1	1	1	3	3	1	3	210.0	5	785	2	Ineligible for SWAP funding (operational expense)
Provide screening of landfill from tourist road	$ 6,500	1	1	1	1	2	3	125.0	13	1	1	1	1	3	120.0	13	1	2	3	2	3	1	2	195.0	10	440	14	Tree planting costed
Install special waste pits for abattoir and medical waste	$ 7,183	3	3	1	3	2	3	275.0	2	3	3	3	3	3	300.0	1	1	1	3	3	2	1	2	180.0	12	755	5	Ineligible for SWAP funding (operational expense)
Place cover soil over completed portion of the landfill pit	$ 8,000	3	3	1	1	2	2	260.0	8	1	2	3	1	3	180.0	11	3	1	2	3	3	1	2	210.0	5	650	8	This would improve amenity of the site and environmental risks
Provide shelter building for bulldozer	$ 13,000	1	1	1	3	2	1	125.0	13	1	1	1	1	3	120.0	13	2	1	3	2	3	1	2	200.0	9	445	13	Important for sustainability of this resource
Provide additional staff and fuel to use bulldozer daily	$ 13,104	3	3	3	2	2	2	275.0	2	3	3	3	3	3	300.0	1	1	2	1	3	3	2	2	190.0	11	765	4	Ineligible for SWAP funding (operational expense)
Relocate landfill to alternative location	$ 2,600,000	3	3	3	2	1	3	265.0	7	3	3	3	3	1	280.0	5	1	1	1	1	1	1	1	100.0	14	645	10	High priority but well beyond budget of SWAP

Figure 8 Outcome of MCA for Luganille intervention options

Appendix B

Presentation to stakeholder workshop on intervention options

Landfill Rehabilitation / Climate Proofing Scoping Study

Feasibility Workshop

Welcome

Purpose

- To discuss the challenges / impacts at Port Vila and Luganville sites
- To discuss priorities to address at each site
- → Options for investments and high level pricing
- Spending prioritisation between sites
- Recommendations for current funds
- Recommendations for future funds

Bouffa Disposal Site Overview

- Site observations
- Challenges
- Impacts


Cell 1
Western Bounday
Lololima River
Waste to Energy Plant
Teouma River
Customary Residences
Access Road
Google

SCE Study - Proposed Resource Recovery Facility

Current landfill area

Leachate and STP area


SHANTUI
DH13
SHANTUI


H 20821


12917

Bouffa Site - list of potential interventions

Key Issue	Potential Interventions	Estimate (US$)
Water Quality	Surface water monitoring - undertaken by Shefa PC	$ -
Resilience	Update training of staff - for supervisors and field workers (J-PRIME)	$ -
Water Quality	Maintain existing surface water swale drains (existing maintenance activity)	$ -
Health/Water Quality	Progressively cover Cell 1 waste (existing maintenance activity)	$ -
Water Quality	Drain ponding leachate (associated with temporary stockpiles) (existing maintenance activity)	$ -
Resilience	Provide additional signage stating safety requirements, operating hours, unpermitted wastes and disposal fees	$ 2,000
Water Quality	Relocate horticulture away from leachate system	$ 2,000
Resilience	Provide store of spare parts for Chinese bulldozer	$ 3,000
Health/Water Quality	Blade C&D waste in disaster waste area into concise piles, clear vegetation and provide access to area	$ 4,000
Health/Water Quality	Review landfill management plan and provide design for tyre pits and special waste	$ 6,000
Resilience	Survey all stockpiles for location and volume and location of special waste pits	$ 7,000
Water Quality	Install surface water channel up-slope of Cell 1	$ 12,000
Water Quality	Amend first leachate pond to have low flow outlet	$ 13,000
Health/Water Quality	Provide 500m2 formal area for special waste pits (e.g. medical waste, tyres, Ewaste and abattoir waste)	$ 16,000
Resilience	Provide towed compactor for waste compaction	$ 20,000
Resilience	Remove waste from Cell 2 area and compact on cell 1 to permit excavation of cover soils for Cell 1 and partial clearance for cell 2 construction	$ 22,000
Resilience	Install on site Diesel tank (and containment) for machinery re-fuelling	$ 26,000
Water Quality	Construct water quality pond for leachate exiting C&D area	$ 27,000
Resilience	Recontour lower access road from the access to Cell 1 and the sludge ponds (430m) allow aggregate surface 4m wide and provide surface drainage.	$ 38,000
Resilience	Supply and install weighbridge	$ 41,000
Resilience	Provide self propelled compactor for waste compaction	$ 43,000
Resilience	Provide all weather access to Cell 1 only	$ 47,000
Resilience	Provide gate house with water tank and toilet	$ 47,000
Health/Water Quality	Remove MSW from temporary stockpiles to Cell 1	$ 53,000
Health/Water Quality	Prepare C&D cell over historical landfill and move existing waste (cover under normal operations)	$ 58,000
Resilience	Replace 4 wheel truck with 6 wheel (2 driven axle) tip truck	$ 65,000
Resilience	Install fence along western boundary (abutting dwellings)	$ 69,000
Health/Water Quality	Construct full cell access as per JICA design (additional to above)	$ 130,000
Resilience	Replace 5x existing flat bed rubbish collection trucks with tippers (already budgeted??)	$ 490,000
Resilience	Budget to replace Bulldozer and excavator in 5 years	$ 650,000
Health/Water Quality	Construct Cell 2 and place waste in as appropriate	$ 2,600,000

Key Priorities at Bouffa Site

- Provide all weather access to Cell 1 and 2
- Relocate waste from temporary stockpiles to Cell 1
- Improve stormwater management upslope of Cell 1
- Amend leachate pond to provide storm flow attenuation and trickle feed to wetlands
- Create cell for C&D waste on historical landfill cell and move C&D to cell
- Prepare for the development of cell 2 (additional budget required)

Recommendations to discuss

Key Issue	Recommended Interventions	Estimate (US$)
Water Quality	Surface water monitoring - undertaken by Shefa PC	$ -
Resilience	Update training of staff - for supervisors and field workers (J-PRIME)	$ -
Water Quality	Maintain existing surface water swale drains (existing maintenance activity)	$ -
Health/Water Quality	Progressively cover Cell 1 waste (existing maintenance activity)	$ -
Water Quality	Drain ponding leachate (associated with temporary stockpiles) (existing maintenance activity)	$ -
Resilience	Provide store of spare parts for Chinese bulldozer	$ 3,000
Water Quality	Install surface water channel up-slope of Cell 1	$ 12,000
Water Quality	Amend first leachate pond to have low flow outlet	$ 13,000
Resilience	Provide all weather access to Cell 1 only	$ 47,000
	Total	$ 75,000

Bouffa – Ranking and proposed work

	Ranking	amount (USD)			
Surface water monitoring - undertaken by Shefa PC	5	$ -			
Update training of staff - for supervisors and field workers (J-PRIME)	18	$ -	send 2 supervisors to Japan through the J-Prime aid and allow on site staff training		
Maintain existing surface water swale drains (existing maintenance activity)	1	$ -			
Progressively cover Cell 1 waste (existing maintenance activity)	5	$ -			
Drain ponding leachate (associated with temporary stockpiles) (existing maintenance activity)	2	$ -			
Provide additional signage stating safety requirements, operating hours, unpermitted wastes and disposal fees	22	$ 1,300			
Relocate horticulture away from leachate system	14	$ 1,768	Allow 1 day of D8		
Provide store of spare parts for Chinese bulldozer	7	$ 2,600			
Blade C&D waste in disaster waste area into concise piles, clear vegetation and provide access to area	18	$ 3,536	D8 - 2 days		
Review landfill management plan and provide design for tyre pits and special waste	15	$ 5,616	Allow consultant 1 day to review and update and 2 people drafting pit design		
Survey all stockpiles for location and volume and location of special waste pits	23	$ 6,175	In country Drone survey		
Install surface water channel up-slope of Cell 1	4	$ 11,375			
Amend first leachate pond to have low flow outlet	8	$ 13,000			
Provide 500m2 formal area for special waste pits (e.g. medical waste, tyres, Ewaste and abattoir waste)	3	$ 15,340	clear area, level and grade and excavate pits	Clear and construct 100m long all weather access road to special wastes area	
Provide towed compactor for waste compaction	21	$ 19,500			
Remove waste from Cell 2 area and compact on cell 1 to permit excavation of cover soils for Cell 1 and partial clearance for cell 2 construction	9	$ 21,060	allow D8, excavator and truck for 1 week		
Install on site Diesel tank (and containment) for machinery re-fuelling	29	$ 26,000			
Construct water quality pond for leachate exiting C&D area	10	$ 26,650	allow for 250m3 pond and wetland down gradient with 50m of 300mm pipe		
Recontour lower access road from the access to Cell 1 and the sludge ponds (430m) allow aggregate surface 4m wide and provide surface	15	$ 37,190	grader to trip road, swale drain each side cut with grader, 4m x 300mm aggregate		
Supply and install weighbridge	31	$ 40,040	second hand weighbridge (Ex fletchers)	concrete base for weighbridge	
Provide self propelled compactor for waste compaction	20	$ 42,250	rates ex Aus (Smart Environmental report) allowing $10k transport		
Provide all weather access to Cell 1 only	13	$ 46,761	Finalise the earthworks required for 150m long all weather access to Cell 1	Install surface water swale drains to the access road and upslope of Cell 1 including installation of 600mm stormwater culvert utilising on site pipes	Apply 300mm of coral aggregate to surface to the access

Luganville Disposal Site Overview

Site observations

→ Challenges

Impacts

Legend

- Luganville Waste Disposal site
- Direction of ground water travel
- Luganville CBD
- water Collection Bores

Paper Size ISO A4

0 500 1,000 1,500 2,000

Meters

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

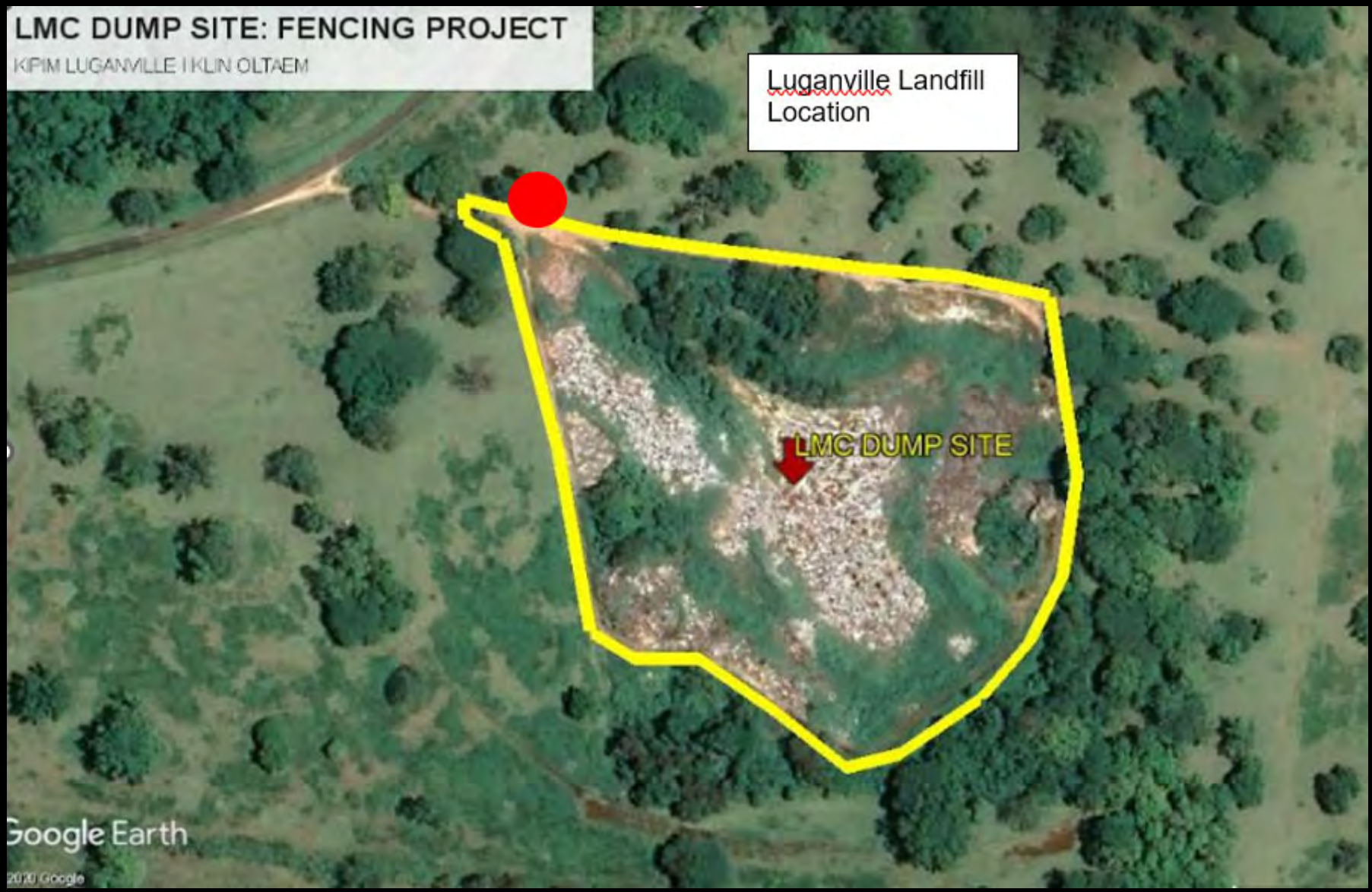
N

GHD

Luganville Locality Plan

Project No. 12587989
Revision No. -
Date 23/12/2022

Data source: Source: Esri Maxar, Earthstar Geographics, and the GIS User Community. Created by: lmillsz


LMC DUMP SITE: FENCING PROJECT
KPIM LUGANVILLE I KLIN OLTAEM
Luganville Landfill Location
LMC DUMP SITE
Google Earth
2020 Google


WELCOME TO
LUGANVILLE THROW
AWAY CULTURE
FEES
LORRY - vuv 2200
PICKUP - vuv 1600
CAR - vuv 1000
DUMP HEMI OPEN LONG
8am NO KLOS LONG 4pm.
SPOS YU KAM BE GATE I
KLOS. PLIS YU NO SAKEM
TOTI LONG GATE.


LUGANVILLE WASTE
DISPOSAL SITE PLAN
SHANTUI

Luganville - list of potential interventions

Key Issue	Potential Interventions	Estimate (US$)
Resilience	Update training of staff - for supervisors and field workers (J-PRIME)	$ -
Resilience	Construct sludge lagoon (other aid agency providing)	$ -
Resilience	Clear area for disaster waste disposal (using existing bulldozer)	$ -
Health/Water Quality	Install soil barriers on ring road to prevent fly tipping (using existing bulldozer)	$ -
Health	Provide staff facilities (toilet, water, rain shelter)	$ 4,000
Health/Water Quality	Provide additional roading aggregate to landfill pit access	$ 6,000
Resilience	Review landfill management plan and provide design for tyre pits and special waste	$ 6,000
Resilience	Provide spare parts for bulldozer	$ 6,000
Resilience	Provide screening of landfill from tourist road	$ 7,000
Health/Water Quality	Install special waste pits for abattoir and medical waste	$ 8,000
Health/Water Quality	Place cover soil over completed portion of the landfill pit	$ 8,000
Resilience	Provide shelter building for bulldozer	$ 13,000
Health/Water Quality	Provide additional staff and fuel to use bulldozer daily	$ 14,000
Health/Water Quality	Relocate landfill to alternative location	$ 2,600,000

Key Priorities at Luganville Site

- Provide all weather access to waste pit
- Prevent dumping around the perimeter
- Move perimeter waste to the landfill
- Provide sufficient staff and fuel to operate the on-site bulldozer to effect the required works

Recommendations to discuss

Recommended interventions for Luganville (list in order of priority and budget estimates)

Key Issue	Recommended Interventions	Estimate (US$)
Resilience	Update training of staff - for supervisors and field workers (J-PRIME)	$ -
Resilience	Construct sludge lagoon (other aid agency providing)	$ -
Resilience	Clear area for disaster waste disposal (using existing bulldozer)	$ -
Health/Water Quality	Install soil barriers on ring road to prevent fly tipping (using existing bulldozer)	$ -
Health/Water Quality	Provide additional roading aggregate to landfill pit access	$ 6,000
Resilience	Provide spare parts for bulldozer	$ 6,000
Health/Water Quality	Install special waste pits for abattoir and medical waste	$ 8,000
Health/Water Quality	Provide additional staff and fuel to use bulldozer daily	$ 14,000
	Total	$ 34,000

Discussion

Split of expenditure between the 2 sites.

Pros and Cons of interventions at Port Vila vs Luganville

Recommended interventions to make a difference now

Priority interventions needing additional funds

* Thank You

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→ The Power of Commitment