CLIMATE CHANGE ASSESSMENT

I. BASIC PROJECT INFORMATION

Project Title:	Greater Port Vila Urban Resilience Project
Project Cost:	$11.77 million
Location:	Republic of Vanuatu
Sector:	Water and Other Urban Infrastructure and Services
Theme:	

Brief Description: The proposed Greater Port Vila Urban Resilience Project will improve urban resilience in Greater Port Vila (GPV), the largest urban area in Vanuatu. It will do so through capacity building, institutional strengthening, and construction of two multipurpose emergency shelters. The project will have four project outputs:

- Output 1: Resilience in urban planning and management strengthened. Under this output, the project will strengthen the capacity of the Department of Urban Affairs and Planning in the Ministry of Internal Affairs (MOIA) and the Port Vila Municipal Council (PVMC) in urban planning, development, climate and disaster resilience and municipal finance.
- Output 2: Urban resilience enhanced through local partnerships. Activities under this output will focus on disaster risk management and climate change adaptation, including training to ward secretaries, financing public awareness campaigns, and supporting the preparation of emergency preparedness plans.
- Output 3: Resilient urban infrastructure constructed in GPV. This output will finance investments in multipurpose and gender-responsive emergency shelters. The investments will follow the Greater Port Vila Resilient Urban Development Strategy and Action Plan and have been prepared based on two shelters.
- Output 4: Asset management and institutional capacity strengthened. This output will improve the capacity of MOIA in project development, implementation and monitoring. It will also improve the capacity of PVMC to operate and maintain works constructed under the project.

This assessment is mainly focused on the multipurpose emergency shelters under Output 3. However, Outputs 1, 2 and 4 also relate directly to climate change adaptation (as explained in Section IV).

II. SUMMARY OF CLIMATE CHANGE FINANCE

Project Financing		Climate Finance	
Source	**Amount**	**Adaptation**	**Mitigation**
Asian Development Bank			
Special Funds resources (Asian Development Fund)	$9.640 million[a]	$4.820 million	$0
Cofinancing			
Government	$2.130 million	$1.065 million	$0

[a] The ADB financing includes $5.130 million grant allocation from the Asian Development Fund Disaster Risk Reduction financing mechanism.
Source: Asian Development Bank.

III. SUMMARY OF CLIMATE RISK SCREENING AND ASSESSMENT

A. Sensitivity of Project Component(s) to Climate or Weather Conditions and the Sea Level

For 5 consecutive years, Vanuatu has been ranked as the country most at risk from natural disasters in the annual World Risk Report. Vanuatu's geographical location in the equatorial cyclone belt makes it highly

exposed to climate-related natural disasters. The island country is also located on the Pacific volcanic ring, so it is also heavily exposed to volcanic activity, earthquakes, and tsunamis.

In Port Vila, communities have identified a need for multiple buildings that offer a safe and secure refuge during and after cyclones and other natural disasters and also cater to the needs of women. In the past, churches, community halls and schools have been used for this purpose; but these buildings are not designed to withstand strong winds, are not accessible for longer periods, and do not have sufficient water, toilets, or cooking facilities.

The project design is based on preparation of two multipurpose emergency shelters. These shelters are designed to withstand cyclones and earthquakes, and also to benefit communities throughout the year. The shelters will accommodate social gatherings, such as community occasions (weddings and funerals), local market activities, social meetings and functions, and cultural handicrafts. They will also include separate sanitation facilities, cooking facilities, office space, and market area improvements.

Further, the shelters will also offer information, training and potential for first point of contact in a gender-based violence referral system and in triage for health emergency, which are essential features to combat the increased incidence of violence brought about by social and economic difficulties during disasters caused by natural hazards and health pandemic.

The shelters are sensitive to climate/geophysical conditions in two main ways:

- Location. The shelters must be located in areas not susceptible to high tide storm surge or localized flooding. The location must also be protected against high winds. The degree of wind exposure of a site will vary according to factors such as topography, height, and the surrounding terrain.
- Structural resilience. The emergency shelters must be built with the required structural resilience to withstand extreme storm conditions (and also small to moderate earthquakes). Total peak loads on a building are influenced by site characteristics and aerodynamic shape factors for different buildings and structures. Even a modest breach of the building envelope can increase internal pressure, increasing the risk of break-up and allowing subsequent water infiltration, greatly increasing the extent of damage.

B. Climate/Disaster Risk Screening and Classification

The project is unique in that activities/investments were informed by a city-wide disaster and climate risk assessment (DCRA). This contrasts with the normal practice of first identifying investments and then screening and assessing those investments for climate risks. Since the initial investments (multipurpose emergency shelters) under the sector project were selected and then designed to address the climate/disaster risks identified in the DCRA, the AWARE risk screening and the investment-specific climate risk assessment are not required. This linked document summarizes the relevant information from the DCRA and feasibility studies for the two emergency shelters.

Supported by an ADB regional technical assistance,[1] the DCRA entailed mapping and analysing Port Vila's exposure to three climate hazards (flooding, coastal inundation, and strong winds) and two geophysical hazards (seismic and tsunami). As described in Section III.D, this analysis made use of existing data on hazards and assets to develop a fine-grained spatial climate and disaster risk assessment for the PVMC. The assessment[2] revealed the following key trends: all urban assets in the GPV area are exposed to at least two of the five hazards; the number of hazards and their individual magnitude generally increase from "ridge to shore;" and the distribution of urban assets is roughly aligned with hazard "hot spots."

The assessment also noted that the poorest of Port Vila's residents are least able to cope with disasters and climate change. Even though poverty incidence has declined slightly, the proportion of people and households living below the basic needs poverty is much higher in Port Vila than in rural areas. The most vulnerable groups live in informal locations without adequate infrastructure and critical services.

[1] ADB. 2016. *Strengthening Urban Infrastructure Investment Planning in the Pacific*. Manila.

[2] ADB. 2019. *Disaster Risk Assessment/Climate Risk and Vulnerability Assessment*. Consultant's Report. Manila (Prepared by Tonkin & Taylor International Ltd.)

C. Climate Risk and Adaptation Assessment

1. Climate Risks

This section discusses the three main climate risks in Port Vila – coastal inundation, flooding, and strong winds. Risks from these hazards are projected to worsen in the future due to climate change.

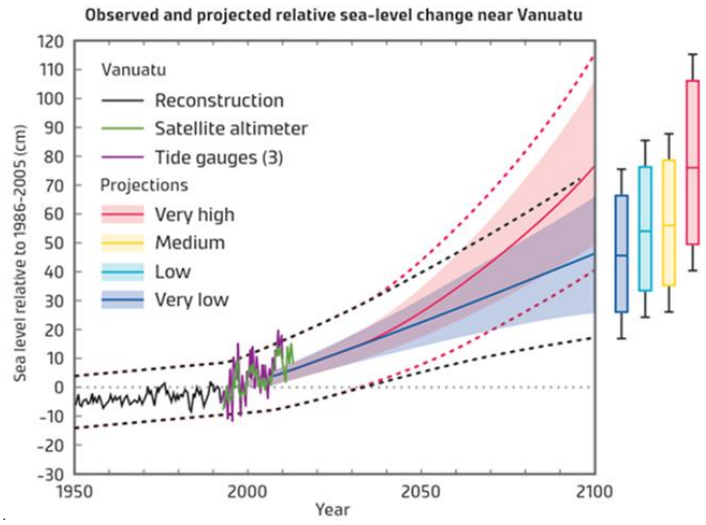
Strong wind. Vanuatu is located in a region just south of the equator known for the regular occurrence of tropical cyclones with damaging winds, rains and storm surge. On a global basis, there is a growing level of consistency between models that the frequency of tropical cyclones is likely to decrease by the end of the 21st century. However, there is also a general agreement between models that there will be an increase in the mean maximum wind speed of cyclones by between 2% and 11% globally.

Port Vila has been hit by devastating cyclones in the recent past, such as the Category 5 Tropical Cyclone Pam in 2015, with estimated wind speeds of 250 km/h, and wind gusts of up to 320 km/h. The extreme winds resulted in total damage estimated at approximately Vt48.6 billion ($449.4 million), or 64.1% of total gross domestic product.

The damage of buildings was typically associated with poor roofing structure arising from poor construction standards in many of the colonial-age buildings. The major mode of failure was roofing iron, followed by roof structures not being securely fastened.

Coastal inundation. Storm surge and wave action can cause considerable damage to waterfront installations and buildings near the waterfront, and Port Vila's exposure to this hazard will increase with sea level rise (very high confidence).[3] Areas of high or extreme risk include the central business district. Much of the infrastructure is located near the coast, including markets, cafes, hotels, and offices. This area also includes the city's most densely populated informal settlements.

Since 1993, sea-level rise has been measured at about 6 millimeters per year, far greater than the global average of 3.2 ± 0.4 millimeter per year. Projected sea level rise is shown in the figure, with increases ranging significantly in the longer term, due to uncertainty regarding the contribution and speed of melting of the Antarctic ice sheet.



Coastal inundation is a concern in Port Vila given that urban development has adversely affected the lagoon environments. Coastal vegetation and wetlands have been cleared to make way for concrete structures that interrupt natural coastal processes, leading to poor water quality, flooding, erosion, and an overall loss of coastal protection (hence a reduced buffer from storms and cyclones). Worsening impacts are expected due to sea level rise, which are likely to include the further loss of coastal habitat, increased coastal erosion, and increased flooding from storm surges.

Pluvial and fluvial flooding. With climate change, there is high confidence that extreme rainfall events will increase in frequency and intensity in Vanuatu (footnote 3). As extreme rainfall and weather events increase in frequency and intensity, pluvial and fluvial flooding will consequently increase. Both hazards present moderate to very high levels of potential damage to the local infrastructure.

[3] Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation. 2014. *Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports*. Melbourne: Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation.

Localized (pluvial) flooding can occur even with average rainfall levels, particularly in flooding hotspots in Port Vila's central business district. Insufficient drainage systems and degraded watersheds compromise Port Vila's ability to cope with this localized flooding. An increase in rainfall or storm surges will exacerbate this issue. In addition, standing water resulting from poor drainage systems has implications for human health, including outbreaks of dengue fever and malaria.

GPV is also prone to fluvial flooding from the two rivers flowing through Mele, which is just north of Port Vila. In the future, increased flooding is expected to occur due to higher sea levels and possibly more intense rainfall events. The most vulnerable locations are those around the lower reaches of the rivers, particularly in places where mangroves and other vegetation have been removed. Flooding in this area impacts agriculture, including traditional wealth crops (e.g., sugar cane, yam, rice).

2. Adaptation Measures

This section focuses on the adaptation measures that will be applied to the emergency shelters (Output 3). The adaptation activities to be implemented under Outputs 1, 2, and 4 are summarized in Section IV.

Location. The two shelters are located at Freshwota Market (Freshwota-Tasariki Ward, north of the city center), and Seaside Showground (Centre Ward). These locations were chosen from a long list of potential sites based on a number of criteria. In terms of disaster/climate risks, the two sites are located above identified flood and high tide storm surge levels, as identified in the DCRA. The two sites are also accessible to poor communities, which are most often displaced after disasters. To foster community cohesion and information sharing, the sites also have the potential to combine with other functions, such as ward office, market, social gatherings, and/or clinic for COVID-19 triage activities.

Design. The detailed design will be guided by suitable standards/guidelines. These include the national building code (first published in 1990 and updated in 2000), which comes under the jurisdiction of the MOIA. Particularly relevant for the evacuation centers, the code refers to standards from Australia and New Zealand for factoring wind loads (AS/NZS1170.2). It is recommended that the Port Vila shelters meet the strictest of these standards, which apply to the severe tropical cyclone region of Western Australia. If these standards are followed, the centers will be built to withstand very strong cyclonic winds, factoring in the projected increase in the mean maximum wind speed of cyclones.

There is also potential to adopt parameters from recent cyclone resistant buildings constructed since Cyclone Pam (e.g., Vanuatu Christian Council cyclone shelter). These include structures built with support from the World Bank's *Increasing Resilience to Climate Change and Natural Hazards* project. These buildings were approved by the National Advisory Board and authorized by the Public Works Department. In addition, the National Disaster Management Office has developed guidelines for the selection and management of centers (they do not cover structural design elements), which the project will follow.

To ensure compliance and wind-firmness in cyclone events, detailed designs will be guided by a suitably qualified structural engineer and will require certification that the final design can withstand extreme wind loads and earthquakes. The design will feature a strong foundation, thick metal roofing, safety glass, and cyclone shutters.

Important design details also pertain to the way roof components are constructed and put together as a whole roof system. Specific measures must be taken to ensure that the fabricated steel roof trusses are strongly anchored to the load-bearing components of the shelters, including the following:

- the base of the steel trusses must be properly welded to steel plates, which have steel bolts anchored to the roof beams (this important detail is often overlooked with disastrous results, such as whole roofs being blown away by a strong typhoon);
- purlins (which sit on top of the trusses and are in direct contact with the metal roof sheets) must be spaced close together for greater wind resistance, which means more screws to hold down the roof sheets; and
- diagonal braces can be placed between trusses to further strengthen the roof system.

D. Climate Risk Screening Tool and/or Procedure Used

The aforementioned DCRA considered risk as the consequence of hazard, exposure and vulnerability, as explained below.

Hazard. The data for hazards was extracted from modeling conducted under the Risk Mapping and Planning for Urban Preparedness project led by the Vanuatu Meteorology and Geo-Hazards Department as part of the wider World Bank-supported Mainstreaming Disaster Risk Reduction Project.[4]

Exposure. Exposure to individual hazards was then measured by the extent of the hazard (it did not measure the severity or scale of the hazard). Exposure was presented in terms of the population and infrastructure assets that are impacted by a particular hazard. Two geographic information system map layers were analyzed in conjunction with the hazard maps. They incorporated buildings and roads, with data from the Pacific Catastrophe Risk Assessment and Financing Initiative and Open Street Maps. A set of asset exposure maps (overview and zoom to hotspot sections) was produced to complement the statistical assessment (pivot tables) with a visual context analysis.

Vulnerability. The vulnerability assessment was based on qualitative indicators that considered five factors: institutional, physical, economic, social and environmental. Risk was then assessed based on hazard, exposure, and vulnerability information.

IV. DISASTER RISK REDUCTION AND CLIMATE ADAPTATION WITHIN THE PROJECT

Adaptation Activity	Target Climate Risk	Estimated Adaptation Costs/Total Costs	Adaptation Finance Justification
Output 1: Resilience in urban planning and management strengthened.	All risks, but particularly flooding, coastal inundation, and strong wind	$0.160 million / $0.321 million	Output 1 will strengthen the capacity of the Department of Urban Affairs and Planning and PVMC, including in some areas related to climate change and disaster risks. These include training, reviewing and amending risk-informed urban planning documents.
Output 2: Urban resilience enhanced through local partnerships.	All risks	$0.085 million / $0.170 million	Under Output 2, the proposed project will seek to increase resilience to the impacts of natural hazards and climate change by supporting trainings, public awareness campaigns, and emergency preparedness plans.
Output 3: Resilient urban infrastructure constructed in Greater Port Vila.	Flooding, coastal inundation, and strong wind	$3.125 million / $6.247 million	As with the other outputs, it is presumed that half of the costs of the shelters can be considered climate change finance, given that one of the main objectives of the project is to address climate change vulnerability (Type 2 adaptation).
Output 4: Asset management and institutional capacity strengthened.	All risks	$1.795 million / $3.595 million	Output 4 will improve the capacity of MOIA in project development, implementation, and monitoring; and will improve the capacity of PVMC to operate and maintain shelters constructed under the project. Since these efforts will focus on the ADB-supported investments, half of these costs are also deemed climate change adaptation finance.

ADB = Asian Development Bank; MOIA = Ministry of Internal Affairs; PVMC = Port Vila Municipal Council
Note: There is also $1.434 million for contingency, half of which will also be counted as climate finance.
Source: Asian Development Bank.

[4] World Bank. 2016. *Hazard and Risk Maps, Risk Mapping and Planning for Urban Preparedness*. Beca International Consultants Ltd, GNS Science and National Institute of Water and Atmospheric Research.