VANUATU
MINISTRY OF CLIMATE CHANGE ADAPTATION,
GEOHAZARDS, METEOROLOGY AND ENERGY
VANUATU METEOROLOGY AND GEO-HAZARDS DEPARTMENT

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR
IMPROVEMENT OF EQUIPMENT
FOR DISASTER RISK MANAGEMENT
IN
THE REPUBLIC OF VANUATU

DECEMBER 2013

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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JAPAN METEOROLOGICAL BUSINESS SUPPORT CENTER

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Summary

1. Outline of the Country

Vanuatu is a republic country in the South Pacific Ocean. It is an archipelagic country consisting of 83 islands which are dotted over a distance of some 1,200 km north by northwest to south by southeast. It has a total land area of approximately 12,190 km^2 and some 70 islands are inhabited. The total population is approximately 250,000 (2011 World Bank). Although the capital of Port-Vila is located on Efate Island, the largest island is Espiritu Santo where the peak of Mt. Tabwemasana boasts the country's highest elevation of 1,878 m. From the viewpoint of ethnicity, some 99% of the population are Melanesian and the remaining 1% is composed of European immigrants and others. The main industries in Vanuatu are the service industry centering on tourism and agriculture. Many residents are engaged in agriculture. Beef exports have been increasing in recent years, gaining the status of the second-most important export item after copra. The GDP per capita is US$ 2,620 (2011, IMF). According to the Trade Policy Framework 2012 published by the Government of Vanuatu, the GDP shares of the primary, secondary and tertiary productive sectors from 2000 to 2011 were 20%, 11% and 69% respectively. In regard to the local climate, entire Vanuatu has a tropical rainforest climate while also showing the characteristics of a maritime climate. Although the mean temperature is approximately 26°C, the temperature can drop to as low as around 13°C at night. While the temperature does not fluctuate much throughout the year, the humidity is high. There is a dry season from May to October and a wet season from November to April. Vanuatu belongs to the Pacific Ring of Fire and half of its islands are volcanic islands. In particular, the volcanoes on Ambrym, Tanna and Loperi Islands are currently active. Strong earthquakes with a magnitude of 7 frequently occur at the ocean bed near Vanuatu.

2. Background, History and Outline of the Requested Project

With very limited land area and low elevation, Pacific island nations are extremely vulnerable to natural disasters requiring the urgent implementation of strategic disaster prevention measures. Many efforts to improve the protection from disasters are taking place within numerous initiatives and frameworks, including the Pacific Islands Forum, Council of Regional Organizations in the Pacific and Pacific Disaster Risk Management Partnership Framework. Meanwhile, the system to develop and implement disaster prevention policies in each of these countries is very weak in terms of both funding and human resources. This situation makes it necessary for these countries to not only pursue their own agenda independently but also assist one another to compensate their weakness by means of dispatching personnel and establishing a regional information communication network. However, taking the Sumatra earthquake and Indian Ocean tsunami in 2004 as an example, although these countries to which massive damage was inflicted have been trying to improve their disaster prevention capability, the creation of a viable earthquake and tsunami observation network is far from sufficient. The present disaster prevention systems in the region still face the daunting tasks of improving the accuracy of predicting the tidal level, cyclones and other events, fully analyzing the available data and

strengthening the information communication system. Against this background, Japan's Ministry of Foreign Affairs instructed the JICA to conduct the Preparatory Study for the Project for Improvement of Equipment for Disaster Risk Management (hereinafter referred to as "the Project"). The Project is implemented in accordance with the Basic Guidelines for Reconstruction in Response to the Great East Japan Earthquake (published by the Reconstruction Headquarters in Response to the Great East Japan Earthquake on 29th July, 2011) for the purpose of forming a grant aid project to be implemented with a third supplementary budget in FY2011.

3. Outline of the Field Study Findings and Contents of the Project

For the initial study under the Project, the JICA dispatched a field study team to Vanuatu from 14th July to 8th August, 2012. The findings of this field study were then analyzed in japan to prepare a basic design and rough cost estimate for the Project. A second field study team was dispatched to Vanuatu from 17th April to 20th April, 2013 and 16th July to 3rd August, 2013 to investigate additional candidate project sites and to confirm the contents of the final request by the Vanuatu side for the Project. The basic design and estimated project cost were then finalized. Moreover, a natural conditions survey was conducted in Vanuatu to select the candidate sites for equipment installation. Based on the findings of this survey, a team was sent to Vanuatu from 25th September to 2nd October, 2013 to explain the outline of the basic design.

The purpose of the Project is to develop and strengthen the system to swiftly issue disaster warnings, based on the findings of the field studies, etc. Through installing meteorological, oceanographic and terrestrial observation equipment with telecommunication equipment, the Vanuatu Meteorology and Geo-Hazards Department (VMGD) will be able to gather almost real-time observation data on earthquakes, extraordinary tidal levels due to cyclones, etc. and heavy rainfall. Its components have been selected in view of the objectives of the Project, technical relevance, priorities of the Government of Vanuatu and beneficial effects (including beneficial effects on the suppliers of the products to be procured in areas hit by the Great East Japan Earthquake). The selection results are shown in the table below.

No.	Name of Island	Name of Site
1. Tide Observation System (2 locations)		
T-1	Malakula	Litzlitz
T-2	Tanna	Lenakel
2. Strong Motion Accelerometer and Broadband Station System (3 locations)		
SB-1	Malakula	Lakatoro
SB-2	Efate	VMGD
SB-3	Tanna	Isangel
3. Automatic Weather Station (AWS) (2 locations)		
A-1	Espiritu Santo	Pekoa Airport
A-2	Efate	Bauerfield Airport
4. GTS Server and MSS (1 set)		
G-1	Efate	VMGD

The organization responsible for the Project on the Vanuatu side is the Ministry of Climate Change Adaptation, Geohazards, Meteorology and Energy and the implementing body is the VMGD. The Disaster Risk Act was enacted in Vanuatu in 2000 (Act No. 31 of 2000). In 2006, the Disaster Risk Management National Action Plan for 2006 – 2016 was prepared with the cooperation of the South Pacific Applied Geoscience Commission, VMGD and others to establish a system for disaster management targeting natural disasters. Based on this Action Plan, the VMGD has formulated a national adaptation and disaster risk reduction project which aims at establishing a quick and reliable observation system through the renewal of observation equipment and the automation of data gathering.

With the implementation of the Project, it is expected that a real-time observation environment will be developed to monitor earthquakes, changing tidal levels, wind velocity and direction, temperature, humidity, rainfall, lightning and other meteorological phenomena. The swift relay of the observed data to the National Disaster Management Office (NDMO) will shorten the time from the occurrence of a disaster to the issue of an evacuation order, etc. Moreover, the observed data will be shared internationally through the Global Telecommunication System (GTS) as it will be relayed to not only stakeholder organizations in Vanuatu but also to Japan and nearby Pacific nations.

4. Construction Period and Estimated Cost of the Project

The required construction period for the Project is 14.5 months, including the detailed design, tender and equipment installation work, based on the Procurement Guidelines for Japan's Grant Aid. The Vanuatu portion of the Project cost is estimated to be approximately ¥1.5 million and the principal cost items are bank commission, expenses of VMGD staff members to travel to and stay at the project sites, installation and usage fees of communication equipment and electricity charge. The priority for the procurement of equipment under the Project is given to Japanese products which are manufactured in areas severely hit by the Great East Japan Earthquake.

5. Evaluation of the Project

1) Quantitative Effects

The introduction of meteorological, oceanographic and terrestrial observation equipment and GTS under the Project is expected to have positive effects such as shortening of the observation interval, increase of the observation points, increase of the observation frequency, widening of the observable area, shortening of the observed data transfer time and improvement of the VMGD's forecasting capability through the intensification of the international exchange of meteorological data. Some of these anticipated effects due to the introduction of new equipment are described in detail below.

① Detailed tidal level observation by Tide Observation System

At present, tidal gauges are installed in Port Vila, the capital of Vanuatu, and in Luganville on the island of Espiritu Santo. As two additional gauges are installed on Tanna Island to the south and Malakula Island in the central area, it will be possible to observe the tidal levels and to monitor tsunami at the main islands of Vanuatu.

In the case of an earthquake originating at the ocean trench near Samoa or Tonga, it will take approximately 3.5 hours for the first tsunami to reach Vanuatu. In a similar case near the Solomon Islands, it will take approximately one hour for the first tsunami to reach Vanuatu. Such a tsunami will reach distant areas and its successive arrival at different coastlines can be observed at intervals of 30 minutes. The observed information will be important to estimate the height of incoming tsunami waves and likely damage along coastal areas.

Indicator	Reference Value (2013)	Target value (2015)
Tide observation and interval time when a tsunami strikes	60 minutes	30 minutes

Observed data is important information for estimating whether or not damage will be caused by high tide and tsunami, and the extent of damage. Accordingly, observed data at sites adjoining populous areas and areas of popular tourism and/or trade and industrial activities can make a major contribution to the accurate provision of information and communication of evacuation orders to citizens at times of disaster. With the additional installation of two tidal gauges in the Project, the number of observation sites will increase and information on the scales of flood tide and tsunami will be quickly conveyed to residents, thereby contributing to the alleviation of disaster damage.

Indicator	Reference Value (2013)	Target value (2015)
Number of Tide Observation System	2 sites	4 sites

② Installation of new Strong Motion Accelerometer and Broadband Station System

In the Project, three sets of Strong Motion Accelerometer and Broadband Station System will be installed at new locations to strengthen the seismic observation system operated by the VMGD. Such equipment is already installed on Efate Island and Espiritu Santo Island, however, through additionally installing it on Malakula Island and Tanna Island, coverage of the seismic observation network will be extended and the accuracy of estimating seismic elements will be improved.

Indicator	Reference Value (2013)	Target value (2015)
Short period seismometer	1 site	1 site
Strong motion accelerometer	-	3 sites
Broadband seismometer	2 sites	5 sites

③ Improvement of meteorological observation around the capital area by AWS

Since AWS measures almost real-time meteorological conditions, it is especially essential to monitor heavy rain disasters. With the installation of new AWS at two sites, VMGD’s capability for observing real-time meteorological conditions from the Headquarters will be improved.

Indicator	Reference Value (2013)	Target value (2015)
AWS owned by VMGD	0 sites	2 sites

④ Improvement of GTS international meteorological data exchange

GTS is a system for both internationally transmitting observation data from Vanuatu and receiving the meteorological data transmitted by other countries. As the existing GTS is not compatible with the new GTS code that was revised in 2011, it is difficult to swiftly gather data.

Installation of GTS in the Project will enable observation data from Vanuatu to be utilized by other countries, thus enhancing the international contribution of Vanuatu. Meanwhile, since it will be possible to collect observation data from countries throughout the world in a short time, the ability of VMGD to analyze meteorological data including that from nearby countries will be improved. At the same time, the VMGD will be able to access to meteorological observation data transmitted by JMA, BOM, NOAA, etc., and this will lead to improvement in the meteorological forecasting capability of VMGD.

Indicator	Reference Value (2013)	Target value (2015)
Input data	Aboveground meteorological, high-altitude meteorological, shipping reports, aerial meteorological	Aboveground meteorological, high-altitude meteorological, shipping reports, aerial meteorological
Output data	Aboveground meteorological, high-altitude meteorological, shipping reports, aerial meteorological	Aboveground meteorological, high-altitude meteorological, shipping reports, aerial meteorological, numerical forecasting data, satellite analysis data
Input/output method	Data is exchanged by BOM and FTP, and input/output is controlled by BOM	Operations conducted from VMGD headquarters

2) Qualitative Effects (Project overall)

Through the installation of meteorological, oceanographic and terrestrial observation equipment in the Project, the nationwide gauging of disaster information in Vanuatu will become possible and the disaster prevention system will be improved. Under this Project, tidal gauges for observing tsunami, Strong motion accelerometers and Broadband seismometers for strengthening seismic observation and analysis capacity, and AWS for putting meteorological observation units online will be installed, and GTS for enhancing international meteorological data exchange ability will be introduced. As a result, VMGD's ability to gauge natural disasters will be quantitatively extended and the time span to establish the occurrence of a natural disaster will be shortened. In turn, this will contribute to the improvement of safety in Vanuatu's key industries of tourism, agriculture and fisheries, as well as the aviation industry that is prone to the effects of meteorological changes. These positive effects are expected to contribute to the general economic development of Vanuatu through the promotion of industries, improvement of safety on transportation and promotion of air travel due to better safety.

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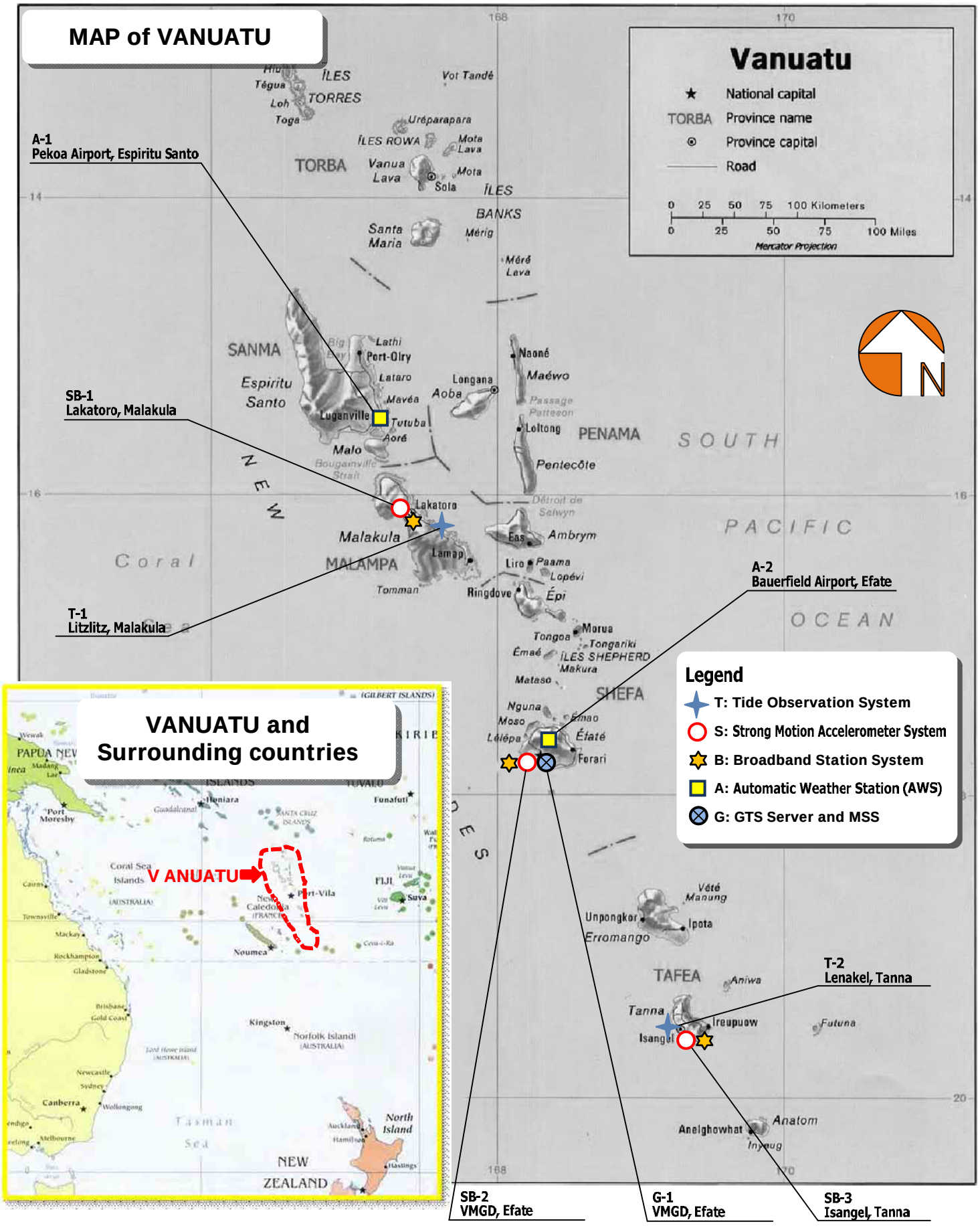
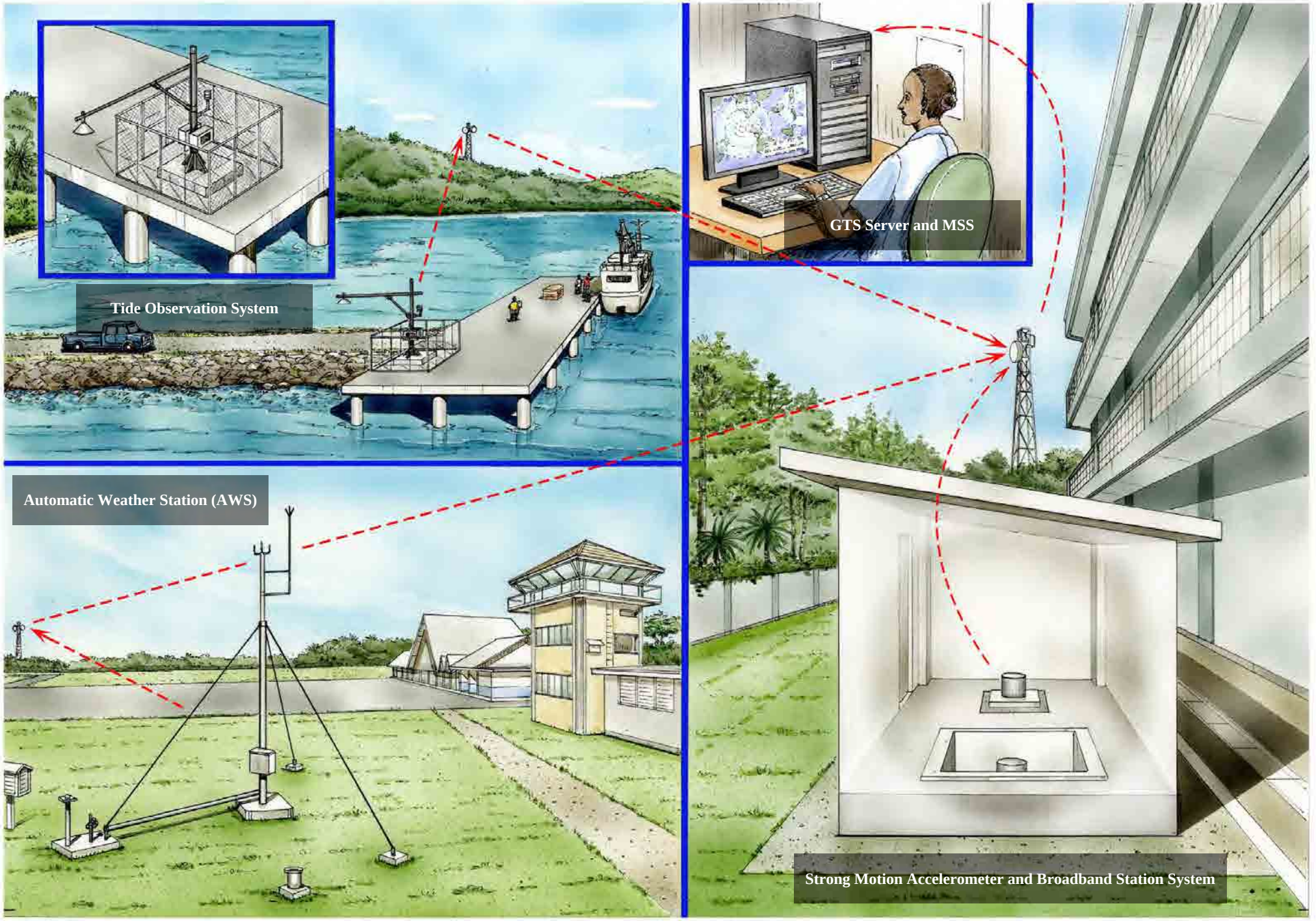


Location of VANUATU



The Project for Improvement for Disaster Risk Management (Perspective)

Photos (Existing Equipment)

VMGD Headquarters

VMGD gathers meteorological, oceanographic and terrestrial data relating to natural disasters and provides key data to the organizations concerned.

Existing terminal and display units for GTS input/output

The observation data gathered by the VMGD Headquarters is distributed worldwide via GTS operated by the WMO.

Existing short period seismometer (Efate Island)

In Vanuatu, VMGD had installed short period seismometers and broadband seismometers for earthquake observation.

Existing tidal gauge owned by BOM (Efate Island)

As VMGD does not possess its own tidal gauges, it is forced to rely on tidal data observed and analysed by BOM.

Planned site for AWS installation (Espiritu Santo Island)

At each station, meteorological observation is visually conducted and the results are conveyed to the VMGD Headquarters by telephone, making the introduction of AWS highly desirable.

iGovernment tower (Efate Island)

iGovernment is a high speed telecommunication line run by the Government of Vanuatu for its exclusive use. It can be used as a transmission line for the observation equipment to be procured in the project.

LIST OF FIGURES & TABLES

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ABBREVIATIONS

AC	Alternating Current
ADSL	Asymmetric Digital Subscriber Line
AMeDAS	Automated Meteorological Data Acquisition System
AusAID	Australian Agency for International Development
AWS	Automatic Weather Station
BGAN	Broadband Global Area Network
BOM	Bureau of Meteorology (Australia)
CPU	Central Processing Unit
CROP	Council of Regional Organization in the Pacific
DC	Direct Current
DCP	Data Collection Platform
EIAJ	Electonic Industries Association of Japan
E/N	Exchange of Notes
FTP	File Transfer Protocol
G/A	Grant Agreement
GDP	Gross Domestic Product
GPS	Global Positioning System
GTS	Global Telecommunication System
HDD	Hard Disc Drive
IEC	International Electrotechnical Commission
IMF	International Monetary Fund
IOC	Intergovernmental Oceanographic Commission
IRIS	Incorporated Research Institutions for Seismology
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JCS	Japan Cable Makers' Association Standard
JEAC	Japan Electric Association Code
JEC	Japanese Electrotechnical Committee
JEM	Japan Electrical Manufacturers
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
JMA	Japan Meteorological Agency
LAN	Local Area Network
M (Mj)	Local Magnitude of JMA
Mb	Body‐wave Magnitude
M/D	Minutes of Discussion
METAR	Meteorological Aviation Report

Ms	Surface wave Magnitude
MSS	Message Switching System
MTSAT	Multi-functional Transport Satellite
Mw	Moment Magnitude Scale
NDMO	National Disaster Management Office
NIWA	National Institute of Water and Atmospheric Research
NOAA	National Oceanic and Atmospheric Administration
NZAID	New Zealand Agency for International Development
OJT	On the Job Training
PTWC	Pacific Tsunami Warning Center
PIF	Pacific Islands Forum
RSMC	Regional Specialized Meteorological Center
SATAID	Satellite Animation and Interactive Diagnosis
SOPAC	South Pacific Applied Geoscience Commission
SPCZ	South Pacific Convergence Zone
SYNOP	surface synoptic observations
TAF	Terminal aerodrome forecast
TVL	Telecom Vanuatu Ltd
UNESCO	United Nations Educational, Scientific and Cultural Organization
VAT	Value Added Tax
VMGD	Vanuatu Meteorology and Geo-hazards Department
WB	World Bank
WMO	World Meteorological Organization

CHAPTER 1 BACKGROUND OF THE PROJECT

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1-1 Background and Outline of the Grant Aid

With very limited land area and a low elevation, Pacific island nations are extremely vulnerable to natural disasters and urgently need to implement strategic disaster prevention measures. The threat of such natural disasters as coastal erosion due to a rising sea level, damage to houses and infrastructure by flooding caused by ever larger cyclones and a shortage of water resources due to drought, all of which are inferred to be the result of climate change, has been steadily growing. This is making the mitigation of any real damage and improvement of the region's adaptability to natural disasters essential. Under these circumstances, efforts to improve the protection from disasters are being made under numerous initiatives and frameworks, including the Pacific Islands Forum (PIF) and the Council of Regional Organizations of the Pacific (CROP). The main donors for the region include Japan, Australia and New Zealand. Apart from the Pacific Tsunami Warning Center (PTWC), such regional frameworks as the Regional Specialized Meteorological Center (RSMC) are being utilized for the purpose of effective disaster prevention. Japan has been providing assistance for the region under its own Disaster Prevention Program designed to mitigate the risk of natural disasters arising from climate change in the region. The Disaster Risk Reduction and Disaster Management Action Plan (2006 – 2016) of Vanuatu puts forward eight strategies, including: (i) mainstreaming of disaster risk reduction and disaster management in the national planning and budgetary processes, (ii) information, information system and knowledge management and (iii) capacity building. For each strategy, key actions are identified along with their classification in terms of the target achievement period: short-term (2006 – 2009), medium-term (2006 – 2012) or long-term (2006 – 2016).

The Great East Japan Earthquake that occurred on March 11, 2011 caused massive damage to Japan and once again reminded the international community of the importance of disaster prevention. However, because Pacific island nations' disaster prevention implementation setup (funding and human resources) is extremely weak, it is necessary to establish effective support based on inter-regional cooperation and networking in addition to the independent efforts of each country. Moreover, it is also necessary to conduct effective support via collaboration and cooperation as required in tandem with donors and other concerned partners. In the aftermath of the Sumatra Earthquake and Indian Ocean Tsunami disaster of 2004, those countries that were badly hit have strived to improve their disaster prevention capability. However despite of their efforts, the observation network is still not adequate and there is room for improvement regarding the system for analyzing and transmitting accurate tsunami forecasting information. For this reason, a Preparatory Study for the Project for Improvement of Equipment for Disaster Risk Management was recently implemented by JICA based on the instruction from the Ministry of Foreign Affairs of Japan. The study aims at forming a grant aid project to be implemented with a third supplementary budget in FY 2011 in accordance with the Basic Guidelines for Reconstruction in Response to the Great East Japan Earthquake (published by the Reconstruction Headquarters in Response to the Great East Japan

Earthquake on 29th July, 2011).

The outline of the original request by the Vanuatu side for the project is shown in Table 1-1-1. Despite the frequent occurrence of earthquakes, Vanuatu has only a few seismometers installed, making expansion of the observation network by the installation of appropriate seismometers essential so that the seismic elements of an earthquake can be properly analyzed. As such, the installation of seismometers is considered to be the highest priority. In Vanuatu, tidal observation along with meteorological observation can minimize damages through swift conveyance of information of high tides, etc. for prompt evacuation of residents. In short, the obtaining of accurate tidal and meteorological information is vital for Vanuatu to predict and prevent damage by natural disasters. In view of these circumstances, the contents of the request by Vanuatu featuring primarily meteorological, oceanographic and terrestrial observation equipment have been verified as highly contributory to disaster prevention in the country. The detailed contents of the request are listed on Page A-4-9 of Appendix 4 – Minutes of Discussions.

Table 1-1-1 Outline of the Contents of the Request

Priority	No.	Item	Quantity
A	1	Tide Observation System	5 sites
	2	Strong Motion Accelerometer System	7 sites
	3	Broadband Station System	7 sites
B	4	Automatic Weather Station (AWS)	7 sites
	5	GTS Server and MSS	1 set
C	6	Tsunami Forecasting System	1 set

<Definitions of Priority>
A: High priority for the Vanuatu side.
B: Medium priority for the Vanuatu side.
C: Low priority for the Vanuatu side.

1-2 Natural Conditions

(1) Topographical features

The Torres Islands located at the northernmost part of Vanuatu is only about 170 km away from the Solomon Islands while Anatom Island located at the southernmost part of Vanuatu is only about 200 km away from the Loyalty Islands of New Caledonia. The territory of Vanuatu stretches about 1,200 km in the north-south direction and the country consists of some 83 islands with a total land area of some 12,190 km^2. The largest island is Espiritu Santo with about 4,010 km^2, followed by Malakula Island and Efate Island. Vanuatu's highest mountain is Mt. Tabwemasana (El. 1,879 m) on Espiritu Santo Island. Vanuatu has nine active volcanoes (of which two are undersea volcanoes). Unlike many South Pacific islands, most of Vanuatu's islands are not coral islands and were formed by volcanic activity or plate collision. There is little flat land.

(2) Climate

Vanuatu has a tropical maritime climate. Due to its proximity to the equator, the temperature changes a little and the humidity is high throughout the year. There is a dry season (May to October) and a wet season (cyclone season; November to April). The months with the highest and lowest mean temperature are February and August respectively. The mean temperature in coastal areas in the wet season is 26°C with mean highest and lowest temperatures of 30°C and 24°C respectively. The temperature can drop to as low as 13°C at night. At Port-Vila located in the western part of Efate Island, the mean monthly temperature is 22°C in August and 27°C in February.

The rainfall level widely varies depending on the specific topography. The southeast trade winds bring wet air which runs along the mountain slopes for form rain clouds for heavy rainfall. In summer in those years when La Nina is prominent, downpours occur as an effect of the South Pacific Convergence Zone (SPCZ). The rainfall level tends to be high in the southeastern part of large islands, such as Efate, and a shortage of rain tends to occur in the northwestern part. The actual rainfall level depends on the location and size of the island. In the southeastern part of large islands, the annual rainfall can be as high as 2,400 mm to 3,000 mm. In the northwestern part, the level is roughly half of the rainfall in the southeastern part. The wettest and driest months are March and August respectively.

Throughout the year, east or southeast trade winds prevail in Vanuatu with strength of some 5 knots (approximately 2.5 m/s). The winds become weaker in the wet season but increase to an average of 10 knots (approximately 10 m/s) in the dry season. The wind velocity can be as strong as some 25 knots (approximately 13 m/s). Tropical storms causing disasters hit Vanuatu in the wet season.

Monthly Mean Temperatures at Port Vila [°C]

Location	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Maximum	30.7	30.7	30.3	29.3	27.9	26.8	26.0	25.2	26.2	27.2	28.3	29.1
Minimum	23.4	23.6	23.5	22.8	21.4	20.5	19.5	19.4	19.6	20.6	21.7	22.6
Average	27.0	27.1	26.9	26.1	24.8	23.7	22.4	22.0	22.6	23.6	24.7	25.4

Monthly Mean Sunlight Hours at Port Vila [hours]

Location	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Maximum Average	318.1	241.5	246.8	228.9	235.2	223.1	250.2	239.9	253.9	270.7	291.8	283.4

Monthly Mean Rainfall at Port Vila [mm]

Location	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Rainfall	244.2	312.8	288.8	222.4	185.5	162.8	82.3	78.6	74.6	94.8	122.2	172.9

Source: VMGD

(3) Earthquake, Tsunami and natural disasters in Pacific Ocean countries including Vanuatu

Oceania around Vanuatu suffers little earthquake and tsunami damage, but there were around 192 victims by such damage in Solomon Islands in 2009. Even though magnitude seven or stronger earthquakes with an epicenter in and around Vanuatu have been recorded six times since 1990, no severe damage has been recorded. Table 1-2-1 lists those earthquakes causing damage in Oceania.

Table 1-2-1 List of Earthquakes and Tsunami Damage in the Pacific Region

Year	Month/Day	Epicenter and Area of Damage	Size	Damage, etc.
1855	01/23	New Zealand (Wellington Earthquake)	M 8.0	Coastal uplift, faults
1875	03/28	New Caledonia: Royalty Island	M 8.0	Fatalities
1900	07/29	Solomon: Santa Cruz Island	M 8.1 (Ms7.6)	
1909	02/22	Fiji	M 7.9 (Mb7.6)	
1910	06/16	Vanuatu: New Hebrides	M 8.6 (Mb7.9)	
1910	11/09	Vanuatu: New Hebrides	M 7.9 (Mb7.5)	
1913	10/14	Vanuatu: New Hebrides	M 8.1 (Mb7.6)	
1917	05/01	New Zealand: Kermadec Islands	M 8.6 (Ms7.9)	
1917	06/26	Tonga~Samoa	M 8.7 (Ms8.4)	
1920	09/20	Vanuatu: New Hebrides	M 8.3 (Ms7.9)	
1931	02/02	New Zealand (Hawks Bay Earthquake)	M 7.9 (Ms7.8)	256 fatalities
1931	10/03	Solomon Islands	M 7.9 (Ms7.9)	50 fatalities
1932	05/26	Fiji Basin	M 7.9 (Mb7.5)	
1937	04/16	Tonga	M 8.1 (Mb7.5)	
1939	04/30	Solomon Islands	M 8.1 (Ms8.0)	12 fatalities
1948	09/08	Tonga	M 7.9 (Ms7.8)	
1950	12/02	Vanuatu: New Hebrides	M 8.1 (Ms7.2, Mb7.6)	
1950	12/14	Fiji	M 7.9 (Mb7.5)	
1955	02/27	New Zealand: Kermadec Islands	M 7.8 (Ms7.7)	
1966	06/15	Solomon Islands	M 7.8 (Ms7.7)	0 fatalities
1973	12/28	Vanuatu: Santo Island	M 7.8 (Ms7.3)	
1975	10/11	Tonga	M 7. 8 (Ms7.7)	
1975	12/26	Tonga	M 7. 8 (Ms7.5)	
1976	01/14	New Zealand: Kermadec Islands	M 7.8 (Ms7.7)	
1976	01/14	New Zealand: Kermadec Islands	M 8.2 (Ms7.9)	
1980	07/17	Solomon Islands: Santa Cruz Island	M 7.9 (Ms7.7, Mw7.7)	0 fatalities
1986	10/20	New Zealand: Kermadec Islands	M 8.2 (Ms8.1, Mw7.7)	
1995	04/07	Tonga	M 8.0 (Mw7.4)	
1995	08/16	Solomon Islands	M 7.8 (Mw7.7)	0 fatalities
2003	01/20	Solomon Islands	M 7.8 (Mw7.3)	
2006	05/03	Tonga	M 7.8 (Mw8.0)	
2007	04/01	Solomon Islands	M 7.9 (Mw8.1)	52 fatalities, tsunami
2007	12/29	Fiji	Mw 7.8	
2009	09/29	Solomon Islands	M 8.1 (Mw8.1)	192 fatalities, tsunami

Source: Chronological Scientific Tables

The magnitudes that express the size of earthquakes are as follows:

- Meteorological Agency magnitude (Mj):
  Used for earthquake information in Japan, this closely approximates to the moment magnitude. In Japan, the Meteorological Agency magnitude (Mj) is frequently written as

just ‘M’.

- Surface-wave magnitude (Ms):
  Here, the magnitude is defined from the horizontal components of surface waves, i.e. the maximum amplitude and epicentral distance (angle).
- Body wave magnitude (Mb):
  Here, the magnitude is defined from the maximum amplitude, cycle and epicentral depth of body waves (P waves and S waves).
- Moment magnitude (Mw):
  This is defined from the moment (Mo) of fault movement caused by an earthquake.

(4) Topography and ground conditions

Based on the request made by the Vanuatu side, the project included buildings to house a seismometer and broadband observation system and large AWS-related equipment, a natural conditions survey was conducted to clarify the topographical and ground conditions of the target sites with a view to determining an appropriate layout and structure for the equipment concerned.

The target sites for the geological survey were three building construction sites; on the premises of the VMGD Headquarters in Efate Island, Tafea Provincial Government Office in Tanna Island and Malampa Provincial Government Office in Malakula Island, and two AWS installation sites; Bauerfield International Airport in Efate Island and the meteorological station at Santo-Pekoa International Airport in Espiritu Santo Island. At each site, the dynamic cone penetration test and sampling were conducted and the soil samples were analyzed at soil laboratory. Topographical surveying was only conducted at those sites where a building would be constructed to house the seismometer and broadband observation system, taking the building location plan into consideration.

Based on the above work, it was confirmed that the ground of the sites selected for the installation of the planned equipment was sufficiently strong, and the topography of each site would not pose any problem for the deployment of equipment. For more detailed analysis results, refer to Appendix 7 – Ground and Topographical Survey Results.

CHAPTER 2 CONTENTS OF THE PROJECT

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2-1 Basic Concept of the Project

(1) Superior Goals and Project Objectives

Vanuatu has tropical rainforest climate and it is prone to the effects of natural disasters such as torrential wind and rain as well as earthquakes and volcanic eruptions and so on. Situated in the Pacific Ring of Fire, it currently has nine active volcanoes and strong earthquakes in the magnitude 7 class occur off the coast. Pacific island nations, where many people live in coastal areas, have small elevation differences and are extremely vulnerable to natural disasters, in particular to seismic tsunami waves. Therefore, it is extremely important to mitigate damage from disasters through collecting and analyzing real-time meteorological, oceanographical and terrestrial phenomena information and to promptly relay such information to related agencies and citizens. However, Vanuatu has limited number of seismic observation equipment, that it is unable to transmit accurate seismic information. Moreover, because it has no tidal gauges for observing tsunami in its own waters, it is unable to issue tsunami information. So far the meteorological observation in Vanuatu has shown steady progress, evolving from primarily seismic and meteorological observation data collection and recording work to meteorological forecasting and analysis work based on collected data. Moreover, the environment for transmitting disaster information to citizens is also being developed. However, since no progress has been made on the automatic collection of meteorological and oceanographic information, except for seismic data, too much time is taken in collecting information of observation data. It is desirable to implement accurate meteorological analysis and reliable meteorological forecasting that is based on information from the WMO and so on.

Based on the above situation, the Project intends to supply and install disaster countermeasure equipment for monitoring and forecasting meteorological, oceanographic and terrestrial phenomena, thereby enabling disaster prevention information on natural disasters, etc. to be rapidly relayed to citizens and mitigating the human damage caused by disasters.

(2) Outline of the Project

In order to realize the above-mentioned objective, the Project intends to install AWS at some of the Vanuatu weather stations including remote islands, and also to install tidal gauges and seismometers. Through doing this, the number of meteorological, oceanographic and terrestrial phenomena observation points in Vanuatu will increase, and observation capability will be enhanced. Moreover, it will enable to quickly relay information for prevention of disasters caused by rising tides, meteorological changes and earthquakes to citizens, and the damage caused by natural disasters will thus be kept to a minimum.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

Through installing meteorological, oceanographic and terrestrial phenomena monitoring equipment, the Project aims to facilitate observation of abnormal tide levels, torrential rains, earthquakes, etc., and the (almost) real-time collection of observation data in VMGD headquarters, and thereby establish and bolster the setup for observing the factors that cause natural disasters.

Through speeding up and enhancing the conveyance of disaster prevention information in, damage caused by natural disasters may be greatly reduced with relatively small investment. As a result, the huge recovery costs that become necessary when disasters occur without any preventive steps may be avoided. Moreover, protecting the lives and property of citizens from natural disasters has a major indirect effect as it mitigates impediments to the social and economic development of the country. In Vanuatu where citizens are scattered over widely dispersed islands and are especially vulnerable to the effects of disasters, the construction of a real-time telecommunications system based on iGovernment (hereinafter referred to as "iGov.") and prompt conveyance of information on natural disasters and evacuation to citizens are important duties of VMGD, which is responsible for meteorological observation in the country. Accordingly, taking into account the findings of the field survey, the Project components were selected based on the items shown in Table 2-2-1.

Table 2-2-1 Criteria of Components Selection

(1) Objectives of the Project	・ To introduce tide monitoring system for observing tide levels such as high tide in real-time ・ To expand and reinforce the existing meteorological monitoring system ・ To expand and reinforce the existing seismic monitoring system ・ To link observation equipment online and automate it.
(2) Technical appropriateness	・ The meteorological, oceanographic and seismic observation equipment to be procured in the Project will be linked online to the VMGD Headquarters by means of wireless communications and internet. ・ It will be possible to observe tide level and meteorological conditions in real-time. ・ Since natural disaster information and so on will be promptly transmitted to citizens through the NDMO and so on, transmission time between outbreak of the disaster and start of evacuation will be shortened. ・ Observed data of meteorological, oceanographic and seismic observation will be shared among the international community and transmitted not only to Vanuatu but also Japan and Pacific Ocean Countries
(3) Order of priority on the Vanuatu side	・ According to the Disaster Risk Reduction and Disaster Management National Action Plan 2006-2016, which is the disaster management plan for Vanuatu, observation equipment that contributes to disaster prevention will be installed and thereby realize the automation and online linkage of observation data. ・ Based on the plan above, examine whether the procured equipment and the locations are appropriate or not.

(4) Benefiting effects	For Vanuatu ・ Through implementing the Project, it is anticipated that anomalous tide level and meteorological information will be conveyed to approximately 250,000 citizens, and disaster damage will be mitigated. For Japan or Pacific Ocean Countries ・ Anomalous tide levels and meteorological information will be shared among the international community and transmitted not only to Vanuatu but also Japan and Pacific Ocean Countries For Stricken Areas of Great East Japan Earthquake ・ As the Project is implemented under "Basic Concept of Rehabilitation from the Great East Japan Earthquake", since some components will be composed of the products manufactured in the "Specified Disaster Affected Area" of the Great East Japan Earthquake, the Project will contribute to the said areas.

Based on the above criteria and a result of cost estimation, components requested by Vanuatu side and the procured components of the Project are compared as shown Table 2-2-2. Moreover, for each component, detailed description including the installation sites, reasons for selection, objectives and anticipated effects, etc. is in "(3) Equipment Arrangement Policy". Locations of the Project sites are shown in Figure 2-2-1.

Table 2-2-2 Comparison between requested components and procured components

Priority	No.	Items	Request	Plan	Reason for Change
A	1	Tide Observation System	5 sites	2 sites	Equipment Arrangement and Budget Constraints
	2	Strong Motion Accelerometer and Broadband Station System	7 sites	3 sites	
B	3	Automatic Weather Station (AWS)	7 sites	2 sites	
	4	GTS Server and MSS	1 set	1 set	No change
C	5	Tsunami Forecasting System	1 set	－	Low Priority

Note: The equipment which is not adopted is in gray.

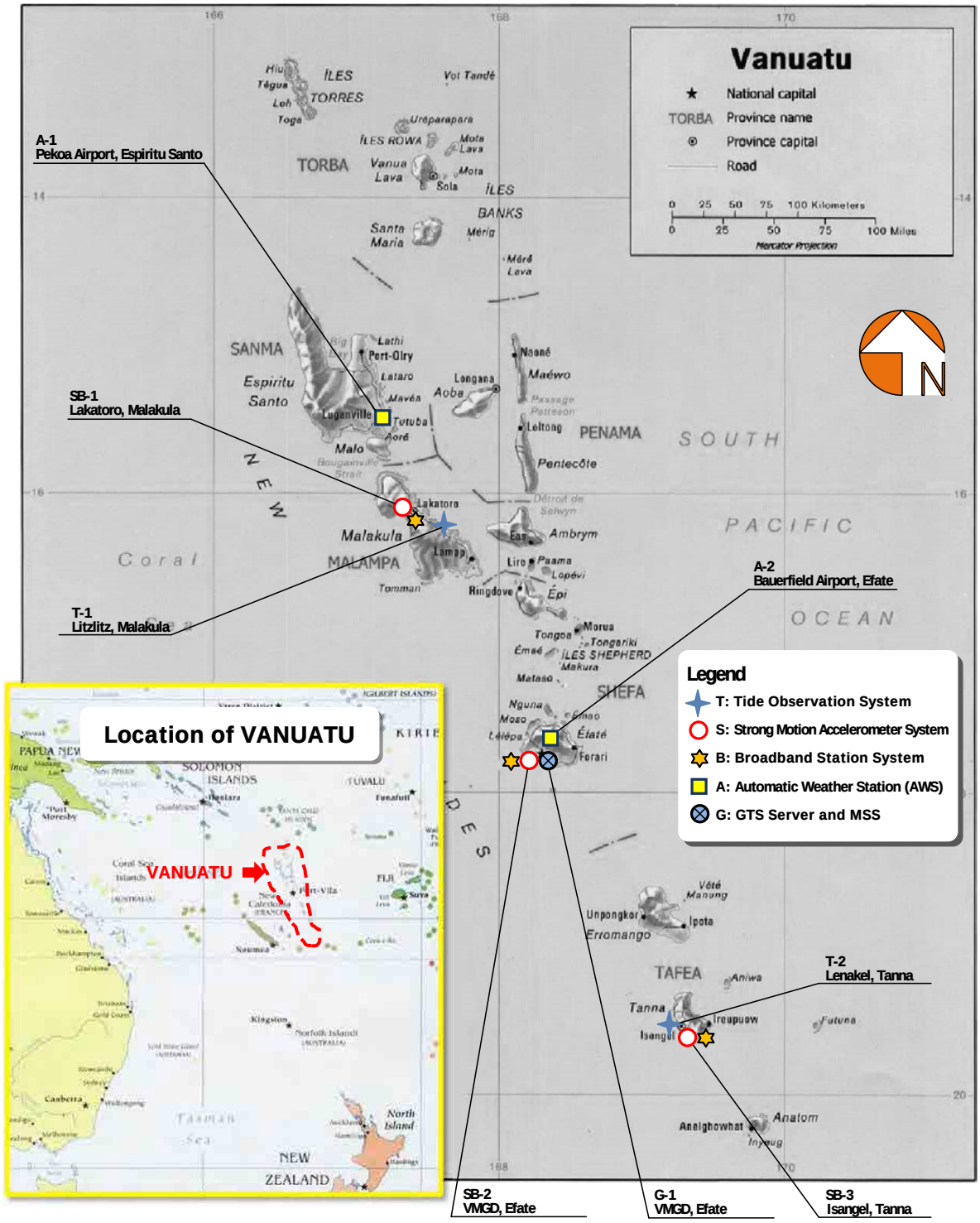


Figure 2-2-1 Locations of each component

(2) Policy regarding Implementation Setup

1) Disaster Prevention Communication Setup in Vanuatu

Meteorological, oceanographic and terrestrial phenomena information in Vanuatu is transmitted from VMGD to disaster prevention agencies such as NDMO. Introduction of the tide monitoring system will enable VMGD to transmit to NDMO this conventional tsunami

information received from PTWC and also independently observed data of tide levels. Moreover, introduction of AWS and utilization of Data Collection Platform (DCP) as an auxiliary means of transmitting tide level data will make it possible to build a setup for promptly and accurately sharing information with neighboring countries via GTS.

2) Maintenance Setup in VMGD

VMGD currently operates 24-hour for meteorological observation, forecasting and observing the other information on disasters. Accordingly, when implementing the Project, consideration will be given to the following points:

- It will be necessary to ensure that the impact on VMGD activities is kept to a minimum and monitoring instruments are designed as far as possible to minimize the need for maintenance.
- Since a new monitoring equipment for VMGD will be introduced, it will be necessary to conduct on-the-job training (OJT) related to maintenance and operation.

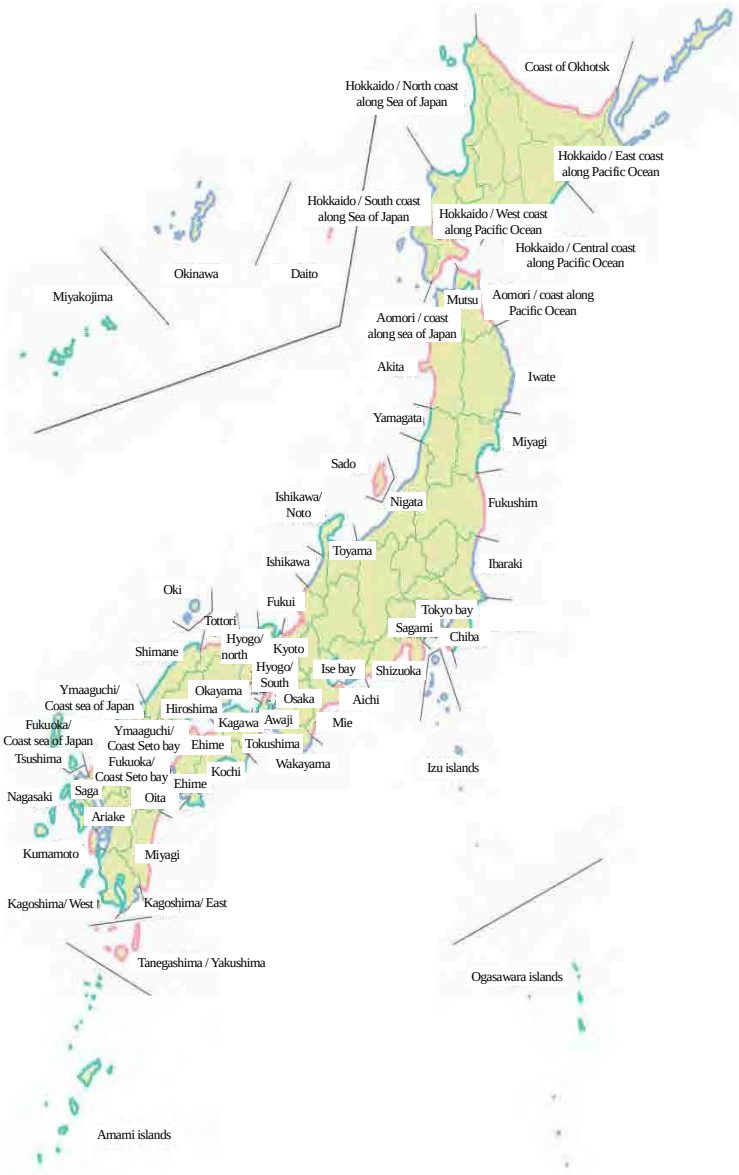
Moreover, in order for comparison observation and detailed inspection to be conducted once a month and once a year to keep conducting accurate observation, VMGD is required to establish periodic operation and maintenance setup.

(3) Policy regarding Equipment Arrangement

1) Tide Observation System

i) Observation outline in Japan

Traditionally, tidal gauges have been installed to monitor elevation and reference levels in port works, high tides caused by typhoons, and tidal variations and anomalous tide levels. Therefore, they have been commonly installed at large ports, major fishing ports and at the mouths of large rivers. In recent years, advances in seismic monitoring equipment and analytic technology have made it possible to clarify the mechanism of undersea earthquake and tsunami occurrence, and tidal gauges have begun to play an important part in tsunami monitoring. There is no standard for tidal gauges arrangement, however, on the international stage, the IOC (Intergovernmental Oceanographic Commission) is advancing the construction of a global tsunami observation network.



(Source: JMA)

Figure 2-2-2 Tsunami Forecasting Districts of Japan

In Japan, the Japan Meteorological Agency (JMA) is deploying tidal gauges all over the for tsunami monitoring and warnings. As standards, JMA installs at least one tidal gauge in each tsunami forecasting district. A tsunami forecasting district is the minimum unit for issuing tsunami forecasts and warnings and is basically set according to prefecture; however, in the case of Hokkaido which has long coastlines or the cases of Tokyo Bay and Ise Bay which have differing types of coast in the same prefecture, the forecasting districts are subdivided into smaller sections. Figure 2-2-2 shows the tsunami forecasting districts of Japan. Taking the case of the Pacific coastline of Japan, there are 24 forecasting districts that cover approximately 2,500 kilometers of coastline from Hokkaido to Kyushu.

This means that one station is installed for approximately every 100 kilometers of the coast on average. Furthermore, since other government agencies (apart from JMA), research agencies and local governments, etc. also install tidal gauges, observations are actually conducted with even higher density. In the United States, the National Oceanic and Atmospheric Administration (NOAA) conducts tidal observations at 250 locations including Hawaii, Alaska and remote islands and has roughly one tidal weather station (mainly for observing high tides) for every 25 kilometers in the hurricane hotspot of the Gulf of Mexico. Weather stations on the Pacific and Atlantic coastlines are installed at intervals of one every 50 kilometers or so.

ii) Selection criteria of observation points

Tidal gauges should be allocated separately for each and widely in order to observe change of tide level depending on high tide and so on. Moreover, it's necessary for tide gauges to be allocated facing the direction from which high tide is expected. Accordingly, observation points need to be selected considering the stability of the data transmission line to obtain real-time tide monitoring data.

iii) Installation locations and reasons for selection

In this survey, since it is necessary to install tidal gauges on coastal jetties or quays to keep the possible water level pier, survey was conducted on jetties in the country.

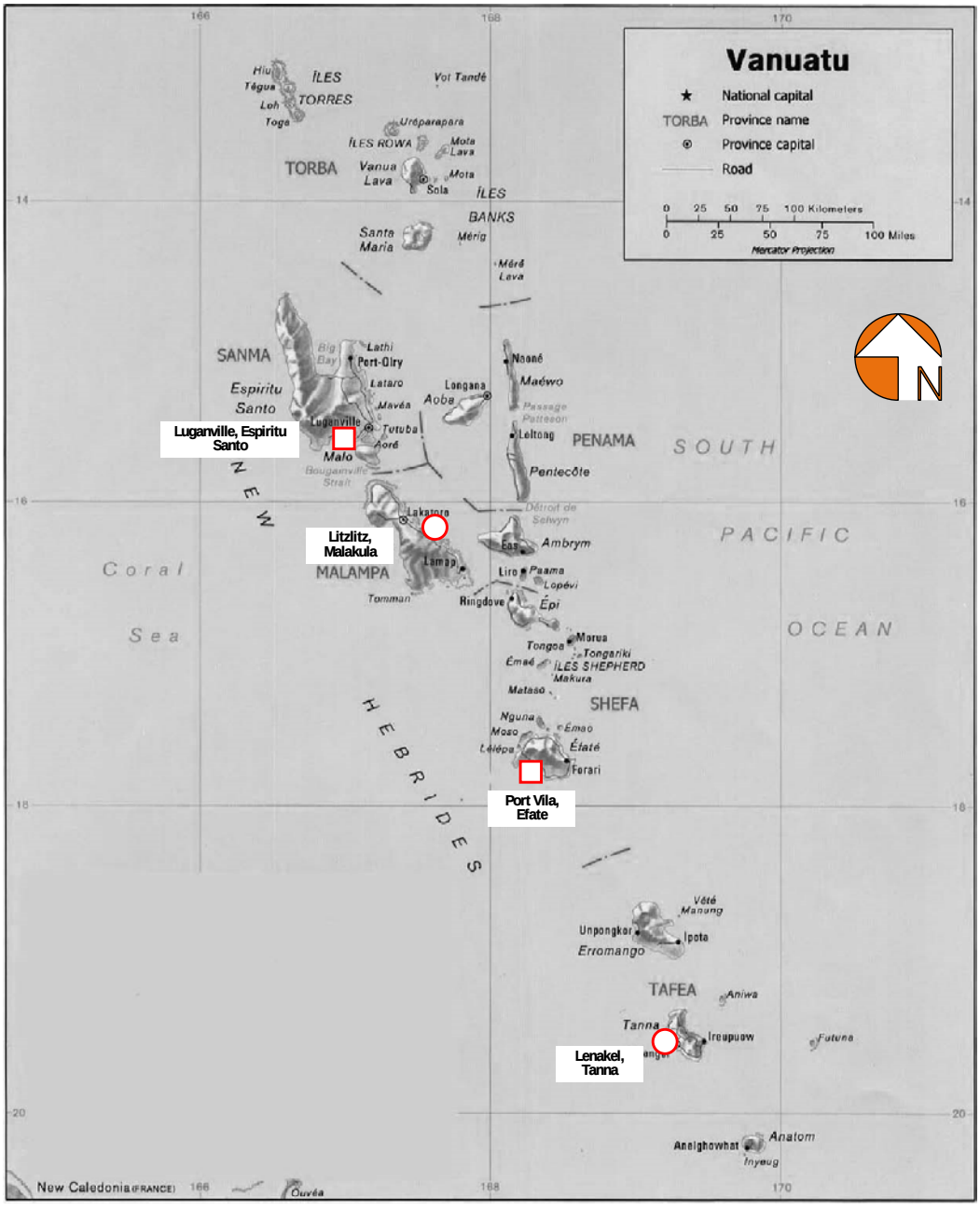
The Study Team and VMGD have decided to adopt the following policy with securing maintenance: utilize the iGov. network for data transmission, with a view to limiting telecommunications costs and securing maintenance, and adopt an arrangement that covers as wide area as possible. Meanwhile, as is stated in the Minutes of Discussion (M/D), since the Project will be implemented based on the "Basic policy for reconstruction following the Great East Japan Earthquake," priority must be given to products of the disaster-affected areas and the budget framework is set in advance. This issue was discussed VMGD and obtained its understanding.

Installation sites were selected based on the assumption that permission can be obtained for using jetties. Based on the survey result, it is planned to install tidal gauges at two locations. However, tides on the four main islands of Vanuatu can be monitored when it becomes possible to collect data from sites managed by BOM, it will become possible to observe at the four locations as shown in Figure 2-2-3.

iv) Prospective Project Effectiveness

Through installing the tide monitoring system at the above-mentioned observation locations of the Project, the following effects are anticipated.

- Real-time observation and observation of anomalous tide levels will become possible.
- Observed data on high tides and anomalous tide levels, etc. will be promptly transmitted to agencies involved with disaster prevention such as NDMO that need to share tide monitoring data.
- Sharing information among the international community, Pacific Ocean Countries and Japan, through GTS, will contribute to disaster prevention.



(Note): ○ Procured in the Project □ Existing

Figure 2-2-3 Arrangement of Tidal Gauges in Vanuatu

2) Strong Motion Accelerometer and Broadband Station System

i) Current observation situation in Japan

Numerous agencies conduct seismic observations in Japan. However, since the JMA is mainly responsible for conveying the information to citizens, the following paragraphs describe the JMA case. There are various types of seismometers, and these are categorized depending on their monitoring purposes as follows:

- Seismic observation - determination of seismic source factors:

In order to determine the location (latitude, longitude and vibration intensity) and scale (magnitude) of earthquake occurrence, high-sensitivity seismometers are used and a bulletin of seismic source factors is issued within a few minutes of earthquake occurrence. JMA currently has a seismic detection network of 200 seismometers throughout the country (as of January 2012, one seismometer each in an area of approximately 43 km by 43 km) as shown in Figure 2-2-4. High-density arrangement is required in order to also observe weak earthquakes; however, since this entails increased quantities of observation data and a greater burden on analysis, it is necessary to link with telecommunication technology and processing hardware and software, etc. Moreover, in cases where the scale of earthquakes is large, reconfirmation of magnitude is carried out through using data from the strong-motion accelerometers described below.

- Seismic observation - observation of strength of seismic movements:

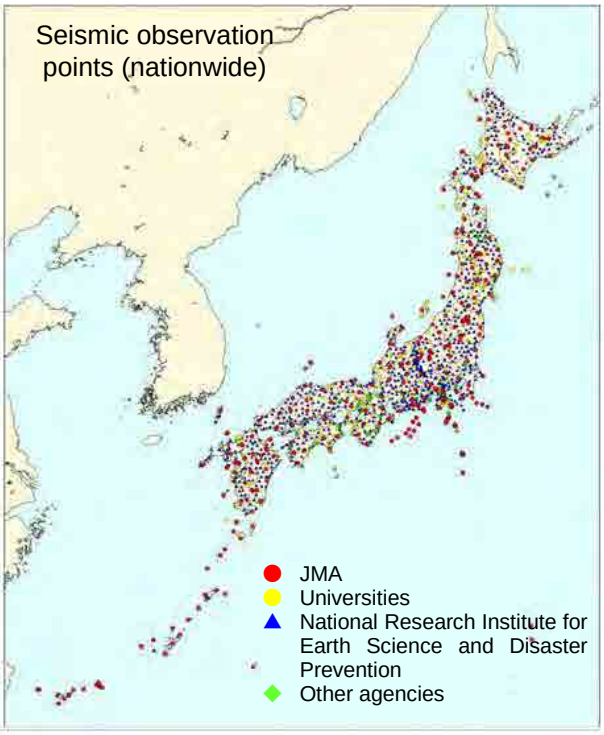
Strong-motion accelerometers, also referred to as acceleration seismometers, are used for observing powerful quakes and measuring vibration intensity. In Japan, ever since the Southern Hyogo Prefecture Earthquake of 1995, efforts have been made to estimate damage rates based on the vibration intensity of earthquakes, and the data is used to estimate damage and determine response setups according to each area when earthquakes occur. Approximately 4,000 such instruments have been installed, mainly by JMA and local governments (as of January 2012, one strong-motion accelerometer in each area of approximately 10 km by 10 km), and these are used for issuing vibration intensity bulletins and information when earthquakes occur as shown in Figure 2-2-5.

- Broadband seismometers:

These instruments can record a wide range of seismic vibrations from high frequencies to very slow frequencies. The seismic waveforms obtained from broadband seismometers are used to conduct analysis of the earthquake mechanism, etc. JMA has currently installed broadband seismometers at roughly 20 locations throughout the country (as of January 2012, one seismometer in each area of approximately 140 km by 140 km). Since

these instruments are suited to conducting observations of relatively large-size earthquakes, such an arrangement is deemed to be sufficient.

The above paragraphs have described the network of seismic observation systems in Japan. However, this does not mean that the current Japanese situation is sufficient; new installation sites continue to be sought while current sites are reviewed continuously for building a better network. Through introducing new seismometers and connecting them with the already existing instruments, it is intended to build a nationwide observation system.



Source: JMA

Figure 2-2-4 Seismic Observation Points

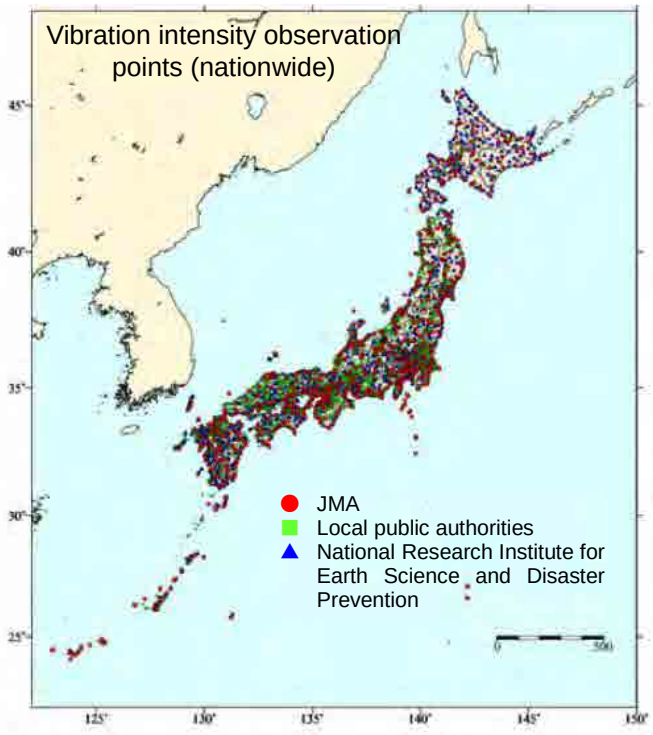


Figure 2-2-5 Vibration Intensity Observation Points

ii) Criteria for selection of observation sites

VMGD has already started conducting seismic observation in Vanuatu, and short-period seismometers and broadband seismometers are installed for this purpose. Pre-existing seismic observation data is transmitted via wireless and iGov. network communications to VMGD headquarters, where it undergoes analysis and displayed by seismic data collection system. Moreover, VMGD uses a program known as Seiscomp3 in order to conduct seismic source analysis using the observation data received from short-period seismometers and broadband seismometers. It has also established a technique for correcting seismic source factors such as magnitude, using the observation values

measured by strong-motion accelerometers. Accordingly, it has been decided to connect the Project strong-motion accelerometers and broadband seismometers to the existing system so that analysis can be performed. The following criteria have been set for selecting seismic observation sites in the Project:

- Installation on rock is desirable.
- Locations close to landfills should be avoided.
- Fragile soil, soils with buried objects should be avoided.
- Cliffs should be avoided.
- There should be no impact from human activities on roads or in factories, etc.
- There should be little impact from vibrations caused by natural phenomena such as waves, waterfalls or rivers, etc.
- Power supply and data transmission should be easy, with low operating cost.
- It should be possible to obtain authorization for leasing of the site land
- Safety management following the installation (prevention of damages and theft) should be easy.
- Ease of maintenance following installation

In addition, observation sites have been selected taking account of VMGD's seismic observation network plan.

iii) Installation sites and reasons for selection

VMGD (the seismic observation agency in Vanuatu) carries out the deployment of seismometers, and the Project serves to complement this. It is desirable to have a high density of seismic observation locations; however, doing so requires establishment of the telecommunications infrastructure, good data processing technology (hardware and software) and enhancement of post-installation maintenance, etc. Currently, VMGD uses two broadband seismometers and one short-period seismometer to determine seismic vibration intensity; however, it plans to make more sophisticated use of observation data through analyzing the earthquake mechanism, in the future. Accordingly, in the Project, the priority of request by VMGD is high, and it has been decided to install strong motion accelerometers and broadband seismometers at three of the locations where can access to iGov. network for data transmission, by the same way as the tide observation system.

iv) Project effects

Through installing strong-motion accelerometers and broadband seismometers by the Project, the following effects are anticipated:

- The seismic observation network that currently covers two islands will be expanded to four islands, and the observation accuracy of seismic source information will be enhanced.

- Because the observation accuracy of seismic source information will be improved, the accuracy of judgments concerning whether or not tsunami will occur will be enhanced.

- Through internationally sharing the observed information (Japan and other Pan-Pacific countries will have access to seismic information from Vanuatu), it will contribute the disaster prevention of other countries.

v) Types and characteristics of seismometers

There are different types of seismometers: acceleration seismometers, broadband seismometers, and velocity seismometers, etc. The following paragraphs give outline descriptions of these representative types.

- Acceleration seismometers

Feedback servo (voltage and current for limiting displacement) is applied to the displacement, and the strength of seismic motion is calculated from the voltage (or current) value. Possessing high-level performance and high resolution, this type of seismometer is used for observing strong seismic motions (up to roughly 3,000 gal). Approximately 4,000 acceleration seismometers have been installed mainly by JMA and local governments (as of January 2012, one strong-motion accelerometer in each area of approximately 10 km by 10 km), and these are used for issuing vibration intensity bulletins and information when earthquakes occur. Ever since the Southern Hyogo Prefecture Earthquake of 1995, efforts have been made to estimate damage rates based on the vibration intensity of earthquakes, and the data is used to estimate damage and determine response setups according to each area when earthquakes occur.

- Broadband seismometers

These instruments can record a wide range of seismic vibrations from high frequencies to very low frequencies. As a result of recent progress in measuring technology, seismometers with a fixed period of hundreds of seconds have been realized. Utilizing the seismic waveforms obtained from broadband seismometers, Centroid Moment Tensor (CMT) analysis (strata slippage and quake mechanism throughout almost the entire period from the start of an earthquake to the finish) and analysis of seismic source time function, etc. that expresses fault motion over time at the seismic source are conducted on major earthquakes that occur all over the world. Because broadband seismometers react sensitively to temperature and air pressure changes, it is necessary to install them deep inside a heat-insulated horizontal adit or vertical adit or an air-conditioned room in order to ensure that long-period seismic motions are observed accurately. JMA has currently installed broadband seismometers at roughly 20 locations throughout the country (as of January 2012, one seismometer in each area of approximately 140 km by 140 km), and

uses them to conduct the analyses described above.

- Velocity seismometers

Comprising a moving coil and fixed magnet, the velocity seismometer generates little noise and its sensitivity can be increased by increasing the number of coil winds. This has been used as the basic instrument for seismic observation. However, since there is a limit to the operating scope (displacement) of the coil, it is unable to cope with very large seismic movements. Moreover, the potential observation cycle is limited to short-period cycles (5 Hz or less). However, because this type has simple structure and high sensitivity, it was previously used for determining seismic origins and magnitudes as well as observing constant minute slight vibrations. Currently, the weaknesses of velocity seismometers have been improved and they are used as high-sensitivity seismometers. JMA has currently installed velocity seismometers at roughly 200 locations throughout the country (as of January 2012, one seismometer in each area of approximately 43 km by 43 km).

Reference:

Tokyo District Meteorological Observatory HP;
http://www.seisvol.kishou.go.jp/tokyo/STOCK/monthly_v-act_doc/fukuoka/02m06/500_02m06memo.pdf

NIED HP;
http://www.hinet.bosai.go.jp/about_earthquake/sec9.4.html
Seismograph manufacturer data

Types of seismic observation and purpose of use are shown in Table 2-2-3.

Table 2-2-3 Types of Seismic Observation and Purposes of Use

Type of seismic observation	Purpose of use	Objective	Urgency on warning
Acceleration seismometer	Vibration intensity bulletins, estimation of damage ratio	Disaster prevention	Needed
Broadband seismometer	Estimation of earthquake occurrence mechanism, Estimation of fault movements	Disaster prevention Research	Unnecessary
Velocity seismometer	Estimation of seismic source factors	Disaster prevention	Needed

vi) Purpose of use of seismic observation data and the types of used seismometers

Seismic observation data is used for a lot of objectives - not just investigation of earthquake sources, but also estimation of the scale of earthquakes, gauging of damage to buildings, investigation of potential for tsunami occurrence, research of volcanic activities, earthquake-proof buildings and technologies for preventing landslide disasters and so on. In the Project, as a result of consultation with VMGD, broadband seismometers and strong motion accelerometers will basically be installed in the same locations so that the estimation of seismic source can be conducted from broadband seismometer data and, in

cases of strong quakes, magnitude correction, etc. can be performed from the strong motion accelerometer data. The purpose of use of seismic observation data and types of used seismometers are shown in Table 2-2-4.

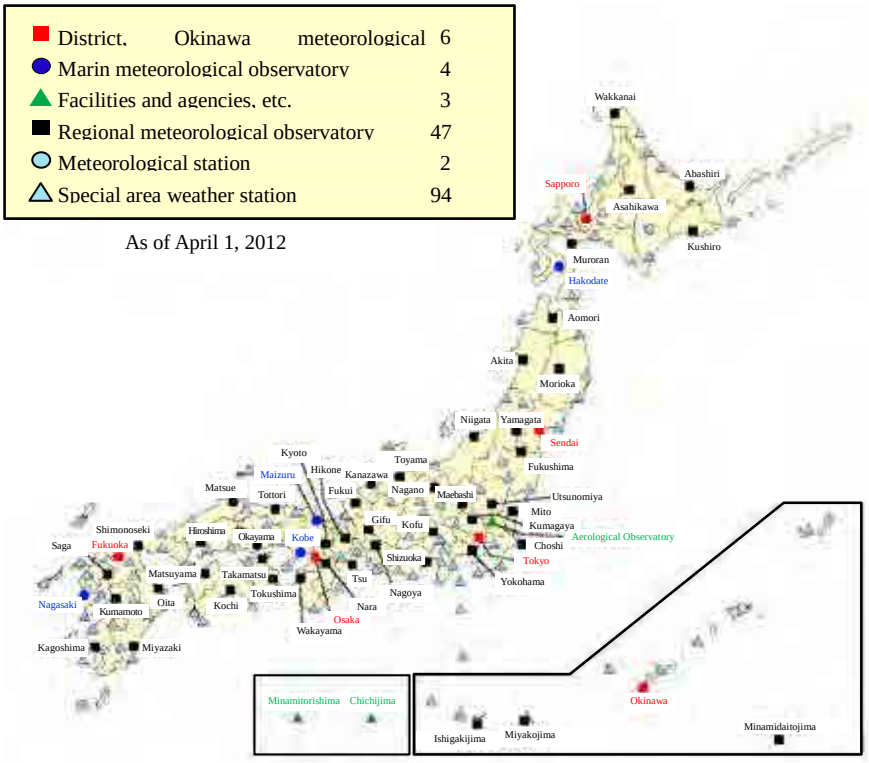
Table 2-2-4 Purpose of Use of Seismic Observation Data and the Types of Used Seismometers

Objective	Seismometer
seismic source factor analysis	short-period seismometer, strong-motion accelerometer
earthquake mechanism and fault motion analysis, tsunami scale estimation	wide area seismometer
vibration intensity determination, damage estimation, examination of initial response	strong-motion accelerometer
aseismic design,, ground movement	wide area seismometer, multi-strata observation, GPS

3) Automatic Weather Station (AWS)

i) Observation outline in Japan

JMA conducts two types of meteorological observation: 1) surface meteorological observation conducted by meteorological observatories (some of which were formerly weather stations), and 2) the local meteorological observation system known as AMeDAS (Automated Meteorological Data Acquisition System). Concerning surface meteorological observation, approximately 60 meteorological observatories and weather stations throughout the country conduct meteorological observation of air pressure, temperature, humidity, wind direction, wind velocity, precipitation, fallen snow (depth), falling snow depth, sunlight hours, solar irradiation, cloud, visibility, atmospheric phenomena, etc. Observation personnel can visually observe cloud, visibility and atmospheric phenomena and so on; however, other items are automatically observed by equipment at surface weather stations. Moreover, approximately 90 local meteorological observatories conduct only automatic observations using the same equipment used for surface meteorological observation. These observation data are utilized for announcing advisories, warnings and weather forecasts. They are also used for grasping meteorological fluctuations, and surveying and researching industrial activities, etc. Some of the observation findings above are transmitted as Japan's meteorological observation data to the world's meteorological agencies via GTS, thereby making an international contribution to meteorological observation and analysis on the global scale, setting of initial values for the numerical forecasting model and observation of meteorological fluctuations. Figure 2-2-6 shows the location of surface meteorological observatories in Japan.



Source : JMA

Figure 2-2-6 Surface Weather Stations in Japan

Meanwhile, AMeDAS automatically observes limited items such as precipitation, wind direction and velocity, temperature and sunlight hours in order to observe meteorological conditions in detail on an hourly and local basis. This system thus plays an important role in preventing and mitigating natural disasters. AMeDAS commenced operation on November 1, 1974 and currently comprises approximately 1,300 observatories observing precipitation throughout the country. Out of these, approximately 840 observatories (at intervals of roughly 21 kilometers) also observe wind direction and velocity, temperature and sunlight hours in addition to precipitation, while 310 observatories in snowy locations also observe the depth of fallen snow during the cold season. Moreover, not only do surface weather stations observe meteorological conditions at each location, but their observations provide important data for early detection of natural disasters and observing of climate change over the long period of time. Since each country's observation findings not only provide meteorological data for domestic use but also prove useful in analyzing meteorological phenomena and climate changes on the global scale, they are important for all countries including Japan. Accordingly, the WMO has established regulations concerning the standards of equipment, observation methods and maintenance in order to realize observations based on internationally common methods and with similar accuracy. JMA has refined these WMO regulations to establish a certification test system for meteorological instruments and it conducts ongoing guidance on guaranteeing accuracy and conducting continuous maintenance in meteorological observation.

ii) Selection criteria of installation locations

At first, it's necessary for AWS to be located in the sites where it's possible to observe meteorological phenomena widely. Secondly, it's effective from perspective of disaster prevention to select the sites that are prone to natural disasters and where many people can benefit from observation findings. Moreover, there are not so many AWS in Vanuatu and manual observation activities such as personnel watching, telephone transmission to VMGD Headquarters are used in many of the weather stations. Accordingly, the installation locations have been decided based on four criteria: 1) Observation can be conducted over as wide an area as possible, 2) Stations are arranged uniformly in geographical terms, 3) Construction of data transmission line is not costly, and 4) Maintenances is certainly conducted.

iii) Installation locations and reasons for selection

Weather stations of VMGD are arranged widely over the entire country; however, because observation is not automated, it is desirable to introduce AWS. VMGD headquarters does not conduct official meteorological observation, and the Port Villa weather station that is registered with the WMO serves as the weather station for Bauerfield Airport. Moreover, weather stations are established on the main islands, mainly at airports, and they conduct meteorological observations. In the Project, AWS will be installed in the weather stations at Bauerfield Airport in Port Villa which can utilize the existing ADSL lines and Pekoa Airport in Espiritu Santo which can access to iGov. network as part of the effort to strengthen VMGD's observation setup.

iv) Prospective Project Effectiveness

In the Project, through installing AWS at the above weather stations, the following effects are anticipated.

- By enabling VMGD headquarters to conduct real-time monitoring of meteorological data observed in weather stations throughout the country, its capability for observing torrential rains and high winds, etc. will be enhanced.
- Observed data in Vanuatu shared among the meteorological agencies of the world will be utilized to grasp meteorological conditions internationally.

4) GTS Server and MSS

i) Current conditions of observation in Japan

The WMO compiles the rules for the global meteorological telecommunications networks that are used in the international sharing of meteorological observation data and meteorological analysis and forecasting data, while the meteorological agencies in each country conduct the inputting and outputting of data. Meteorological agencies in each

country input aboveground, ocean and aerological meteorological data and observation data from meteorological satellites into the GTS in order to ensure global information exchange.

In Japan, JMA transmits observation data and issues calculation results from numerical forecasting models, weather forecast guidance and other forecasting information and tsunami warnings, and these items of information are essential in terms of both disaster prevention and accurate weather forecasting.

ii) Criteria for selecting observation points

Since disaster prevention information such as tsunami warnings is also exchanged in the GTS, this system is at the heart of each country's meteorological agencies that conduct 24-hour monitoring. In the Project, the existing GTS will be renewed.

iii) Installation sites and reasons for selection

Since the existing GTS will be renewed, it will be installed in VMGD headquarters, which has dedicated communications lines, a server room and forecasters working on a 24-hour shift system.

iv) Project effects

Through renewing GTS in the Project, the following effects can be anticipated.

- Since VMGD will have access to even greater meteorological information, the time required to prepare meteorological forecasts will be shortened and the accuracy of forecasts will be enhanced.
- VMGD's meteorological observation data will be shared with overseas meteorological agencies more rapidly, thus making it useful for grasping meteorological conditions on a global scale.

(4) Policy regarding Measurement System of Tidal Gauges

There are various types of tidal gauge depending on objectives. For example, not only the ultrasonic type that emits ultrasonic wave signals from above the ocean to the ocean surface and measures the position of the sea surface based on the time taken by reflected signals, but also the float type, the buoy type and the hydraulic type are generally used. In the Project, since the basic policy is to realize a tide level automatic observation and automatic transmission system for as low a cost as possible, ultrasound gauges fitted to existing jetties have been adopted and will also facilitate maintenance by the Vanuatu side.

(5) Policy regarding Power Sources

In the Project, power supply is not secured in almost all the Project site except for the area of

VMGD Headquarters. The ways to secure power supply are leading from the commercial grid or installing independent sources. In the former case, it's necessary to install equipment, which considers voltage drop depending on distance between existing distribution lines and installed locations and backup (uninterrupted power supply) in the event of power cuts due to disasters, etc.. In the latter case, though generator and solar power system are relevant as independent sources, generators which vibrate, are noisy and generate heat are not suitable for meteorological, oceanographic and terrestrial phenomena observation points; moreover, they incur costs for fuel and expendables and so on. Since the procured equipment and other measuring instruments of the Project will have relatively low power consumption, solar power systems that entail lower initial investment and maintenance costs will be principally adopted as the power source.

(6) Policy regarding Transmission of Measurement Data

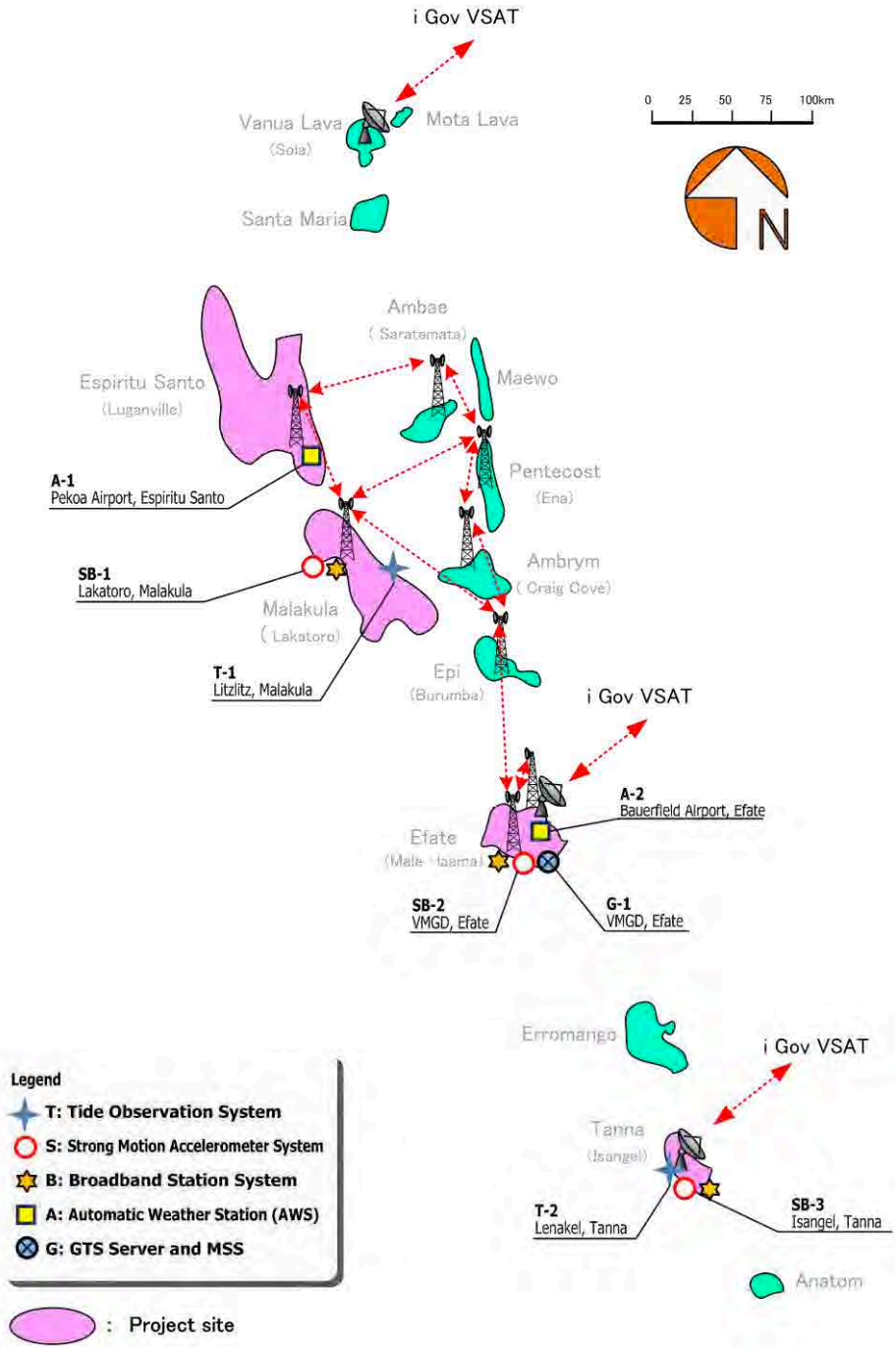
Thanks to recent advances in computer technology, it is possible to digitize and encode meteorological, oceanographic and terrestrial phenomena observation data measurements and waveforms, and to convert them into signals for transmission. Transmission systems, in order from those with the largest capacity, comprise satellite lines, wireless and internet lines, etc. Since the seismometers to be introduced in the Project will observe continuous data, relatively large amounts of data will need to be transmitted. Moreover, concerning the tidal gauges and AWS, the volume of transmitted data tends to increase as the extraction interval is shortened in the interests of disaster prevention. Therefore, concerning the meteorological, oceanographic and terrestrial phenomena observation and telecommunications data transmission method in the Project, the optimum method shall be adopted according to the volume of the data being transmitted. Particularly, in order to limit communications costs, it has been decided to utilize the iGov. network that is operated by the Government of Vanuatu and was found at the site survey as suitable for a method of the data transmission in the Project. Therefore, there will be cases where wireless LAN is utilized for the maritime propagation of data from observation points to the iGov. network terminals. Since fading interference may arise in wireless maritime propagation, the diversity antenna system will be adopted in order to alleviate fading interference at the maritime propagation sites.

1) Method of Data Transmission

Since all the equipment installation sites are unsuitable for use of aboveground communications such as wireless, internet and telephone lines, it is planned to utilize the iGov. network operated by the Government of Vanuatu for transmitting observation data. The features of communication lines to be used in the Project are as indicated in Table 2-2-5.

Table 2-2-5 Features of Telecommunication Systems

Telecommunication system	Features
iGov.	iGov. is the government's dedicated communication line in Vanuatu and it links islands by high-speed lines via 8 micro communication relay stations and 3 satellite communication earth stations. In Vanuatu, iGov. is utilized for conducting TV conferences and communicating emergency medical information, education, tourism and financial information, etc. between the islands. In the case where iGov. is used in the Project, telecommunications expenses will not be incurred. Figure 2-2-7 shows a map of the iGov. network in Vanuatu.
Wireless LAN	In this type of LAN system where data is communicated using low-electric power wireless lines, an advantage is that operating costs can be avoided because autonomous communications lines can be constructed. Also, concerning routes where maritime propagation must be conducted, diversity antennas are adopted in order to counter the effects of fading caused by ocean surface reflection and changing meteorological conditions.
DCP	This is the dedicated meteorological data line that uses Japan's stationary meteorological telecommunications satellite. Because the communication speed is slow, it can only be used for communicating small quantities of meteorological observation data and tidal observation data, etc., but there is no cost burden incurred. Since communications are occasionally interrupted due to maintenance, etc., it is desirable to use this as a secondary method.



Source: VMGD

Figure 2-2-7 iGov. Network Map

The seismic observation system, broadband station system, tide observation system and AWS are connected online in VMGD headquarters. The data observed in each system can be observed in the VMGD headquarters monitoring room. In the Project, it is planned to mainly procure Japanese products from areas affected by the Great East Japan Earthquake; however, because VMGD's existing systems produced by U.S. use a different data communication format, a unique data receiving system (observation monitor, etc.) has been built at VMGD headquarters to make it compatible with existing seismometers. The components of data transmission method are shown in Table 2-2-6.

Table 2-2-6 Components of Data Transmission Method

No.	Item	Installation Site		Data Transmission Method
1	Tide Observation System (2 sites)	T-1	Litzlitz, Malakula	Wireless LAN, iGov. and DCP
		T-2	Lanakel, Tanna	Wireless LAN, iGov. and DCP
2	Strong Motion Accelerometer and Broadband Station System (3 sites)	SB-1	Lakatoro, Malakula	LAN cable, iGov.
		SB-2	VMGD, Efate	LAN cable
		SB-3	Isangel, Tanna	LAN cable, iGov.
3	Automatic Weather Station (AWS) (2 sites)	A-1	Pekoa Airport, Espiritu Santo	LAN cable, ADSL
		A-2	Bauerfield Airport, Efate	LAN cable, iGov.
4	GTS Server and MSS (1 site)	G-1	VMGD Head Office	－

2) Securing signal quality in maritime propagation by Diversity antenna system

i) Fading interference arising in maritime propagation

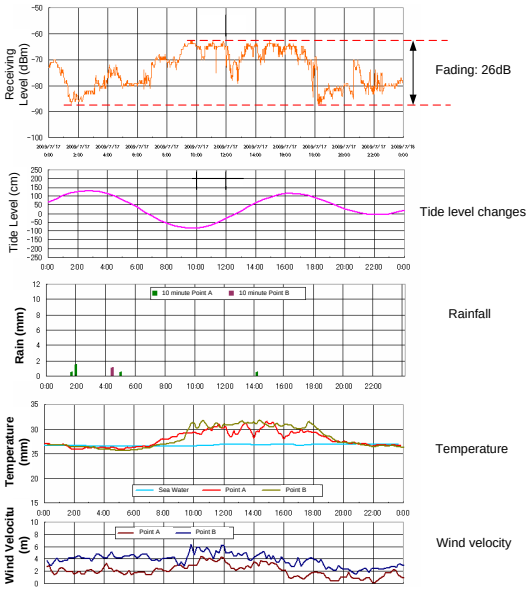
Maritime wireless propagation over long distances tends to be prone to fading whereby the communication signal level fluctuates due to the effects of changing ocean surface reflection (caused by tide differences), temperature and seawater temperature, etc. as shown in Table 2-2-7.

Table 2-2-7 Factors behind Fading

Cause	Phenomenon
Tide level	Changes in the radio path caused by tide levels or wave heights
Move	Changes in the radio path caused when wind direction changes between daytime and nighttime
Ocean	Changes in the radio path caused by trade winds
Pressure	Changes in the radio path caused by high pressure
Weather front	Changes in the radio path caused by weather fronts
Fog	Changes in the radio path caused by fog

ii) Relationship between meteorology and fading (example)

The single day changes of communication signal level in fading that arise due to tide level and meteorological changes are indicated in Figure 2-2-8.



(Frequency: 5GHz, Distance: 20.4 km)

Source: Kyushu Bureau of Telecommunications
Ministry of Internal Affairs and Communications

Figure 2-2-8 Relationship between Meteorological Changes and Fading

iii) Diversity antenna system

In the diversity antenna system, wireless signals are received from multiple antennas but noise is removed through giving preference to the signals from the antenna with the best signal quality, synthesizing the received signals, thereby enabling the quality and reliability of the communications to be enhanced.

In the Project, the diversity antenna system will be adopted at Litzlitz on Malakula Island (T-1), where the tide observation system that will entail maritime propagation of observation data will be installed. The system composition of the diversity antenna is shown in Figure 2-2-9.

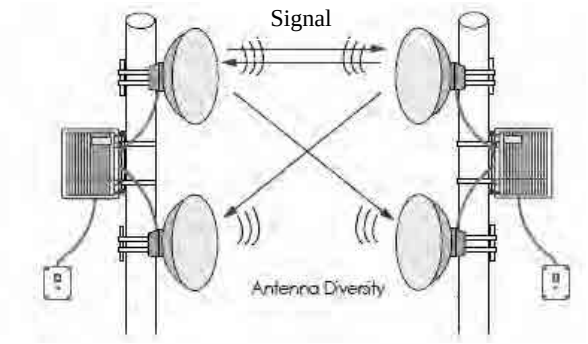


Figure 2-2-9 Conceptual Drawing of the Diversity Antenna System

(7) Policy regarding Online Uploading and Sharing of Data

The data concerning meteorological, oceanographic and terrestrial phenomena observation is

generally recorded in data loggers installed in each pieces of equipment. If equipment is not online, it is necessary to dispatch employees into the field to recover the data from the loggers. Therefore, since observed data cannot be promptly transmitted and analyzed, it's considered that information related to disasters is not promptly transmitted to citizens. In the Project, satellite transmission system will be introduced in order to put meteorological, oceanographic and terrestrial phenomena observation equipment online. Doing so will make it possible to immediately transmit meteorological, oceanographic and terrestrial phenomena observation information to disaster prevention agencies, and the rapid provision of information for citizens to evacuate to safe places. Moreover, principally iGov. network will be used to transmit data from each observation device to monitoring systems installed in VMGD Headquarters, in the Project. However, in terms of tide observation system, DCP provided on the Japanese Multi-functional Transport Satelite (MTSAT) will be used and the sent data can be incorporated into GTS and shared among international meteorological observation agencies. Concerning data that doesn't pass through weather satellites, it has been decided to distribute information through the internet via the monitoring system network so that it too can be shared internationally.

(8) Policy regarding Natural Conditions

1) Concerning temperature and humidity conditions

According to meteorological statistics of VMGD, the highest temperature recorded so far in the Project target area is 35.3 ºC, the minimum is 8.5 ºC, and maximum humidity is 100%. Considering these conditions, equipment functions will be secured for use in minimum temperature of 5 ºC, maximum temperature of 40 ºC and maximum humidity of 100%. As for equipment (tidal gauge, etc.) installed on the coast of stainless steel is used to protect from salt damage.

2) Concerning rainfall and lightning

The maximum daily rainfall observed by a weather station in Vanuatu was 539 mm (January 1999). Maximum daily rainfall in the Project will be set at 550 mm to ensure that this figure can be tolerated. Moreover, since squalls occur during the rainy season from November to April, waterproofing and moisture-proof measures will be considered for observation instruments and auxiliary equipment installed outside (tidal gauges, AWS, transmitter antennas, GPS sensors, solar power systems, etc.). Moreover, lightning conductors and lightning arresters will be attached in order to avert lightning strikes and prevent induced lightning. In particular, since river flooding causes a lot of inundation damage from November to March, it is necessary to install equipment on high ground free from flood risks.

(9) Policy regarding Social Conditions

Since almost all people in Vanuatu are Christians, there are no social customs such as the Moslem custom of Ramadan that have a relatively long-term impact on the construction schedule.

(10) Policy regarding the Construction Situation

The procured equipment in the Project is composed of relatively small-size precision instruments. When installing, adjusting and testing such instruments, it is normal for engineers dispatched from the maker or operators specified by the maker to conduct work to ensure the performance and quality of equipment. Moreover, whenever necessary, an efficient and economical works implementation setup will be adopted through employing electricians, qualified laborer and common laborer, etc., from local firms to assist in the carrying-in, unpacking and installation of the equipment.

(11) Policy regarding Procurement Conditions in Third Countries

The Project is implemented in accordance with the Basic Guidelines for Reconstruction in Response to the Great East Japan Earthquake and the Project policy will be to select Japanese products primarily from areas affected by the Great East Japan Earthquake. However, where the following conditions apply, equipment from other countries may be procured:

- When it is necessary to select the same products as currently installed due to issues of format and structure when connecting with existing facilities
- When it is necessary to purchase products that are widely used in the recipient country in the interests of maintenance
- When products are not produced in Japan

(12) Policy regarding Grade Setting

In designing the observation equipment to be procured in the Project, considering the existing equipment composition and implementation setup, care will be taken not to deviate from the technical level of VMGD staffs, which will implement operation and maintenance following procurement.

(13) Policy regarding Procurement Method and Implementation Schedule

Equipment procured from Japan or third countries will primarily be transported oversea to the main Port Villa Port on Efate in Vanuatu. The required lead time for transportation from Japan to locations in Vanuatu, including customs clearance procedure at Port Villa Port, will be around 45 days maximum.

From Port Villa Port, equipment will be transported overland to target sites on Efate Island,

however, oversea or air transportation will be adopted when transporting to sites on other islands. Meanwhile, it has been found that for the target sites on most of the islands, not only are there no port facilities capable of loading and unloading equipment and materials, but also it is difficult to secure means of transport within islands (due to poor road conditions and absence of trucks) and to secure or procure heavy machinery for construction works. In order to complete the installation work smoothly and in short time, it will be necessary to consider hiring barges that can be loaded with the work materials, equipment, trucks and heavy machines and moored close to the target sites for unloading. Moreover, before the Japanese side implements installation of the procured equipment, it will be necessary for the Vanuatu side to secure authorization to use observation instrument and installation sites and complete the application procedure concerning use of communication lines (including applications to the Meteorological Agency concerning use of meteorological satellite DCP functions) when installation work complete. Accordingly, the Consultant will give appropriate advice and guidance to the counterparts to ensure that these obligations on the Vanuatu side can be implemented without delay.

2-2-2 Basic Plan (Equipment Plan)

(1) General Plan

1) Weather and Site Conditions

① Temperature
- Minimum: 5 ºC
- Maximum: 40 ºC

② Humidity: Maximum 100%

③ Wind velocity: Maximum 60 m/s

④ Rainfall: Daily maximum rainfall 550 mm

⑤ Altitude: 300m or less

⑥ AC power supply: 415/240 V, 50Hz

⑦ Ground bearing capacity: 10.0 ton/m^2 (SB-1; Lakatoro, Malakula)
16.0 ton/m^2 (SB-2; VMGD, Efate)
16.0 ton/m^2 (SB-3; Isangel, Tanna)
5.0 ton/m^2 (A-1; Pekoa Airport, Espiritu Santo)
10.0 ton/m^2 (A-2; Bauerfield Airport, Efate)

⑧ Seismic force shear coefficient: 0.2

2) Applicable Standards

	Name of Standards	Application
(a)	International Electrotechnical Commission (IEC)	Main functions of electrical goods in general
(b)	International Standardization Organization (ISO)	Performance of industrial products in general

	Name of Standards	Application
(c)	Japanese Industrial Standards (JIS)	Industrial products in general
(d)	Japanese Electrotechnical Commission (JEC)	Electrical goods in general
(e)	The Standard of Japan Electrical Manufacturer's Association (JEM)	Same as above
(f)	Japan Electric Association Code (JEAC)	Same as above
(g)	Japan Cable Maker's Association Standard (JCS)	Electrical wires and cable
(h)	Electrical Industrial Association of Japan (EIAJ)	Electrical goods in general
(i)	International Telecommunication Union (ITU)	Electrical goods in general
(j)	World Meteorological Organization (WMO)	Meteorological instruments
(k)	Japan Meteorological Agency (JMA)	Meteorological instruments, Statistics

(2) Equipment Plan

1) Tide Observation System

In this system, tide levels will be observed from jetties, and VMGD headquarters will introduce a system for collecting and analyzing tidal data and monitoring tide levels in real time. Tidal gauges will be installed on jetties and coasts under the control of VMGD. The tidal gauges will adopt the ultrasonic method of measurement, and tidal data will be transmitted to VMGD Headquarters via wireless LAN and iGov. network, while weather satellite DCP (Data Collection Platform) will be used for transmission. Since DCP has slow data transmission speed, it is not suitable for disaster prevention use; however, since observation data can be directly incorporated into GTS via MTSAT that is managed by JMA, the observation data shared on GTS can also be viewed by VMGD. Power to the tidal gauges will be supplied from solar power systems.

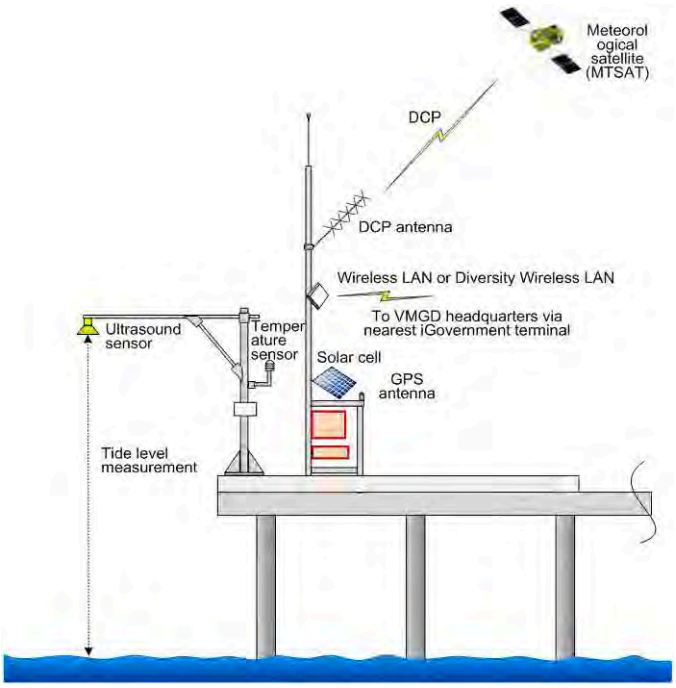


Figure 2-2-10 Outline of Tide Observation System

Since tidal gauges will be installed at the ends of jetties as shown in Figure 2-2-10, salt damage prevention specifications will be adopted and exposed metal parts will comprise anti-corrosive aluminum or stainless steel, etc. Also, since it will be necessary to protect tidal gauge sensors, data loggers and batteries, etc., from humidity and dust, these instruments will be housed in waterproof and dustproof cabinets. To ensure that sensors can be easily cleaned, structures that permit easy maintenance will be adopted and fences will be

constructed to prevent theft and ensure safety. Ultrasonic tidal gauges emit ultrasonic waves from above to the sea surface and calculate the tide level by measuring the time it takes for the waves to rebound and return from the sea. Since the measured outward and inward time differs according to temperature in the propagation route, it is necessary to simultaneously measure temperature and correct the tide level.

2) Strong Motion Accelerometer and Broadband Station System

i) Strong Motion Accelerometer and Broadband Station System

Concerning installation of strong-motion accelerometers and broadband seismometers, the shed will be installed at each site under the management of VMGD and strong motion accelerometers and broadband seismometers, data loggers (digitizers), transmission systems and power supply, etc., will be installed as shown in Figure 2-2-11. Two of three sites on Lakatoro, Malakula and Isangel, Tanna will be connected to the iGov. hub for conveying observation data to the existing seismic observation system in VMGD head office. The seismometers in VMGD head office will be coupled to the observation system. VMGD will make connections to the seismic observation server, and SEEDLINK data will be provided from the seismometer system of the Project. The compatibility of the equipment to be procured under the Project with the same system will be ensured. Moreover, due to their characteristics, broadband seismometers need to be operated at constant temperature; however, effort will be made to keep temperature changes to a minimum through utilizing insulating materials, etc. around the unit.

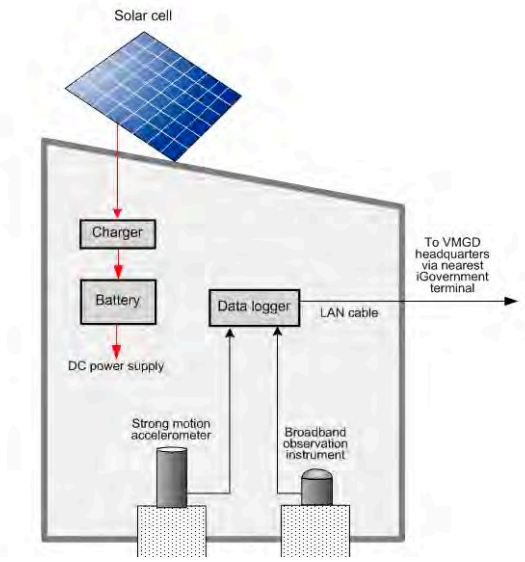


Figure 2-2-11 Outline of Strong Motion Accelerometer and Broadband Station System

ii) Shed for the System

a) Outline of Plan

Concerning the size of buildings for housing the System of the Project, the areas of rooms have been set based on the conditions of setting the minimum required area for equipment installation and ensuring that there is no interference between building foundations and equipment foundations. The following table outlines the plan.

Outline of Plan		
Shed for Strong Motion Accelerometer and broadband Station System	(1) Area:	18.28 m^2 x 3 sites = 54.84 m^2
	(2) Eaves height:	GL + 3 m
	(3) Structure:	RC single story structure with concrete block walls

b) Elevation Plan

Since the construction sites are located close to the coast, reinforced concrete roofs rather than steel plate roofs will be adopted and steel fittings will be given anti-rust coating in consideration of salt damage and blowing by cyclones. Exterior coating that is widely adopted in the local area will be adopted for easier maintenance.

c) Section Plan

In order to conduct accurate observations, concrete sub-slab will be placed over macadam; then the seismometer foundation will be placed over that according to the JMA installation standard; and proper interval will be secured to prevent interference between the building foundation and seismometer foundation. As for the broadband observation equipment, unlike the seismometer (strong motion sensor), since it is susceptible to the effects of temperature changes, it will be installed in an underground pit surrounded by insulation materials.

d) Structural Plan

The reinforced concrete rigid-frame structure and continuous footing, which can be constructed by local contractors, will be adopted, while concrete block walls, which are again common in the local area, will be used.

e) Used Materials

・Concrete

Almost all islands in Vanuatu have limestone geology derived from the accumulation of coral, and it is generally used as aggregate material for concrete. However, since limestone frequently does not satisfy JIS standards in terms of density in oven-dry condition and coefficient of water absorption, it is difficult to secure the required quality as a buildings material for housing precision instruments for conducting long-term seismic observations. Therefore, aggregate materials made of basalt imported from neighboring Fiji, etc., that can be procured locally will be used for the building concrete works.

・Reinforcing bars

Locally used reinforcing bars comply with the New Zealand standard (NZS), however, since bars that comply with JIS are also available locally, the JIS standard will be adopted in the design.

3) Automatic Weather Station (AWS)

Introduction of this system will enable meteorological observation to be automatized and observed data to be transmitted to VMGD Head office in real-time. At the AWS installation site of Pekoa Airport, Espiritu Santo, iGov. network will be used to connect it to the weather station will be used. At the AWS installation site of Bauerfield Airport, Efate, iGov. network is not connected, since the telecommunication state at the capital Port Vila is good, ADSL lines leading to the weather station will be used. At VMGD head office, meteorological data can be monitored in real-time by introducing a system for collecting and analyzing the observation data. This system is composed of instruments for observing meteorological observation items such as wind direction, velocity, rainfall, temperature, humidity, air pressure and solar radiation as shown in Figure 2-2-12. Each instrument in this system will have passed the examination test of JMA, and will be designed to be weatherproof in Vanuatu. In addition, weather observation instruments in AWS and the data logger have to be removed for periodic inspections, a set of alternate instrument will be procured.

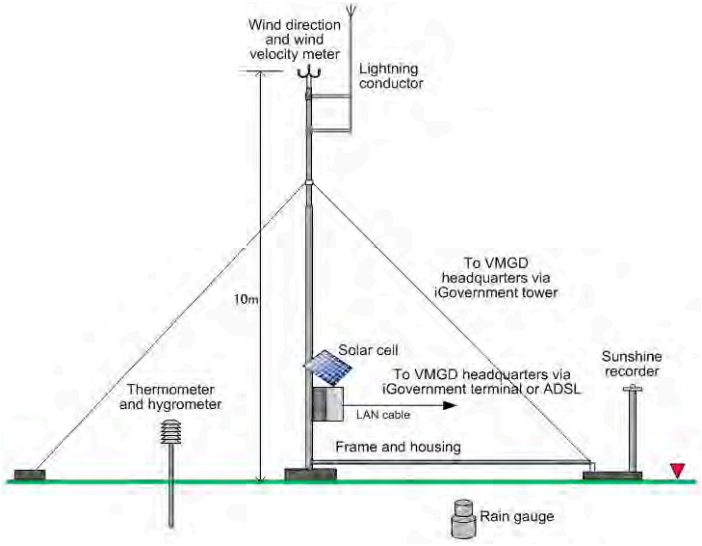


Figure 2-2-12 Outline of AWS

4) GTS Server and MSS

In the Project, through making it possible to acquire forecasting information exchanged by GTS, the existing GTS system will be upgraded with the objectives of improving the accuracy of meteorological forecasting, enhancing capacity for inputting/outputting data to and from the GTS, simplifying operations and facilitating acquisition of tidal data newly introduced in the Project. Since GTS is an important system for receiving tsunami information, etc., from international agencies, it will basically be a duplex system. Moreover, the ADSL (1Mbps) line that was newly installed in 2012 will be used for connecting to the GTS.

(3) Equipment List

1) Outline specifications of major equipment

Table 2-2-8 Outline specifications of major equipment

No.			Item	Requirement
1			**Tide Observation System**	
	1.1		Tidal Gauge	
		(1)	General condition	
			- Operating time	24 hours/ 365(366) days
			- Operating temperature	-20 to 50°C
			- Weatherproof	All weather-proof and Salinity tolerance
			- Power supply	DC 12V +/-2V
		(2)	Ultrasonic Sensor	
			- Measuring range (MR)	0 to 10 m
			- Resolution	Less than +/-1.0cm (In calm condition)
			- Dead zone	Less than 1 m
			- Mounting	Shall be mounted on the supporting pole
			- Frequency band	Shall not be much affected by weather condition such as rainfall and so on.
			-Width of ultrasonic beam	Shall be narrow as possible not to be affected by the landing pier, landing facilities and so on.
		(3)	Temperature Sensor	
			- Measuring range	-30 to 50 °C
			-Resolution	Less than+/- 0.1 °C
			-Ventilation	Natural vent sleeve
			-Mounting	Shall be mounted on the supporting pole
		(4)	Converter	
			-Output data	Shall convert the traveling time to tide level with temperature correcting
			-Output signal	Digital RS232C Analogue +/- 1.0V/ 5.0 V (FS)
			-Standard level	Shall set up a standard observation level.
		(5)	Supporting Pole	
			-Composition	Shall consist of a vertical pole and a horizontal pole.
			-Material	Aluminium or stainless steel.
			-Installation	Shall be installed on the landing pier/ landing facility by anchor bolts strongly enough. Vertical pole shall be rotary for inspections.
			-Sensor installation	Ultrasonic sensor shall be installed on the end of a horizontal pole and Temperature sensor shall be installed on an adequate position.

No.			Item	Requirement
		(6)	Lightning Arrester	
			-Function	Shall protect the Ultrasonic sensor and converter from induced lightning.
	1.2		Data Logger	
			-Sampling time	Shall sampled every one (1) second from the converter.
			-Statistic	Shall calculate and record average, maximum and minimum of tide data every one (1) minute.
			-Temperature	Shall calculate an average every one (1) minute.
			-Battery status	Battery voltage status shall be recorded every one (1) minute.
			-Data storage	Shall store raw data, statistic data, temperature and battery status data with station ID, date and time in an external memory device at least amount of one (1) month.
			-External memory device	SD or CF
			-Date/ time correction	Using GPS time base
			-Input channel	3 channel or more
			-Input Data	Signal form Sensor
			-Data Format	Text file
			-Power supply	DC 12 V +/-2 V
			-Data transmission	Transmits to the VMGD head office the data of every 1 minute.
	1.3		GPS	
			-Function	Date and time shall be provided to the data logger.
			- Output Data Format	NMEA-0138 Standard/ NTP Protocol
			- Power Supply	DC 12 V +/-2 V
			- Accessories	Receiving antenna
	1.4		Transmitter and Antenna (DCP)	
		(1)	Transmitter	
			- Input Data	Shall comply with the existing transmission protocol of DCP of Meteorological satellite (MTSAT).
			- Frequency Band	401 to 403 MHz
			- Transmitting Power	1 to 16 W
			- Modulation	GOES DCS 100 or 300 bps, ARGOS/SCD 400bps
			- Power Supply	DC 12 V
		(2)	Antenna	
			- Type	Shall comply with a carrier company
			- Weather-proof	Salinity tolerance
			- Antenna type	Yagi or Flat array antenna
			- Polarization	LHPC or RHPC switchable

No.			Item	Requirement
			- Center frequency	402 MHz Band
			- Antenna gain	9 dBi or more
			- Impedance	50 ohm
	1.5		Transmitter and Antenna (Wireless LAN) to iGov.	
			- Frequency Band	5.8 GHz
			- LAN Interface	100 Base-T
			- Communication distance	4 km or more
			- Power Supply	At site: DC 12 V At TVL Tower: AC 240 V At Provincial Office: AC 240 V
			-Interface Cable	LAN cable and power cable shall be provided for installation and connection at site.
	1.6		Transmitter and Antenna (Diversity Wireless LAN) to iGov.	
			- Frequency Band	5.8 GHz
			- LAN Interface	100Base-T
			- Communication distance	4 km or more including propagation on the sea
			-Antenna system	Diversity
			- Power Supply	At site: DC 12 V At iGov. Tower: DC 48 V
			-Interface Cable	LAN cable and power cable shall be provided for installation and connection at site.
	1.7		Antenna Mast (for Connection to iGov. in Provincial Office)	
		(1)	Mast	
			-Height	2.4 m or more
			-Size	40 mm diameter
			-Material	Steel (Hot dipped galvanizing)
		(2)	Mast Base	
			-Height	1.3 m or more
			-Size of Base	50 cm or more
			-Material	Steel (Hot dipped galvanizing)
		(3)	Anchor Bolts	
			-Height	250 mm or more
			-Size of Base	50 cm or more
			-Material	Steel (Hot dipped galvanizing)
	1.8		UPS with Water-proof Case (for TVL Tower in Tanna)	
		(1)	UPS	
			- Power Supply	Single phase AC 240 V 50 Hz
			- Capacity	Shall cover 100% of total power consumption of 2 sets Wireless LAN terminal.
			- Duration of power supply	2 hours or more

No.			Item	Requirement
			- Remarks	The total power consumption of all equipment shall be specified.
		(2)	Water-proof Case	
			-Size	Shall cover the whole set of UPS
			- Degree of Protection	IP 56 or equivalent
	1.9		Solar Power System (PV Module, Batteries, Charge Controller)	
		(1)	PV Module	
			- Voltage	DC 12V
			- Capacity	Shall cover 100% of the total power consumption of whole system
		(2)	Battery	
			- Type	Sealed Lead Acid Battery
			- Voltage	DC 12V
			- Capacity	72 hours or more after the charge stop.
		(3)	Charge controller	
			- Function	Shall protect from over load and low voltage
		(4)	MCB	Shall be provided
		(5)	Others	
			- Power consumption	The power consumption of each equipment in the whole system shall be indicated.
			-Frame for PV module	The frame which attaches PV module shall be the weather-proof which bears strong winds, such as steel (Hot dipped galvanizing) or stainless steel, and damage from salt water. Considered as the structure which protects PV module from the theft.
	1.10		Frame and Container	
			- Weather-proof	All weatherproof and Salinity tolerance such as stainless
			- Degree of Protection	IP 56 or equivalent
			- Container-1	Shall contain all equipment except power supply unit.
			- Container-2	Shall contain power supply unit.
			- Frame	Shall contain the Container-1.-2 and PV module
			- Pole for Lightning Rod	Pole height 4 m or more with Lightning Rod
	1.11		Data Collection System for VMGD Head Office	
			- CPU	Intel Xeon ES-1660 or equivalent
			- Memory	16 GB or more
			- Hard Disk	2.0 TB or more
			- Display	42 inch or more
			- OS	Linux or equivalent (latest English version)

No.			Item	Requirement
			- Software	For processing the tidal information from the sites through iGov. transmission system, monitoring and storing those information in HDD
			- Information to be monitored	Tide level (Bar graph / Time progress of the level) Anomaly between measured tide and estimated tide (Estimated tide data file shall be recorded.)
			- Extensibility	Shall to add locations (stations) in future.
			- Browsing	Shall enable the observed data to be viewable through internet.
	1.12		Hub (for Connection to iGov. in Provincial Office)	
			-Number of port	4 ports or more
			-Interface	100BASE-T
2			**Strong Motion Accelerometer and Broadband Station System**	
	2.1		Strong Motion Accelerometer	
		(1)	Feedback	Force feedback
		(2)	Performance	
			- Measurement range	3,000 Gal or mote
			- Frequency response	100 Hz
			- Dynamic range	130 dB or more
			- Resolution	1 micro G or more
		(3)	Power	
			- Supply Voltage	DC 10 to 36 V or DC +/- 1 2V
			- Power Consumption	1.0 W (typical) or less
		(4)	Environmental	
			- Operating temperature	-10 to 60 °C
			- Case integrity	Robust and water proof (IP 67 or equivalent)
	2.2		Broadband Seismometer	
		(1)	Feedback:	Force feedback
		(2)	Performance	
			- Band width	-3 dB points at 120 sec and 145 Hz
			-Output sensitivity	2x 750 (V·s/m), 1200 to 1500 (V·s/m)
			-Peak/Full scale output	+/- 10 V differential selectable XYZ or UVW mode
			-Linearity	107 dB (horizontal) or more, 111 dB (vertical) or more
			-Lowest spurious resonance	140 Hz (vertical) or more
			-Dynamic range	140 dB (over the entire pass band) or more
		(3)	Calibration	
			-Type	Pulse, sine wave and broadband
		(4)	Interface	
			-Digital interface	RS-232C compatible serial IP On-board web server standard HTTP

No.			Item	Requirement
		(5)	Power	
			-Supply Voltage	DC 9 to 36 V
			-Power Consumption	1.0 W (typical) or less
			-Protection	Reverse-voltage and over-voltage protected and Self-resetting over-current protection
		(6)	Environmental	
			-Operating temperature	-20 to 50 °C
			-Case integrity	Robust and water proof (IP 67 or equivalent)
	2.3		Data Logger	
		(1)	Channel	6 channels
		(2)	Sampling rate	100 Hz or more
		(3)	Data format	SEEDLINK or WIN
		(4)	Data storage	720 hours or more
		(5)	External memory device	SD or CF
		(6)	Resolution A/D converter	24 bit
		(7)	Dynamic range	130 dB (at100 Hz) or more
		(8)	Communication port	LAN and Serial
		(9)	Date/Time correction	Using simple GPS
		(10)	Accessories	Simple GPS
		(11)	Input data format	To be specified.
		(12)	Output data format	Text file
		(13)	Power supply	DC 12 V +/- 2 V
	2.4		LAN Cable (for Connection to iGov. in Provincial Office)	
			- Category	5e
			-Length	Shall be provided between Data Logger and the existing LAN port
	2.5		Solar Power System (PV Module, Batteries, Charge Controller)	
		(1)	PV Module	
			- Voltage	DC 12 V
			- Capacity	Shall cover 100% of the total power consumption of whole system
		(2)	Battery	
			- Type	Sealed Lead Acid Battery
			- Voltage	DC 12 V +/- 2 V
			- Capacity	72 hours or more after the charge stop.
		(3)	Charge controller	
			- Function	Shall protect from over load and low voltage
		(4)	MCB	Shall be provided

No.			Item	Requirement
		(5)	Others	The frame which attaches PV module shall be the weather-proof which bears strong winds, such as steel (Hot dipped galvanizing) or stainless steel, and damage from salt water. Considered as the structure which protects PV module from the theft.
			- Power consumption	The power consumption of each equipment in the whole system shall be indicated.
	2.6		UPS (for VMGD Headquarters)	
			- Power Supply	Single phase AC 240 V 50 Hz
			- Capacity	Shall cover 100% of total power consumption of whole system.
			- Duration of power supply	2 hours or more
			- Remarks	The total power consumption of all equipment shall be specified.
	2.7		Format Converter (WIN format to Seedlink format)	
			- Conditions	In case that the output signals from the system are WIN format, it shall be changed into Seedlink Format at VMGD Head Office.
	2.8		Hub (for Connection to iGov. in Provincial Office)	
			-Number of port	4 ports or more
			-Interface	100BASE-T
3			**Automatic Weather Station (AWS)**	
			General	All meteorological instruments shall be approved by JMA inspection and attached certification.
	3.1		Actinometer	
			-Measuring Range	0 to 1,400 W/m^2 or more
			-Resolution	7 mV/ kW･m^2
			-Accuracy	0.5% or less
			-Operating temperature	5 to 40 °C
	3.2		Barometer	
			-Type	Electronic type
			-Measuring Range	800 to 1100hPa or more
			-Resolution	0.01 h Pa or less
			-Accuracy	+/- 0.2hPa or less
			-Operating temperature	5 to 40 °C
	3.3		Anemometer (Ultrasonic Type)	
			-Type	Ultrasonic type
		(1)	Wind direction	
			-Measuring Range	0 to 360°
			-Resolution	1° or less
			-Accuracy	+/-5° or less

No.			Item	Requirement
			-Operating temperature	5 to 40 °C
			-Setting height	10 m (above GL)
		(2)	Wind speed	
			-Measuring Range	0.3 to 60 m/s or more
			-Resolution	0.1 m/s or less
			-Accuracy	+/-0.3 m/s or less
			-Starting threshold	0.5 m/s or less
			-Operating temperature	5 to 40 °C
			-Setting height	10 m (above GL)
	3.4		Pluviometer	
			-Type	Tipping bucket
			-Resolution	0.5 mm
			-Measuring Range	100 mm/h or more
			-Accuracy	+/- 0.5 mm in case of 20mm/h or less +/- 3% in case of 20mm/h or more
			-Diameter	200 to 255 mm
			-Operating temperature	5 to 40 °C
	3.5		Thermometer	
			-Type	Electric type (Pt100)
			-Measuring Range	-10 to 60 °C
			-Resolution	0.01 °C or less
			-Accuracy	+/- 0.1 °C or less
			-Operating temperature	5 to 40 °C
	3.6		Hygrometer	
			-Type	Capacitance type
			-Measuring Range	0 to 100%
			-Resolution	0.1% or less
			-Accuracy	+/- 5% or less
			-Operating temperature	5 to 40 °C
	3.7		Data Logger with Lightening Arrester	
			-Sampling time	0.25 second or less
			-Input channel	16 channel or more
			-Statistics	Shall comply with JMA standard
			-Data storage	Statistic data (1min, 10min and hourly data)
			-External memory device	SD or CF
			-Display	Shall display all meteorological statistics
			-Date/ time correction	GPS
			-Lightening arrester	Shall protect Sensor cable, GPS cable and power cable.

No.			Item	Requirement
			-Battery	Floating charge, 12 V, 50 AH or more
			-Data transmission	Those statistic data shall be transmitted to VMGD Head Office
			- Extendibility	In case that the sensor is added (eight channels), the data sampling and the 1-minute value data file are extensible.
	3.8		LAN Cable (for Bauerfield Airport)	
			- Category	5e
			- Length	Shall be provided between Data Logger and the existing LAN port
	3.9		UPS (for Bauerfield Airport)	
			- Power Supply	Single phase AC 240 V 50 Hz
			- Capacity	Shall cover 100% of total power consumption of whole system.
			- Duration of power supply	2hours or more
			- Remarks	The total power consumption of all equipment shall be specified.
	3.10		Equipment Cabinet	
			-Degree of protection	IP 43 or equivalent
	3.11		Supporting Pole with Lightening Rod	
			-Type	Tiltable type
			-Height	10 m
			-Material	Aluminum or stainless steel
			-Lightning arrester	Lightning Rod and earthing
			-Function	Meteorological instruments shall be mounted on the Pole.
	3.12		Pole for Equipment Cabinet (for Bauerfield Airpor)	
			- Height	2 m
			- Material	Aluminum or stainless steel
			- Function	Shall mount meteorological instruments
	3.13		Hub (for Connection to iGov. in Met. Office)	
			-Number of port	4 ports or more
			-Interface	100BASE-T
	3.14		Monitoring PC and Software	
		(1)	Function	The observational data of the AWS is collected and processed.
		(2)	Display	17 inch
		(3)	CPU	Intel Core i7-2860QM Core or equivalent
		(4)	Memory	8 GB or more
		(5)	HDD	500 GB or more
		(6)	OS	Microsoft Windows (latest English version)

No.			Item	Requirement
	3.15		Data Collection System for VMGD Head Office	
			-Function	AWS observed data shall be collected and processed.
			-Display	42 inch or more
			-Software	Observed data shall be received via iGov. and displayed on the System. And statistic value (1 min, 10 min value, and 1 hourly value) shall be recorded in HDD.
			-Information to be monitored	Daily list and daily chart of 1 minute data and 10 minute data. Daily list and daily chart of 1 hour data and daily statistics. Monthly list and monthly chart of daily statistics and monthly statistics. Observation data distribution map and emphasizing extreme value which is beyond the threshold.
			-CPU	Intel Xeon ES-1660 or equivalent
			-Memory	16 GB or more
			-HDD	2.0 TB or more
			-OS	Linux or equivalent (latest English version)
			-Expandability	Shall support to add locations (stations) in future.
			-Data share	Shall enable the observed data to be viewable through internet.
	3.16		Assman Psychrometer for Thermometer Calibration	
			-Type	Asmann psychrometer
			-Measuring Range	-30 to 50 °C
			-Resolution	0.2 °C or less
			-Accuracy	+/- 0.3 °C or less
			-Function	Shall be VMGD’s carrying standard
	3.17		Digital Barometer for Barometer Calibration	
			-Type	Electronic type
			-Measuring Range	800 to 1100 hPa or more
			-Resolution	0.01 hPa or less
			-Accuracy	+/-0.2 hPa or less
			-Operating temperature	5 to 40 °C
			-Function	Shall be VMGD’s standard with RS-232C port complied with WMO regulation
	3.18		Buret for Pluviometer Calibration	
			- Capacity of buret	Equivalent to rainfall amount 50 mm
			- Rainfall intensity	Variable setting from 20 mm/h to 80 mm/h
			- Capacity error	Shall be less than 0.5 mm rainfall amount

No.			Item	Requirement
4			**GTS Server and MSS**	
	4.1		GTS Server and Software	
		(1)	GTS server	
			-CPU	Intel Xeon ES-1660 or equivalent
			-Memory	16 GB or more
			-HDD	2.0 TB or more
			-OS	Linux or equivalent (latest English version)
			-Display	42 inch or more
		(2)	Connection equipment to GTS links	
			- Basic software	Control software for GTS communication
				Monitoring software for MSS
				Processing software for domestic data
				Monitoring software for meteorological information
				Utility software for data browsing
			- Basic performance	Data receiving and transmitting
				Data handling
				Message routing performance
				Database management and access control
				Client service
				Data monitoring
				Data listing and plotting
				Data and software maintenance
	4.2		MSS Control Terminal and Software	
		(1)	MSS terminal	
			-CPU	Intel Core i7-2860QM Quad core or equivalent
			-Memory	4 GB or more
			-HDD	500 GB or more
			-OS	Microsoft Windows (latest English version)
			-Display	17 inch or more
		(2)	Connection equipment to GTS links	
			- Basic software	Control software for GTS communication
				Monitoring software for MSS
				Processing software for domestic data
				Monitoring software for meteorological information
				Utility software for data browsing
			- Basic performance	Data receiving and transmitting
				Data handling
				Message routing performance

No.			Item	Requirement
				Database management and access control
				Client service
				Data monitoring
				Data listing and plotting
				Data and software maintenance
	4.3		Meteorological Data I/O Terminal	Specification shall be as same as MSS Control Terminal and Software
	4.4		Forecaster Terminal PC	Specification shall be as same as MSS Control Terminal and Software
	4.5		Router and Hub	
			- Type	Shall be CISCO product specified by WMO
			- IOS version	Shall be more than 15.1
			- Security	Fill inspection firewall

2) Measuring instruments and tools for maintenance

Measuring instruments and tools for maintenance are not included within the Project components.

3) Replacement parts and expendables

Replacement parts and expendables are not included within the Project components.

2-2-3 Outline Design Drawings

The draft basic design drawings of the equipment targeted in the Project are indicated below. [Drawings are attached in the Appendix "Outline Design Drawings"].

Dwg no	Dwg Title
G-01	Location Map of the Project Sites
SY-01	System Diagram of Tide Observation Network
SY-02	Block Diagram of Tide Observation System
LT-01	Location of the Site and Survey Photos of Litzlitz, Malakula
LT-02	Location of the Site and Survey Photos of Lenakel, Tanna
SY-03	System Diagram of Strong Motion Accelerometer and Broadband Station Network
SY-04	Block Diagram of Strong Motion Accelerometer and Broadband Station System
DSB-01	Design of Shed for Strong Motion Accelerometer and Broadband Station System
LSB-01	Location of the Site and Survey Photos of Lakatoro, Malakula
LSB-02	Location of the Site and Survey Photos of VMGD, Efate
LSB-03	Location of the Site and Survey Photos of Isangel, Tanna
SY-05	System Diagram of Automatic Weather Station (AWS) Network
SY-06	Block Diagram of AWS Network System
LA-01	Location of the Site and Survey Photos of Pekoa Airport, Espiritu Santo
LA-02	Location of the Site and Survey Photos of Bauerfield Airport, Efate
SY-07	System Diagram of GTS Server and MSS System

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project will be implemented based on the Government of Japan's Grant Aid scheme. Therefore, after the Government of Japan has given approval for Project implementation and the Exchange of Notes (E/N) has been conducted between the Government of Japan and Government of Vanuatu, the Grant Agreement (G/A) will be signed between the Japan International Cooperation Agency (JICA) and the Ministry of Climate Change Adaptation, Geohazards, Meteorology and Energy, which is the responsible agency and the Project will be implemented. (However, due to the urgency of this project, the E/N and G/A have been concluded parallel with the outline design with the Ministry of Infrastructure and Public Utilities, which was the responsible agency at that time). The Procurement Agent will be recommended by the Government of Japan to the Vanuatu side, and will bind a procurement agency agreement with the responsible agency, under which it will act as the agent for the responsible agency in implementing the Project work to ensure that the Project (tender and equipment procurement) is appropriately and smoothly executed. The Project is implemented in accordance with the Basic Guidelines for Reconstruction in Response to the Great East Japan Earthquake. Therefore, the plan is to mainly procure Japanese products from areas affected by the Great East Japan Earthquake; however, to concern the procurement policy of cooperation with the ASEAN countries and South Pacific countries for construction of international disaster prevention network. In case that the Project has a remaining budget as the result of the tender, it was confirmed with VMGD that the following additional procurement may be considered:

- The remaining budget is large: Procurement of AWS by the priority below,
  ①Norsup Airport in Malakula
  ②Whitegrass Airport in Tanna
- The remaining budget is small: Emergency spare parts, replacement parts, maintenance tools, etc.

The following paragraphs describe the basic items and points requiring particular consideration when Project is implemented.

(1) Responsible and Implementing Agency

VMGD is the implementing agency on the Vanuatu side of the Project and organize the Consultative Committee. Therefore, in order to smoothly advance the Project, it will be necessary for VMGD as the implementing agency to conduct close communications and discussions with the Japanese Consultant and contractor, and appoint a person who is responsible for the Project.

(2) Procurement Agent

In implementing the procurement work for the Project, the Procurement Agent will conclude an Agency Agreement (A/A) with the Ministry of Climate Change Adaptation, Geohazards,

Meteorology and Energy, which is the responsible agency. In general, the Procurement Agent will implement the tender and procurement management work. This includes fund management such as transfer of funds, signing of contracts and making of payments to the Consultant and Contractor on behalf of the implementing agency.

(3) Consultant

To smoothly implement the procurement and installation of equipment, the Japanese Consultant will conclude a consultant agreement with the procurement agency and implement the Project tender work and consultant supervision.

(4) Contractor

In accordance with Japan's Grant Aid scheme, the Japanese contractor that has been selected by open tender will implement the Project equipment and materials procurement, installation works and initial operation guidance. Moreover, after completion of the Project, since it will be necessary to continue supplying spare parts and conducting post-installation service to resolve breakdowns and so on, it will be necessary to establish a liaison setup with VMGD after the handover of equipment and materials.

(5) Necessity for Dispatch of Engineers

VMGD employees have learned the operation and maintenance techniques for existing equipment and have no particular technical difficulties in maintaining it. However, since high-level techniques will be required for installing the Project equipment and conducting adjustment and testing after installation, it will be necessary to dispatch engineers from Japan to conduct quality control, technical guidance and schedule control. Moreover, because VMGD employees are inexperienced in operating and maintaining Japanese manufactured equipment, it will be necessary for Japanese engineers dispatched from the manufacturer of the equipment to conduct technical guidance on the operation and maintenance.

2-2-4-2 Implementation Conditions

(1) Procurement Situation

In Vanuatu it is possible to secure workers (laborers) to take part in the installation works; however, there are few skilled operators or engineers who are experts in technology like process, quality and safety controlling. Therefore, it will be necessary for the Japanese contractor to dispatch engineers and skilled operators to Vanuatu when it deems necessary.

(2) Utilization of Local Materials

In planning of the installation work of the Project, locally procurable materials shall be adopted as much as possible. However, since the possibility that locally produced aggregate

(Limestone) for concrete does not meet the JIS standard, is high and for this reason, aggregate made of basalt which imported from neighboring countries such as Fiji but procurable in Vanuatu shall be used.

2-2-4-3 Scope of Works

Table 2-2-9 shows the scope of works on the Japanese and Vanuatu sides

Table 2-2-9 The Work Demarcation of the Project

No.	Undertakings	To be covered by		Notes
		Japan	Vanuatu	
A	**Common to All Components**			
1*	Obtaining of permission from the owners of the land (hereinafter referred to as "the Project sites") for the installation of the Equipment		○	Completed in November 2013.
2*	Levelling, bush clearing and removal of obstacles in the Project sites		○	To be completed before the Installation Work of the Equipment
3*	Obtaining of permission from the Government of Vanuatu for the use of the iGov. Towers, frequencies (5.8GHz) and satellites for data transmission		○	Completed in September 2013.
4*	Preparation of Access road to the Project sites, if necessary		○	
5	Ensuring the required power supply for operation of the Equipment		○	To be completed before the Installation Work of the Equipment
6*	Clearing of necessary procedures for social and environmental considerations and obtain an approval of environmental related regulations by relevant authorities before the commencement of the procurement of the equipment, if required		○	To be completed **by December 2013.**
7	Obtaining of the following permits for the Japanese Consultant and Supplier, if necessary: - Permits required for the Installation Work - Permits to access to airport and other restricted areas		○	The Japanese side shall submit passport information of each member to VMGD before dispatching to Vanuatu.
8	Procurement of the Equipment	○		"The Equipment" is defined as the equipment and materials to be provided by the Japanese Supplier under the Project.
9*	Transportation of the Equipment, customs procedures and tax procedures			
	(1) Marine/air transportation to a port of disembarkation in Vanuatu	○		
	(2) Procedures for tax exemption		○	The Japanese Supplier shall submit application to Custom and Inland Revenue (CIR) through VMGD.
	(3) Procedures for customs clearance at the port of disembarkation		○	
	(4) Internal transportation from the port of disembarkation to the Project sites	○		
	(5) Exemption or payment of value-added tax (VAT) on locally procured items		○	
10	Securing of land of temporary material storage yard		○	
11	Installation of the Equipment, Adjustment and Testing	○		

No.	Undertakings	To be covered by		Notes
		Japan	Vanuatu	
12*	Installation of security fences and gates in and around the Project sites and Guardhouse, if necessary		○	
13	Provision of trainings for Initial operation and maintenance of the Equipment	○		
14	Assuring security for personnel in the Project sites, when necessary		○	
15*	Allocation of necessary staff and budget for operation and maintenance of the Equipment		○	
16	Providing of security to the Equipment and Project sites.		○	
17*	Proper disposing of spent batteries		○	
18*	Payment of bank commissions to the Japanese bank for banking services based upon the Banking Arrangement		○	
19*	Bearing of all the expenses, other than those covered by the Grant and its accrued interest, necessary for the implementation of the Project		○	
20*	Periodical cleaning of the Equipment and the Project sites		○	Especially Solar Power System should be cleaned every month at least.
21*	Publishing positive results through the observed data and information provided by the equipment procured under the Japan's Grant Aid Project		○	
22*	Secure the budget for travel cost to the Project sites for VMGD's staffs during the Implementation stage including accommodation and allowances		○	
B	**Tide Observation System**			
1*	Application to use Data Collection Platform (DCP) to Japan Meteorological Agency (JMA)		○	To be completed **by July 2014.** The Supplier shall provide VMGD the detail specifications of the exact model to be required for the application.
2*	Obtaining of agreement letter from the owner of the land to VMGD for the installation of the equipment, fee, security and method of maintenance of the land, including the Building Permit if necessary		○	Completed in November 2013, For T-1 Litzlitz, Malakula; Issued by Malampa Provincial Government. For T-2 Lenakel, Tanna; Issued by Lenakel Stevedoring Company.
3	[T-1 Litzlitz, Malakula] Obtaining of permission from the Government of Vanuatu for the installation of the diversity wireless LAN on the iGov. Tower and the use of the existing LAN ports		○	Completed in September 2013. The installation of the diversity wireless LAN shall be done by the Japanese Supplier.
4*	[T-2 Lenakel, Tanna] Obtaining of permission from Telecom Vanuatu Ltd. (TVL) for the installation of wireless LAN equipment on the TVL tower		○	Completed in October 2013. Size: Approx. 0.5m x 0.5m x 2pcs Weight: Approx. 10kg x 2pcs Setup fee: 50,000 Vt Hosting fee: 50,000 Vt/month The installation of the wireless LAN equipment shall be done by the Japanese Supplier.
5*	[T-2 Lenakel, Tanna] Obtaining of permission from CREST FM Station for the installation of UPS		○	Completed in October 2013. The installation of the UPS shall be done by the Japanese Supplier.

No.	Undertakings	To be covered by		Notes
		Japan	Vanuatu	
6*	[T-2 Lenakel, Tanna] Obtaining of permission from Tafea Provincial Government for the installation of the antenna mast, wireless LAN equipment and hub and the use of the existing LAN ports		○	Completed in October 2013. The installation of the antenna mast and hub shall be done by the Japanese Supplier.
7*	Ensuring the power supply for the operation of the following equipment:			
	[T-1 Litzlitz, Malakula] For the diversity wireless LAN to be installed on the iGov. Tower (DC 48V, 20W)		○	To be completed **by December 2014**.
	[T-2 Lenakel, Tanna] For UPS to be installed at CREST FM Station (AC 240V)		○	To be completed **by December 2014.** Setup of kWh meter: 30,000 Vt Electricity charge: 10,000 Vt/month
	[T-2 Lenakel, Tanna] For wireless LAN equipment and hub to be installed at Tafea Provincial Government office (AC 240V)		○	To be completed **by December 2014**.
8	Procurement and installation of Data Collection System at VMGD Head Office	○		
9	Connection between the existing Message Switching System (MSS) and new Data Collection System		○	
10	Sharing observed data with relevant authorities through internet		○	
11	Real time data request of the existing tide gauge equipment in Port Vila and Luganville to BOM		○	
12	Obtaining of the following information of the existing Bench Mark of the Project sites: - Latitude and Longitude - Above sea level		○	To be completed **by December 2014**.
C	**Strong Motion Accelerometer and Broadband Station System**			
1*	Obtaining of agreement letter from the owner of the land to VMGD for the installation of the equipment, fee, security and method of maintenance of the land, including the Building Permit if necessary		○	Completed in November 2013. For SB-1 Lakatoro, Malakula; Issued by Malampa Provincial Government. For SB-3 Isangel, Tanna; Issued by Tafea Provincial Government.
2*	Obtaining of permission for the installation of a hub in the Provincial offices, the use of the existing LAN ports and power supply for the hub (AC 240V)		○	Completed in November 2013. The installation of the hub shall be done by the Japanese Supplier.
3	Construction of a shed for the installation of the system	○		
4	Connection to the existing seismic server at VMGD Head Office and registration of new locations		○	To be completed during the Installation Work of the Equipment.
D	**Automatic Weather Station (AWS)**			
1*	Obtaining of permission from Airports Vanuatu Ltd. to VMGD for the installation of the equipment, power supply to UPS (AC 240V) and the use of the existing LAN ports in the Met. Offices		○	Completed in October 2013. The installation of the UPS shall be done by the Japanese Supplier.

No.	Undertakings	To be covered by		Notes
		Japan	Vanuatu	
2	Procurement and installation of Data Collection System at VMGD Head Office	○		
E	**GTS Server and MSS**			
*	Uploading observed data and information to GTS (Global Telecommunication System) operated by WMO (World Meteorological Organization) for sharing those data and information with international organizations, Japan and neighbouring countries		○	

Note: ○ indicates the scope of works. Items marked with * are described in the "Minutes of Discussion."

2-2-4-4 Consultant Supervision

(1) Basic Policy of Consultant Supervision

The Procurement Agent will organize a project team to smoothly implement the tender work and consultant supervision according to the Japan's Grant Aid guidelines and the design. Moreover, the Consultant will dispatch expert engineers in line with the progress of equipment installation, testing and adjustment works, and it will instruct and supervise the contractor and strive to ensure that schedule control, quality control, progress management and safety management are as planned. It will also have the duty of implementing pre-shipping inspections and preventing troubles after the delivery of the equipment. The following paragraphs describe the important points to consider in the procurement supervision.

1) Schedule control

The Consultant will compare progress with the implementation schedule specified in the contract every month or every week to ensure that the contractor adheres to the delivery deadline given in the contract. When delays are predicted, the Consultant will report to the procurement agency, caution the contractor, demanding the submission and implementation of a plan of countermeasures. The comparison of the planned schedule and actual progress will be carried out according to the following items:

① Confirmation of works performance (manufacture of equipment in plant and shipping)

② Confirmation of equipment delivery

③ Confirmation of yield and actual numbers of engineers, skilled workers and laborers, etc.

2) Quality and performance control

The Consultant will carry out supervision of quality and performance based to ensure the procured equipment satisfies the required quality and performance stated in the contract

documents. When doubts arise over quality and performance, the Consultant will immediately conduct a proper guidance to the Supplier. The supervision will be conducted based on the following items:

① Checking of the equipment specifications

② Checking of the shop drawings and specifications of the equipment

③ Attendance of plant inspections of equipment and checking of plant inspection results

④ Checking of the installation guidelines

⑤ Checking of trial operation, adjustment, test and inspection guidelines of equipment

⑥ Supervision of the equipment site installation works and attendance of trial operations, adjustments, tests and inspection

3) Labor supervision

The Consultant will hold ample discussions with the safety officers of the contractor to prevent industrial accidents and accidents affecting third parties on the works sites during the construction period. Important points to consider in safety control on the ground are:

① Establishment of safety control regulations and appointment of manager

② Planning of the works vehicles and construction machinery operating routes and thorough enforcement of safe driving

③ Encouragement of laborers to utilize welfare measures and vacations

(2) Contractor

The contractor will procure and deliver the equipment and implement the installation works. Since the contractor will need to thoroughly ensure that subcontractors comply with the works schedule, quality, performance and safety measures prescribed in the contract, it will dispatch engineers who have experience of similar projects in overseas countries to provide guidance and education on the ground. Figure 2-2-13 shows the mutual relationships between Project parties.

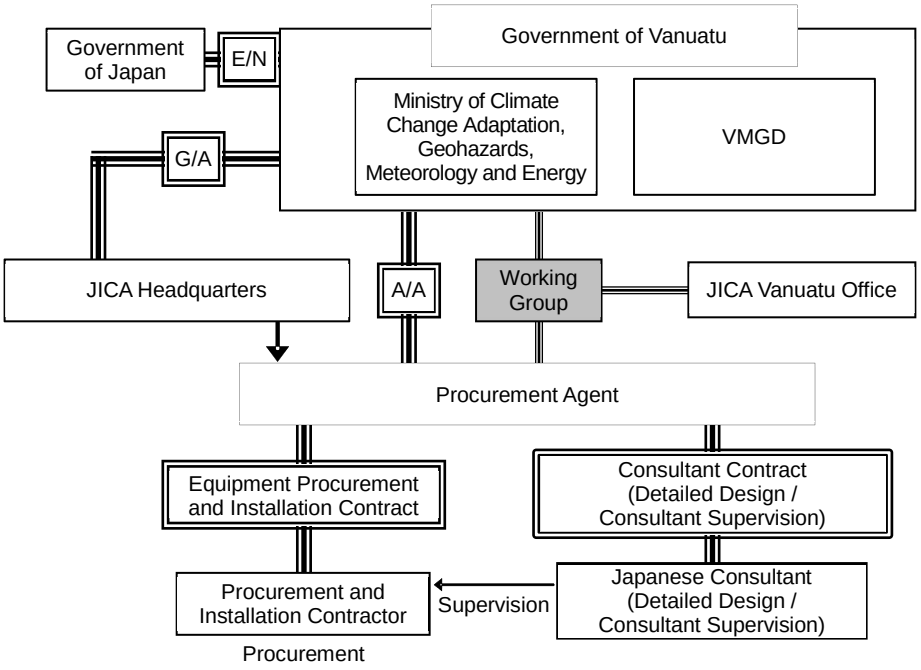


Figure 2-2-13 Project Implementation Relationships

The Consultative Committee will be organized to coordinate and solve problems, etc., that arise during the implementation of the Project with the Ministry of Climate Change Adaptation, Geohazards, Meteorology and Energy, which is the responsible agency, the Embassy of Japan in Fiji, JICA and the Procurement Agent. The committee will be organized by VMGD which is the implementing agency.

2-2-4-5 Quality Control Plan

The Consultant will conduct plant pre-shipping inspections to make sure that the procured equipment complies with the technical specifications, dimensions, functions, electrical and mechanical characteristics, etc., that are specified in the tender documents. Moreover, on completion of the installation works, it will conduct handover inspections to confirm that the installed equipment operates and functions normally.

2-2-4-6 Procurement Plan

Since the Project will be implemented based on the Basic Policy for Reconstruction from the Great East Japan Earthquake, equipment will basically be procured from Japan, and some of items will comprise products and parts made from the disaster-affected area. However, equipment which is not available to procure from Japan will be procured from local or third countries.

2-2-4-7 Operational Guidance Plan

VMGD has so far experienced no particular technical difficulties in operating and maintaining existing equipment including telecommunications and measuring equipment. However, the equipment of the Project is procured mainly in Japan, and the local side has limited experience in operating and maintaining of such products. Therefore, it will be necessary to dispatch engineers from Japan in

order to conduct initial operational guidance on how to operate the equipment, conduct troubleshooting and implement routine inspections following the installation, testing and adjustment of the equipment.

2-2-4-8 Soft Component Plan

The following paragraphs briefly describe the soft component plan. For details, refer to the soft component plan in the annex of this report.

(1) Soft Component Plan and Background

The Japanese engineers dispatched from manufacturer of the equipment will conduct technology transfer to VMGD on how to operate and maintain the Project equipment via initial operation guidance and maintenance inspection guidance. However, as VMGD has strongly requested for training in basic know-how concerning tsunami observation and technology for analyzing observation data, technology transfer will be conducted via the soft component. VMGD employees already possess basic know-how on meteorological and oceanographic affairs and the technical capability to operate, maintain and inspect existing tidal gauges. They also have the technical ability to run a homepage. Therefore, VMGD is considered to have enough human resources for operating and maintaining, and the training will focus on effectively utilizing the procured equipment.

(2) Soft Component Goals

The soft component aims to enable VMGD employees to understand the characteristics of data obtained from tidal gauges and acquire the basic know-how for contributing to disaster prevention. It is also to enable observation data including tidal data obtained via the VMGD website to be widely transmitted.

(3) Outputs of the Soft Component

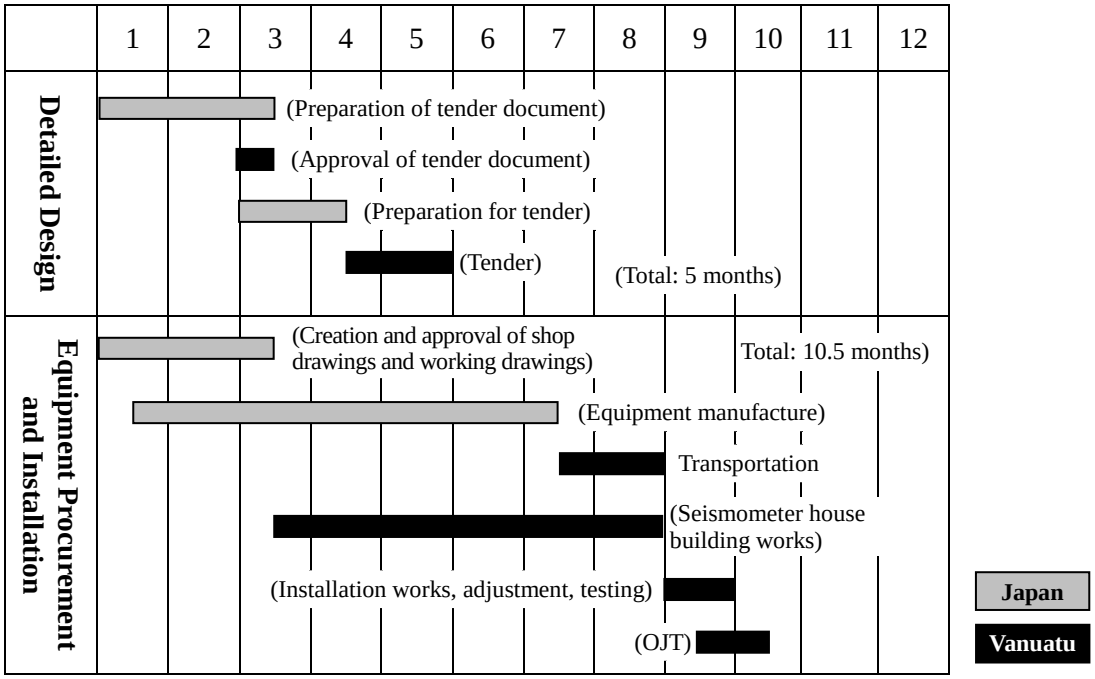
It is anticipated that the following outputs will be realized through implementation of the soft component.

- Basic know-how concerning oceanographic phenomenon and tidal gauges will be acquired, enabling useful disaster prevention information to be obtained from observation data.
- Observation data from tidal gauges will be subject to appropriate quality control and be appropriately edited and stored.
- The environment for appropriately analyzing observation data from tidal gauges and utilizing it for disaster prevention will be established.
- Through building a website, an environment to allow tidal observation data to be shared among disaster prevention agencies and in the international community will be prepared.

2-2-4-9 Implementation Schedule

Based on the Government of Japan's Grant Aid guidelines, the following implementation schedule has been adopted. The time required for the Project including the implementation design will be 14.5 months.

Table 2-2-10 Project Implementation Schedule



2-3 Obligations of Recipient Country

Whereas the Japanese side will conduct the procurement and installation of equipment, the Vanuatu side will carry out the removal of existing equipment and so on that is required to implement the said works. The items to be borne by the Vanuatu side are indicated in Table 2-3-1.

Table 2-3-1 Obligations of Recipient Country

No.	Undertakings	Notes
A	**Common to All Components**	
1	Obtaining of permission from the owners of the land (hereinafter referred to as "the Project sites") for the installation of the Equipment	Completed in November 2013.
2	Levelling, bush clearing and removal of obstacles in the Project sites	To be completed before the Installation Work of the Equipment
3	Obtaining of permission from the Government of Vanuatu for the use of the iGov. Towers, frequencies (5.8GHz) and satellites for data transmission	Completed in September 2013.
4	Preparation of Access road to the Project sites, if necessary	
5	Ensuring the required power supply for operation of the Equipment	To be completed before the Installation Work of the Equipment

No.	Undertakings	Notes
6	Clearing of necessary procedures for social and environmental considerations and obtain an approval of environmental related regulations by relevant authorities before the commencement of the procurement of the equipment, if required	To be completed **by December 2013.**
7	Obtaining of the following permits for the Japanese Consultant and Supplier, if necessary: - Permits required for the Installation Work - Permits to access to airport and other restricted areas	The Japanese side shall submit passport information of each member to VMGD before dispatching to Vanuatu.
8	Transportation of the Equipment, customs procedures and tax procedures	
	(1) Procedures for tax exemption	The Japanese Supplier shall submit application to Custom and Inland Revenue (CIR) through VMGD.
	(2) Procedures for customs clearance at the port of disembarkation	
	(3) Exemption or payment of value-added tax (VAT) on locally procured items	
9	Securing of land of temporary material storage yard	
10	Installation of security fences and gates in and around the Project sites and Guardhouse, if necessary	
11	Assuring security for personnel in the Project sites, when necessary	
12	Allocation of necessary staff and budget for operation and maintenance of the Equipment	
13	Providing of security to the Equipment and Project sites.	
14	Proper disposing of spent batteries	
15	Payment of bank commissions to the Japanese bank for banking services based upon the Banking Arrangement	
16	Bearing of all the expenses, other than those covered by the Grant and its accrued interest, necessary for the implementation of the Project	
17	Periodical cleaning of the Equipment and the Project sites	Especially Solar Power System should be cleaned every month at least.
18	Publishing positive results through the observed data and information provided by the equipment procured under the Japan's Grant Aid Project	
19	Secure the budget for travel cost to the Project sites for VMGD's staffs during the Implementation stage including accommodation and allowances	
B	**Tide Observation System**	
1	Application to use Data Collection Platform (DCP) to Japan Meteorological Agency (JMA)	To be completed **by July 2014.** The Supplier shall provide VMGD the detail specifications of the exact model to be required for the application.
2	Obtaining of agreement letter from the owner of the land to VMGD for the installation of the equipment, fee, security and method of maintenance of the land, including the Building Permit if necessary	Completed in November 2013, For T-1 Litzlitz, Malakula; Issued by Malampa Provincial Government. For T-2 Lenakel, Tanna; Issued by Lenakel Stevedoring Company.
3	[T-1 Litzlitz, Malakula] Obtaining of permission from the Government of Vanuatu for the installation of the diversity wireless LAN on the iGov. Tower and the use of the existing LAN ports	Completed in September 2013. The installation of the diversity wireless LAN shall be done by the Japanese Supplier.

No.	Undertakings	Notes
4	[T-2 Lenakel, Tanna] Obtaining of permission from Telecom Vanuatu Ltd. (TVL) for the installation of wireless LAN equipment on the TVL tower	Completed in October 2013. Size: Approx. 0.5m x 0.5m x 2pcs Weight: Approx. 10kg x 2pcs Setup fee: 50,000 Vt Hosting fee: 50,000 Vt/month The installation of the wireless LAN equipment shall be done by the Japanese Supplier.
5	[T-2 Lenakel, Tanna] Obtaining of permission from CREST FM Station for the installation of UPS	Completed in October 2013. The installation of the UPS shall be done by the Japanese Supplier.
6	[T-2 Lenakel, Tanna] Obtaining of permission from Tafea Provincial Government for the installation of the antenna mast, wireless LAN equipment and hub and the use of the existing LAN ports	Completed in October 2013. The installation of the antenna mast and hub shall be done by the Japanese Supplier.
7	Ensuring the power supply for the operation of the following equipment:	
	[T-1 Litzlitz, Malakula] For the diversity wireless LAN to be installed on the iGov. Tower (DC 48V, 20W)	To be completed **by December 2014**.
	[T-2 Lenakel, Tanna] For UPS to be installed at CREST FM Station (AC 240V)	To be completed **by December 2014.** Setup of kWh meter: 30,000 Vt Electricity charge: 10,000 Vt/month
	[T-2 Lenakel, Tanna] For wireless LAN equipment and hub to be installed at Tafea Provincial Government office (AC 240V)	To be completed **by December 2014**.
8	Connection between the existing Message Switching System (MSS) and new Data Collection System	
9	Sharing observed data with relevant authorities through internet	
10	Real time data request of the existing tide gauge equipment in Port Vila and Luganville to BOM	
11	Obtaining of the following information of the existing Bench Mark of the Project sites: - Latitude and Longitude - Above sea level	To be completed **by December 2014**.
C	**Strong Motion Accelerometer and Broadband Station System**	
1	Obtaining of agreement letter from the owner of the land to VMGD for the installation of the equipment, fee, security and method of maintenance of the land, including the Building Permit if necessary	Completed in November 2013. For SB-1 Lakatoro, Malakula; Issued by Malampa Provincial Government. For SB-3 Isangel, Tanna; Issued by Tafea Provincial Government.
2	Obtaining of permission for the installation of a hub in the Provincial offices, the use of the existing LAN ports and power supply for the hub (AC 240V)	Completed in November 2013. The installation of the hub shall be done by the Japanese Supplier.
3	Connection to the existing seismic server at VMGD Head Office and registration of new locations	To be completed during the Installation Work of the Equipment.
D	**Automatic Weather Station (AWS)**	
	Obtaining of permission from Airports Vanuatu Ltd. to VMGD for the installation of the equipment, power supply to UPS (AC 240V) and the use of the existing LAN ports in the Met. Offices	Completed in October 2013. The installation of the UPS shall be done by the Japanese Supplier.
E	**GTS Server and MSS**	
	Uploading observed data and information to GTS (Global Telecommunication System) operated by WMO (World Meteorological Organization) for sharing those data and information with international organizations, Japan and neighbouring countries	

2-4 Project Operation Plan

2-4-1 Operation Setup

The Equipment to be procured under the Project has neither moving parts nor consumables. Since the tide observation system includes a lightning rod, the surge absorber will need to be replaced, and so will the batteries used in the solar power systems used as the power sources for each system. In the Project, it will be necessary for VMGD, which will manage the meteorological observation instruments, to procure spare parts based on a maintenance plan in order to fulfill its role as a meteorological agency. Moreover, since the equipment will be installed in harsh natural environments such as outside, in consideration of deterioration over time and the need for model changes of units and peripheral equipment including transmission systems and solar power systems, it will be necessary to renew the equipment after 10 years or so. Therefore, the maintenance plan for the Project equipment will incorporate periodic renewals as shown in Table 2-4-1. In addition, the cost of equipment maintenance plan as shown in Table 2-4-1 is financed by budget from the Vanuatu government.

Table 2-4-1 Equipment Maintenance Plan (Vt)

Replacement interval	Target parts
3 years	Solar panel batteries (100,000Vt×6sets≒800,000Vt)
When damaged	Lightning arrester absorbers, fuses (400,000Vt)
After 10 years	Seismometers, tidal gauges, etc. (300,000,000Vt)

2-4-2 Routine Inspections

Thanks to recent technical innovations, electronic instruments have become more reliable and durable, and reduction in the number of component parts has contributed to lowering frequency of equipment difficulties. Due to this, maintenance inspection intervals are becoming longer in Japan. However, for agencies that do not have the financial freedom to conduct frequent equipment upgrades, it is important to implement routine and periodic inspections without fail to ensure that equipment can be effectively utilized over long period of time. Therefore, it will be necessary to compile the minimum required maintenance criteria for routine inspections and periodic inspections and develop a setup for preventing equipment failures. VMGD currently encounters no difficulties in operating its existing meteorological, oceanographic and terrestrial phenomena observation instruments and it possesses the minimum equipment required to conduct inspections. Table 2-4-2 shows the routine inspection and periodic inspection items for the Project equipment and the measuring instruments that are needed for inspections.

Table 2-4-2 Equipment Inspection Items and Necessary Instruments

Inspection Contents	Inspection Item	ry Measuring Instrument
Routine inspection and pre-work inspection	Visual inspection of meters and failure displays, etc.	—
	Visual inspection of connections	Tool set
	Voltage measurement of power source, etc.	Tester
1 year inspection (characteristics inspection)	Tide level	Scales

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

This section is closed due to confidentiality.

2-5-2 Operation and Maintenance Cost

In order to be soundly operated by VMGD into the future, it will need to renew the procured equipment in the Project at appropriate intervals. Therefore, it will need to formulate a maintenance plan that incorporates not only the maintenance cost for new and existing equipment but also the cost of periodic equipment upgrading.

2-5-2-1 Setting Conditions

Conditions for estimating operating expenditure and revenue have been set as follows.

(1) Expenditure

The procured equipment in the Project will go into operation from 2015, and annual expenditure will be estimated assuming that funds will be secured for the target year of 2025 (10 years). The original capital for the reserve fund will come from government subsidies. Table 2-5-1 shows the other expenditure items and method for setting the budget.

Table 2-5-1 Budget Setting

(Unit: Vt)

Operating Expenditure Item	Budget Setting Method	Necessary Budget
Salaries	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	63,369,845
Allowances	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	13,338,001

Operating Expenditure Item	Budget Setting Method	Necessary Budget
Business trip expenses	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	3,072,548
Training costs	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	890,370
Vehicle costs	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	3,319,951
Communications costs	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	6,207,073
Welfare expenses	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	1,480,852
Maintenance costs	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. Also, reflect the contents of the recommended replacement parts shown in 3-4-2 to the equipment investment cost shown in the financial statements.	613,880
Equipment costs	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	8,388,678
Research and development costs	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	1,142,988
Spare parts purchase costs	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. This increases by 10% per years.	2,577,611
General administration costs	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	3,578,162
Utilities expenses	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	7,832,393

Operating Expenditure Item	Budget Setting Method	Necessary Budget
VAT	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	4,604,004
Facilities construction costs	The mean expenditure amount for the past 5 years (2008-2012) will be adopted. (Concerning the forecast indicator, it is intended to limit the rate of increase to around 3.0% per year while considering the projected GDP for Vanuatu of 5.1%. IMF, 2011)	8,000,000 (from 2016)

(2) Revenue

All revenue will be obtained from government subsidies.

Table 2-5-2 Annual Revenue

(Unit: Vt)

Revenue Item	Setting Method	Revenue (Annual)
Central government	Calculated from mean expenditure between 2008~2012	About 120,416,355

2-5-2-2 Results of Estimation

Table 2-5-3 shows the revenue and expenditure balance for 10 years up to the upgrading of equipment based on the aforementioned setting conditions. It is assumed a reserve fund for upgrading equipment can be secured in 2020.

Table 2-5-3 Projected Revenue and Expenditure Balance

VMGD (Unit: VT)

		Project completion	1	2	3	4	5	6	7	8	9	10
No.	Item	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
A	Total Budget	120,416,355	162,282,944	166,534,624	172,146,409	175,706,994	180,492,817	186,671,198	190,833,940	196,260,974	203,123,540	208,017,855
	Budget	120,416,355	162,282,944	166,534,624	172,146,409	175,706,994	180,492,817	186,671,198	190,833,940	196,260,974	203,123,540	208,017,855
B	Total Expenses	120,416,355	132,282,944	136,534,624	142,146,409	145,706,994	150,492,817	156,671,198	160,833,940	166,260,974	173,123,540	178,017,855
1	Wages	63,369,845	65,270,941	67,229,069	69,245,941	71,323,319	73,463,019	75,666,909	77,936,917	80,275,024	82,683,275	85,163,773
2	Allowances	13,338,001	13,738,141	14,150,285	14,574,794	15,012,038	15,462,399	15,926,271	16,404,059	16,896,181	17,403,066	17,925,158
3	Travel	3,072,548	3,164,724	3,259,666	3,357,456	3,458,180	3,561,925	3,668,783	3,778,846	3,892,212	4,008,978	4,129,247
4	Workshops	890,370	917,081	944,593	972,931	1,002,119	1,032,182	1,063,148	1,095,042	1,127,894	1,161,730	1,196,582
5	Vehicles Fuel	3,319,951	3,419,550	3,522,136	3,627,800	3,736,634	3,848,733	3,964,195	4,083,121	4,205,615	4,331,783	4,461,737
6	Communications	6,207,073	6,393,285	6,585,083	6,782,636	6,986,115	7,195,698	7,411,569	7,633,916	7,862,934	8,098,822	8,341,787
7	Medical Treatment	1,480,852	1,525,278	1,571,036	1,618,167	1,666,712	1,716,714	1,768,215	1,821,261	1,875,899	1,932,176	1,990,142
8	Repairs & Maintenance	613,880	705,962	811,856	2,133,635	1,253,680	1,441,732	2,857,992	2,086,691	2,399,694	3,959,648	3,353,595
9	Equipment -	8,388,678	8,640,338	8,899,548	9,166,535	9,441,531	9,724,776	10,016,520	10,317,015	10,626,526	10,945,322	11,273,681
10	Research & Development	1,142,988	1,177,278	1,212,596	1,248,974	1,286,444	1,325,037	1,364,788	1,405,732	1,447,904	1,491,341	1,536,081
11	Maintenance Parts	2,577,611	2,835,372	3,118,909	3,430,800	3,773,880	4,151,268	4,566,394	5,023,034	5,525,337	6,077,871	6,685,658
12	Subsistence Allowances	3,578,162	3,685,507	3,796,072	3,909,955	4,027,253	4,148,071	4,272,513	4,400,688	4,532,709	4,668,690	4,808,751
13	Gas Electricity Utilities	7,832,393	8,067,365	8,309,386	8,558,667	8,815,427	9,079,890	9,352,287	9,632,855	9,921,841	10,219,496	10,526,081
14	Value Added Tax	4,604,004	4,742,124	4,884,388	5,030,919	5,181,847	5,337,302	5,497,421	5,662,344	5,832,214	6,007,181	6,187,396
15	Buildings - Houses -	0	8,000,000	8,240,000	8,487,200	8,741,816	9,004,070	9,274,193	9,552,418	9,838,991	10,134,161	10,438,185
C	Total balance (A – B)	0	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000
D	Reserve Fund	0	30,000,000	60,000,000	90,000,000	120,000,000	150,000,000	180,000,000	210,000,000	240,000,000	270,000,000	300,000,000

CHAPTER 3 PROJECT EVALUATION

CHAPTER 3 PROJECT EVALUATION

3-1 Preconditions

- The scope of works on the Vanuatu side as shown in Table 2-2-9 will be smoothly executed.

3-2 Necessary Inputs by Recipient Country

- Securing of the sites for seismometers and tidal gauges, etc. will be completed before the Japanese side starts the work.
- Contracts for transmission lines for data from seismometers and tidal gauges, etc. will be completed before the Japanese side starts the work.
- The budget needed to recruit the personnel and purchase repair parts, etc. for routine inspections and other maintenance work will be secured.

3-3 Important Assumptions

- Vanuatu government policies concerning the meteorological observation sector and disaster prevention sector will remain unchanged.
- Major natural disasters such as earthquake will not occur.
- Sudden incidents such as acts of terrorism will not occur.

3-4 Project Evaluation

3-4-1 Relevance

Since the Project will contribute to the disaster prevention of Vanuatu, it is deemed to be highly relevant for implementation under Japan's grant aid program.

(1) Benefiting population

Through the installation of Tide Observation System, Strong Motion Accelerometer and Broadband Station System and Automatic Weather Station (AWS), Project implementation will make it possible to provide information on earthquakes and tsunami to approximately 250,000 citizens of Vanuatu (according to WB's statistics for 2011).

(2) Projects contributing to development plans in Vanuatu

National plans in the disaster prevention sector in Vanuatu are indicated in the Disaster Management Act of 2000. This was later revised and replaced with the Disaster Risk Reduction and Disaster Management National Action Plan 2006-2016 in 2006. The Project is consistent with the promotion of "development plans and projects in consideration of disaster prevention," it will contribute to development plans in Vanuatu.

(3) Necessity and superiority of using Japanese technology

The equipment for meteorological, oceanographic and terrestrial phenomena observation and telecommunication that will be procured for the Project is mostly manufactured in Japan and some of them are done in the areas affected by the Great East Japan Earthquake. Those Japanese products offer good post-sales services such as troubleshooting, repairs and spare parts supply, and they offer good durability and reliability. Especially, the equipment for AWS such as barometers, thermometers, anemometers, pluviometers, etc. shall be complied with WMO's regulations on performance of observation and certified by JMA's inspection, because those observed data will be shared in GTS network internationally in proper quality. The equipment for oceanographic and seismographic observation shall be also the products well-proven by JMA, etc. in accuracy of observation and durability. Therefore, it is necessity that technically superior equipment manufactured in Japan is renewed.

(4) Sharing of information for disaster prevention with neighboring countries

Vanuatu's existing tidal gauges are installed at two locations and observation is conducted by BOM. VMGD conducts inspections; however, it cannot perform real-time monitoring. Concerning the tide observation systems to be introduced at two more locations by the Project, data will be directly received by VMGD headquarters via iGov., and real-time data will be disclosed on the VMGD homepage. This will enable disaster prevention agencies in Vanuatu and other countries to share tidal data. Moreover, because these two locations also have DCP, it will be possible for the transmitted data to be shared with JMA. The aboveground meteorological data taken at the existing observation stations are transmitted and inputted to the existing GTS in VMGD. By installing AWS and upgrading GTS on the Project, the quality of the observation data will be improved and the duration to reach the data from the observation stations to GTS will be reduced. It can be expected to contribute to the global forecasting provided by JMA and other countries to be more accurate. This will also enable VMGD to receive real-time observation data, tsunami information, etc. provided by JMA, PTWC, etc. Then, VMGD can rapidly start an initial motion to tsunami warning and help to perform a disaster prevention system in Vanuatu. In addition, the VMGD's existing seismic server is connected to the Global Seismic Network operated by IRIS and the observation data by Strong Motion Accelerometer and Broadband Station System will be shared internationally through the Network.

3-4-2 Effectiveness

(1) Quantitative effects

Installation of the meteorological, oceanographic and terrestrial phenomena observation equipment, GTS and software is expected to have positive effects: shortening of observation intervals, increase of observation points, increase of observation frequency, widening of

observation areas, shortening of observation data transmission times, improvement of VMGD forecasting capacity through enhancement of international meteorological data exchange and so on. Sections 1) through 4) explains the anticipated effects of the equipment introduction in detail.

1) Detailed tide observation - Tide Observation System

Currently in Vanuatu, tidal gauges are installed at two locations in Port Vila, the capital and largest tourist port and Luganville on the island of Espiritu Santo. BOM directly monitors those observed data; however, observed data is not monitored by VMGD in real-time. Regarding the two locations mentioned above, VMGD will be able to monitor observed data in real-time just by adding transmitting equipment and data collection system, as the data collection system (included within Tide Observation System procured for the Project,) will be able to cater for future increase of observation points. Moreover, the existing tidal gauges are only installed on the islands of Efate and Espiritu Santo, leading to a fairly large imbalance over the entire island area that stretches for 1,200 kilometers from north to south. In the Project, through installing new tidal gauges at Tanna Island on the south and Malakula Island in the central area, it will be possible to observe tide levels and monitor tsunami at the main islands of Vanuatu.

In case an earthquake originates at the ocean trench near Samoa or Tonga, it would take approximately 3.5 hours for the first tsunami to reach Vanuatu. And in the same case near the Solomon Islands, it would take approximately 1 hour for the first tsunami to arrive at Vanuatu. Since such a tsunami would reach successive coastlines at intervals of 30 minutes, observed information would be important for predicting damage along coastal areas that have already been hit and estimating the height of tsunami waves that have not yet arrived.

Indicator	Reference value (2013)	Target value (2015)
Tide observation and interval time when tsunami strikes	60 minutes	30 minutes

Observed data is important information for estimating whether or not damage caused by high tide and tsunami will occur and what the extent of damage will be. Accordingly, observed data by observation points adjoining populous areas and areas of trade and industrial activity can make a major contribution to the accurate provision of information and telecommunication of evacuation orders to citizens at times of disaster. Meanwhile, since Vanuatu is a Pacific island nation, it is difficult for it to issue tsunami information, warnings and evacuation orders in units of administrative districts (prefectures) like Japan. With the additional installation of two tidal gauges and Data Collection System at VMGD Headquarters by the Project, it will be possible for Vanuatu to expand the observation

network by itself in the future.

Indicator	Reference value (2013)	Target value (2015)
Number of tide observation stations	2 sites	4 sites

2) Reinforcement of strong-motion accelerometers and broadband seismometers

In the Project, strong-motion accelerometers and broadband seismometers will be installed at three locations of the seismic observation system operated by VMGD. Such equipment was previously installed only on Efate Island and Espiritu Santo Island; however, through additionally installing it on Malakula Island and Tanna Island, coverage of the seismic observation network will be extended and the accuracy of estimating seismic elements will be improved. Since Vanuatu is such an elongated country in the north-south axis, the Project installations at three sites alone will still not be sufficient; however, the Vanuatu side will be able to expand the observation network based on its own efforts in the future. Moreover, since Vanuatu is elongated in a straight line, it will be necessary to promote data sharing with surrounding countries for more accurate analysis.

Indicator	Reference value (2013)	Target value (2015)
Short-period seismometer	1 site	1 site
Strong-motion accelerometers	-	3 sites
Broadband seismometer	2 sites	5 sites

3) Improvement of meteorological observation around the capital area by AWS

Since AWS observes meteorological information approximately in real-time, it is especially essential for observing heavy rains. None of VMGD's existing offices has AWS. However, through installing it at two sites, VMGD's capability for observing real-time meteorological conditions from headquarters will be improved.

Indicator	Reference value (2013)	Target value (2015)
AWS in VMGD	0 sites	2 sites

4) Improvement of GTS international meteorological data exchange

GTS is a system for both internationally transmitting observation data from Vanuatu, and also receiving the meteorological data transmitted by other countries. As the existing GTS is not compatible with the new GTS code that was revised in 2011, data input/output is dependent on BOM.

Generally speaking, aboveground meteorological data, high-altitude meteorological data and observation data from ships are exchanged. Therefore the installation of GTS will enable observation data from Vanuatu to be utilized by other countries, thus enhancing the

international contribution of Vanuatu. Meanwhile, since it will be possible to collect observation data from countries throughout the world in a short time, the ability of VMGD to analyze meteorological data including that from nearby countries will be improved. At the same time, since VMGD will acquire access to meteorological observation data transmitted by JMA, BOM, NOAA and others, its meteorological forecasting capability will improve.

Indicator	Reference value (2013)	Target value (2015)
Input data	Aboveground meteorological, high-altitude meteorological, shipping reports, aerial meteorological	Aboveground meteorological, high-altitude meteorological, shipping reports, aerial meteorological
Output data	Aboveground meteorological, high-altitude meteorological, shipping reports, aerial meteorological	Aboveground meteorological, high-altitude meteorological, shipping reports, aerial meteorological, numerical forecasting data, satellite analysis data
Input/ output method	Data is exchanged by BOM and FTP, and input/output is conducted by BOM	Operations conducted from VMGD headquarters

5) Qualitative effects (Project overall)

Through installing tide observation systems and various types of observation equipment (meteorological, oceanographic and terrestrial phenomena) by the Project, the nationwide gauging of disaster information in Vanuatu will become possible and the disaster prevention system will be improved. By the Project, tidal gauges for observing tsunami, seismometers for strengthening seismic observation and analysis capacity, and AWS for putting meteorological observation units online will be installed by the Project. Moreover, the project will introduce GTS for enhancing international meteorological data exchange ability. As a result, VMGD's ability to gauge natural disasters will be quantitatively extended and observation time to understand the occurrence of a natural disaster will be shorter. In turn, this will contribute to improvement of safety in Vanuatu's key industries of tourism, agriculture and fisheries, as well as the aviation industry that is prone to the effects of meteorological changes. As a result, this will contribute to the general economic development of Vanuatu through the promotion of industries, improvement of safety on transportation and promotion of air travel due to better safety.

Appendices

Appendix-1. Member List of the Study Team

1. Member List of the Study Team

First Field Survey

Name	Work Assignment	Position
Mr. Yutaka HUKASE	Leader/ Project Coordinator	Deputy Resident Representative, JICA Fiji Office, JICA
Mr. Yohei Hashimoto	Cooperation Planning	Assistant Resident Representative, JICA Fiji Office, JICA
Ms. Yuki TANAKA	Study Planning / Disaster Management	Assistant Director Global Environment Department, JICA
Mr. Toshiyuki NAKAZAWA	Grant Aid Program / Procurement Agent	Japan International Cooperation System
Mr. Kiyofusa TANAKA	Chief Consultant / Operation & Maintenance Planning	Yachiyo Engineering Co., Ltd.
Mr. Tatsuya KOBAYASHI	Sub Chief Consultant / Procurement Planning / Cost Estimation 1	Yachiyo Engineering Co., Ltd.
Mr. Chuji YAMAMOTO	Weather and Oceanic Phenomenon Equipment	Japan Meteorological Business Support Center
Mr. Masuo WADA	Earthquake and Tsunami Warning System / Information Network Planning	Yachiyo Engineering Co., Ltd.
Mr. Koji MITSUHASHI	Earthquake & Tsunami Equipment / Installation Planning 1	Japan Meteorological Business Support Center
Mr. Hironori KOMATSU	Construction/ Installation Planning 2/ Cost Estimation 2	Yachiyo Engineering Co., Ltd.
Mr. Yoshio NAKAGAWA	Social Condition Survey	Yachiyo Engineering Co., Ltd.

Second Field Survey

Name	Work Assignment	Position
Mr. Kiyofusa TANAKA	Chief Consultant/ Operation & Maintenance Planning	Yachiyo Engineering Co., Ltd.
Mr. Tatsuya KOBAYASHI	Sub Chief Consultant / Procurement Planning / Cost Estimation 1	Yachiyo Engineering Co., Ltd.
Mr. Chuji YAMAMOTO	Weather and Oceanic Phenomenon Equipment	Japan Meteorological Business Support Center
Mr. Masuo WADA	Earthquake and Tsunami Warning System / Information Network Planning	Yachiyo Engineering Co., Ltd.
Mr. Koji MITSUHASHI	Earthquake & Tsunami Equipment / Installation Planning 1	Japan Meteorological Business Support Center
Mr. Hironori KOMATSU	Construction / Installation Planning 2 / Cost Estimation 2 / Soil Investigation & Topographical Survey 1	Yachiyo Engineering Co., Ltd.
Mr. Takayasu KASE	Construction / Installation Planning 3 / Cost Estimation 3 / Soil Investigation & Topographical Survey 2	Yachiyo Engineering Co., Ltd.

Explanation of the Draft Preparatory Survey Report

Name	Work Assignment	Position
Mr. Minoru Miyasaka	Leader/ Project Coordinator	Senior Advisor to the Director General Global Environment Department, JICA
Mr. Kota Katsumata	Study Planning / Disaster Management	Disaster Management Division 1 Water Resources and Disaster management Group, Global Environment Department, JICA
Mr. Kiyofusa TANAKA	Chief Consultant/ Operation & Maintenance Planning	Yachiyo Engineering Co., Ltd.
Mr. Tatsuya KOBAYASHI	Sub Chief Consultant / Procurement Planning / Cost Estimation 1	Yachiyo Engineering Co., Ltd.
Mr. Chuji YAMAMOTO	Weather and Oceanic Phenomenon Equipment	Japan Meteorological Business Support Center

Appendix-2. Study Schedule

First Field Survey (2012)

No.	Date		Content Survey								Stay at
			JICA / Ms. Tanaka, Mr. Fukase, Mr. Hashimoto	JICS Mr. Yaginuma	YEC Mr. Tanaka	YEC Mr. Wada	JMBSC Mr. Yamamoto	JMBSC Mr. Mitsuhashi	YEC Mr.Komatsu	YEC Mr. Kobayashi	YEC Mr. Nakagawa	
Person in Charge				Grant Aid Program /Procurement Agent	Chief Consultant /Operating& Maintenance Planning	Earthquake and Tsunami Warning System /Information Network Planning	Weather and Oceanic phenomenon Equipment	Earthquake Tsunami Equipment /Installation Planning1	Construction/Installation Planning2 /Cost Estimation2	Sub Chief Consultant /Procurement Planning /Cost Estimation1	Social Condition Survey	
1	14 July	Sat	Trip [Narita 19:50→Australia 06:35,JL771]		Trip [Fiji 11:30→Vanuatu 12:10, FJ261=NF041]						Trip [Narita 19:50→Australia 06:35, JL771]	Port Vila
2	15 July	Sun	Trip [Australia 10:45→Vanuatu 15:10,NF011] ・Team meeting		・Team meeting						Trip [Australia 10:45→Vanuatu 15:10, NF011]	Port Vila
3	16 July	Mon	・Courtesy call to VMGD ・Meeting with JICA Vanuatu Office ・Courtesy call to AusAID			・Courtesy call to VMGD ・Technical Meetihg with VMGD						Port Vila
4	17 July	Tue	・Discussion on M/D-1 ・Courtesy call to NDMO ・Courtesy call to NZAID ・Courtesy call to Department of Finance and Tresury			・Site Survey at VMGD for Strong Motion Accelerometer System **(S-6)** ・Site survey at RTV for Broadband Station System **(B-6)**			・Site Survey of existing Tide Observation System ・Site Survey at Bauerfield Airport for AWS (A-6)			Port Vila
5	18 July	Wed	・Discussion on M/D-2 ・Meeting with Department of Strategical Policy Planning/Aid Cordination (DSPPAC)			・Meeting with Vanuatu Telecom		Trip [Port Vila (08:00) → Epi (09:00), Charter Flight] ・Site Survey at Lamen Bay for Tide Observation System **(T-3)** Trip [Ambae (16:00) → Port Vila (17:00), Charter Flight]	Trip [Epi (12:00) → Ambae (13:00), Charter Flight] ・Site Survey at Lolopuepue for Tide Observation System **(T-1)** ・Site Survey at Longana Airport for AWS **(A-2)**			Port Vila
6	19 July	Thu	・Conclude M/D ・Meeting with Ministy of Finance and Economic Management ・Reporting to JICA Vanuatu Office			・Meeting with VMGD for the site survey and technical issues						Port Vila
7	20 July	Fri	Trip [Vanuatu 07:00→Australia 09:45, NF010]		(Tanaka, Yamamoto, Komatsu, Nakagawa) Trip [Port Vila (10:05) → Santo (10:55), NF210]				(Kobayashi, Wada, Mitsuhashi) Trip [Port Vila (10:05) → Santo (10:55), NF210]			Espiritu Santo
8	21 July	Sat	Trip [Australia 08:15→Narita 17:05, JL772]		・Data collection ・Internal Meeting							Espiritu Santo
9	22 July	Sun			・Data collection ・Internal Meeting							Espiritu Santo
10	23 July	Mon			(Tanaka, Yamamoto, Komatsu, Nakagawa) ・Site Survey at Pekoa Airport for AWS **(A-3)** Trip [Santo (14:25) → Port Vila (15:15), NF209]				(Kobayashi, Wada, Mitsuhashi) ・Site Survey at Luganville for Strong Motion Accelerometer System **(S-2)** ・Site Survey at Luganville for Broadband Station System **(B-2)**			Port Vila(Tanaka, Yamamoto, Komatsu, Nakagawa) Espiritu Santo(Others)
11	24 July	Tue			(Tanaka, Yamamoto, Komatsu, Nakagawa) ・Technical Meeting with VMGD ・Analysing data				(Kobayashi, Mitsuhashi) Trip [Santo (0800) → Vanua Lava (09:00), Charter Flight] ・Site Survey at Sola for AWS **(A-1)** Trip [Mota Lava (12:00) → Santo (13:00), Charter Flight]	(Wada) ・Supplementary Survey		Port Vila(Tanaka, Yamamoto, Komatsu, Nakagawa) Espiritu Santo(Others)
12	25 July	Wed			(Tanaka, Yamamoto, Komatsu, Nakagawa) ・Technical Meeting with VMGD Trip [Port Vila (15:30) → Tanna (16:10), NF238] ・Site Survey at Whitegrass airport for AWS **(A-7)**				(Wadai, Mitsuhashi) Trip [Santo (0800) → Mota Lava (09:00), Charter Flight] ・Site survey for Strong Motion Accelerometer System **(S-1)** ・Site survey for Broadband Station System **(B-1)** Trip [Mota Lava (14:00) → Santo (15:00), Charter Flight]	(Kobayashi) ・Supplementary Survey		Tanna(Tanaka, Yamamoto, Komatsu, Nakagawa) Espiritu Santo(Others)
13	26 July	Thu			(Tanaka, Yamamoto, Komatsu, Nakagawa) ・Site Survey at Lenakel for Strong Motion Accelerometer System **(S-7)** ・Site Survey at Lenakel for Broadband Station System **(B-7)** ・Site Survey at Lenakel for Tide Observation System **(T-5)**				(Kobayashi, Wada, Mitsuhashi) Trip [Santo (8:55) – Port Villa (9:45), NF211]			Tanna(Tanaka, Yamamoto, Komatsu, Nakagawa) Port Vila(Others)
14	27 July	Fri			(Tanaka, Yamamoto, Komatsu, Nakagawa) ・Supplementary Survey at Lenakel				(Kobayashi, Wada, Mitsuhashi) ・Technical Meeting with VMGD			Tanna(Tanaka, Yamamoto, Komatsu, Nakagawa) Port Vila(Others)
15	28 July	Sat			(Tanaka, Yamamoto, Komatsu, Nakagawa) Trip [Tanna (08:50) → Port Vila (09:30), NF241] ・Internal Meeting				(Kobayashi, Wada, Mitsuhashi) ・Internal Meeting			Port Vila
16	29 July	Sun			(Komatsu) ・Preparing of drawings	(Tanaka, Yamamoto, Nakagawa) Trip [Port Vila (08:30) → Pentecost (10:00), Charter Flight] ・Site Survey at Waterfall village for Strong Motion Accelerometer System **(S-4)** ・Site Survey at Waterfall village for Broadband System **(B-4)**			(Kobayashi, Wada, Mitsuhashi) ・Internal Meeting ・Analysing Data			Pentecost(Tanaka, Yamamoto, Komatsu, Nakagawa), Port Vila(Others)
17	30 July	Mon			(Komatsu) ・Preparing of drawings	(Tanaka) Trip [Pentecost (13:50) → Port Vila (14:50), NF223]	(Yamamoto, Nakagawa) ・Site Survey at Lonorore airport for AWS **(A-4)** ・Supplementary Site Survey		(Kobayashi, Wada, Mitsuhashi) ・Supplementary Survey			Pentecost(Yamamoto, Komatsu, Nakagawa), Port Vila(Others)
18	31 July	Tue			(Tanaka, Komatsu) Trip [Port Vila 14:55→Nadi 17:20, FJ260]		(Yamamoto, Nakagawa) Trip [Pentecost (09:00) → Maewo (09:30), Charter Flight] ・Site Survey at Naone for Strong Motion Accelerometer System **(S-3)** ・Site Survey at Naone for Broadband Station System **(B-3)** Trip [Maewo (12:00) → Port Vila (13:30), Charter Flight]		(Kobayashi, Wada, Mitsuhashi) Trip [Port Vila (10:00) – Norsup (11:00), NF212] ・Site Survey at Litzlitz for Tide Observation System **(T-2)** ・Norsup Airport for AWS **(A-5)**			Malakula(Kobayashi, Wada, Mitsuhashi) Port Vila(Yamamoto, Nakagawa) Fiji (Tanaka, Komatsu)
19	1 August	Wed			(Tanaka, Komatsu) Trip [Nadi (09:00) → Lakeba (10:00), Charter Flight] ・Site Survey at Lakeba Trip [Lakeba (13:00) → Nadi (14:00), Charter Flight]		(Yamamoto, Nakagawa) ・Technical Meeting with VMGD		(Kobayashi, Wada, Mitsuhashi) ・Site Survey at Lamap for Strong Motion Accelerometer System **(S-5)** ・Site Survey at Lamap for Broadband Station System **(B-5)**			Malakula(Kobayashi, Wada, Mitsuhashi) Port Vila(Yamamoto, Nakagawa) Fiji (Tanaka, Komatsu)
20	2 August	Thu			(Tanaka, Komatsu) Trip [Nadi 08:00 → Suva 08:30, FJ007] ・Site Survey and Meeting with Suva FMS ・Reporting toJICA Fiji Trip [Suva 16:00 → Nadi 16:30, FJ016]		(Yamamoto, Nakagawa) ・Preparing of Field Report ・Supplementary Survey		(Kobayashi, Wada, Mitsuhashi) ・Supplementary Survey			Malakula(Kobayashi, Wada, Mitsuhashi) Port Vila(Yamamoto, Nakagawa) Fiji (Tanaka, Komatsu)
21	3 August	Fri			(Tanaka) [Nadi 09:00→Sydney 11:40, QF392]	(Komatsu) ・Supplementary Survey	(Yamamoto, Nakagawa) ・Preparing of Field Report ・Internal Meeting		(Kobayashi, Wada, Mitsuhashi) Trip [Norsup (15:00) – Port Vila (16:00), NF213] ・Internal Meeting			Malakula(Kobayashi, Wada, Mitsuhashi) Port Vila(Yamamoto, Nakagawa) Fiji (Komatsu) Sydney(Tanaka)
22	4 August	Sat			(Tanaka) Trip [Sydney 08:15→Narita 17:05,JL772]	(Komatsu) Trip [Nadi 11:30 → Port Vila 12:10, FJ261]	(Kobayashi, Wada, Yamamoto, Mitsuhashi, Nakagawa) ・Internal Meeting ・Preparing of Filed Survey					Port Vila
23	5 August	Sun				・Internal Meeting ・Preparing of Filed Survey						Port Vila
24	6 August	Mon				・Discussion on the Field Report with VMGD ・Supplementary Survey						Port Vila
25	7 August	Tue				・Signing on the Field Report with VMGD ・Supplementary Survey						Port Vila
26	8 August	Wed				Trip [Vanuatu 15:20→Australia 18:05, NF010=QF376]						Sydney
27	9 August	Thu				Trip [Australia 08:15→Narita 17:05, JL772]						

Second Field Survey (2013)

No.	Date		Content Survey		Stay at
			YEC Mr. Kobayashi	JMBSC Mr. Yamamoto	
Person in Charge			Sub Chief Consultant /Procurement Planning /Cost Estimation1	Chief Consultant /Operating& Maintenance Planning	
1	16 April	Tue	Trip [Narita 20:30→ Sydney, Australia 7:05 QF22]		on flight
2	17 April	Wed	Trip [Sydney, Australia 19:05→ Port Vila, Vanuatu 23:30 NF11]		Port Vila
3	18 April	Thu	・Meeting with VMGD, Explanation Component of the Project ・Meeting with JICA		Port Vila
4	19 April	Fri	・Meeting with VMGD, Explanation Component of the Project ・Meeting with JICA		Port Vila
5	20 April	Sat	Trip [Port Vila, Vanuatu 15:20→ Sydney, Australia 18:05 NF10]		Sydney
6	21 April	Sun	Trip [Sydney, Australia 21:30→ Narita 6:15 QF21]		

No.	Date		Content Survey						Stay at
			YEC Mr. Tanaka	JMBSC Mr. Yamamoto	YEC Mr. Wada	JMBSC Mr. Mitsuhashi	YEC Mr.Komatsu	YEC Mr.Kase	
Person in Charge			Chief Consultant /Operating& Maintenance Planning	Weather and Oceanic phenomenon Equipment	Earthquake and Tsunami Warning System /Information Network Planning	Earthquake Tsunami Equipment /Installation Planning1	Construction/Installation Planning2/Cost Estimation2/Soil Investigation & Topographical Survey1	Construction/Installation Planning3/Cost Estimation3/Soil Investigation & Topographical Survey2	
1	15 July	Mon	Trip [Narita 19:50→Sydney, Australia 6:35, JL771]			Trip [Itami 14:40→Narita 16:00, JL3006] Trip [Narita 19:50→Sydney, Australia 6:35, JL771]	Trip [Narita 19:50→Sydney, Australia 6:35, JL771]		on flight
2	16 July	Tue	Trip [Sydney, Australia 21:00→Port Vila, Vanuatu 1:25, NF11]						Sydney
3	17 July	Wed	・Meeting with JICA ・Meeting with VMGD, Explanation Component of the Project, Confirmation of progress of land acquisition, etc. ・Meeting with New Responsible Agency of the Project		・Technical meeting with VMGD				Port Vila
4	18 July	Thu	・Site survey (Devil' s Point in Efate Alt.SB-2) ・Technical meeting with VMGD						Port Vila
5	19 July	Fri	Trip [Port Vila 7:00→Tanna 8:00, NF240]				・Technical meeting with VMGD ・Local construction condition survey		Tanna
6	20 July	Sat	・Site survey (Lenakel in Tanna T-2) ・Site survey (Isangel in Tanna SB-3)				・Preparing of Filed Survey ・Local construction condition survey		Tanna
7	21 July	Sun	Trip [Tanna 15:55→Port Vila 16:55, NF239] ・Preparing of drawings				・Preparing of Filed Survey ・Local construction condition survey		Port Vila
8	22 July	Mon	・Meeting with VBTC ・Meeting with NDMO ・Technical meeting with VMGD	Trip [Port Vila 8:00→Malakula→Port Vila16:00] by Charter Flight ・Site survey: Lakatoro in Malakula (SB-1)					Port Vila
9	23 July	Tue	・Technical meeting with VMGD ・Meeting with JICA	・Technical meeting with VMGD					Port Vila
10	24 July	Wed	・Technical meeting with VMGD						Port Vila
11	25 July	Thu	・Technical meeting with VMGD ・Meeting with JICA	・Technical meeting with VMGD					Port Vila
12	26 July	Fri	Trip [Port Vila, Vanuatu 7:00→Sydney, Australia 9:45, NF10]				・Preparing of Filed Survey	Trip [Narita 19:50→Sydney, Australia 6:35, JL771]	Port Vila(Komatsu) Sydney(Others) on flight(Kase)
13	27 July	Sat	Trip [Sydney, Australia8:15→ Narita 17:05, JL772]			Trip [Sydney, Australia8:15→ Narita 17:05, JL772] Trip [Narita 18:30→Itami 19:50, JL3007]	・Soil investigation (VMGD in Efate SB-2)	Trip [Sydney, Australia 19:05→Port Vila, Vanuatu 23:30, NF11]	Port Vila
14	28 July	Sun					・Team meeting ・Soil investigation (Bauerfield Airport in Efate A-2)		Port Vila
15	29 July	Mon					・Topo Survey (VMGD in Efate SB-2)		Port Vila
16	30 July	Tue					Trip [Port Vila 7:00→Malakula Norsup 8:00, NF212] ・Soil investigation (Lakatoro in Malakula SB-1)	・Topo Survey (VMGD in Efate SB-2)	Malakula(Komatsu) Port Vila(Kase)
17	31 July	Wed					・Topo Survey (Lakatoro in Malakula SB-1)	Trip [Port Vila 7:00→Tanna 8:00, NF240] ・Topo Survey (Isangel in Tanna SB-3)	Malakula(Komatsu) Tanna(Kase)
18	1 August	Thu					Trip [Malakula Norsup 9:50→Santo 10:20, NF1230] ・Soil investigation (Pekoa Airport in Santo A-1)	・Soil investigation (Isangel in Tanna SB-3)	Espiritu Santo(Komatsu) Tanna(Kase)
19	2 August	Fri					Trip [Santo 8:00→Port Vila 9:00, NF209] ・Team meeting ・Meeting with JICA	・Soil investigation (Isangel in Tanna SB-3) Trip [Tanna(16:20)→Port Vila(17:00), NF239]	Port Vila(Komatsu) Tanna(Kase)
20	3 August	Sat					Trip [Port Vila, Vanuatu 15:20→Sydney, Australia 18:05, NF10]		Sydney
21	4 August	Sun					Trip [Sydney, Australia8:15→ Narita 17:05, JL772]		

Explanation of Draft Outline Design (2013)

No.	Date		Content Survey						Stay at
			Mr. Miyasaka	Mr. Katsumata	Mr. Inoue	YEC Mr. Tanaka	YEC Mr. Kobayashi	JMBSC Mr. Yamamoto	
Person in Charge			JICA	JICA	NIED	Chief Consultant /Operating& Maintenance Planning	Sub Chief Consultant /Procurement Planning /Cost Estimation1	Weather and Oceanic phenomenon Equipment	
1	24 Sept.	Tue				Trip [Narita 19:50→Sydney, Australia 6:35, JL771]			on flight
2	25 Sept.	Wed				Trip [Sydney, Australia 19:05→Port Vila, Vanuatu 23:30, QF375]			Port Vila
3	26 Sept.	Thu				・Meeting with VMGD (Explanation of DF/R)			Port Vila
4	27 Sept.	Fri				・Meeting with VMGD (Explanation of equipment specification)			Port Vila
5	28 Sept.	Sat	Trip [Narita 20:30→Sydney, Australia 7:05, QF022]			・Site observation			Port Vila
6	29 Sept.	Sun	Trip [Sydney, Australia 10:45→Port Vila, Vanuatu 15:10, QF375]			・Site observation ・Internal Meeting			Port Vila
7	30 Sept.	Mon	・Meeting with JICA Vanuatu office ・Meeting with VMGD ・Meeting with Ministry of Finance						Port Vila
8	1 Oct.	Tue	・Signing on M/D ・Report to JICA Vanuatu office						Port Vila
9	2 Oct.	Wed	Trip [Port Vila, Vanuatu 15:20→ Sydney, Australia 18:00, QF376]	Trip [Port Vila, Vanuatu 7:00→Auckuland, New Zealand 12:05, NF050] Trip [Auckuland, New Zealand 13:55→Nadi, Fiji 16:00, FJ410] Trip [Nadi 18:00→Suva 18:30, FJ021]		Trip [Port Vila, Vanuatu 15:20→Sydney, Australia 18:05, QF376]			Sydney
10	3 Oct.	Thu	Trip [Sydney, Australia 21:30→ Narita 6:15, QF021]	・Meeting with JICA Fiji Office ・Meeting with MRD ・Continuing Survey in Fiji		Trip [Sydney, Australia 8:15→ Narita 17:05, JL772]			

Appendix-3. List of Parties Concerned in the Recipient Country

3. List of Parties Concerned in the Recipient Country

Name and Organization	Position
Prime Ministers Office	
Fred Samuel	Government Chief Information Officer
Johnson Naviti	Head of Aid Coordination Unit
Department of Finance and Treasury	
Antonneth Arnhambat	Budget Manager
Dorothy Ericson	Acting Director
Baddley Tany	Acting Principal Officer, Custom and Inland Revenue (CIR)
Hamphlley Tamata	Acting Manager, Custom and Inland Revenue (CIR)
Meteorology and Geohazards Department, Ministry of Climate Change Adaptation, Geohazards, Meteorology and Energy	
Jotham Napat	Acting Director General
Vanuatu Meteorology and Geo-hazards Department (VMGD)	
David Givson	Acting Director
Esline Garaebiti Bule	Manager of Geohazards
Sylvain Todman	TA Volcanology and Engineer
Patricia Mawa	Principal Scientific Officer IT and Engineer
Morris Jim Harrison	Geophysicist
Fred Jockley	Principal Scientific Officer Forecasting
Joe Mala	Principal Scientific Officer Observation
David Nakedau	Senior technician Seismology
Simon Boe	Technician
Tom Kaio	Senior Met. Officer, Sola MET Office
Athanase Worwor	Technician
National Disaster Management Office (NDMO)	
Shadrack Rubart Welegtabit	Director
Simon Donald	Emergency Communications Advisor
Gideon Mael	Operations Manager

Peter Korisa	Senior Planner

Public Works Department (PWD)

Dick Abel Manuake	Principal Architect of PWD Office at Port Vila
Fred Siba	Division Manager of PWD Office at Salatamata, Tannna
Titus Tari	Road Maintenance Officer of PWD Office at Penama Province, Pentecost
Shin George Jr.	Project Engineer

Vanuatu Broadcasting and Television corporation (VBTC)

Warren Robert	Technical Service Team Leader

Telecom Vanuatu Ltd (TVL)

Sebastien Kappel	Customer Care Manager

Relevant Authorities of the Surveyed Areas

【Efate】

Jonathan Delaney	Land owner of the site in Samoa Point Havannay Harbor Development Ltd

【Espiritu Santo】

Willie Molisa	Weather Observer of Pekoa Met. Office

【Maewo】

Paul Ren Tari	Weather Observer of Maewo Met. Office
Albet Weris	Chief of Naone community

【Pentecost】

Paul Bule	Chief of Lonorore community
Ben Bule	Acting Chief of Lonorore community
Peter Bebe	Chief of Panngi community
Harry Webak	Leader of Panngi community
Asaya Tabi	Chief of Waterfall village
Jeffry Tabi	Acting Chief of Waterfall village
Silas Buli	Land owner of the site in Waterfall village

【Malakula】

Williamson. W.	Chief of Norsup Community
Edwell Edwin	Chief of Litzlitz Tovena House
Leymang Lulu	South Malakula Area Secretary of Malampa Provincial Government
Paul Ian	Weather Observer of Lamap Met. Office

Palen Ata	Planner of Malampa Provincial Government

【Epi】

Joseph Atis Onda	Chief of Lamen Bay Community

【Tanna】

Ketty Napwatt	Secretary General of Tafea Provincial Government
Arnaud Yaukelo	Weater Observer of Whitegrass Met. Office
Sam Tukuma	Land owner of the site in Lenakel wharf
Iau Tuan	Officer of Tafea Provincial Custom Office

World Bank

Michael Bonte Grapantin	Disaster Risk Management Specialist

Australia Agency for International Development (AusAID)

Patrick Haines	Procurement and Operations Manager

New Zealand Agency for International Development (NZAID)

Jimmy Nipo	Development Program Coordinator

JICA Fiji Office

Shumon Yoshiara	Resident Representative
Yutaka Fukase	Deputy Director
Yohei Hashimoto	Assistant Resident Representative

JICA Vanuatu Office

Tsutomu Moriya	Resident Representative
Akihito Motegi	Project Formulation Advisor
Hiroko Watahashi	Project Formulation Advisor (Aid Coordination)
Yoko Asano	Project Formulation Advisor (Aid Coordination)

Appendix-4. Minutes of Discussions (M/D)

4. Minutes of Discussions (M/D)
(1) First Field Survey

MINUTES OF DISCUSSIONS
ON THE PREPARATORY SURVEY
ON THE PROJECT FOR IMPROVEMENT OF EQUIPMENT
FOR DISASTER RISK MANAGEMENT
IN THE REPUBLIC OF VANUATU

In response to the request from the Government of the Republic of Vanuatu (hereinafter referred to as "Vanuatu"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan (hereinafter referred to as "the GOJ") decided to conduct a Preparatory Survey on the Project for Improvement of Equipment for Disaster Risk Management (hereinafter referred to as "the Project").

JICA sent to Vanuatu the Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Mr. Yutaka FUKASE, Senior Representative, JICA Fiji Office, and is scheduled to stay in the country from July 14th to August 8th, 2012.

The Team held discussions with the officials concerned of the Government of Vanuatu and conducted a field survey at the survey area.

In the course of discussions and field survey, both sides confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Port Vila, 19th July, 2012

Yutaka FUKASE
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Jhonson BINARU
Director General
Ministry of Infrastructure and Public Utilities
Republic of Vanuatu

ATTACHMENT

1. Objective of the Project

The objective of the Project is to contribute toward improving disaster risk management in Vanuatu through the provision and installation of equipment.

2. Project site

The candidate sites of the Project proposed by each implementing agency are confirmed as show in **Annex-1** respectively.

3. Responsible and Implementing Agency

3-1. The Responsible Agency is Ministry of Infrastructure and Public Utilities, Vanuatu Meteorology and Geo-hazards Department (VMGD).

3-2. The Implementing Agency is VMGD.

3-3. The organization chart is shown in **Annex-2.**

4. Items requested by the Government of Vanuatu

After discussions between the Vanuatu side and the Team (hereinafter referred to as "the both sides"), the items described in **Annex-3** and necessary soft components were finally requested by the Vanuatu side.

The both sides confirmed that the appropriateness of the request would be examined in accordance with the further studies and analysis of the Team, and the final components and the design including the sites of installation of the equipment would be explained by the Team.

5. Japan's Grant Aid for Disaster Prevention and Reconstruction (GADPR)

5-1. Outline of GADPR

The Grant Aid provides a recipient country (hereafter referred to as "the Recipient") with non-reimbursable funds to procure the facilities, equipment, and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

The Japan's Grant Aid for Disaster Prevention and Reconstruction (hereinafter referred to as "GADPR") was introduced in 2006, in the context of worldwide greater interest in disaster management after the Sumatra Earthquake and the Asian Tsunami in December 2004. Japan can contribute assistance in disaster prevention and reconstruction sector, based on its experience and knowledge, to the international community.

5-2. This Project will be implemented under GADPR. The Vanuatu side understands the Japan's Grant Aid scheme explained by the Team, as described in **Annex-4**.

5-3. Both sides confirmed major undertakings to be taken by each side under GADPR, as described in Annex-5.

6. Special Consideration

When the Grant Aid for this Project is extended in Vanuatu, it would be required (1) to procure products which can contribute to reconstruction of industry in "Specified Disaster Affected Area" in Japan stipulated in "the Act on Special Fiscal Aid and Subsidy for Recovery from the Great East Japan Earthquake", and (2) to procure equipment for disaster management especially for earthquake and tsunami, which was developed based on lessons learnt and technologies in Japan as public properties to the international community. Therefore, equipment covered by this Grant shall be made in and procured from Japan principally, while it may not apply for installation works which will be locally procured, manufactured and/or built.

Since the Project components may include equipment with Japan's advanced technologies, soft components will be appropriately considered to encourage sustainable operation and maintenance of the equipment, together with considerations to the present situation and needs in Vanuatu.

7. Schedule of the Survey

7-1. The consultant members of the Team will proceed to further studies in Vanuatu until August 8, 2012.

7-2. JICA will prepare the draft preparatory survey report in English and dispatch a mission in order to explain its contents to the Vanuatu side around December 2012.

7-3. In case that the contents of the report are accepted in principle by the Vanuatu side, JICA will finalize the report and send it to the Vanuatu side around February 2013.

7-4. The both sides confirmed the Project will be carried out in accordance with the tentative schedule as shown in **Annex-6**.

8. Consultative Committee

VMGD shall be the focal point for the Project and responsible for the coordination with

related organizations. The Vanuatu side agreed to establish a consultative committee in order to coordinate with the Japanese side which consists of the JICA office. The procurement agency will participate in this committee as an advisor. The Terms of Reference of the Consultative Committee is referred to **Annex-7.**

9. Undertakings of the Vanuatu side

9-1. Besides Annex-5, both sides confirmed that the following measures would be undertaken by the Vanuatu side for the implementation of the Project:

(a) To secure land, security and adequate infrastructure for preparation and installation of the equipment to be procured under the Project,

(b) To ensure the required electricity supply for the equipment to be procured and installed under the Project,

(c) To obtain necessary permission from competent authorities for installation works of the equipment and the use of frequencies and satellites, which shall be borne by the Vanuatu side,

(d) To clear necessary procedures for social and environmental considerations and obtain an approval of environmental related regulations by relevant authorities before commencement of the procurement of equipment in accordance with the relevant guidelines in Vanuatu, including Environmental Impact Assessment (EIA) if required,

(e) To secure the budget or take any necessary procedures for bearing Value Added Tax (VAT), custom duty, and any other taxes and fiscal levies in Vanuatu which is to be arisen from the Project activities at their responsibility,

(f) To allocate necessary staff and budget for operation and maintenance of the equipment to be procured by the Project,

(g) To utilize the equipment procured under the Project to improve the disaster risk management in Vanuatu,

(h) To bear necessary expenses accrued from the procedures for the Banking Arrangement (B/A), and

(i) To arrange the banking account and send the official letter to JICA Vanuatu Office by the end of July, 2012.

9-2. Arrangement for the Survey

As a response to the request by the Team, the Vanuatu side agreed to arrange the followings:

(a) To provide the Team with available relevant data, information and materials necessary for the execution for the Project,

(b) To prepare the answers for the Questionnaires presented by the Team by 30th July,2012,

(c) To assign full-time counterparts to the Team during their stay in Vanuatu and play the following roles as the coordinator to the Team:

i) To make the appointments and set up the meetings with authorities, departments, factories and firms when the Team intends to visit,

ii) To attend the site survey and other visiting places with the Team and to make convenience on accommodation, working room, adequate transportation, getting the permissions if required, etc. and,

iii) To assist and advice the Team for their collection of data and information as much as possible.

(d) To secure the permission to photograph and enter into private properties and restricted areas for the Team for proper execution of the Project, if necessary,

(e) To take measures deemed necessary to secure safety of the Team members, and

(f) To obtain necessary permission for the Team to bring back to Japan necessary data, maps and materials related to the Survey, subject to approval of the Government of Vanuatu, in order to prepare the report.

10. Other relevant issues

The following issues were discussed and confirmed by both sides.

10-1. Collaborations with Other Projects

The Vanuatu side explained that the Project would not be overlapped with any other project supported by other donor agencies, NGO, and Vanuatu official organizations.

However, the Vanuatu side confirmed to coordinate and to collaborate with related projects to maximize an outcome of the Project.

10-2. Sharing Data and Information

Both sides confirmed that existing communication system such as the Global Telecommunication System to share observed data and information with international organizations, Japan and neighboring countries shall be continuously utilized.

10-3.Visibility of the Project

The Team explained that the visibility of the Project should be ensured as a token of cooperation from the Japanese people if the Project was realized. The following ideas could be considered to enhance publicity of the Project:

(a) To display commemoration panels and/or stickers on the equipment procured and at the facilities where the equipment installed by the Grant Aid, and

(b) To publicize the Project in the mass media after the Project is approved by the both governments.

10-4. Language of the tender documents

Both sides confirmed that the tender documents will be prepared in English.

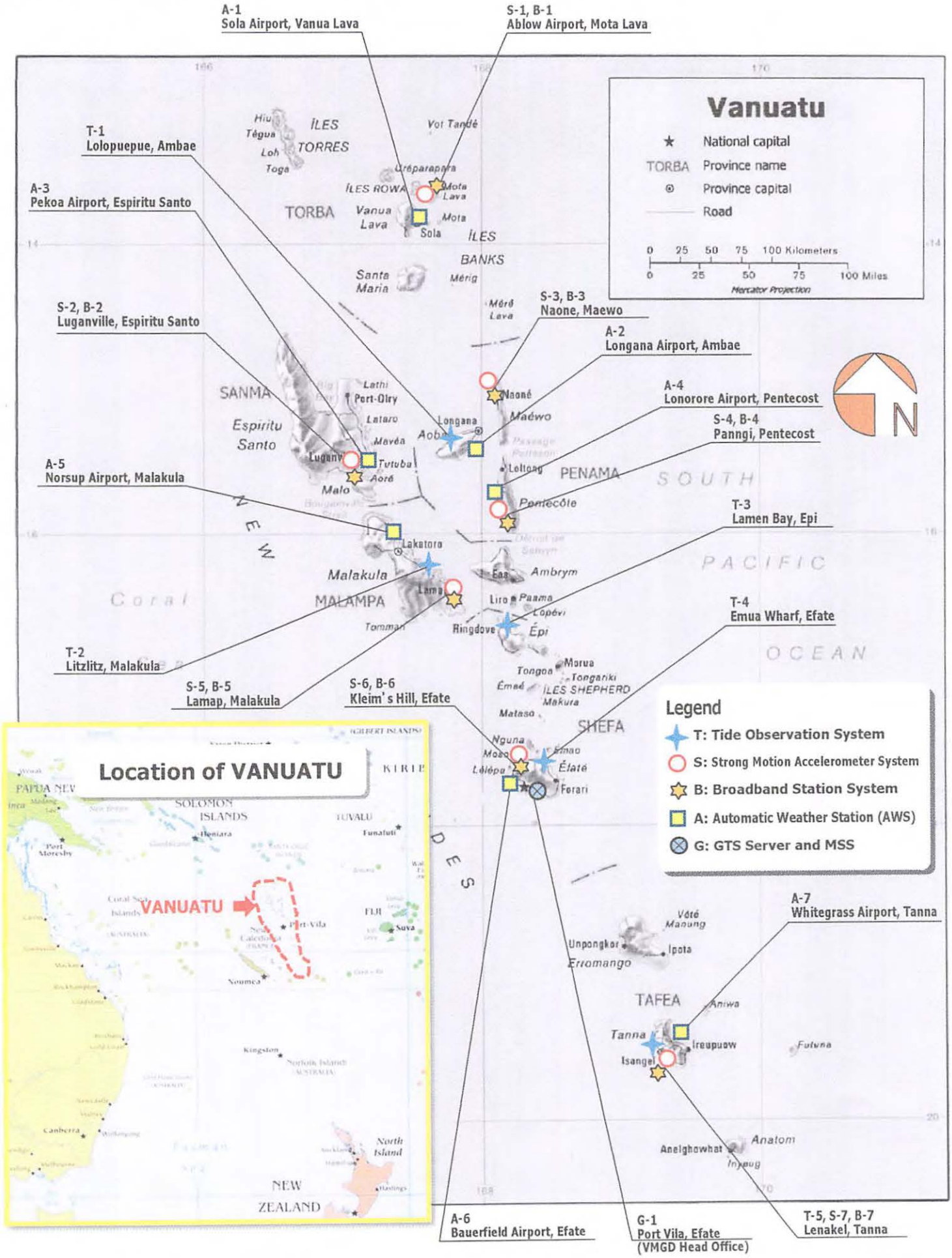
10-5. Confidentiality of the Survey Report

The Team explained that the preparatory survey report to be prepared at the end of the Survey

would be disclosed to the public in principle in Japan. However the Team also explained that a confidential part which might affect tendering process such as cost estimation should be kept undisclosed until the tendering has completed.

Annex-1 Proposed Project Sites Map
Annex-2 Organization Charts
Annex-3 Items Requested by the Vanuatu Side
Annex-4 Japan's Grant Aid Scheme
Annex-5 Major Undertakings to be taken by Each Side
Annex-6 Tentative Implementation Schedule
Annex-7 Terms of Reference of the Consultative Committee

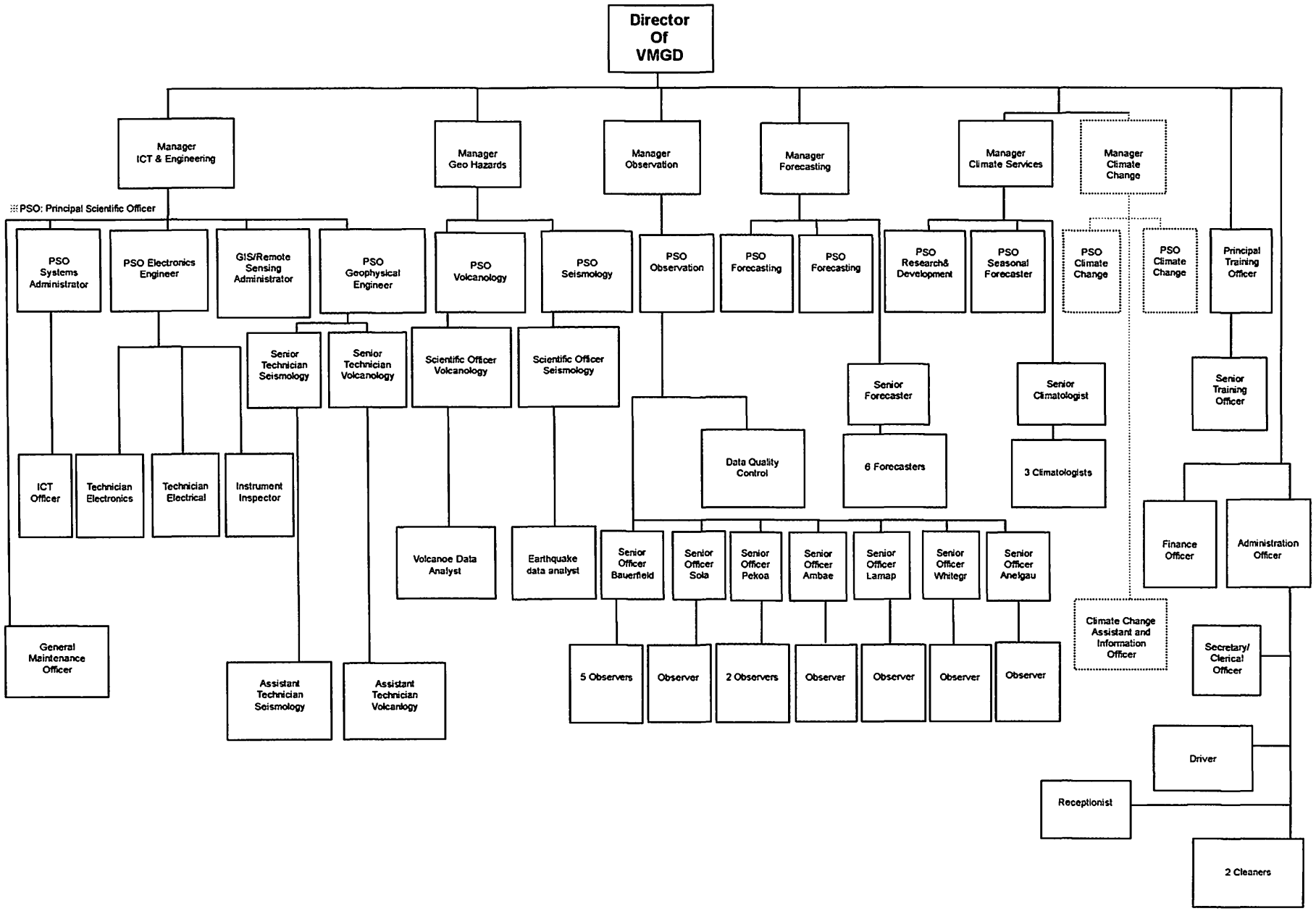
Annex-1: Proposed Project Sites Map



Location Map of the Project Sites

Annex-2: Organization Charts

The Vanuatu Meteorology Geo-hazard Department



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Annex-3: Items Requested by the Vanuatu Side

Priority	No.	Name of Island	Name of Site
A	**1. Tide Observation System (5 sets)**		
	T-1	Ambae	Lolopuepue
	T-2	Malakula	Litzlitz
	T-3	Epi	Lamen Bay
	T-4	Efate	Emua Wharf
	T-5	Tanna	Lenakel
A	**2. Strong Motion Accelerometer System (7 sets)**		
	S-1	Mota Lava	Ablow Airport
	S-2	Espiritu Santo	Luganville
	S-3	Maewo	Naone
	S-4	Pentecost	Panngi
	S-5	Malakula	Lamap
	S-6	Efate	Kleim's Hill
	S-7	Tanna	Lenakel
A	**3. Broadband Station System (7 sets)**		
	B-1	Mota Lava	Ablow Airport
	B-2	Espiritu Santo	Luganville
	B-3	Maewo	Naone
	B-4	Pentecost	Panngi
	B-5	Malakula	Lamap
	B-6	Efate	Kleim's Hill
	B-7	Tanna	Lenakel
B	**4. Automatic Weather Station (AWS) (7 sets)**		
	A-1	Vanua Lava	Sola Airport
	A-2	Ambae	Longana Airport
	A-3	Espiritu Santo	Pekoa Airport
	A-4	Pentecost	Lonorore Airport
	A-5	Malakula	Norsup Airport
	A-6	Efate	Bauerfield Airport
	A-7	Tanna	Whitegrass Airport
B	**5. GTS Server and MSS (1 set)**		
	G-1	Efate	Port Vila (VMGD Head Office)
C	**6. Tsunami Forecasting System (1 set)**		

Priority:
A: High priority for the Vanuatu side
B: Medium priority for the Vanuatu side
C: Relatively low priority for the Vanuatu side

Annex-4: JAPAN'S GRANT AID SCHEME FOR DISASTER PREVENTION AND RECONSTRUCTION

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Grant Aid for Disaster Prevention and Reconstruction (GADPR) is one of the several types of the scheme designed to assist disaster affected countries in disaster prevention and / or disaster reconstruction. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

Japanese Grant Aid is supplied through following procedures:

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal & Approval
  -Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Authority for Determining Implementation
  -The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  -Agreement concluded between JICA and a recipient country
- Implementation
  -Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the

guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid for Disaster Prevention and Reconstruction Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consultant firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue work on the Project's implementation after the E/N and the G/A.

(3) Banking Arrangements (B/A)

The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"), and shall notify JICA in the written form prescribed in the G/A of the completion of the procedures for the opening the account. JICA will execute the Grant Aid by making payments in Japanese yen to the account during the period referred to in the G/A and on or after the date of receipt of the written notification above.

(4) Contract with Procurement Agent

The recipient country will conclude an Agent Agreement with the Designated Procurement Agent stipulated in the E/N in order to secure smooth implementation of the Project.

(5) Details of Procedures

Details of procedures on procurement and services under GADPR will be agreed between the authorities of the two governments concerned at the time of the signing of the G/A.

Essential points to be agreed are outlined as follows:

a) JICA will supervise the implementation of the Project.

b) Products and services will be procured and provided in accordance with JICA's "Procurement Guidelines of Japan's Grant Aid for Disaster Prevention and Reconstruction (Type I-D)."

c) The Recipient will conclude a contract with the Agent.

d) The Agent is the representative acting in the name of the Recipient concerning all transfers of funds to.

(6) Focal points of "Procurement Guidelines of Japan's Grant Aid for Disaster Prevention and Reconstruction (Type I-D)

a) The Agent

The Agent is the organization, which provides procurement of products and services on behalf of the Recipient according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan. The selection of the Agent is agreed between the two Governments in the Agreed Minutes (A/M).

b) Agent Agreement

The Recipient will conclude the Agent Agreement, in principle, within two months after the signing of the G/A, in accordance with the A/M. The scope of the Agent's services will be clearly specified in the Agent Agreement.

c) Approval of the Agent Agreement

The Agent Agreement is prepared as two identical documents and the copy of the Agent Agreement will be submitted to JICA by the Recipient through the Agent. JICA confirms whether the Agent Agreement is concluded in conformity with the E/N, A/M, and G/A and the Procurement Guidelines of Japan's Grant Aid for Disaster Prevention and Reconstruction (Type I-D) then approves the Agent Agreement.

The Agent Agreement concluded between the Recipient and the Agent will become effective after the approval by JICA in a written form.

d) Payment Methods

The Agent Agreement will stipulate that "Regarding all transfers of the fund to the Agent, the Recipient will designate the Agent to act on behalf of the Recipient and issue a Blanket Disbursement Authorization ("the BDA") to conduct the transfer of the fund (hereinafter referred to as "the Advances") to the Procurement Account from the Recipient Account.

The Agent Agreement will clearly state that the payment to the Agent will be made in Japanese yen from the Advances and that the final payment to the Agent will be made when the total remaining amount becomes less than three percent (3%) of the Grant and its accrued interests excluding the Agent's fees.

(1) Blanket Disbursement Authorization (BDA)

By issuing the "Blanket Disbursement Authorization (BDA)" to the Bank, the Government of the recipient country designates a procurement agent as the representative authorized to act in the name of the recipient country concerning all transfers of the Grant to an account in the name of the procurement agent.

e) Products and Services Eligible for Procurement

Products and services to be procured will be selected from those defined in the G/A.

f) Method of Procurement

When conducting the procurement, sufficient attention will be paid to transparency in selecting the firms and for this purpose, competitive tendering will be employed in principle.

g) Additional procurement

If there is any remaining balance after the competitive and/or selective tendering and/or direct negotiation for a contract, and if the Recipient would like to procure additional items, the Agent is allowed to conduct this additional procurement, following the points mentioned below:

(1) Procurement of same products and services

When the products and services to be additionally procured are identical with the initial tender and a competitive tendering is judged not efficient, additional procurement can be conducted by a negotiated contract with the successful tenderer of the initial tender.

(2) Other procurements

When products and services other than those mentioned above in (1) are to be procured, the procurement should be conducted through competitive tendering. In this case, the products and services for additional procurement will be selected from among those in accordance with the G/A.

h) Conclusion of the Contracts

In order to procure products and services in accordance with the guideline, the Agent will conclude contracts with firms selected by tendering or other methods.

(7) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

(8) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-5.

(9) Proper Use

The Government of recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

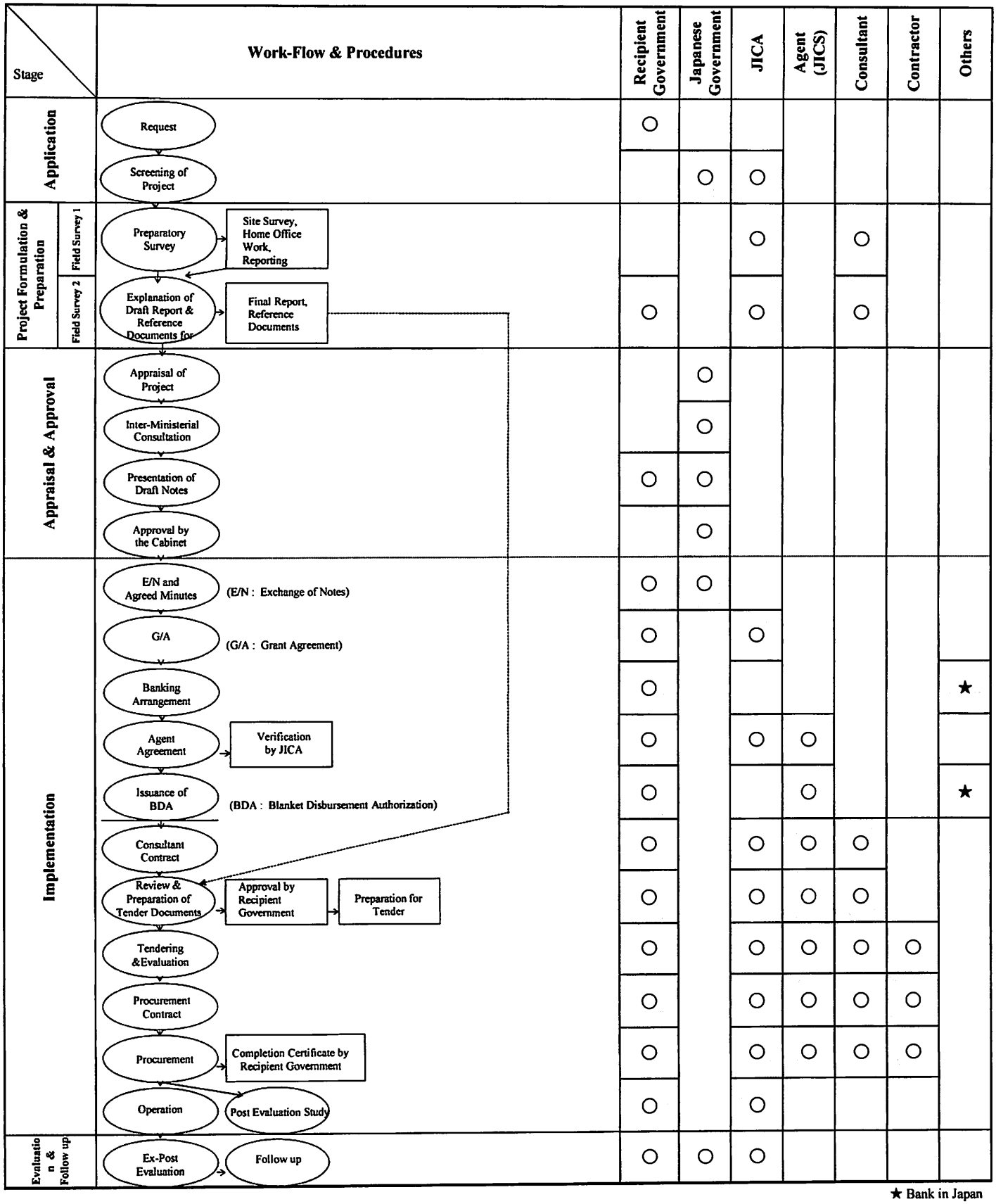
(10) Export and Re-export

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

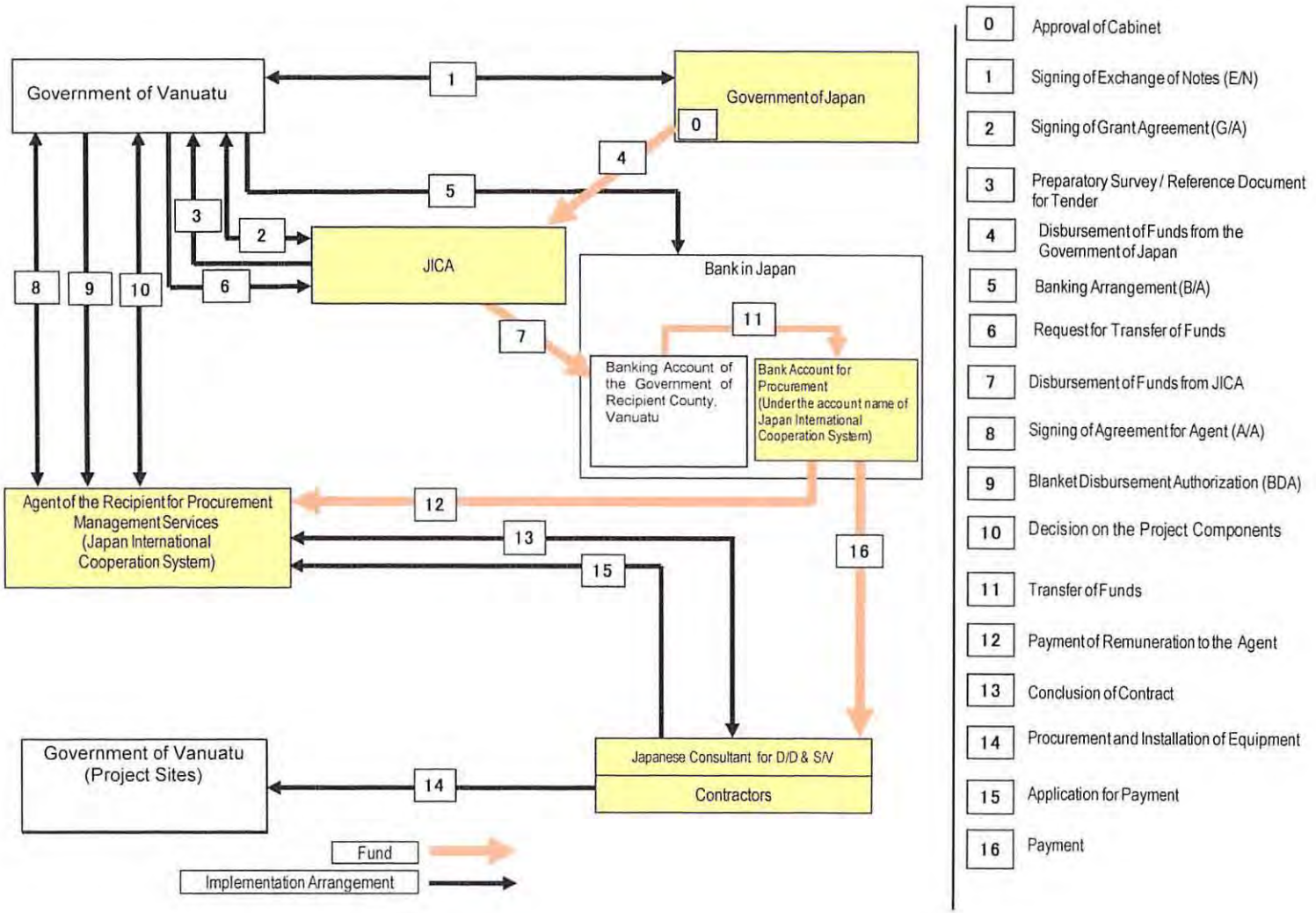
(11) Social and Environmental Considerations

A recipient country must carefully consider the social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

FLOW CHART OF JAPAN's GRANT AID PROCEDURES



FLOW OF FUNDS AND SERVICES
FOR THE IMPLEMENTATION OF JAPAN'S GRANT AID (Exceptional Version for this Project)



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Annex-5: Major Undertakings to be taken by Each Side

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure lots of land necessary for the implementation of the Project and to clear the sites		●
2	To construct the facility if necessary and install the equipment	(●)	(●)
3	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax assumption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	(●)	(●)
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services as well as the employment of the Agent be be borne by the Authority without using the Grant and its accrued interest.		●
5	To accord Japanese nationals and / or nationals of third countries, including such nationals employed by the Agent, whose services may be required in connection with the supply of the products and the services such facilities may be necessary for their entry into the recipient country and stay therein for the performance of their work (The term "nationals" whenever used in the G/A means Japanese physical persons or Japanese juridical persons controlled by Japanese physical persons in the case of Japanese nationals, and physical or juridical persons of third countries in the case of nationals of third countries.)		●
6	To ensure that the products be maintained and used properly and effectively for the implementation of the Project		●
7	To bear all the expenses, other than those covered by the Grant and its accrued interest, necessary for the implementation of the Project		●
8	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Payment of bank commission		●
9	To give due environmental and social consideration in the implementation of the Project		●

Annex-6: Tentative Implementation Schedule

Year			2012												2013						
Japanese Fiscal Year			2011			2012									2013						
Item		Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7
Preparatory Survey (OD DFR DD)															DF/R	F/R					
Implementation Schedule	Contract	EN / GA / BA																			
		Agent Agreement (AA)				E/N, G/A			B/A												
		Final Selection of the Procducts and the Services																			
		Consultant Contracts																			
	Procurement	Review & Preparation of Tender Documents																			
		Approval of Tender Documents by Recipient Government																			
		Tender Notice																			
		Tender Closing																			
		Etender Evaluation																			
		Supply Contaract																			

Annex-7: Terms of Reference of the Consultative Committee

1. To confirm an implementation schedule of the Project for the speedy and effective utilization of the Grant and its accrued interest;

2. To discuss modifications of the Project, including modifications of designs of the Facilities;

3. To exchange views on allocations of the Grant and its accrued interest as well as on potential end-users;

4. To identify problems which may delay the utilization of the Grant and its accrued interest, and to explore solutions to such problems;

5. To exchange views on publicity related to the utilization of the Grant and its accrued interest; and

6. To discuss any other matters that may arise from or in connection with the G/A.

(2) Explanation of Draft Outline Design

MINUTES OF DISCUSSIONS
ON
THE PREPARATORY SURVEY
ON
THE PROJECT FOR IMPROVEMENT OF EQUIPMENT
FOR DISASTER RISK MANAGEMENT
IN
THE REPUBLIC OF VANUATU
(Explanation of the Draft Preparatory Survey Report)

In July 2012, Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team on the Project for Improvement of Equipment for Disaster Risk Management (hereinafter referred to as "the Project") to the Republic of Vanuatu (hereinafter referred to as "Vanuatu"), and through discussions, field survey and technical examination of the results in Japan, JICA prepared the Draft Preparatory Survey Report of the Project.

In order to explain and to consult with the officials concerned of the Government of Vanuatu (hereinafter referred to as "the GOV") on the components of the Draft Preparatory Survey Report, JICA sent the Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Minoru Miyasaka, Senior Advisor to Director General, Global Environment Department, JICA to Vanuatu, from September 25th to October 2nd, 2013. As a result of discussions, both sides confirmed the main items described in the attached sheets.

Port Vila, 1st October 2013

宮坂 実

Minoru Miyasaka
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

For

Jotham Napat
Acting Director General
Ministry of Climate Change Adaption,
Geohazards, Meteorology and Energy
Republic of Vanuatu

ATTACHMENT

1. Components of the Draft Preparatory Survey Report (Draft Outline Design Report)

The Vanuatu side agreed and accepted in principle the components of the Draft Preparatory Survey Report (Draft Outline Design Report) as explained by the Team. The project sites and the project components are shown in Annex-1 and Annex-2 respectively.

2. Cost Estimation of the Project

2-1. The Team explained the cost estimation of the Project as described in Annex-3.

2-2. Both sides agreed that cost estimation of the Project as attached in Annex-3 should never be duplicated or released to any third parties before the signing of all the contract(s) for the Project.

2-3. The Vanuatu side understood that cost estimation of the Project described in Annex-3 is a provisional one as a result of the Survey and could be subject to change according to further examination or situation changed.

3. Special Consideration of the Project

3-1. Both sides reconfirmed the contents of article 6 "Special Consideration" in the Minutes of Discussions signed on 19th July 2012.

3-2. The Vanuatu side accepted that the equipment described in Annex-4 will be procured under the condition of "Special Consideration" mentioned above in order to contribute to reconstruction of industry in "Specified Disaster Affected Area" in Japan. The team promised to inform of the change of equipment in case the equipment list in Annex-4 will be modified.

3-3. The Vanuatu side understood that the cost of equipment described in Annex-3 was estimated under the "Special Consideration".

4. Undertakings to be taken by the Vanuatu side

Both sides confirmed that the Vanuatu side shall complete the following undertakings shown in accordance with the implementation schedule of the Project, in addition to article 9 of the Minutes of Discussions signed on 19th July 2012;

[Common to All Components]

- To obtain an agreement letter(s) on the approval to use land/facilities from the owners of the land /facilities by the end of December 2013 in order to secure necessary land;
- To ensure leveling, bush clearing and removing obstacles on the Project sites for installation of the equipment;
- To prepare access roads to the Project sites (if necessary);
- To conduct periodic cleaning of the equipment and the Project sites (including PV panels);
- To install security fences, gates and guardhouses in and around the Project sites;

- To dispose used batteries properly;
- To publicize the outputs derived from the observation data acquired from the Project equipment.
- To secure the budget for travel cost to the Project sites for VMGD's staff during the Implementation stage including accommodation and allowances;

[For Tide Observation System]

- To obtain an approval for use of Data Collection Platform (DCP) from Japan Meteorological Agency (JMA) necessary for data transmission of the Tide Observation System by the end of July 2014;
- To obtain an agreement letter(s) from Malampa Provincial Government for T-1 Litzlitz in Malakula and Tafea Provincial Government for T-2 Lenakel in Tanna, for the installation of the equipment, fee, security and method of maintenance of the land, including the Building Permit if necessary, by the end of December 2013;
- To obtain permission from Telecom Vanuatu Ltd. (TVL) for the installation of wireless LAN equipment on the TVL tower for T-2 Lenakel in Tanna, by the end of December 2013;
- To obtain permission from CREST FM Station for the installation of UPS for T-2 Lenakel in Tanna, by the end of December 2013;
- To ensure the power supply for the diversity wireless LAN to be installed on the iGovernment Tower (DC 48V, 20W) for T-1 Litzlitz in Malakula, by the end of December 2014 before the Installation Work of the Equipment;
- To ensure the power supply for UPS to be installed at CREST FM Station (AC 240V) and for wireless LAN equipment and hub to be installed at Tafea Provincial Government office (AC 240V) for T-2 Lenakel in Tanna, by the end of December 2014 before the Installation Work of the Equipment;

[For Strong Motion Accelerometers and Broadband Station System]

- To obtain an agreement letter(s) from Malampa Provincial Government for SB-1 Lakatoro in Malakula and Tafea Provincial Government for SB-2 Isangel in Tanna, for the installation of the equipment, fee, security and method of maintenance of the land, including the Building Permit if necessary, by the end of December 2013;
- To obtain permission for the installation of a hub in the Provincial offices, the use of the existing LAN ports and power supply for the hub (AC 240V) , by the end of December 2013;

[For Automatic Weather Station (AWS)]

- To obtain permission from Airports Vanuatu Ltd. for the installation of the equipment, power supply to UPS (AC 240V) and the use of the existing LAN ports in the Met. Offices, by the end of December 2013; and

[For GTS Server and MSS]

- To carry out initial uploading of observed data and information to Global Telecommunication System (GTS) operated by World Meteorological Organization (WMO) for sharing those data and information with international organizations, Japan and neighboring countries after acceptance testing and commissioning.

5. Scheme of Japan's Grant Aid for Disaster Prevention and Reconstruction

Both sides reconfirmed the Scheme of Japan's Grant Aid for Disaster Prevention and Reconstruction (hereinafter referred to as "GADPR") and major undertakings to be taken by each side under GADPR, as described in article 5 in the Minutes of Discussions signed on 19th July 2012.

6. Implementation Structure

6-1. Both sides confirmed that Ministry of Climate Change Adaptation, Geohazards, Meteorology and Energy shall be a responsible agency due to the reform of the Government of the Vanuatu side. However, both sides reconfirmed that there is no change in implementation agency, Vanuatu Meteorology and Geo-hazards Department (hereinafter referred to as "VMGD"), which were confirmed in the Minutes of Discussions signed on 19th July 2012.

6-2. Both sides reconfirmed that VMGD shall be the focal point and coordinate the members of the Consultative Committee which was agreed to be established in the Minutes of Discussions signed on 19th July 2012. The Vanuatu side explained that the Consultative Committee shall be held to accomplish the terms of reference of this committee described in Annex-7 in the Minutes of Discussions signed on 19th July 2012.

7. Tentative Schedule of the Project

7-1. The Team shall complete the Preparatory Survey Report in English and send it to Vanuatu in January 2014.

7-2. Both sides confirmed that the Project shall be carried out in accordance with the tentative schedule as shown in Annex-5.

7-3. Both sides confirmed that the tender notice would be delayed or the exclusion of the Project components would be considered if undertakings by the Vanuatu side mentioned in Article 4 are not met by the designated timing.

8. Other Relevant Issues

8-1. Social and Environmental Considerations

The Vanuatu side promised to clear necessary procedures for social and environmental considerations and obtain a necessary approval from relevant authorities before commencement of the procurement in accordance with the relevant guidelines in Vanuatu, including Environmental Impact Assessment (EIA), if required.

8-2. Responsibility for the Tender Documents

The Team promised to send the Technical Specifications for the equipment to be procured in the Project as a result of the Survey to the Vanuatu side.

The Vanuatu side understood that the Vanuatu side shall review and complete the entire Tender Documents including the Technical Specifications of the equipment in cooperation with the procurement agent. The Vanuatu side is responsible for project implementation and the output of the Project being executed.

8-3. Tax Assumption

The Vanuatu side shall secure the budget or take any necessary procedure for bearing Value Added Tax (VAT), custom duties, and any other taxes and fiscal levies in Vanuatu which may arise from the Project activities at their responsibility.

8-4. A Use for Remaining Budget after Tender

Both sides confirmed to consider the possibility that the spare parts or maintenance tools etc. for the components in Annex-2 will be purchased in case the Project has a remaining budget as the result of the tender.

8-5. Confidentiality of the Draft Preparatory Survey Report and the Preparatory Survey Report

The Team explained that the Draft Preparatory Survey Report and the Preparatory Survey Report to be prepared at the end of the Survey shall be disclosed to the public in principle in Japan. However, the Team also explained that a confidential part which might affect tendering process such as cost estimation should be kept undisclosed until the tendering has been completed.

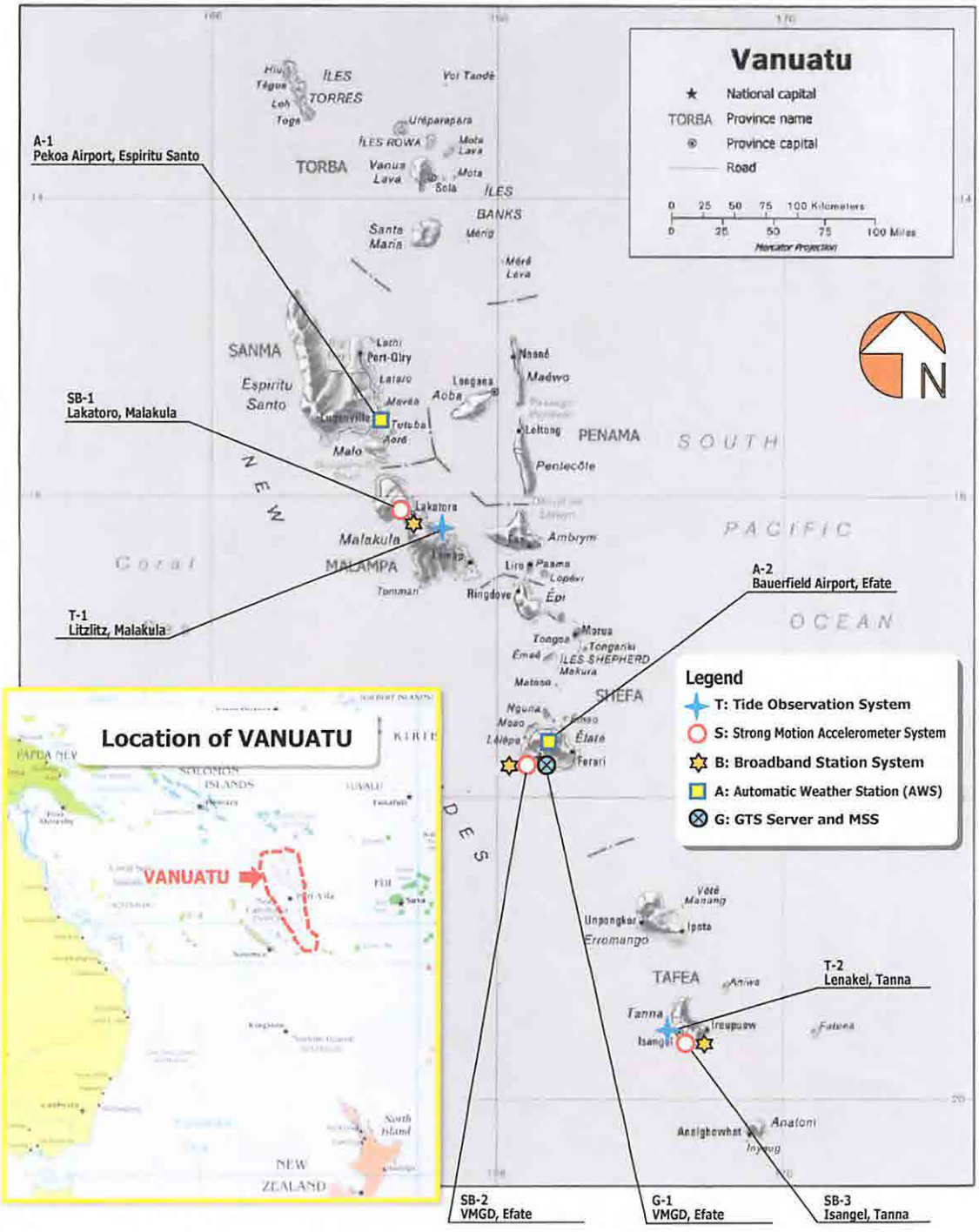
8-6. Visibility of the Project

The Team explained that the visibility of the Project should be ensured as a token of cooperation from the Japanese people if the Project was realized. The following ideas could be considered to enhance publicity of the Project:

(a) To display commemoration panels and/or stickers on the equipment procured and at the facilities where the equipment installed by the Grant Aid, and
(b) To publicize the Project in the mass media after the Project is approved by both governments.

Annex-1 Project Sites
Annex-2 Project Components
Annex-3 Project Cost Estimates
Annex-4 Equipment to be procured under special consideration
Annex-5 Tentative Schedule

Project Sites



Annex-2

Project Components

No.	Description	Q'ty
1	Tide Observation System (T-1 Litzlitz in Malakula, T-2 Lenakel in Tanna)	2 sites
2	Strong Motion Accelerometer and Broadband Station System (SB-1 Lakatoro in Malakula, SB-2 VMGD in Efate, SB-3 Isangel in Tanna)	3 sites
3	Automatic Weather Station (AWS) (A-1 Pekoa Airport in Espiritu Santo, A-2 Bauerfield Airport in Efate)	2 sites
4	GTS Server and MSS	1 lot

<Confidential>

Annex-3

1. Project Cost to be borne by Japan's Grant Aid

This section is closed due to confidentiality.

2. Project Cost to be borne by the Vanuatu side

<Cost for the first year of the Project>

No.	Undertakings	Estimated Cost (US$)	Notes
1	Payment of bank commissions to the Japanese bank for banking services based upon the Banking Arrangement	3,000	Assumed. It will be determined when B/A is prepared by the Japanese Bank.
2	Travel cost to the Project sites for VMGD's staffs during the Implementation stage		
(1)	During the Installation Work	2,400	Air fare to Malakula: 25,000Vt x 2 persons = 50,000Vt Air fare to Tanna: 30,000Vt x 2 persons = 60,000Vt Accommodation and allowance: 10,000Vt x 3 days x 2 persons x 2 sites = 120,000Vt Total: 230,000Vt = US$2,384
(2)	During the Operation Training Work	1,300	Air fare to Malakula or Tanna: 30,000Vt x 2 persons = 60,000Vt Accommodation and allowance: 10,000Vt x 3 days x 2 persons = 60,000Vt Total: 120,000Vt = US$1,244
3	[T-2 Lenakel, Tanna] Obtaining of permission from Telecom Vanuatu Ltd. (TVL) for the installation of wireless LAN equipment on the TVL tower	6,800	Setup fee: 50,000 Vt Hosting fee: 50,000 Vt/month x 12 months = 600,000 Vt Total: 650,000 Vt = US$6,736
4	[T-2 Lenakel, Tanna] Ensuring the power supply for UPS to be installed at CREST FM Station (AC 240V)	1,600	kWh meter setup fee: 30,000 Vt Electricity: 10,000 Vt/month x 12 months = 120,000 Vt Total: 150,000 Vt = US$1,555
	Total	**15,100**	

(Exchange rate: JPY99.77/US$, JPY1.034/Vt, Vt96.49/US$, As of July 2013)

<Annual Operation & Maintenance Cost from the 2nd year of the Project>

No.	Undertakings	Estimated Cost (US$)	Notes
1	Travel cost to the Project sites for VMGD's staffs for the maintenance works of the Equipment	2,400	Air fare to Malakula: 25,000Vt x 1 person x 2 trips = 50,000Vt Air fare to Tanna: 30,000Vt x 1 person x 2 trips = 60,000Vt Accommodation and allowance: 10,000Vt x 3 days x 1 person x 2 trips x 2 sites = 120,000Vt Total: 230,000Vt = US$2,384
2	[T-2 Lenakel, Tanna] Bearing charges for the use of the wireless LAN equipment on the TVL tower	6,200	Hosting fee: 50,000 Vt/month x 12 months = 600,000 Vt = US$6,218
3	[T-2 Lenakel, Tanna] Bearing electricity charges for UPS to be installed at CREST FM Station (AC 240V)	1,300	Electricity: 10,000 Vt/month x 12 months = 120,000 Vt = US$1,244
	Total	**9,900**	

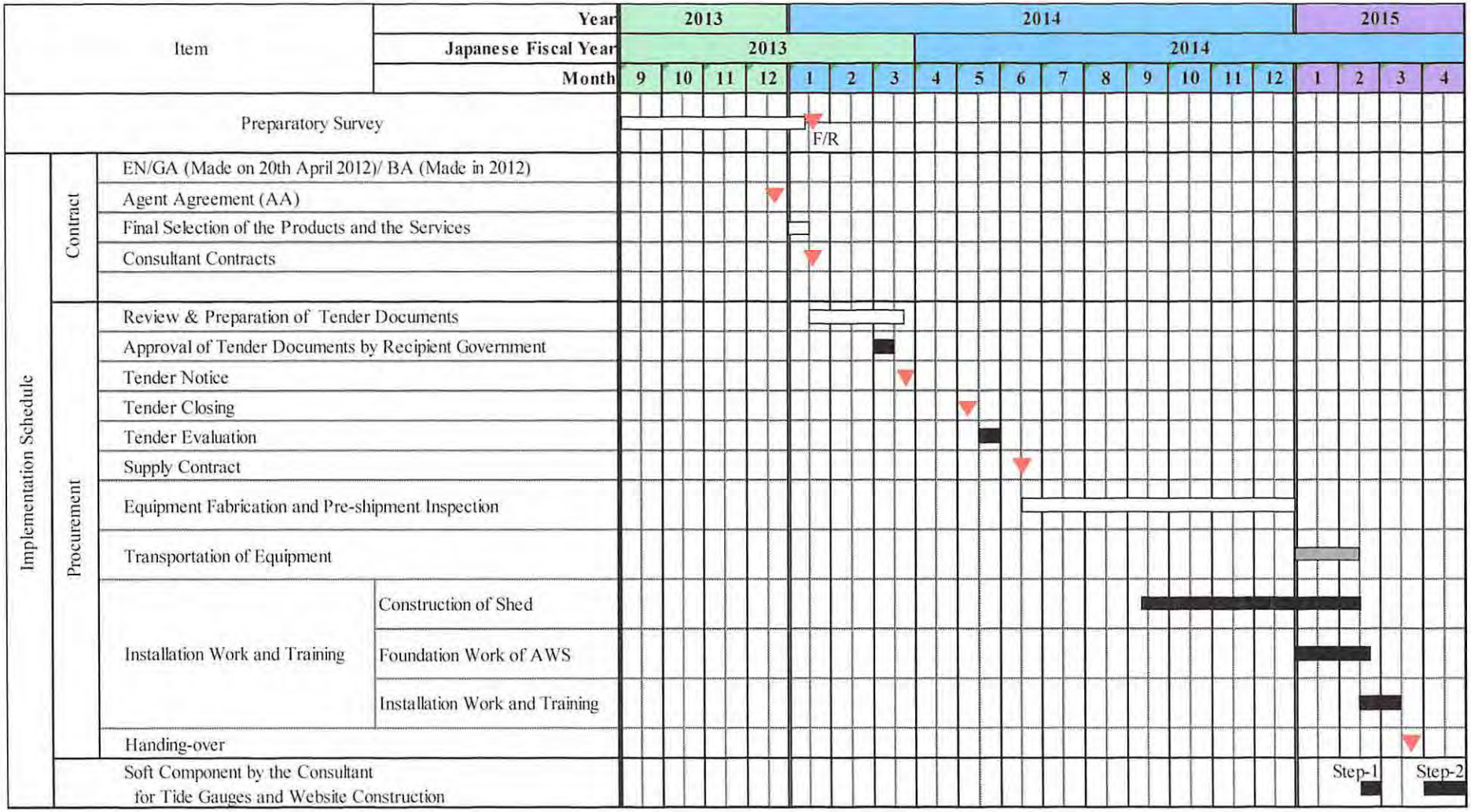
(Exchange rate: JPY99.77/US$, JPY1.034/Vt, Vt96.49/US$, As of July 2013)

Notes: Specific items are shown in the draft Outline Design report.

Equipment to be procured under special consideration

1. Tide Observation System
Tidal Gauge
Transmitter and Antenna (Wireless LAN) to iGov.
Transmitter and Antenna (Diversity Wireless LAN) to iGov.
2. Strong Motion Accelerometer and Broadband Station System
Strong Motion Accelerometer
Data Logger
3. Automatic Weather Station (AWS)
Actinometer
Barometer
Anemometer (Ultrasonic Type)
Pluviometer
Thermometer
Hygrometer
Data Logger with Lightening Arrester
Assman Psychrometer for Thermometer Calibration
Digital Barometer for Barometer Calibration

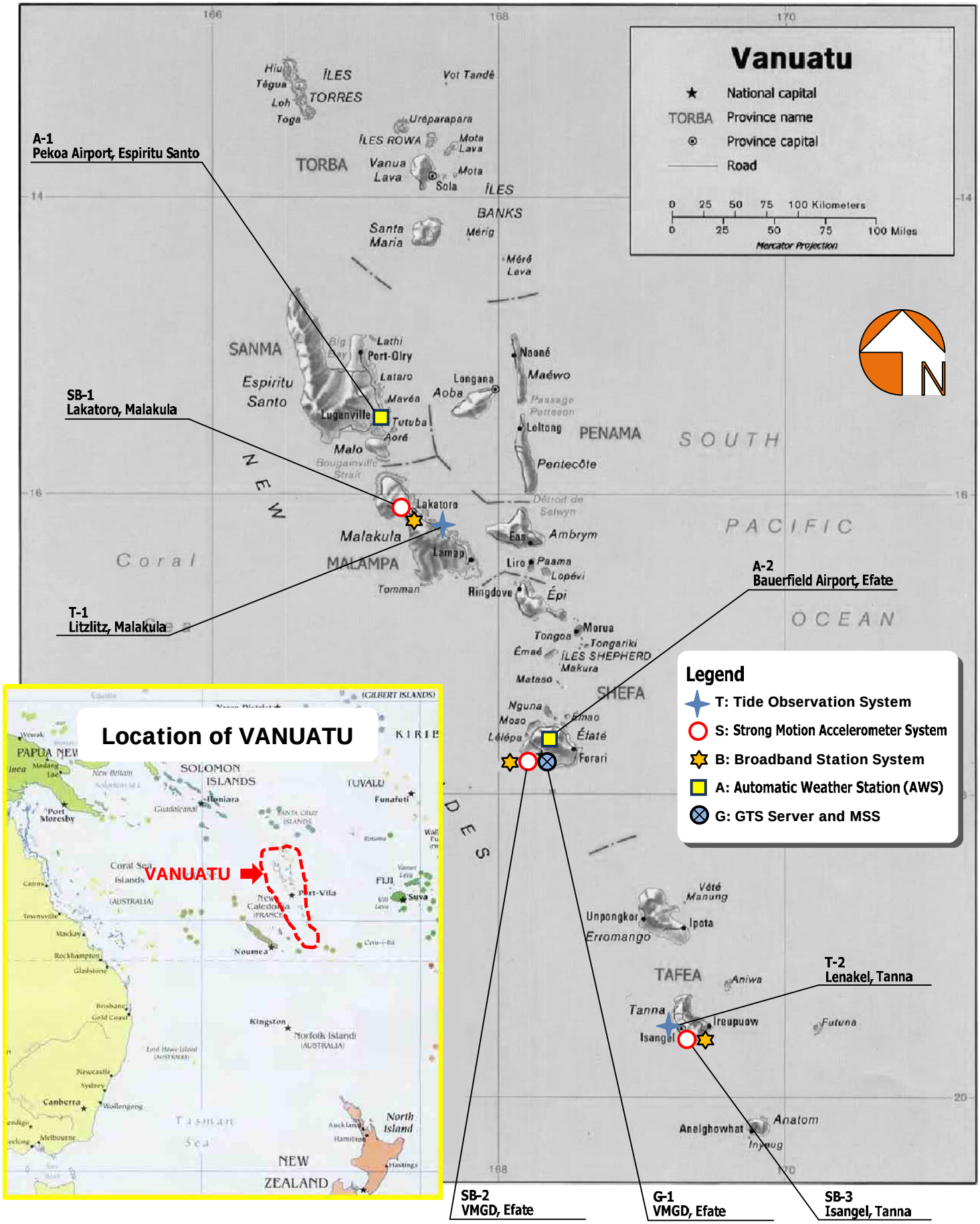
Tentative Schedule of the Project



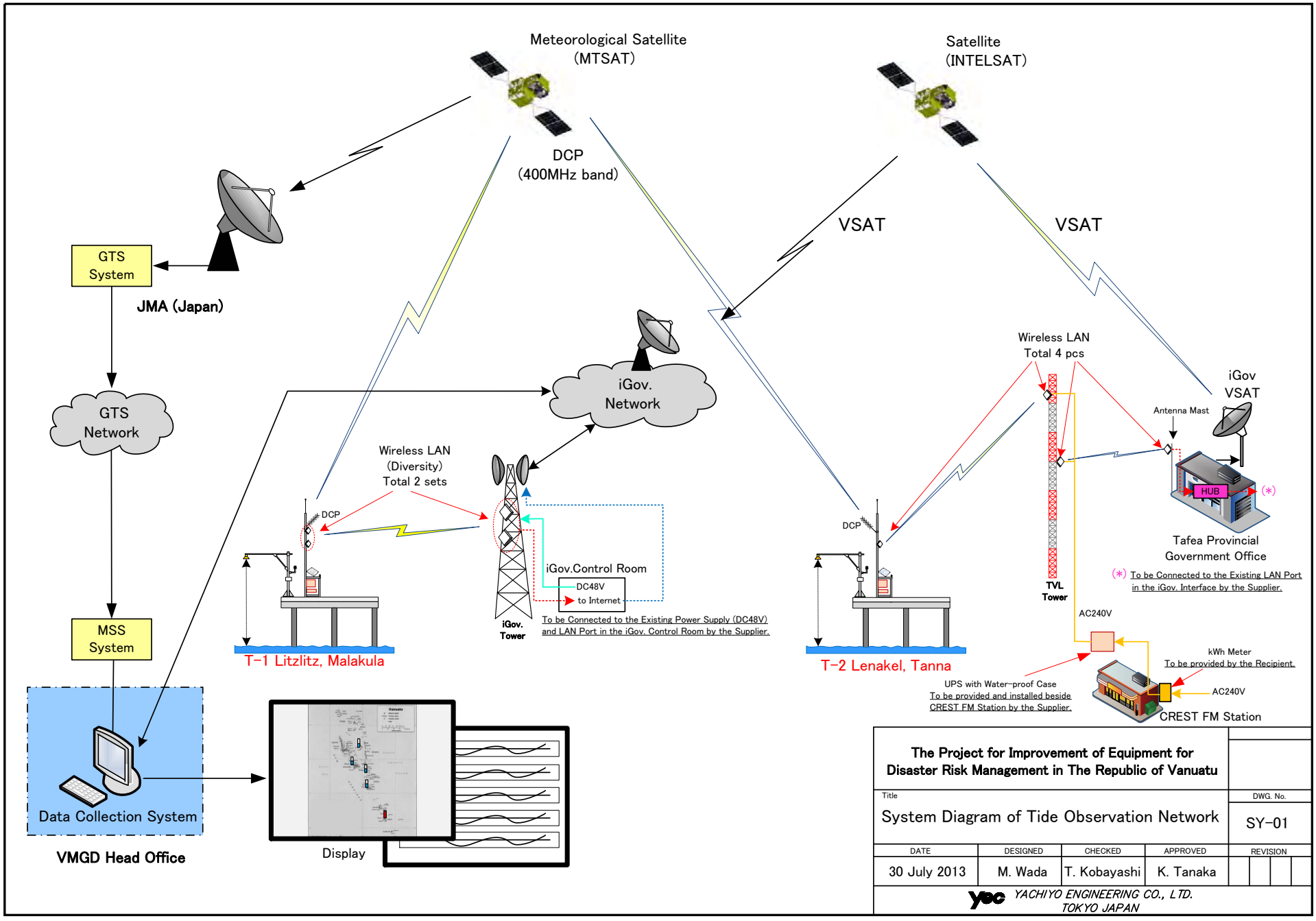
Appendix-5. Outline Design Drawings

5. Outline Design Drawing

Dwg no	Title
G-01	Location Map of the Project Sites
SY-01	System Diagram of Tide Observation Network
SY-02	Block Diagram of Tide Observation System
LT-01	Location of the Site and Survey Photos of Litzlitz, Malakula
LT-02	Location of the Site and Survey Photos of Lenakel, Tanna
SY-03	System Diagram of Strong Motion Accelerometer and Broadband Station Network
SY-04	Block Diagram of Strong Motion Accelerometer and Broadband Station System
DSB-01	Design of Shed for Strong Motion Accelerometer and Broadband Station System
LSB-01	Location of the Site and Survey Photos of Lakatoro, Malakula
LSB-02	Location of the Site and Survey Photos of VMGD, Efate
LSB-03	Location of the Site and Survey Photos of Isangel, Tanna
SY-05	System Diagram of Automatic Weather Station (AWS) Network
SY-06	Block Diagram of AWS Network System
LA-01	Location of the Site and Survey Photos of Pekoa Airport, Espiritu Santo
LA-02	Location of the Site and Survey Photos of Bauerfield Airport, Efate
SY-07	System Diagram of GTS Server and MSS System



G-01 Location Map of the Project Sites



The Project for Improvement of Equipment for Disaster Risk Management in The Republic of Vanuatu				
Title: System Diagram of Tide Observation Network				DWG. No.: SY-01
DATE	DESIGNED	CHECKED	APPROVED	REVISION
30 July 2013	M. Wada	T. Kobayashi	K. Tanaka	

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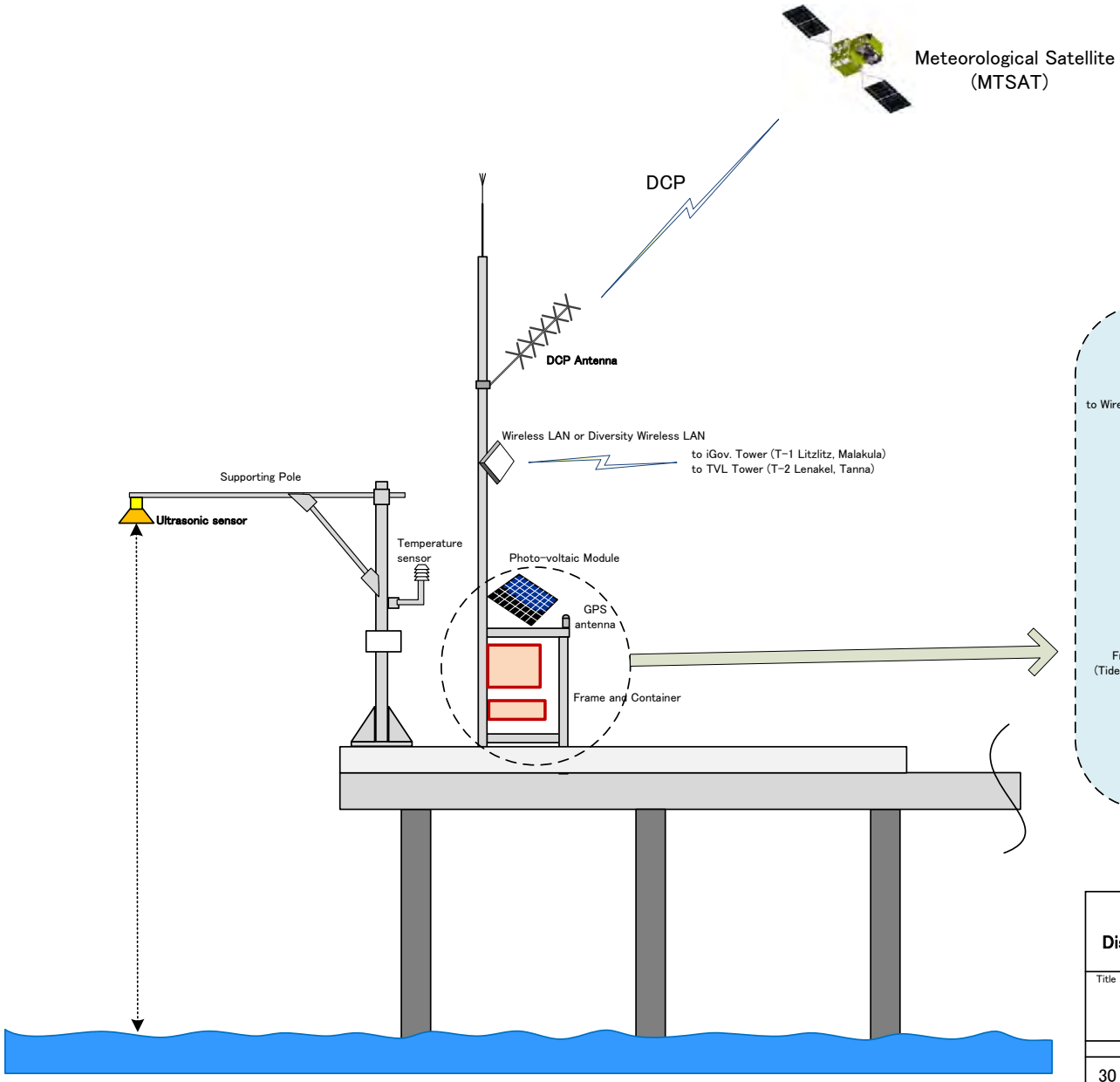

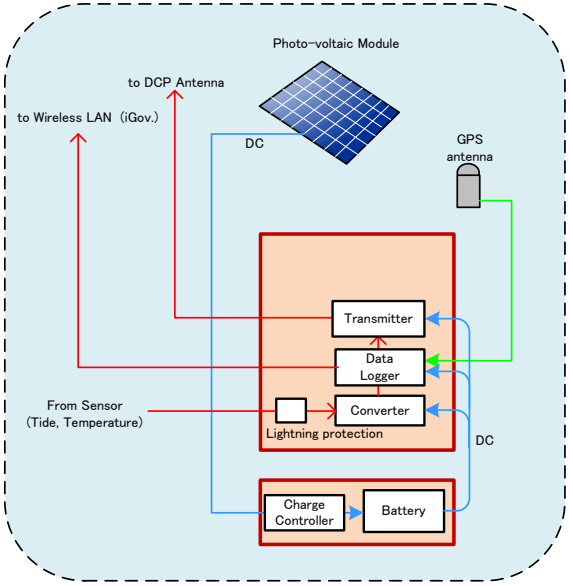

The Project for Improvement of Equipment for Disaster Risk Management in The Republic of Vanuatu

Title	DWG. No.
Block Diagram of Tide Observation System	SY-02

DATE	DESIGNED	CHECKED	APPROVED	REVISION
30 July 2013	M. Wada	T. Kobayashi	K. Tanaka	

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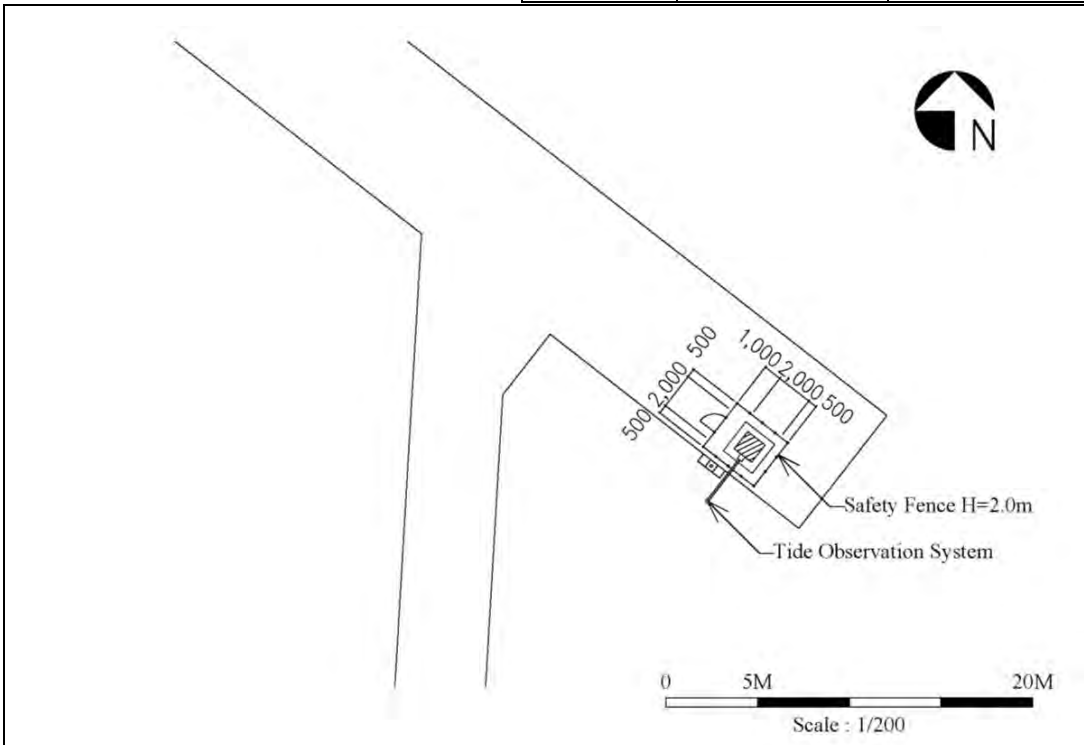
LT-01: Location of the Site and Survey Photos

T-1: Litzlitz, Malakula	Date	31 July, 2012 / 22 July, 2013	
---Tide Observation System	L/L	S 16°06'46.19"	E 167°26'38.29"



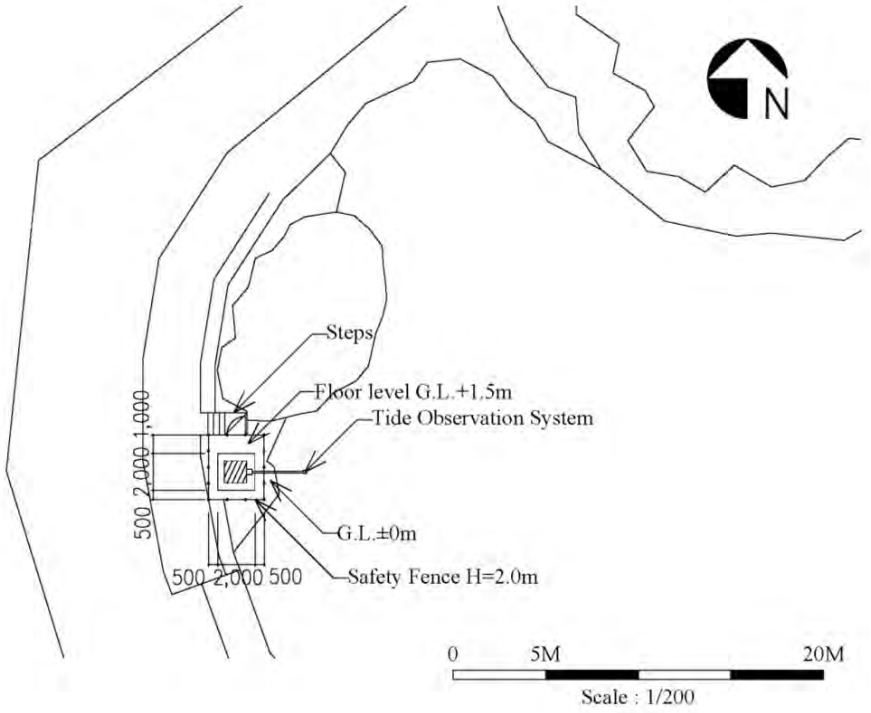
Location of the Site

Distant View

Install Area of Tide Observation System

LT-02: Location of the Site and Survey Photos

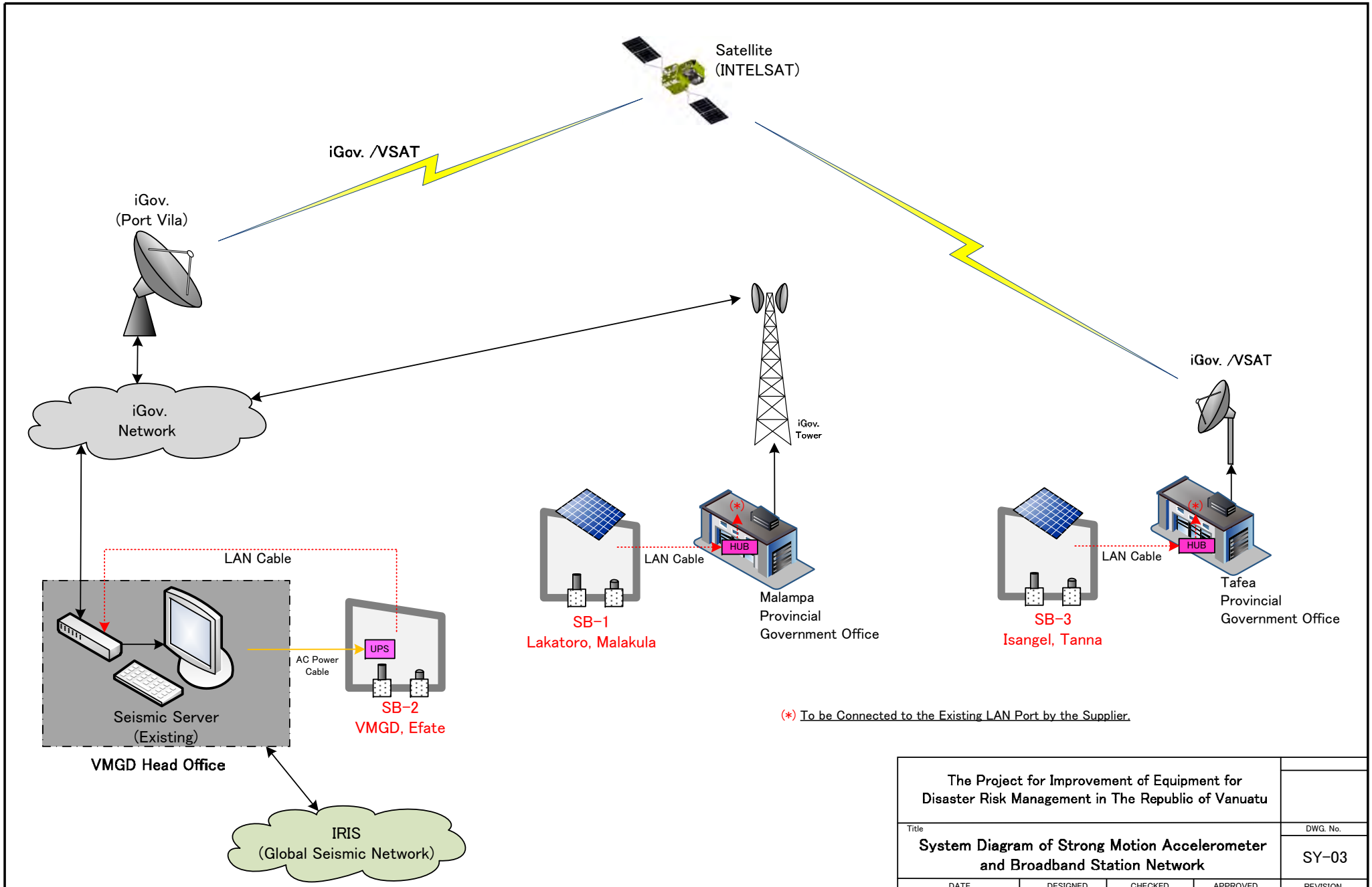
T-2: Lenakel, Tanna	Date	26 July, 2012 / 19 July, 2013	
---Tide Observation System	L/L	S 19°31'57.22"	E 169°15'57.43"



Location of the Site

Distant View

Install Area of Tide Observation System



(*) To be Connected to the Existing LAN Port by the Supplier.

The Project for Improvement of Equipment for Disaster Risk Management in The Republic of Vanuatu				
Title: System Diagram of Strong Motion Accelerometer and Broadband Station Network				DWG. No. SY-03
DATE	DESIGNED	CHECKED	APPROVED	REVISION
30 July 2013	M. Wada	T. Kobayashi	K. Tanaka	

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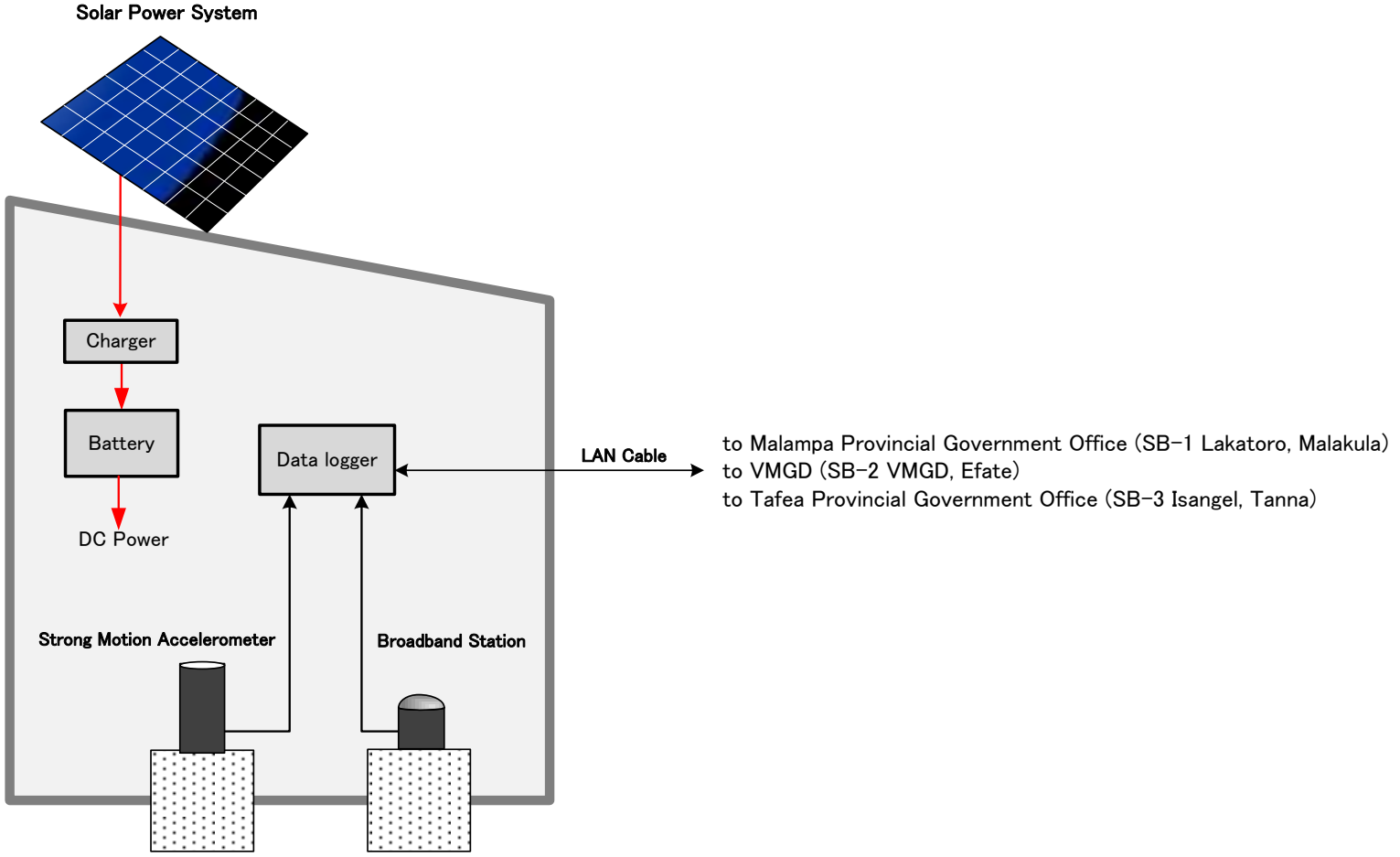
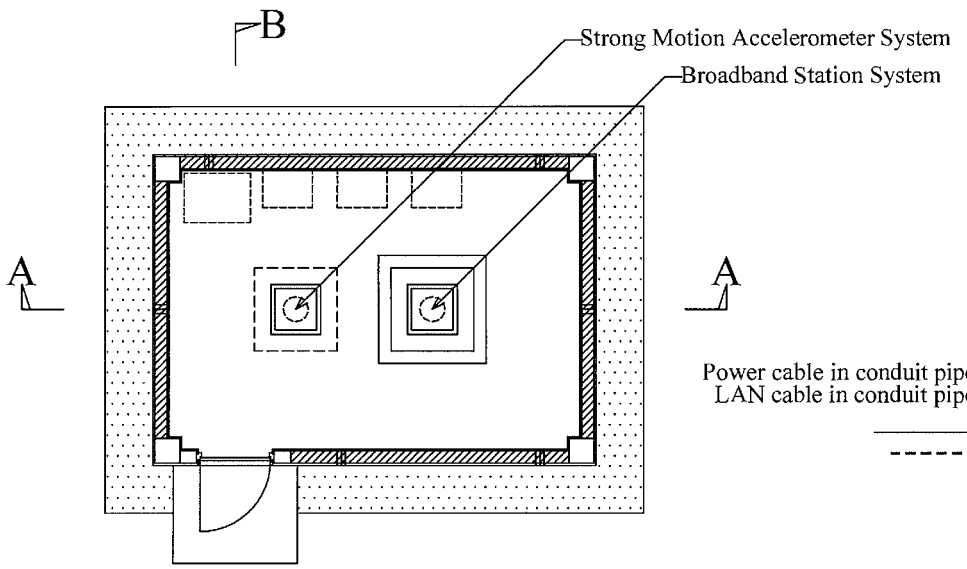
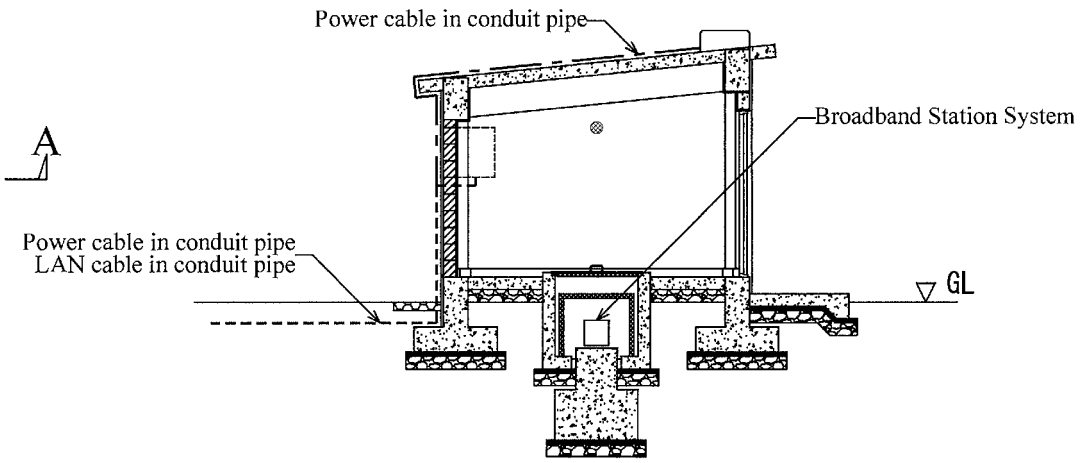
TOKYO JAPAN



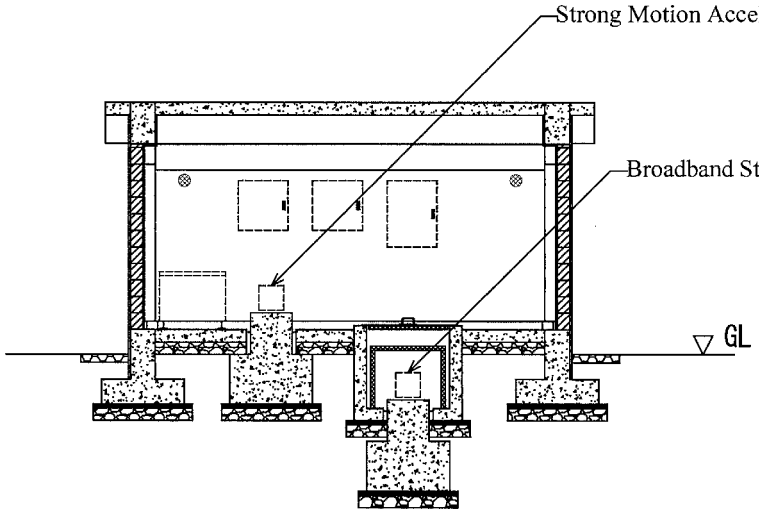
The Project for Improvement of Equipment for Disaster Risk Management in The Republic of Vanuatu				
Title: Block Diagram of Strong Motion Accelerometer and Broadband Station System				DWG. No.: SY-04
DATE	DESIGNED	CHECKED	APPROVED	REVISION
30 July 2013	M. Wada	T. Kobayashi	K. Tanaka	
YACHIYO ENGINEERING CO., LTD. TOKYO JAPAN				



G. FLOOR PLAN



SECTION B-B



SECTION A-A

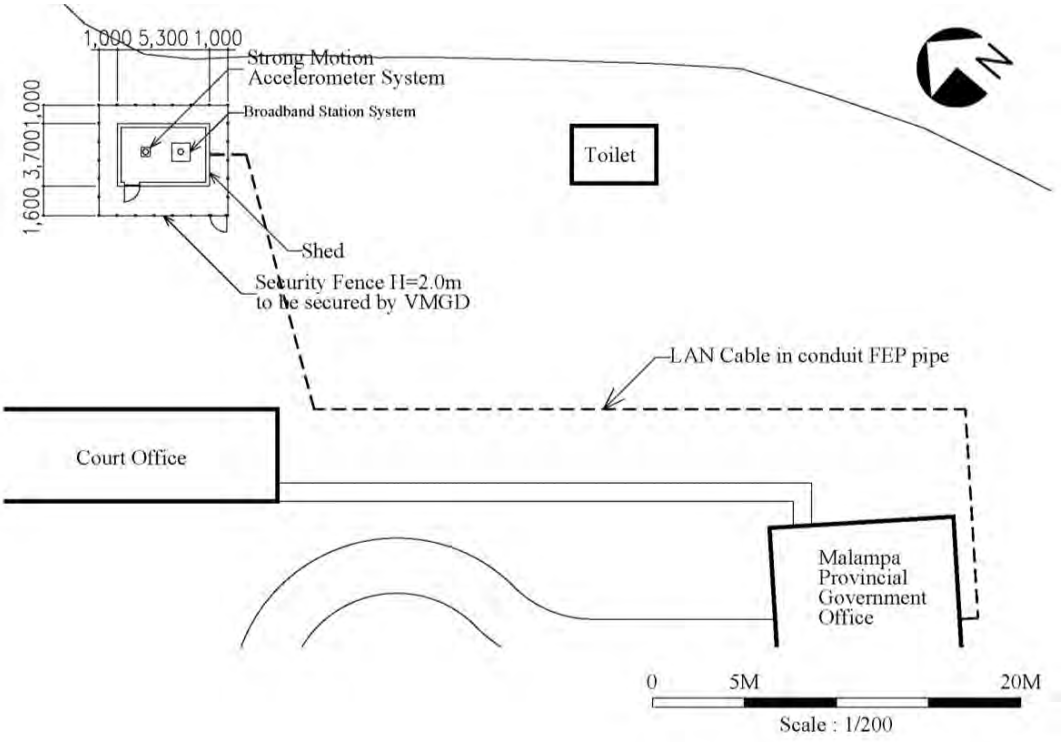
The Project for Improvement of Equipment for Disaster Risk Management in The Republic of Vanuatu				SCALE: S=1/80
Title: Design of Shed for Strong Motion Accelerometer System and Broadband System Plan, Section				DWG. No.: DSB-01
DATE	DESIGNED	CHECKED	APPROVED	REVISION

LSB-01: Location of the Site and Survey Photos

SB-1: Lakatoro, Malakula

---Strong Motion Accelerometer System and Broadband Station System

Date	22 July, 2013	
L/L	S 16°06'23.0"	E 167°25'02.2"



Location of the Site

Distant View

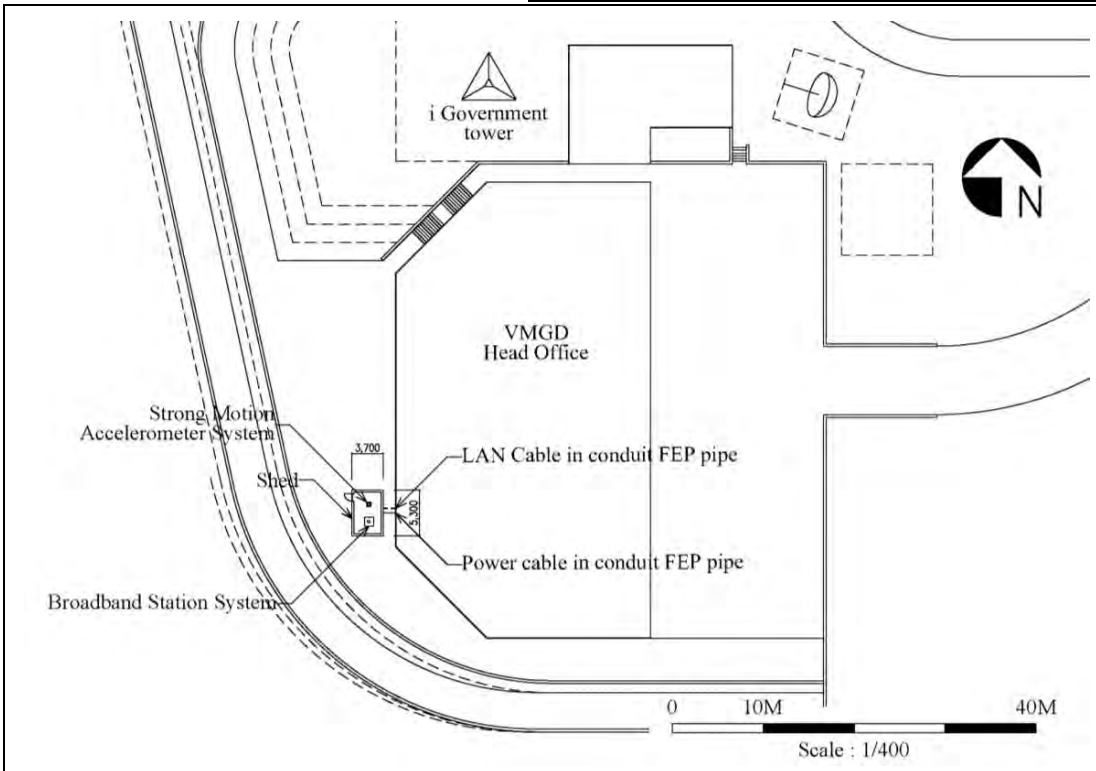
Install Area of Strong Motion Accelerometer System and Broadband Station System

LSB-02: Location of the Site and Survey Photos

SB-2: VMGD, Efate

---Strong Motion Accelerometer System and Broadband Station System

Date	25 July, 2013	
L/L	S 17°44'59.5"	E 168°18'51.0"



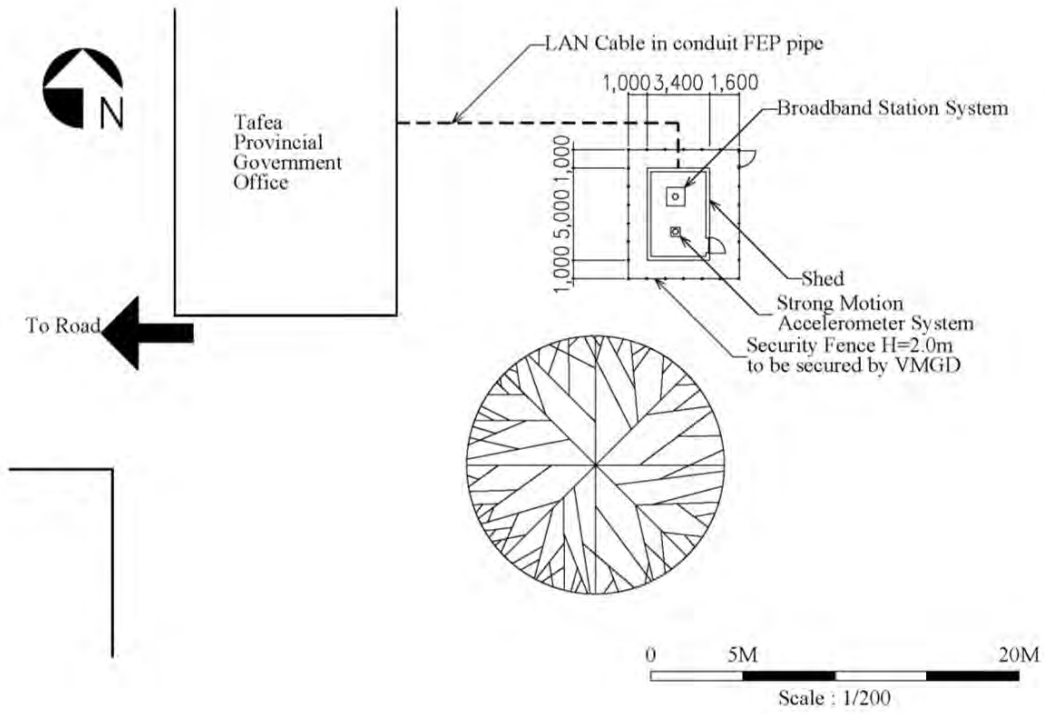
Location of the Site

Distant View

Install Area of Strong Motion Accelerometer System

LSB-03: Location of the Site and Survey Photos

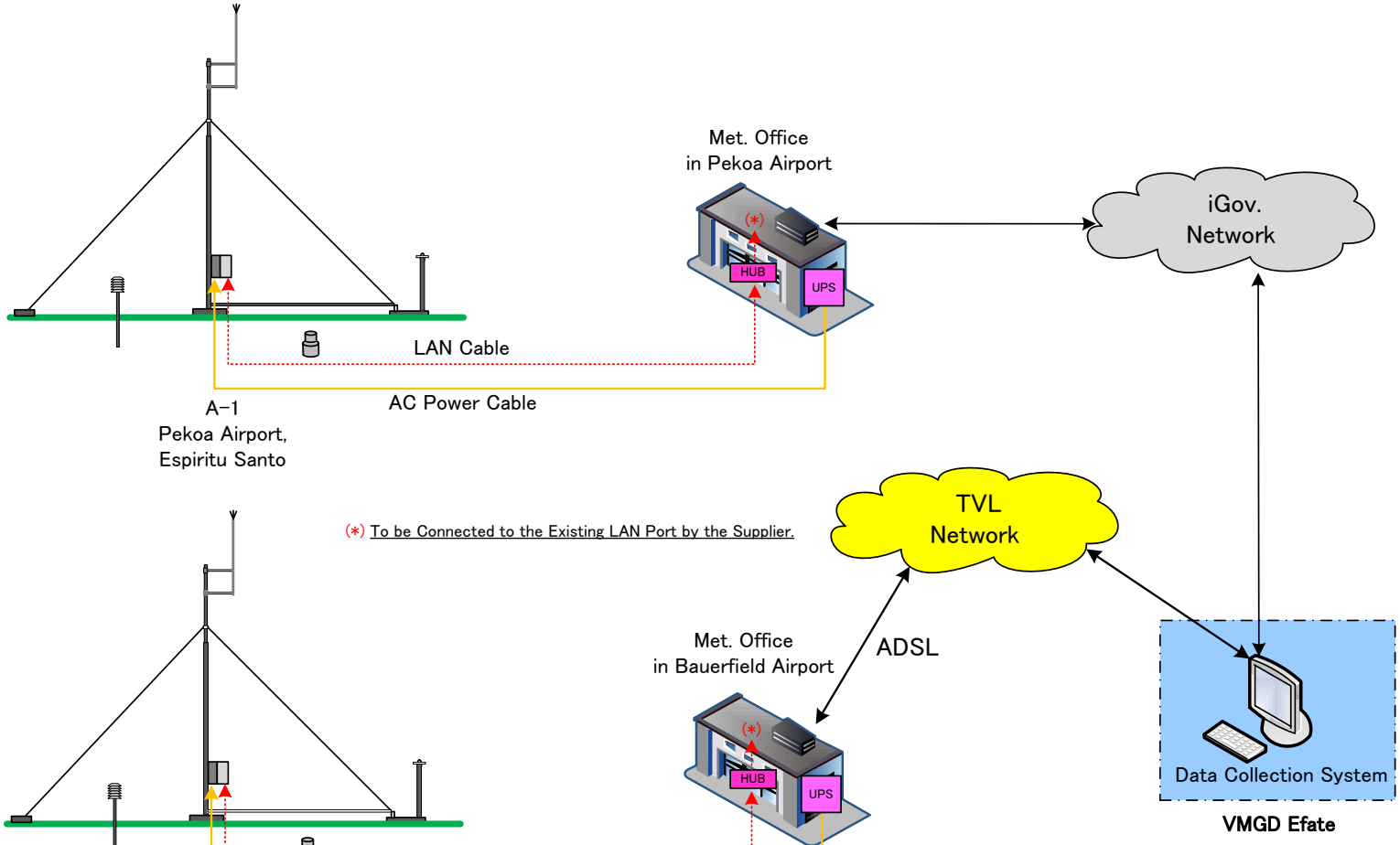
SB-3: Isangel, Tanna **---Strong Motion Accelerometer System and Broadband Station System**	Date	26 July, 2012 / 19 July, 2013	
	L/L	S 19°32'32.5"	E 169°16'53.0"



Location of the Site

Distant View

Install Area of Strong Motion Accelerometer System and Broadband Station System



The Project for Improvement of Equipment for Disaster Risk Management in The Republic of Vanuatu				
Title: System Diagram of Automatic Weather Station (AWS) Network				DWG. No.: SY-05
DATE	DESIGNED	CHECKED	APPROVED	REVISION
30 July 2013	M. Wada	T. Kobayashi	K. Tanaka	

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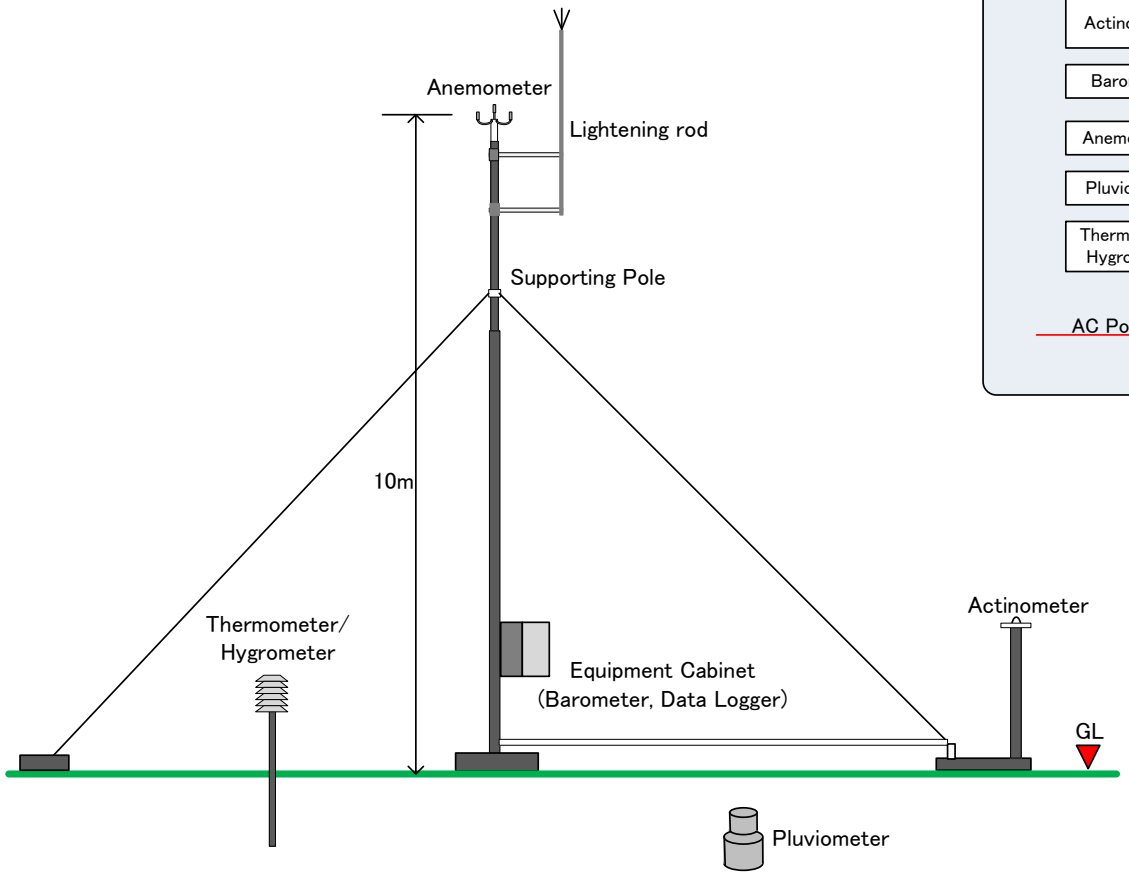
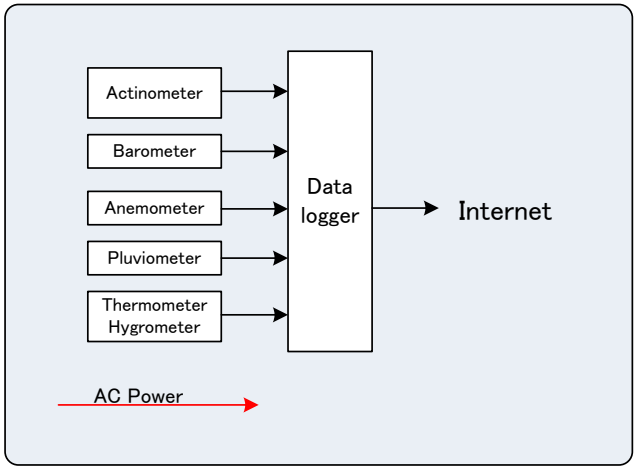


System Diagram of AWS



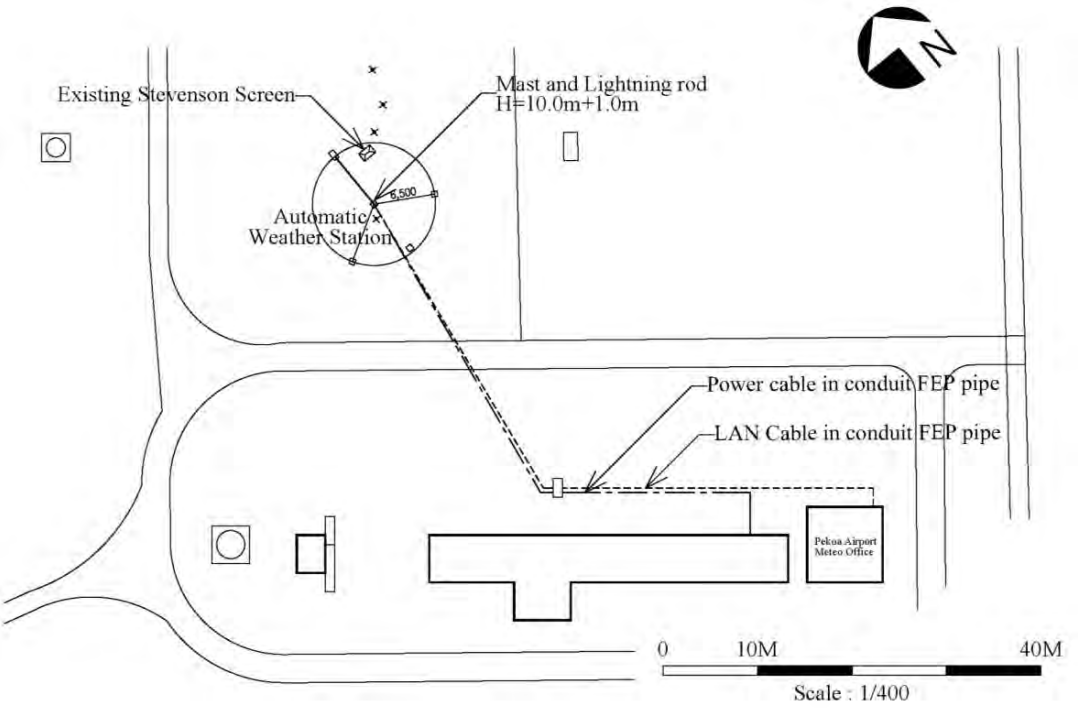
Note)

In case of Bauerfield Airport (Site A-2), Anemometer and Supporting Pole will be separated from the above-indicated composition and installed at another location. In this connection, another pole shall be provided for installation of Equipment Cabinet.

The Project for Improvement of Equipment for Disaster Risk Management in The Republic of Vanuatu				
Title: Block Diagram of Automatic Weather Station (AWS) System				DWG. No. SY-06
DATE	DESIGNED	CHECKED	APPROVED	REVISION
30 July 2013	M. Wada	T. Kobayashi	K. Tanaka	
YACHIYO ENGINEERING CO., LTD. TOKYO JAPAN				

LA-01: Location of the Site and Survey Photos

A-1: Pekoa Airport, Espiritu Santo	Date	23 July, 2012	
--- Automatic Weather Station (AWS)	L/L	S 15°30'25.8"	E 167°13'07.3"



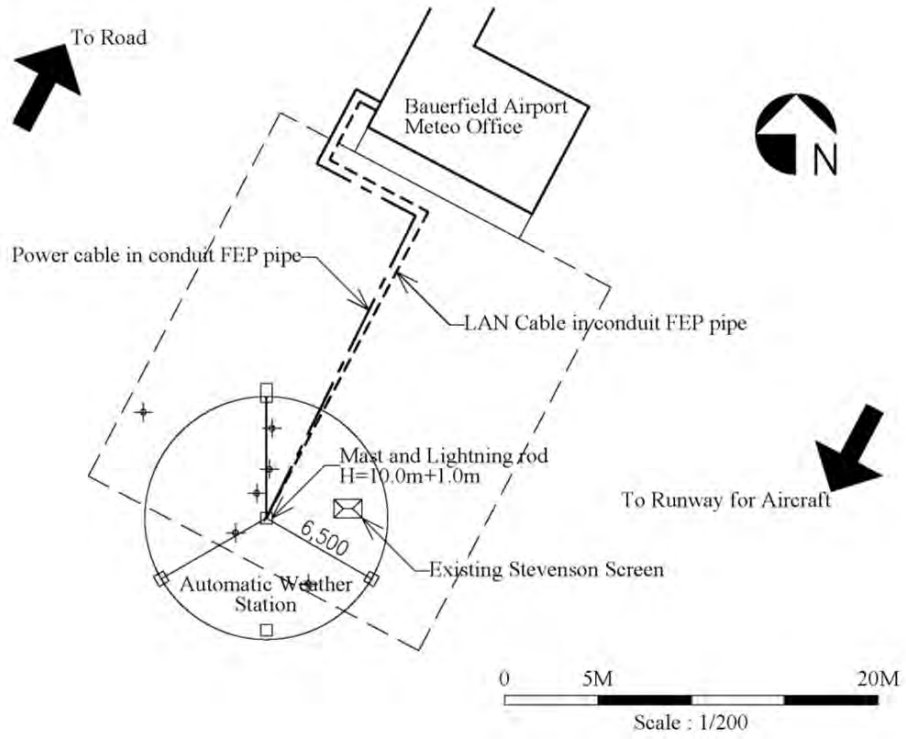
Location of the Site

Distant View

Install Area of Automatic Weather Station

LA-02: Location of the Site and Survey Photos

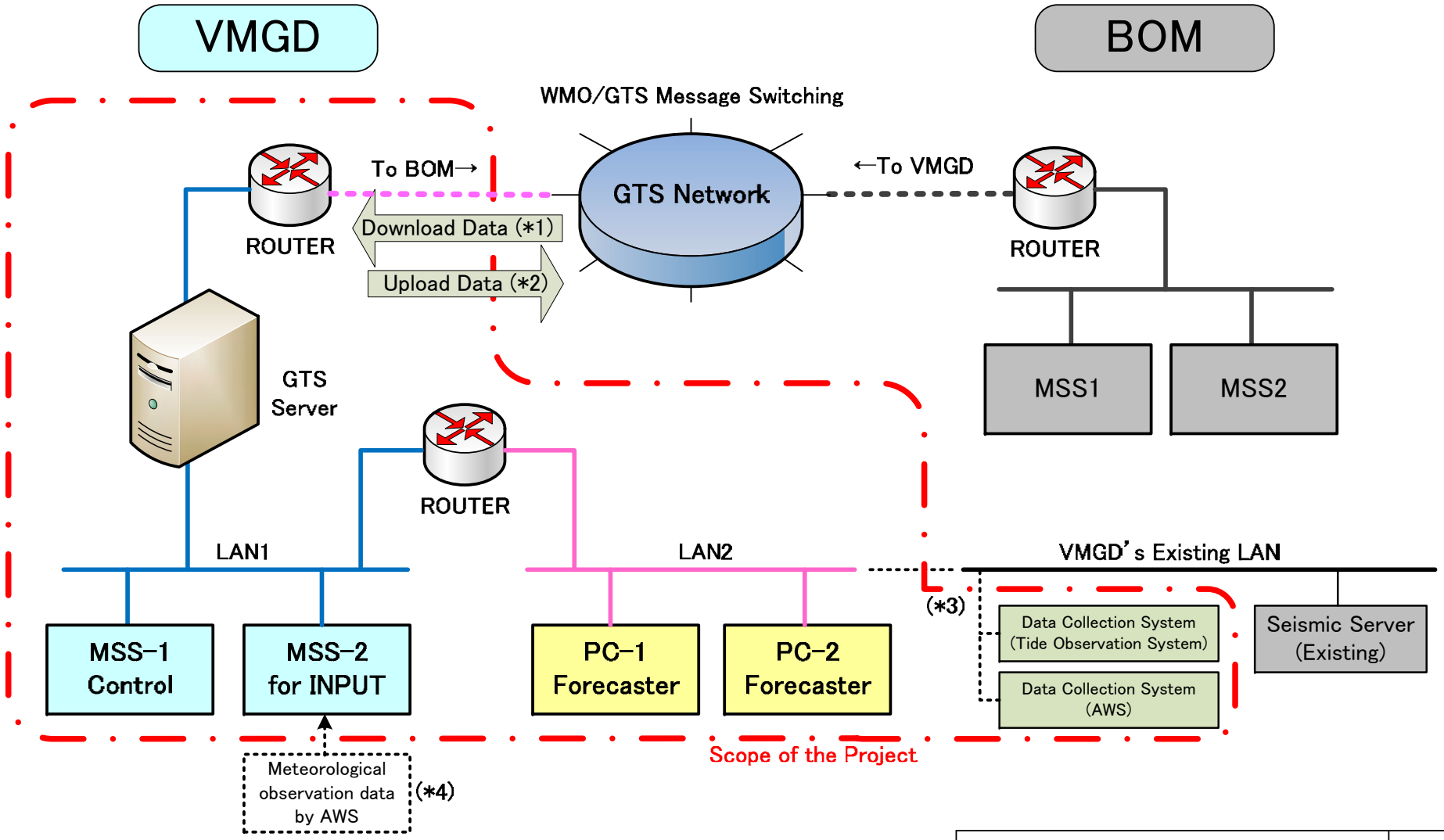
A-2: Bauerfield Airport, Efate	Date	17 July, 2012	
--- Automatic Weather Station (AWS)	L/L	S 17°41'40.82"	E 168°18'46.57"



Location of the Site

Distant View

Install Area of Automatic Weather Station



Remarks

*1. Download Data: Tide observation data by DCP, Tsunami information, Meteorological observation data (Overseas), NWP data, etc.

*2. Upload Data: Meteorological observation data (Domestic), etc.

*3. Connection among GTS Server, VMGD's existing LAN and Data Collection System will be done by VMGD after the Installation Work.

*4. Input of Meteorological observation data will be done by VMGD after the Installation Work.

The Project for Improvement of Equipment for Disaster Risk Management in The Republic of Vanuatu				
Title: System Diagram of GTS Server and MSS System				DWG. No.: SY-07
DATE	DESIGNED	CHECKED	APPROVED	REVISION
30 July 2013	M. Wada	T. Kobayashi	K. Tanaka	

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TOKYO JAPAN

Appendix-6. Plan for Soft Component

Preparatory Survey
on
the Project for
Improvement of Equipment for Disaster Risk Management
in Vanuatu

Plan for Soft Component

September 2013

JICA Study Team
Yachiyo Engineering Co., Ltd.
Japan Meteorological Business Support Center

1. Background to Planning the Soft Component

Vanuatu currently has two tide gauges. These were installed under assistance from the Bureau of Meteorology (BOM) of Australia, and out of the observed data, only the results for Portvila that have been acquired and analyzed by BOM are disclosed on the BOM homepage. Vanuatu Meteorology and Geo-Hazards Department (VMGD) is unable to directly monitor these two tide gauges, but it looks at data on the BOM homepage as needed. Since tsunami waves generally strike after the occurrence of major earthquakes, it should be possible to roughly estimate the arrival time of tsunami by monitoring the post-quake tide level waveform, so the disclosed data can be said to fulfill a certain role. Meanwhile, since the tide data observed in Portvila is transmitted via weather satellite and it takes around 15 minutes between observation and disclosure on the homepage, the current situation of simply perusing the data cannot be described as observation geared to tsunami monitoring for Vanuatu.

In the Project, through installing tsunami monitoring tide gauges in 2 locations in Vanuatu and establishing an observation server in VMGD headquarters, beneficial effects can be anticipated, for example, it will become possible to conduct real-time monitoring of tide levels over a wide area in Vanuatu. The tide fluctuation data obtained from tide gauges includes the regular tidal component, the high tide component arising from waves and cyclones, the tsunami component arising from ocean earthquakes and so on, however, in order for national agencies to install tide gauges and monitor tsunami, it is desirable for the tide level waveform to be displayed on a screen and for the results of tsunami analysis to be displayed as quantitative indicators such as tsunami arrival time and tsunami height. For this purpose, it is necessary for technicians who are well-versed in the topographical and ocean characteristics of Vanuatu to conduct technology transfer in order to analyze the observation data and provide highly reliable data. Moreover, since tide level observation data contributes not only to tsunami monitoring but also benchmark analysis, shipping lane safety management (minimum tide level analysis) and compilation of reference planes for port works and so on, it can impart a major beneficial effect on the public interest. Furthermore, observation information on tsunami caused by ocean earthquakes is not only useful for preparing disaster prevention measures in Vanuatu disaster prevention agencies and outlying island governments, it can have a major beneficial effect in terms of allowing Japan and other Pan-Pacific nations to grasp the scale of tsunami. Therefore, the Project aims to conduct technology transfer for appropriately processing tide data and analyzing tide information and for building a website that is geared to disclosing the observed data.

Concerning the operation and maintenance of equipment procured in the Project, technology transfer to VMGD will be carried out through initial operation guidance and maintenance inspection guidance, etc. by the Japanese Supplier contracted with VMGD as the Buyer after the Tender. However, because VMGD has forcefully requested assistance for embedding basic knowledge on earthquake and tsunami observation and acquiring data analysis technology like that described above among VMGD staff, the soft component and technology transfer will be implemented. VMGD employees possess basic knowledge on meteorology and marine phenomena and they also have the technical capability to inspect, maintain and operate the existing tide gauges. VMGD also operates the existing homepage and has the necessary skills for website building. Therefore, there is deemed to be ample sustainability concerning human resources, operation and utilization of equipment, and it will be possible to effectively utilize the equipment procured under the Project through implementing the soft component.

2. Goals of the Soft Component

The VMGD employees will understand the characteristics of the data obtained from the tide gauges and acquire basic knowledge for contributing to disaster prevention. Moreover, through the website that is prepared by VMGD, it will be possible to advertise and transmit observation data including tide level data.

3. Outputs of the Soft Component

The following outputs can be anticipated from implementation of the soft component:

① Basic information concerning natural ocean phenomena and tide gauges will be learned, and it will be possible to extract useful information concerning disaster prevention from the observation data.

② The appropriate quality control of tide level observation data will be conducted, and the data will be appropriately edited and stored

③ The environment will be prepared in order for tide level observation data to be appropriately analyzed and utilized as disaster prevention information.

④ Through construction of the website, the environment will be prepared for tide level observation data to be shared among the disaster prevention agencies of Vanuatu and international community.

4. Methods for Confirming Degree of Achievement of Outputs

Field	Outputs	Method for Confirming Outputs
1. Tide gauges	Learning of basic knowledge and understanding of observation devices 1. The differences between waves, tsunami and high tides, etc. will be understood. 2. The differences between types of tide gauges and observed elements will be understood. 3. The method for converting to the surface wave pattern will be understood. 4. Information that should be analyzed from observation data can be judged.	In order to confirm the degree of understanding of basic knowledge, tests prepared by the lecturers will be implemented for each item. Any trainees that do not achieve the pass mark and lack the understanding to achieve the intended goals will receive additional lessons and tests.
	Quality control, editing and storage of observation data 1. Anomalous data can be recognized, deleted and corrected. 2. Observation data can be stored in external memory devices and appropriately archived.	In order to confirm the degree of understanding, the lecturer extracts a typical case from past tidal waveform data and verifies if the trainees can make an appropriate judgment on the contents (confirm, correct or delete anomalous data). The degree of understanding of trainees cannot be assessed in numerical terms (point scoring, etc.), however, the lecturer confirms that the trainees can operate the tidal waveform data and correct and store the data.
	Analysis of observation data and extraction of disaster prevention information 1. Harmonic analysis and astronomical tide levels can be compiled. 2. Tsunami can be differentiated from high tides. 3. Monitoring of tsunami 4. Preparation of disaster prevention information 5. Method for applying tidal observation (analysis of reference planes and forecasting of tide level) is understood.	In order to confirm the degree of understanding, the lecturer extracts a typical case from past tidal waveform data and verifies if the trainees can conduct appropriate operations. Practical training in tide harmonic analysis and estimated tide levels using a year's observation data is conducted and the lecturer confirms the degree of achievement. The lecturer confirms that the trainees can remove the estimated tide level from the tide level observation data and can discern anomalous tide levels (tsunami and high tides). Analysis is conducted on tide level observation data from the past 5 years, and the lecturer confirms the degree of achievement in practical training on tide reference plane analysis, estimated tide level and abnormal tide level detection, etc.

Field	Outputs	Method for Confirming Outputs
2. Website construction	Website construction basics and server setting 1. The basics of website construction are understood. 2. Employees can autonomously perform server setting work. 3. Employees can autonomously perform security settings.	In order to confirm the basics of website construction and degree of understanding of server settings, tests prepared by each lecturer are implemented for each component. Any trainees that do not achieve the pass mark and lack the understanding to achieve the intended goals will receive additional lessons and tests.
	Website construction 1. Employees can autonomously perform website settings. 2. Knowledge concerning screen development (tabulation and figure drawing) is acquired. 3. Settings for data exchange with the observation server can be performed.	In order to confirm the degree of understanding, the lecturer confirms whether or not the trainees can construct a simple website on the web server, perform security settings and conduct settings to enable external viewing. Using existing figures and tables, the lecturer confirms the degree of achievement regarding ability to register and delete information on the website. The lecturer confirms the degree of achievement regarding ability to read data and prepare simple tables on the observation server.
	Website improvement 1. Methods for correcting, adding to and deleting from the information screen are understood. 2. Employees can autonomously perform minor information screen improvements. 3. In cases where the information screen needs to be improved, the contents of improvement can be accurately instructed to outsourced operators, etc.	In order to confirm the degree of understanding, the lecturer confirms the degree of achievement regarding ability to correct, add to or delete from the information screen prepared in this component. Using existing figures and tables, the lecturer confirms the degree of achievement regarding ability to register and delete information on the website. The lecturer confirms the degree of achievement regarding ability to conduct basic design, input and output data and understand the main points of screen development through preparing a basic information screen.

5. Soft Component Activities (Input Plan)

The contents of the soft component activities (input plan) are indicated below. The implementation resources will be provided through direct assistance by the outsourced consultant.

Field and Targets	Contents of Training	Outputs	Implementation resources (manpower M/M)
Step 1	(Preliminary survey, preparatory work)		
Common to all fields [Targets] Ocean observation and analysis field Information technology field	Field dispatch of 0.5 months is scheduled for the preliminary survey in each field. Week 1: ▫ Survey of existing data archives in VMGD and extraction of the data required for training ▫ Selection of the targets for training and discussion on the contents of technical guidance Week 2: ▫ Hearing of the targets for training ▫ Preparatory work for compiling texts	Compiled in Step 2	■ Japanese lecturers: 0.5M/M x 2 persons (1.0M/M)

Field and Targets	Contents of Training	Outputs	Implementation resources (manpower M/M)
Step 2	(Lectures, practical training and evaluation tests)		
① Tide gauges 【Targets】 Ocean observation and analysis field	(1) Basic knowledge ▫ Characteristics of ocean waves (waves, tides, high tide, tsunami) ▫ Types of tide gauges, measuring principles and equipment characteristics ▫ Information obtained from tide observations	・ Maintenance inspection manual	■ Japanese lecturer: 1.0M/M x 1 person (1.0M/M)
	(2) Quality control and data editing ▫ Tide observation and processing system ▫ Maintaining accuracy in observation instruments ▫ Observation data noise and quality control ▫ Editing and storage of observation data	・Operation guidance manual ・Periodic inspection log ・Routine inspection log	
	(3) Analysis and processing ▫ Separation and analysis of waves, tides, high tide, tsunami ▫ Tsunami monitoring ▫ Applied tidal observation (elevation and course control, tide level forecasting) ▫ Compilation of disaster prevention information	・Analysis manual ・ Harmonic analysis program ・Estimated tide level program	
	(4) Drills and practical training		
	(5) Evaluation		
② website construction 【Targets】 Information technology field	(1) Basics of website construction and server setting ▫ Website construction and security ▫ Security setting method ▫ Server setting	・Website construction manual ・ Website setting manual	■ Japanese lecturer: 1.0M/M x 1 person (1.0M/M)
	(2) Website construction ▫ Understanding of development language ▫ Data exchange with observation server ▫ Construction of information screen for disaster prevention agencies ▫ Information screen updating and data storage	・Data flow ・ Instrument configuration diagram ・Source code	
	(3) Website improvement ▫ Security setting ▫ Information screen correction, addition and deletion	・ WEB renovation manual	
	(4) Drills and practical training		
	(5) Evaluation		

The following table shows the detailed schedule of activities.

【Step 1】(Data collection and analysis)

Day number	Day	Tide gauges	Website construction
1	Sat	Leave Japan	
2	Sun	Arrive in Vanuatu	
3	Mon	Discussions with VMGD concerning the soft component (training schedule, training contents, request for selection of trainees) Technical discussions (technology for analyzing current conditions, analysis contents, outputs)	
4	Tue	Extraction of data from the VMGD system	Acquisition of source codes from the existing VMGD web system
5	Wed		
6	Thu	Analysis of extracted data	Analysis of existing source codes
7	Fri		
8	Sat	Arrangement of materials	
9	Sun	Arrangement of materials	
10	Mon	Technical discussions (implementation of re-analysis by VMGD using actual data, extraction of technical issues)	Technical discussions (confirmation of the technical level of VMGD staff, extraction of technical issues)
11	Tue	Analysis of extracted data	Examination of the optimum system plan
12	Wed		
13	Thu	Confirmation of requests concerning the soft component (training schedule, request for selection of trainees) Technical discussions (issues in technology for analyzing current conditions, contents of training)	
14	Fri	Leave Vanuatu	
15	Sat	Arrive in Japan	

【Step 2】(Lectures, practical training, evaluation)

Day number	Day	Tide gauges	Website construction
1	Sat	Leave Japan	
2	Sun	Arrive in Vanuatu	
3	Mon	Technical discussions with VMGD technicians and training orienteering	Technical discussions with VMGD web managers and training orienteering
4	Tue	Basics of tide level observation	Basics of website construction
5	Wed		
6	Thu		
7	Fri		
8	Sat	Arrangement of materials	Arrangement of materials
9	Sun	Arrangement of materials	Arrangement of materials
10	Mon	Quality control of tide level waveform data and extraction of anomalous data	Examination and discussion of optimum system plan, and system design
11	Tue		Data reading from the observation server
12	Wed	Quality control of tide level waveform data and extraction and correction of anomalous data	Basic design of information screen
13	Thu		Setting of web server
14	Fri	Outdoor training (data collection at an observation post)	
15	Sat	Arrangement of materials	Arrangement of materials
16	Sun	Arrangement of materials	Arrangement of materials
17	Mon	Harmonic analysis and estimated tide level Analysis of reference planes	Construction of information screen
18	Tue		
19	Wed	Applied tidal analysis Tsunami analysis	
20	Thu		
21	Fri		Website setting
22	Sat	Arrangement of materials	Arrangement of materials
23	Sun	Arrangement of materials	Arrangement of materials

Day number	Day	Tide gauges	Website construction
24	Mon	Compilation of disaster prevention information	Website renovation
25	Tue	Training review and questions and answers	Training review and questions and answers
26	Wed	Report preparation	
27	Thu		
28	Fri	Technical discussions and reporting	
29	Sat	Leave Vanuatu	
30	Sun	Arrive in Japan	

6. Method for Procuring the Soft Component Implementation Resources

As described in section 1 above, there are currently two tide gauges installed in Vanuatu, and the observation data from these is processed by BOM. Since VMGD itself does not conduct tsunami analysis, it will be necessary to advance the technology transfer while ascertaining the technical capacity of officers.

Japan is the leading nation when it comes to technology for eliminating wave components and tide components and extracting high tide and tsunami from tide level waveform data. Moreover, in order to update such monitoring and analysis data on the website, it will be necessary for the VMGD side to conduct autonomous management. Concerning the implementation resources for that purpose, it is deemed appropriate to adopt the direct assistance model whereby an outsourced consultant that is well-versed in the equipment specifications and understands the overall methods of use on the counterpart side is utilized.

It is desirable that the lecturers have knowledge concerning tide level waveform analysis, tide gauges and tide level analysis as well as experience of professional work and research. Therefore, it is deemed appropriate to require that candidates belong (or previously belonged) to related agencies or their satellite organizations in Japan (Meteorological Agency or Port Authority) and that they have experience of the work concerned. Concerning website construction, since this will be a national level website, staff will require the capability to secure high-level security and conduct data exchange with the observation server. Accordingly, it will be desirable to recruit personnel who have experience of building similar websites. The consultant will select and secure the implementation personnel (Japanese lecturers) according to the selection criteria. Moreover, the consultant will be responsible for managing progress based on regular reports from staff, and the said staff will directly report on progress and present outputs to the local agencies under instructions from the consultant.

7. Soft Component Implementation Schedule

The following table shows the implementation schedule for the soft component. The preliminary survey and preparatory work (Step 1) will be conducted during the local equipment installation works, and the optimum technical guidance program will be compiled while exchanging information with the system coordinator of the equipment procurement operator. Technical guidance (Step 2) will be implemented following completion of the equipment installation works.

Table Soft Component Implementation Schedule

Year	2015											
Month	1	2	3	4	5	6	7	8	9	10	11	12
Equipment installation works (Including initial operation and total system trainings)												
Tide gauges												
Website construction												

: Local preparatory survey (Step 1)
: Local technical guidance period (Step 2)

8. Soft Component Outputs

The outputs of the soft component are as described in section 5 above.

9. Soft Component Cost Estimate

The following table shows the rough cost of the soft component. (There are no local subcontracting costs).

Item	Amount (1000 JPY)
1. Direct personnel expenses	2,334
2. Direct costs	4,269
3. Indirect costs	2,987
Total:	**9,590**

10. Obligations of the Recipient Side

Following implementation of the soft component, the recipient side will need to implement the following items.

(1) Establishment of the management setup

- VMGD will carry out appropriate data management and analysis primarily through the employees that implemented the soft component. Also, it will need to establish a setup whereby the learned contents can be passed on for a long time.

(2) Implementation of periodic inspections and regular inspections

- The periodic inspections and regular inspections described in Step 2 of the inputted components in section 5 will be implemented. A system will be established whereby inspections can be implemented with responsibility while utilizing the inspection logs prepared in the soft component, and data updating and equipment maintenance and so on will be carried out without delay.

(3) Collection and updating of ocean phenomena information

- Because the general information on ocean phenomena is constantly updated based on information collected by specialist agencies in each country, it will be necessary for VMGD to gather information from overseas, continue learning even after the soft component and update the contents.

(4) Securing of budget

The local side will need to secure the necessary budget to ensure that the expenses for the above activities can be borne on an ongoing basis.

Appendix-7. Official Letter about Agreement of Land Use

7. 土地取得証明書類等 / Official Letter about Agreement of Land Use

No.	発行者/Issuer	サイト名等/Name of Site, etc.
1	マランパ州政府 Malampa Provincial Office	- T-1 マラクラ島リツリツ / Litzlitz, Malakulaz 潮位計測システム / Tide Observation System - SB-1 マラクラ島ラカトロ / Lakatoro, Malakula 地震計及びブロードバンド観測システム / Strong Motion Accelerometer and Broadband Station System
2	レナケル荷役請負会社 Lenakel Stevedoring Company	- T-2 タンナ島レナケル / Lenakel, Tanna 潮位計測システム / Tide Observation System
3	VMGD	- SB-2 エファテ島 VMGD / VMGD, Efate 地震計及びブロードバンド観測システム / Strong Motion Accelerometer and Broadband Station System - 既設測候所における AWS 用インフラの整備 / Provision of relevant issues for AWS in the existing Met. Office
4	タフェア州政府 Tafea Provincial Office	- SB-3 タンナ島イサンゲル / Isangel, Tanna 地震計及びブロードバンド観測システム / Strong Motion Accelerometer and Broadband Station System
5	バヌアツ航空公社 Airport Vanuatu Ltd.	- A-1 エスピリッツ・サント島ペコア空港 / Pekoa Airport, Espiritu Santo - A-2 エファテ島バウアフィールド空港 / Bauerfield Airport, Efate
6	内閣府 Prime Ministers Office	- マラクラ島 iGov.タワー上のダイバーシティ無線 LAN 機器の設置及び既設 LAN ポートの使用に関する許可 / Permission of the use of iGovernment Tower in Malakula for the installation of the diversity wireless LAN on the Tower and the use of the existing LAN port.
7	テレコムバヌアツ Telecom Vanuatu Ltd.	- タンナ島 TVL タワー上の無線 LAN 機器の設置に関する許可 / Permission of the use of TVL Tower in Isangel, Tanna for the installation of the wireless LAN on the Tower
8	CREST FM ラジオ局 CREST FM Station	- タンナ島 CREST FM ラジオ局内の UPS の設置 / Permission of the installation of UPS beside CREST FM Station in Tanna

MALAMPA PROVINCE

SECRETARIAT OF MALAMPA
PROVINCIAL GOVERNMENT COUNCIL
LAKATORO, MALEKULA

PROVINS BLONG MALAMPA

OFIS BLONG MALAMPA PROVINSEL
KAVMAN KAONSEL
LAKATORO, MALEKULA

SEVEM PIPOL BLONG MALEKULA, AMBRYM MO PAAMA

Date: 14 November 2013

Mr David Gibson
Director
Meteorology and Geo-Hazards Department
Port Vila

Dear Director,

RE: PERMISSION FOR THE INSTALLATION OF EQUIPMENT FOR DISASTER RISK MANAGEMENT UNDER JAPAN'S GRANT AID IN MALAMPA PROVINCE

I write in reference to the abovementioned matter.

First and foremost, I would like to reiterate that the Malampa Provincial Administration is supportive of your Departments involvement in inserting the following plants within our province:

(1). The Tide Observation System at Litzlitz Wharf
(2). The Strong Motion Accelerometer and Broadband Station System at Lakatoro.

When mentioning the above, please take note that renovation works are in the pipeline for the Litzlitz Wharf and it is proper that there is consultation between your department and the Project Managers to look at the available options that can be adopted to accommodate the installation of the observation system at Litzlitz.

Post Office Box 22 Tel : (678) 48491 Fax : (678) 48491 Email : malpc@vanuatu.com.vu

Accordingly, the Malampa Provincial Government Administration is hereby taking this opportunity to convey our approval for the two proposed sites and further confirm our support during the actual installation and construction of the sites.

Thank you.

Yours Sincerely,

MALAMPA PROVINSEL KAVMAN KAONSEL
SECRETARIAT

Lawson Jack Samuel
Secretary General

Cc: -Planner, Malampa Provincila Government Council;
-Hon. Chairman, Malampa Provincial Government Council;
-File

Post Office Box 22 Tel : (678) 48491 Fax : (678) 48491 Email : malpc@vanuatu.com.vu

Lenakel Wharf & Stevedoring (LWS)

Address: TAFEA Commercial Centre, Lenakel Wharf, TANNA. Tel: 88002 Mobile phone 5552864/7776079

8 November, 2013

Mr. David Gibson

Vanuatu Meteorological Department

Port Vila

Dear David

Thank you for the email with regards to picking Lenakel as a locating for setting up the tide gauge to measure the tide in the event of determining the possibility of a tsunami hitting the coastal areas of Tanna or measuring the occurrence of any such event in other locations.

We at the Lenakel Wharf and Stevedoring responsible for looking after the immediate vicinity of the Lenakel Wharf agree for the site to be used for the installation of the equipment as per the Project for Disaster Risk Management under the Japan's Grant Aid for the purpose of using the site as a No. 2 Tide Observation system.

Please work together with the staff on the ground at Lenakel Wharf and the propose wharf extension to be sponsored by the EU to ensure the location you pick will not be hampered with when work on the extension gets underway.

By copy of this letter responsible people in the office of the JICA here in Vanuatu are informed of this approval.

The information I have from Tanna is that the EU has already met with the people on Tanna regarding the maintenance or extension, this I am not sure which. But our concern is since it is a JICA project we at the Lenakel Wharf and Stevedoring are very concern whether there is a discussion between JICA and EU concerning the project EU is considering embarking on. We have other better ideas for a control storage to monitor what comes to and from the island which can be considered if there is a possibility.

With kind regards,

LENAKEL WHARF & STEVEDORING LWS

Jerry

Chairman Lenakel Wharf and Stevedoring

Cc: Yoko ASANO (Ms) Project Formulation Advisor (Aid Coordination), JICA Vanuatu Office

REPUBLIC OF VANUATU

VANUATU METEOROLOGY AND GEO-HAZARDS DEPARTMENT
Private Mail Bag 9054, Port Vila
Telephone: (678) 22331, 24686, 22932, 23866
Fax: (678) 22310
Email: Administration -: admin@meteo.gov.vu
Forecasting -: forecast@meteo.gov.vu
Climatology -: climate@meteo.gov.vu
Climate Change -: piccap@vanuatu.com.vu
Geo-Hazards-: geohazards@meteo.gov.vu

(Address Correspondence to Director)

Our Ref: PV/MET-GEO/JICA:dg

27 September 2013

JICA Vanuatu Office
4th Floor, Air Vanuatu Building,
Rue de Paris/PMB 9005,
Port Vila, VANUATU

Dear Sir/Madam,

Subject: installation of a Strong Motion Accelerometer System and Broadband Station System at the Vanuatu Meteorology and Geo-Hazards Headquarter

We agree to the use of the following locations and the existing infrastructures as the site for installation of the equipment on the Project for Improvement of Equipment for Disaster Risk Management under the Japan's Grant Aid:

Site No. SB-2 VMGD, Efate for Strong Motion Accelerometer and Broadband Station System, including provision of power supply (AC 240V) and the use of the existing 1 LAN port in VMGD
Provision of power supply (AC 240V) to new UPS for AWS and the use of the existing 1 LAN port in each Met. Office in Pekoa Airport, Espiritu Santo and Bauerfield Airport, Efate

Sincerely,

David Gibson
Acting Director

REPUBLIC OF VANUATU

TAFEA PROVINCIAL GOVERNMENT
POST OFFICE BOX 28
ISANGEL
TANNA
VANUATU
Tel 88664 Fax 88638

REPUBLIQUE DE VANUATU

CONSEIL PROVINCIAL DE TAFEA
BOITE POTALE 28
ISANGEL
TANNA
VANUATU
Tel 88664 Fax 88638

Our File Ref: 2/9/4

DATE: 14th October 2013

The Director
Meteo – Geohazard
PORT VILA

Dear Sir

RE: Meteo-Geohazard Seismic Station (Tafea)

Pertaining to the above, I would like to inform you of the Council's decision on a request you made to the council requesting an office space.

The Council has decided on locating a space for your Seismic Station and they have agreed that you build your office behind the Provincial Headquarter.

Thank you very much for your understanding.

RECEIVED
16 OCT 2013
BY:

Yours faithfully

Ketty Napwati
Secretary General
Tafea Provincial Government

David Gibson
Acting Director
Vanuatu Meteorology and Hazards Department
PMB 9054
Port Vila

2 October 2013

Dear Sir,

Re: Permission to build two (2) Automatic Weather Stations (AWSs) at Bauerfield and Pekoa International Airport.

I write in response to your letter and corresponding emails with our Legal Officer regarding the above subject.

Airports Vanuatu Limited has agreed to the use of the following locations as the site for installation of Automatic Weather Station (AWS) on the Project for Improvement of Equipment for Disaster Risk Management under the Japan's Grant Aid:

- Site No. A-1 Pekoa Airport, Espiritu Santo
- Site No. A-2 Bauerfield Airport, Efate

I understand the importance of installing such equipments as it will be of great help to airport operations as well.

Regarding Bauerfield Meteo Offices rental, it is my understanding that Vanuatu Meteorology and Hazards Department has not been paying AVL any rental fees for the offices as there was no agreement in place to cater for such a transaction. An agreement will be finalized and sent over to your office for your perusal before signing takes place.

I thank you for your understanding and looking forward to a sound working relationship with your office.

Yours sincerely

Harrison Toar
Acting Chief Executive Officer

AIRPORTS VANUATU LIMITED P.O BOX 131 PORT VILA

Cc: JICA Vanuatu Office
A/DG, Mr. Jotham Napat, MCCAMEF and NDMO
File

Airports Vanuatu Limited
Aeroports du Vanuatu

Bauerfield Airport
PO Box 131 Port Vila
Vanuatu SW Pacific

Tel: + 678 25111
Fax: + 678 25532
Web: www.airports.vu
E-mail: info@airports.vu

GOVERNMENT OF THE REPUBLIC OF VANUATU

PRIME MINISTER'S OFFICE

OFFICE OF THE GOVERNMENT CHIEF INFORMATION OFFICER

P M B 9108 Port Vila, Vanuatu
Tel: (678) 33380 www.ogcio.gov.vu

GOUVERNEMENT DE LA REPUBLIQUE DU VANUATU

BUREAU DU PREMIER MINISTRE

BUREAU DU CHEF DE SERVICE DE L'INFORMATION

SPP 9108 Port Vila, Vanuatu
Tel: (678) 33380 www.ogcio.gov.vu

Date: 27th September 2013

Jotham Napat
Acting Director General
Ministry of Climate Change and Energy

Dear Acting DG,

Subject: Use of iGov Network to support the Japan Grant funder Disaster Risk Management Project

I write to confirm our agreement to the use of our iGovernment Network for transmission of observed data by the newly installed equipment on the Project for Improvement of Equipment for Disaster Risk Management under the Japan's Grant Aid, including the following relevant infrastructures:

IGovernment Tower in Norsup, Malakula for the installation of the diversity wireless LAN on the Tower, power supply to the diversity wireless LAN (DC 48V, 20W) and the use of the existing 1 LAN port in the iGov. Control room.

Yours sincerely,

Fred Samuel
Chief Information Officer

cc:. JICA office

Telecom Vanuatu Ltd

Port-Vila. 1st October 2013.

Ref.: 43190/COM & MKG/1538

Mr David Gibson
Acting Director
Vanuatu Meteorology and Geo-Hazards Department
PMB 9054 - Port Vila

Dear Sir.

We would like to confirm that we agree to the use of the following existing infrastructures for transmission of observed data by the newly installed equipment on the Project for Improvement of Equipment for Disaster Risk Management under the Japan's Grant Aid:

- TVL Tower in Isangel. Tanna for the installation of the wireless LAN on the Tower

Please find below the hosting cost:

- setup cost: 50.000 VT VAT Excl.
- hosting montly rate: 50.000 VT VAT Excl.

We are actually finalising the contract and once it is ready it will be submitted to you.

Should you need further information, please do not hesitate to contact me on telephone 22185.

We take this opportunity to thank-you for having requested our services.

Yours faithfully.

Sébastien KAPPEL.
Corporate Sales and Customer Services Manager

Telecom House, PO Box 146, Lini Highway, Port Vila, Vanuatu. T +678 22185 F +678 22628 E telecom@tvl.net.vu

REPUBLIC OF VANUATU

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REPUBLIQUE DE VANUATU

CONSEIL PROVINCIAL DE TAFEA
BOITE POTALE 28
ISANGEL
TANNA
VANUATU
Tel 88664 Fax 88638

14 October 2013

The Director
Meteo Department
PORT VILA

Dear Sir

Agreement to Install your machines at FM Station

Pertain to the above, I would like to state my confirmation as the Manager to FM 104 Station that I have agreed that your UBS and other machines can be installed at the FM station on your request, knowing that information collected through this machines will be helpful to the population of TAFEA especially the advice you will giving during any disaster.

Thank you very much for you understanding.

Yours Faithfully,

David Kiel Junior
Station Manager
FM 104

Cc: Secretary General, Tafea Provincial Government

RECEIVED
16 OCT 2013
BY:

Appendix-8. Report of Topographical Survey and Soil Investigation

REPORT

Yachiyo Engineering Co Ltd.

The Project for Improvement of Equipment for Disaster Risk Management in the Republic of Vanuatu

Soils Investigation Report

Report prepared for:

Yachiyo Engineering Co Ltd.

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1 Introduction

1.1 General

Yachiyo Engineering Co. Ltd (YEC) engaged Tonkin & Taylor International Ltd (T&TI) to carry out the soils investigations and topographical surveys for the project for improvement of equipment for disaster risk management at five sites in the republic of Vanuatu.

The investigations and surveys have been carried out in accordance with the "Contract of Topographical Survey and Soil Explorations" for Lot 1 and Lot 2 provided to T&TI by YEC (ref: Appendix A). The soils investigation consisted of 2 hand auger boreholes and 2 Scala penetrometer tests at each investigation site. Laboratory testing of recovered soil samples from the five sites was also undertaken. This work scope was agreed with YEC.

The soil investigations were carried out at the following sites:

Lot 1

- VMGD, Efate
- Isangel, Tanna

Lot 2

- Lakatoro, Malekula
- Bauerfield Airport, Efate
- Pekoa Airport, Santo

In addition, a topographical survey of the VMGD (Efate), Isangel (Tanna) and Lakatoro (Malekula) sites have been undertaken by surveyors, Civil Services (HB) Limited under the supervision of T&TI.

This report summarises the results of the soils investigations carried out at these five sites.

1.2 Project Description

The Republic of Vanuatu consists of 82 islands occupying over 12,200 square kilometres in the southern Pacific Ocean. The capital is Port Vila located on the main island of Efate.

The project involves construction of various equipment buildings at five separate sites, two on Efate Island and one each on Malekula, Santo and Tanna Islands. The works at the VMGD (Efate), Malekula and Tanna sites comprise construction of a strong motion accelerometer station, whilst the construction at the Bauerfield Airport (Efate) and Pekoa Airport (Santo) sites comprise construction of an Automatic Weather Station Network.

The works are part of the project for Improvement of Equipment for Disaster Risk Management in the Republic of Vanuatu.

2 Site Description

2.1 Lot 1 Sites

2.1.1 Site 1 – VMGD, Efate

Site 1 is located at the Vanuatu Meteorological and Geo-Hazards Department (VMGD), on the south western coast of Efate which is near the centre of the Vanuatu Islands Archipelago, approximately 5.5km from Bauerfield Airport. The eastern portion of the site is relatively flat, whilst the western portion comprises a moderate slope leading towards a flat cut platform (at the eastern extent of the site). Limestone rock is exposed at ground level on the cut platform on the western section of the site. The property is currently occupied by a large office building and meteorological instruments including rainfall gauges and a large radio tower. Several overhead cables supplying power to the external equipment transect the site. A steep slope (limestone rock face) exists past the western extent of the site, sloping towards the coastline.

2.1.2 Site 2 - Isangel, Tanna

Site 2 is located at the Isangel Provisional Office on the south western coast of Tanna Island, approximately 10 km from the Tanna airport. Tanna Island is located at the southern extent of the Vanuatu Island Archipelago. The Provincial office site is generally flat to slightly sloping (east to west) and comprises a single level office building surrounded by open fields, roads and dwellings.

2.2 Lot 2 Sites

2.2.1 Site 3 – Lakatoro, Malekula

Site 3 is located in the compound of the Provincial Government office in Lakatoro, approximately 3.5km from Norsup Airport, at the north eastern coast of Malekula. The site was located directly north of the court buildings, on a gently sloping ($<10^0$) grassed field. We estimate that the site is approximately 40 – 50m above sea level.

2.2.2 Site 4 - Bauerfield Airport, Efate

Site 4 is located at the Bauerfield Airport in Port Vila, on the south western coast of Efate. The site is approximately 4km from the centre of town and is located at the Bauerfield Airport Meteorological office. The site is situated to the north of the runway, at the north-western corner of the airport site. The site is approximately 1m above the runway level. The site is currently occupied by the Met office building, grassed fields and various weather monitoring equipment, including rain and temperature gauges.

2.2.3 Site 5 - Pekoa Airport, Santo

Site 5 is located at the Pekoa Airport on the south east coast of Santo. The site is approximately 5km from the centre of Luganville town and is located at the south western corner of site. The site is approximately 1-2m above the aircraft apron area. The site is currently occupied by some weather monitoring equipment, including rain and temperature gauges.

A site plan for each location is attached in Appendix B.

3 Summary of the Topographical Survey

A topographical survey of the Sites 1 - 3 were undertaken by surveyors, Civil Services (HB) Ltd in July and August 2013 under the supervision of T&TI. The topographical survey details and results are summarised in the following sections.

The topographic survey plans are also presented in Appendix B. Two cross sections from each surveyed site were also taken and these are presented in Appendix B

3.1.1 Site 1 – VMGD, Efate

Topographical survey of the site was undertaken on 29th and 30th July 2013.

Equipment used included: Sokkia RTK GPS XR1 Base and Rover

Sokkia SET4130R3-36T Reflectorless Total Station

Local benchmark used: Benchmark (Met Office) RL20.52m

Coordinate System used: UTM/WGS84/Zone 59

Height Datum: Measured Sea Level

Survey control marks were installed at various locations around the site, refer to Civil Services HB Ltd plans “Site 1 Plan, VMGD, Efate, Vanuatu” and “Site 1 Cross Sections, VMGD, Efate, Vanuatu”.

3.1.2 Site 2 - Isangel, Tanna

Topographical survey of the site was undertaken on 31st July 2013.

Equipment used included: Sokkia RTK GPS XR1 Base and Rover

Local benchmark used: Benchmark (Wharf) RL0.97m

Coordinate System used: UTM/WGS84/Zone 59

Height Datum: Measured Sea Level

Survey control marks were installed at various locations around the site and steel rods were also installed on the corners of the proposed building, refer to Civil Services HB Ltd plans “Site 2 Plan, Isangel, Tanna, Vanuatu” and “Site 2 Cross Sections, Isangel, Tanna, Vanuatu”

3.1.3 Site 2 - Isangel, Tanna

Topographical survey of the site was undertaken on 30th July 2013.

Equipment used included: Sokkia RTK GPS 2700IS Base and Rover

Local benchmark used: ISI RL50.00m

Coordinate System used: UTM/WGS84/Zone 58

Height Datum: Assumed

Survey control marks were installed at various locations around the site and steel rods were also installed on the corners of the proposed building, refer to Civil Services HB Ltd plans “Site 3 Plan, Lakatoro, Malekula, Vanuatu” and “Site 3 Cross Sections Lakatoro, Malekula, Vanuatu”

4 Summary of Soils Investigation

4.1 General

The soils investigations were carried out in July and August 2013 and the scope of work was completed in accordance with the "Contract of Topographical Survey and Soil Explorations" attached in Appendix A. All tests were terminated in hard ground or at the target depth.

The following tasks were completed for the soils investigation:

- Site 1– VMGD, Efate
  - 2 No. Hand auger boreholes (SB02-HA1 and SB02-HA2) to 0.20m and 0.30m below existing ground level
  - 2 No. Scala penetrometer tests (SB02-SC1 and SB02-SC2) to 0.55m and 0.25 below existing ground level
- Site 2 - Isangel, Tanna
  - 2 No. Hand auger boreholes (SB03-HA1 and SB03-HA2) to between 2.0m and 2.05m below existing ground level
  - 2 No. Scala penetrometer tests (SB03-SC1 – SB03-SC2) to between 2.0m and 3.75m below existing ground level
- Site 3 – Lakatoro, Malekula
  - 2 No. Hand auger boreholes (SB01-HA1 and SB02-HA2) to between 0.92m and 1.05m below existing ground level
  - 2 No. Scala penetrometer tests (SB01-SC1 and SB02-SC2) to 1.45m below existing ground level
- Site 4 – Bauerfield Airport, Efate
  - 2 No. Hand auger boreholes (A02-HA1 and A02-HA2) to 3m below existing ground level
  - 2 No. Scala penetrometer tests (A02-SC1 and A02-SC2) to 5m below existing ground level
- Site 5 – Pekoa Airport, Santo
  - 2 No. Hand auger boreholes (A01-HA1 and A01-HA2) to 1.7m below existing ground level
  - 2 No. Scala penetrometer tests (A01-SC1 and A01-SC2) to between 2.95m and 2.7m below existing ground level

The subsections below present a summary of the investigation work and laboratory testing results. Site investigation logs and laboratory testing results are presented in Appendix C.

4.2 Handauger and Scala Penetrometer Investigations

The soil investigation testing, including hand augered boreholes and Scala penetrometer tests, was undertaken over a period of 6 days (27 July - 1 August 2013) at the various sites. In-situ shear strength testing was carried out in the hand auger boreholes in cohesive materials using a calibrated pilcon shear vane and samples were taken for geotechnical laboratory testing. The subsurface soils were described in accordance with NZ Geotechnical Society guidelines and shear

strengths are recorded on the borehole logs presented in Appendix C. The Scala penetrometer provides continuous soil strength data until hard ground/refusal is achieved (10 - 20 blows per 50mm penetration). The results of the Scala penetrometer tests are included in Appendix C.

Correlations between Scala penetrometer test results and SPT 'N' values have been developed over a long period of time. The developed correlations are particularly relevant in granular soils.

4.2.1 Site 1 – VMGD, Efate

Two hand auger boreholes and two Scala penetrometer tests were undertaken in the area of the proposed Strong Motion Accelerometer Station, immediately west of the existing office building at this site on 27th July 2013. The hand auger boreholes extended to a depth of up to 0.3m below existing ground level as weak limestone rock was encountered at ground level. No groundwater was encountered in either borehole at the site. The Scala penetrometer tests were terminated at depths of up to 0.5m below ground level (due to refusal).

4.2.2 Site 2 - Isangel, Tanna

Two hand auger boreholes and two Scala penetrometer tests were undertaken in the area of the proposed Strong Motion Accelerometer Station, immediately east of the existing provincial office building at this site on 31st July 2013. The hand auger boreholes were drilled to a depth of up to 2.05m below existing ground level where refusal (due to very stiff to hard soil) was encountered. No ground water was encountered in any of the boreholes. The Scala penetrometer tests were terminated at depths of up to 3.75m due to refusal (stiff soil).

4.2.3 Site 3 - Lakatoro, Malekula

Two hand auger boreholes and two Scala penetrometer tests were undertaken in the area of the proposed Strong Motion Accelerometer Station, immediately north of the existing court buildings at this site on 30th July 2013. The hand auger boreholes extended to a depth of up to 1.05m below existing ground level where hard limestone boulders or weathered limestone bedrock was encountered. No groundwater was encountered in either borehole at the site. The Scala penetrometer tests were terminated at a depth of 1.45m below ground level (due to refusal).

4.2.4 Site 4 - Bauerfield Airport, Efate

Two hand auger boreholes and two Scala penetrometer tests were undertaken in the area of the proposed Automatic Weather Station, immediately south west of the existing met office building at this site on 28th July 2013. Both hand auger boreholes were drilled to the target depth of 3.0m and both Scala penetrometer test also terminated at the target depth of 5.0m. No groundwater was encountered in either borehole at the site.

4.2.5 Site 5 – Pekoa Airport, Santo

Two hand auger boreholes and two Scala penetrometer tests were undertaken in the area of the proposed Automatic Weather Station, immediately south west of the existing weather station and runway at this site on 1st August 2013. Both hand auger boreholes extended to a depth of 1.70m below existing ground level where very stiff soils were encountered. The Scala penetrometer tests were terminated at depths of up to 2.95m due to refusal (stiff soil or bedrock). No groundwater was encountered in either borehole at the site.

4.3 Geotechnical Laboratory Schedule

The recovered samples were brought back to Auckland and geotechnical laboratory testing was carried out by Geotechnics Ltd. The laboratory tests have been completed in full accordance with

the relevant New Zealand standards, identified in the subsections below, and the laboratory is fully accredited with International Accreditation New Zealand (IANZ) registration.

The soil testing consisted of the following:

- Site 1 - VMGD, Efate
  - Moisture content (2 No.)
  - Particle size distribution (1 No.)
  - Soil density (1 No.)
- Site 2 - Isangel, Tanna
  - Moisture content (4 No.)
  - Particle size distribution (2 No.)
  - Soil density (2 No.)
- Site 3 - Lakatoro, Malekula
  - Moisture content (4 No.)
  - Particle size distribution (2 No.)
  - Soil density (2 No.)
- Site 4 – Bauerfield Airport, Efate
  - Moisture content (5 No.)
  - Particle size distribution (3 No.)
  - Soil density (3 No.)
- Site 5 – Pekoa Airport, Santo
  - Moisture content (4 No.)
  - Particle size distribution (2 No.)
  - Soil density (2 No.)

5 Subsurface Conditions

5.1 Geological Setting

The published geology, Geology of Efate and offshore Islands[1] indicates Site 1 (VMGD) is underlain by a recently raised limestone reef of the Reef Limestone Formation. This Geological map indicates that Site 4 (Bauerfield Airport) is underlain by Holocene Alluvium deposits.

Geological maps for the outer Islands of Vanuatu (where sites 2, 3 and 5 were located) have not been available for this Geotechnical assessment.

[1] Geology of Efate and offshore Islands: New Hebrides Geological Survey [map] sheet 9

5.2 Ground and Groundwater Conditions

5.2.1 Site 1 - VMGD, Efate

The two hand auger boreholes across the building platform encountered very similar ground conditions and these are summarised in Table 1 below. The investigations did not extend to full depth as they met refusal on what is believed to be weathered limestone rock surface. A visual inspection identified exposed limestone rock outcrops on the steep cut slope at the western edge of the site. Some limestone outcrops, at ground level were also visible in the vicinity of the investigation area.

Table 1 – Summary of ground conditions

Depth (Below ground level)	Geological unit	Soil description	Soil undrained shear strength (kPa)
0.0m – 0.1m	Topsoil	Sandy SILT, dark brown, moist, non-plastic	N/A
0.1m – >0.3m	Limestone	Limestone, light brownish white, highly weathered, fractured with some sand and silt infill, weak, moist	210^{+}kPa

Groundwater was not encountered in either borehole during geotechnical investigations at this site. It is anticipated that the ground water level will be at a significant depth beneath this site (ie >10m).

The two Scala penetrometer tests SB02-SC1 and SB02-SC2 were terminated at depths of up to 0.5m below ground level. From this in-situ testing, we can assess the soil strengths at specific depths below the site. The Scala results and inferred soil strength are summarised in Table 2 below:

Table 2 – Summary of Scala penetrometer results (Site 1 – VMGD, Efate)

Depth (Below ground level)	Average Scala Blows per 50mm	Soil Type	Inferred Strength	Equivalent SPT "N" values
0.5m	30	Non – Cohesive (Rock)	Dense	>40

From the table above, it can be inferred that rock with competent strength exists at the site.

5.2.2 Site 2 - Isangel, Tanna

The 2 No. hand auger boreholes across the site encountered similar ground conditions and these are summarised in Table 3 below. The investigations did not extend to full depth as they met refusal on very stiff volcanic tuff.

Table 3 – Summary of ground conditions

Depth (Below ground level)	Geological unit	Soil description	Soil undrained shear strength (kPa)
0.0m – 0.4m	Topsoil	Clayey SILT with fine to medium gravel, light brown, dry, non plastic	N/A
0.4m – >2.05m	Volcanic Tuff	Organic silt trace sand, dark reddish brown, low to moderate plasticity, dry to moist	180kPa - 210kPa

N/A – not applicable

Groundwater was not encountered in either borehole during geotechnical investigations at this site.

The two Scala penetrometer tests SB03-SC1 and SB03-SC2 were terminated at depths of up to 0.5m below ground level. From this in-situ testing, we can assess the soil strengths at specific depths below the site. The Scala results and inferred soil strength are summarised in Table 4 below:

Table 4 – Summary of Scala penetrometer results (Site 2 –Isangel, Tanna)

Depth (Below ground level)	Average Scala Blows per 50mm	Soil Type	Inferred Strength	Equivalent SPT "N" values
0.5m	2	Cohesive	Very Stiff	8
1.0m	3	Cohesive	Very Stiff	12
1.5m	4	Cohesive	Very Stiff	16
2.0m	10	Cohesive	Hard	40
2.5m	5	Cohesive	Hard	20
3.0m	8	Cohesive	Hard	32
3.5m	10	Cohesive	Hard	40
3.75	20	Cohesive	Hard	>40

5.2.3 Site 3 - Lakatoro, Malekula

The 2 No. hand auger boreholes across the site encountered similar ground conditions and these are summarised in Table 5 below. The investigations did not extend to full depth as they met refusal on dense limestone gravel/weathered bedrock.

Table 5 – Summary of ground conditions

Depth (Below ground level)	Geological unit	Soil description	Soil undrained shear strength (kPa)
0.0m – 0.4m	Topsoil	Clayey SILT with trace sand, dark brown, dry, contains rootlets	N/A
0.4m – 1.05	Colluvium	Clayey silt with occasional fine limestone gravel, dark brown, dry to moist	N/A

N/A – not applicable

Groundwater was not encountered in either borehole during geotechnical investigations at this site.

The two Scala penetrometer tests SB01-SC1 and SB01-SC2 were both terminated at a depth of 1.45m below ground level. From this in-situ testing, we can assess the soil strengths at specific depths below the site. The Scala results and inferred soil strength are summarised in Table 6 below:

Table 6 – Summary of Scala penetrometer results (Site 3 –Lakatoro, Malekula)

Depth (Below ground level)	Average Scala Blows per 50mm	Soil Type	Inferred Strength	Equivalent SPT "N" values
0.5m	2	Cohesive	Very Stiff	8
1.0m	6	Cohesive	Very Stiff	24
1.45	17	Gravel/Boulders or Weathered Rock	Dense	>40

5.2.4 Site 4 - Bauerfield Airport, Efate

The 2 No. hand auger boreholes across the site generally encountered similar ground conditions and these are summarised in Table 7 below:

Table 7 – Summary of ground conditions

Depth (Below ground level)	Geological unit	Soil description	Soil undrained shear strength (kPa)
0.0m – 0.2m	Topsoil	SILT, dark brown, moist, non-plastic, organic	N/A
0.2 – 1.3m	Fill	Fine to medium coarse Sand with trace silt and gravel, light brown, moist to wet, non-plastic.	130kPa to 210kPa
1.3 – 3m	Alluvial Sediments	Fine to medium coarse Sand with trace silt and gravel. Occasional fine gravel layers. Brownish grey with some black and white mottling. Dense, moist, non-plastic	N/A

N/A – not applicable

Groundwater was not encountered in either borehole during geotechnical investigations at this site.

The two Scala penetrometer tests A02-SC1 and A02-SC2 were terminated at the target depth of 5.0m below ground level. From this in-situ testing, we can assess the soil strengths at specific depths below the site. The Scala results and inferred soil strength are summarised in Table 8 below:

Table 8 – Summary of Scala penetrometer results (Site 4 – Bauerfield Airport, Efate)

Depth (Below ground level)	Average Scala Blows per 50mm	Soil Type	Inferred Strength	Equivalent SPT "N" values
0.5m	1	Granular	Stiff	4
1.0m	4	Granular	Very Stiff	16
1.5m	3	Granular	Very Stiff	12
2.0m	5	Granular	Very Stiff	20
2.5m	4	Granular	Very Stiff	16
3.0m	4.5	Granular	Very Stiff	18
3.5m	3	Granular	Very Stiff	12
4.0m	3	Granular	Very Stiff	12
4.5m	3.5	Granular	Very Stiff	14

5.0m	4.5	Granular	Very Stiff	18

5.2.5 Site 5 - Pekoa Airport, Santo

The 2 No. hand auger boreholes across the site encountered similar ground conditions and these are summarised in Table 9 below. The investigations did not extend to full depth as they met refusal on very stiff to hard soil.

Table 9 – Summary of ground conditions

Depth (Below ground level)	Geological unit	Soil description	Soil undrained shear strength (kPa)
0.0m – >1.7m	Non-engineered Fill	Silty Clay, with trace gravel. Brown/light brown, stiff to very stiff	50kPa - 210kPa

N/A – not applicable

Groundwater was not encountered in either borehole during geotechnical investigations at this site.

The two Scala penetrometer tests A01-SC1 and A01-SC2 were terminated at depths of up to 2.95m below ground level. From this in-situ testing, we can assess the soil strengths at specific depths below the site. The Scala results and inferred soil strength are summarised in Table 10 below:

Table 10 – Summary of Scala penetrometer results (Site 5 – Pekoa Airport, Santo)

Depth (Below ground level)	Average Scala Blows per 50mm	Soil Type	Inferred Strength	Equivalent SPT "N" values
0.5m	1.5	Cohesive	Very Stiff	6
1.0m	1.5	Cohesive	Very Stiff	6
1.5m	4	Cohesive	Very Stiff	16
2.0m	4	Cohesive	Very Stiff	16
2.5m	6	Cohesive	Hard	24
2.95m	20	Weathered Rock	Dense	>40

6 Geotechnical Laboratory Testing Results

A summary of the geotechnical laboratory testing results is presented in Table 11 below. A full set of the geotechnical testing data sheets is presented in Appendix D.

Table 11 – Summary of geotechnical testing

Site Location	Hand Auger No.	Sample Depth	Solid Density	Grain Size Analysis	Moisture Content
Site 1 – VMGD, Efate	SB02-HA1	0.2	2.70 t/m^3	N/A	9.6%
Site 1 – VMGD, Efate	SB02-HA2	0.1	N/A	Sandy GRAVEL with trace of silt, few rootlets, loose, dark brown and white	8.4%
Site 2 – Isangel, Tanna	SB03-HA1	0.5	N/A	SAND with minor gravel, minor silt and trace of clay, few rootlets, loose to stiff, dark brown	61.5%
Site 2 – Isangel, Tanna	SB03-HA1	1.8	2.78 t/m^3	N/A	44.8%
Site 2 – Isangel, Tanna	SB03-HA2	1.0	N/A	SAND with some gravel, some silt and trace of clay, few rootlets, soft to stiff, dark brown	61.4%
Site 2 – Isangel, Tanna	SB03-HA2	1.5	2.73 t/m^3	N/A	40.6%
Site 3 – Lakatoro, Malekula	SB01-HA1	0.35	2.80 t/m^3	Gravelly SAND with minor silt and trace of clay, few rootlets, loose, dark brown with white	24.7%

Site 3 – Lakatoro, Malekula	SB01-HA1	0.80	N/A	N/A	36.2%
Site 3 – Lakatoro, Malekula	SB01-HA2	0.50	N/A	Gravelly SAND with minor silt and trace of clay, few rootlets, loose, dark brown with white	35.2%
Site 3 – Lakatoro, Malekula	SB01-HA2	0.75	2.81 t/m^3	N/A	38.4%
Site 4 – Bauerfield Airport, Efate	A02-HA1	0.5	2.46 t/m^3	SAND with minor gravel – Pumiceous, some silt and trace of clay, few rootlets, loose/soft, medium brown and white	34.0%
Site 4 – Bauerfield Airport, Efate	A02-HA1	1.0	2.44 t/m^3	N/A	39.3%
Site 4 – Bauerfield Airport, Efate	A02-HA1	1.5	N/A	SAND with minor gravel – Pumiceous, some silt and trace of clay, loose/soft, light brown with light to dark grey/white	37.9%
Site 4 – Bauerfield Airport, Efate	A02-HA2	1.1	N/A	SAND with minor gravel – Pumiceous, minor silt and trace of clay, loose, light brown with light grey/white	32.2%
Site 4 – Bauerfield Airport, Efate	A02-HA2	2.0	2.56 t/m^3	N/A	17.2%
Site 5 – Pekoa Airport, Santo	A01-HA1	0.5	2.87 t/m^3	N/A	54.5%
Site 5 – Pekoa Airport, Santo	A01-HA1	1.25	N/A	Silty CLAY with trace of sand, very stiff, dark brown, high plasticity	51.5%

Site 5 – Pekoa Airport, Santo	A01-HA2	1.05	2.93 t/m^3	N/A	63.6%
Site 5 – Pekoa Airport, Santo	A01-HA2	1.5	N/A	Silty CLAY with trace of sand, very stiff, dark brown, high plasticity	65.3%

7 Discussion and Engineering Properties

Recommendations and opinions contained in this report are based upon data from 10 No. hand auger boreholes and 10 No. Scala penetrometer tests from the following sites:

- VMGD, Efate
- Isangel, Tanna
- Lakatoro, Malekula
- Bauerfield Airport, Efate
- Pekoa Airport, Santo

The nature and continuity of the subsoil away from the test locations is inferred, but it must be appreciated that actual conditions could vary from the assumed model.

From the results of the soils investigation, geotechnical laboratory testing and also using published empirical relationships, we have assessed the engineering properties for the underlying soils at the five sites for the designer's consideration in the following subsections.

Actual ground conditions should be confirmed by a geotechnical engineer competent to judge whether the soils exposed in the foundation excavations are compatible with those described within this report.

7.1 Solid Density, Cohesion and Internal Friction Angle Range

Table 12 below summarises the approximate solid densities, cohesion and effective internal friction angles for the different sites. These have been assessed using results of the site investigations and laboratory testing.

Table 12 – Summary of Solid Density, Cohesion and Internal Friction Angle

Site Location	Material Name	Solid Density (t/m^3)	Cohesion (kPa)	Effective Internal Friction Angle (deg)
Site 1 (VMGD)	Topsoil with Limestone Gravel	2.70	0	30
Site 2 (Tanna)	Volcanic Tuff	2.75	2	30
Site 3 (Malekula)	Colluvium	2.80	2	30
Site 4 (Bauerfield Airport)	Non- Engineered Fill and Alluvial Sediments	2.50	0	30
Site 5 (Santo)	Non-Engineered Fill	2.90	4	28

7.2 Young's Modulus Range (E)

The soil stiffness or Youngs Modulus, E has been calculated from a correlation with SPT N values derived from the available shear strength and Scala penetrometer readings. The following table provides the range of Youngs Modulus values for varying depths.

7.2.1 Site 1 - VMGD, Efate

Table 12 – Summary of Youngs Modulus (E) with depth (cohesive soils only)

Depth (Below Ground level)	Shear strength (kPa)	Estimated Young's Modulus, E (MPa)
0.5 m	210+	35

7.2.2 Site 2 - Isangel, Tanna

Table 13 – Summary of Youngs Modulus (E) with depth (cohesive soils only)

Depth (Below Ground level)	Shear strength (kPa)	Estimated Young's Modulus, E (MPa)
0.5	190	30
1.0	180	28
1.5	200	32
2.0	210+	35

7.2.3 Site 3 - Lakatoro, Malekula

Table 14 – Summary of Youngs Modulus (E) with depth (cohesive soils only)

Depth (Below Ground level)	Shear strength (kPa)	Estimated Young's Modulus, E (MPa)
0.5	100	16
1.0	150	24

7.2.4 Site 4 - Bauerfield Airport, Efate

Table 15 – Summary of Youngs Modulus (E) with depth (cohesive soils only)

Depth (Below Ground level)	Shear strength (kPa)	Estimated Young's Modulus, E (MPa)
0.5	190	30
1.0	150	24
1.5	210+	35
2.0	210+	35
2.5	210+	35
3.0	210+	35

7.2.5 Site 5 - Pekoa Airport, Santo

Table 16 – Summary of Youngs Modulus (E) with depth (cohesive soils only)

Depth (Below Ground level)	Shear strength (kPa)	Estimated Young's Modulus, E (MPa)
0.5	50	8
1.0	90	14
1.5	210+	35

7.3 Foundation Design

7.3.1 General

Following discussions with YEC, it is understood that either strip or pad foundations will be constructed for the three proposed equipment installations at the five sites, providing the ground conditions are suitable.

The site investigation data has indicated that shallow foundations may be utilised at the five sites depending on actual loadings. We have provided bearing pressures at different depths in the upper 3m of subsoil.

We recommend using a strength reduction factor of 0.5 (ϕ_G = 0.5) to give an ultimate limit state (ULS) bearing capacity, in accordance with New Zealand Design Standards (ref: NZS 1170). For serviceability limit state design we recommend a strength reduction factor of 0.33 (ϕ_G = 0.3) to give an allowable bearing capacity.

We recommend that all foundations should be embedded at least 0.5m below finished ground level.

7.3.2 Shallow Foundation Parameters

Strip or pad foundations would be constructed in the near surface soils. Bearing capacities for this material, based on the in situ testing undertaken, are shown in Table 17 below for the following sites:

- Site 1 - VMGD, Efate
- Site 2 - Isangel, Tanna
- Site 3 - Lakatoro, Malekula
- Site 4 – Bauerfield Airport, Efate
- Site 5 – Pekoa Airport, Santo

Table 17 – Summary of bearing capacities at the 5 sites in Vanuatu

Site	Depth	Bearing Capacities					
		Shallow strip footings up to 1 m wide			Shallow isolated pad footings up to 2.5 m wide		
		Allowable	*ULS*[(1)]	*Ultimate*	*Allowable*	*ULS*[(1)]	*Ultimate*
Site 1	0.5m	167kPa	250kPa	500kPa	200kPa	300kPa	600kPa
Site 2	0.5m	167kPa	250kPa	500kPa	200kPa	300kPa	600kPa
Site 3	0.5m	100kPa	150kPa	300kPa	120kPa	180kPa	360kPa
Site 4	0.5m	100kPa	150kPa	300kPa	120kPa	180kPa	360kPa
Site 5	0.5m	50kPa	75kPa	150kPa	60kPa	90kPa	180kPa

(1) ULS = Ultimate Limit State (ref. NZS1170)

We recommend that all foundation excavations are inspected and tested by a competent person to ensure the ground conditions and bearing capacities are similar to those encountered during this investigation.

7.4 Settlement

T&TI have not been provided with any vertical loads for the proposed structures. It is recommended that settlement analysis is carried out following completion of the detailed design of the new equipment.

8 Applicability

This report has been prepared for the benefit of YEC with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor International Ltd

Environmental and Engineering Consultants

Report prepared by:

Shiraz Soysa

Geotechnical engineer

Reviewed for Tonkin & Taylor International Ltd by:

Andy Pomfret

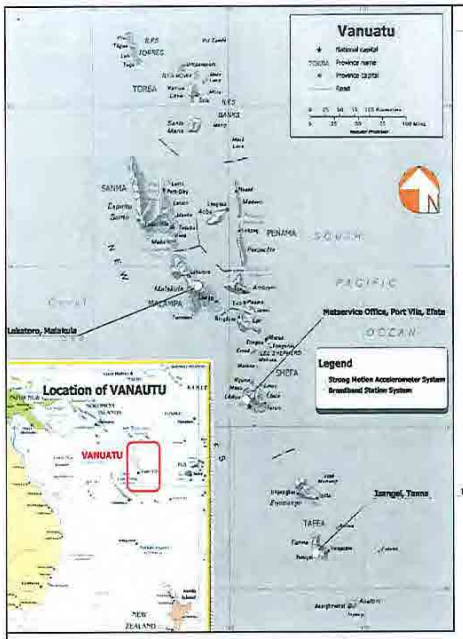
Project Manager

Authorised for Tonkin & Taylor International Ltd by:

Chris Freer

Project Director

Appendix B: Topographical Survey and Geotechnical Investigation Location Plans



LOCALITY PLAN
N.T.S.

BUILDING TEST SITES SCHEDULE

mE	mN	RL	Description
215191.16	8035465.24	13.38	SH02-HA1
215188.96	8035460.51	13.50	SH02-HA2
215189.68	8035463.48	13.48	SH02-SC1
215189.64	8035462.66	13.50	SH02-SC2

SURVEY MARK SCHEDULE

mE	mN	RL	Description
215259.67	8035474.60	18.76	ISCS 1
215222.30	8035444.81	16.73	ISCS 2
215189.43	8035440.30	13.60	ISCS 3
215188.25	8035495.12	17.32	ISCS 4
215279.15	8035499.15	20.52	Benchmark (Met. Office)

LEGEND
- Survey Mark
- Hand Auger Test
- Scala Penetrometer Test
- Gauge
- Thermometer
- Weather Station
- Spot Level (at decimal point)
- Contour Minor
- Contour Major (with text)
- Building Wall Line
- Fences
- Concrete Wall (200mm thick)

NOTES:
Contours are at 0.2m intervals.
Information shown is based on a survey conducted on the 29th July 2013
Refer to Dwg T02 for cross section details

SURVEY DATUM UTM/WGS84/Zone 59
HEIGHT DATUM, BENCHMARK (Met. Office) RL 20.52m
HEIGHT ORIGIN MEASURED SEA LEVEL RL 0.00m

Revision	Description	Approved	Date
B	Hand Auger, Scala and Site Name Amended		15-08-13
A	Topographical Information		06-09-13

Client: Tonkin & Taylor

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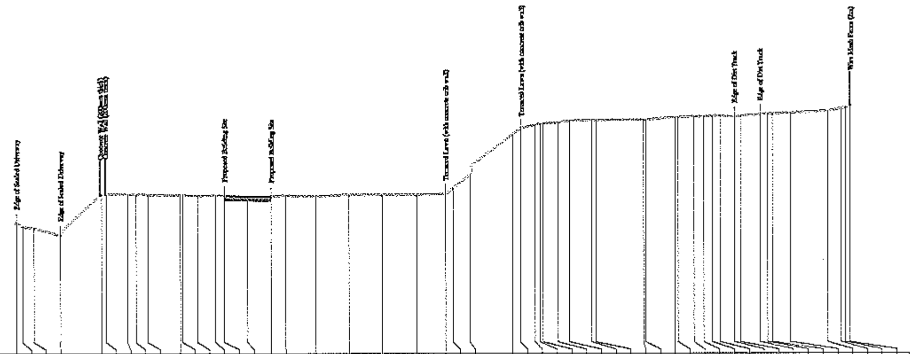
Web Site: www.civilservices.co.nz
Email: admin@civilservices.co.nz

Drawn	JH
Designed	
Surveyed	Civil Services (HB) Ltd
Project	Efate Topo
Scale	1:250 (A1) 1:500 (A3)
Title	Plan View VMGD Efate Efate, Vanuatu Ch to Ch
Dwg. No.	T01
Job No.	13012
Revision	B

Date Plotted: Fri Sep 13 11:25:22 2013

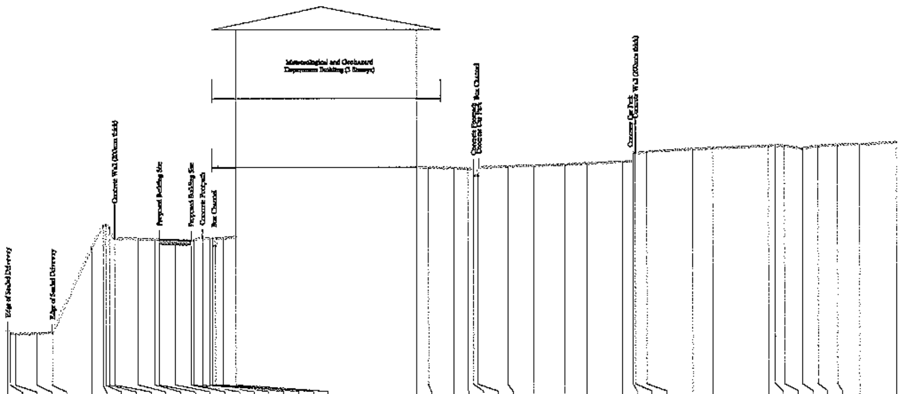
NOTES:
Information shown is based on a survey conducted on the 29th July 2013
Refer to Dwg T01 for Plan View



Datum (m) 5

Distances	Existing Ground Levels
-45.77	12.00
-45.08	11.82
-43.93	11.74
-41.08	11.36
-36.73	13.57
-36.21	13.57
-33.91	13.55
-33.00	13.55
-31.76	13.54
-28.31	13.53
-28.05	13.53
-26.48	13.47
-24.53	13.49
-23.60	13.47
-21.10	13.44
-18.69	13.42
-17.05	13.50
-13.84	13.43
-10.29	13.52
-6.79	13.51
-3.10	13.52
0.00	13.56
0.80	13.89
2.62	14.56
7.16	16.75
8.01	17.07
9.55	17.24
10.09	17.30
10.37	17.32
12.01	17.39
13.18	17.47
15.58	17.50
16.03	17.49
21.10	17.52
21.35	17.53
24.47	17.67
24.77	17.68
26.50	17.70
27.54	17.70
28.45	17.73
29.26	17.76
30.79	17.67
31.45	17.73
33.53	17.79
34.34	17.85
34.84	17.86
36.75	17.90
40.76	18.00
42.17	18.14
42.63	18.21
43.14	18.29

Cross Section B-B



Datum (m) 5

Distances	Existing Ground Levels
-24.38	8.56
-24.09	8.48
-23.54	8.38
-21.25	8.42
-19.60	8.46
-15.39	13.05
-14.18	14.24
-13.89	14.32
-13.51	14.16
-12.95	13.53
-10.42	13.48
-8.64	13.47
-8.19	13.48
-6.49	13.44
-4.79	13.42
-4.49	13.46
-3.58	13.51
-2.76	13.48
-2.51	13.47
-2.17	13.08
-1.37	13.53
0.00	13.60
19.26	17.29
20.54	17.29
23.24	17.25
24.73	17.23
25.35	17.21
25.78	16.79
29.00	17.32
31.76	17.36
35.07	17.42
37.43	17.46
41.20	17.57
42.36	17.60
42.59	18.02
43.82	18.09
48.74	18.24
50.83	18.28
56.79	18.41
57.51	18.43
58.49	18.42
60.43	18.27
62.09	18.40
64.15	18.45
66.53	18.46
70.43	18.60

Cross Section A-A

SURVEY DATUM UTM/WGS84/Zone 59
HEIGHT DATUM, BENCHMARK (Met. Office) RL 20.52m
HEIGHT ORIGIN MEASURED SEA LEVEL RL 0.00m

Revision	Description	Approved	Date
B	Site Name Amended		13-09-13
A	Topographical Information		22-08-13

Client: Tonkin & Taylor

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Web Site: www.civilservices.co.nz
Email: admin@civilservices.co.nz

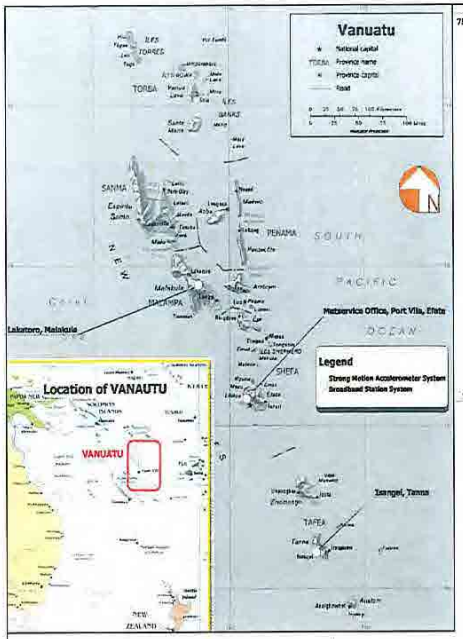
Drawn: JH
Designed:
Surveyed: Civil Services (HB) Ltd
Project: Efate Topo

Scale: H - 1:250 (A1) V - 1:125 (A1) H - 1:500 (A3) V - 1:250 (A3)

Title: Cross Sections VMGD Efate Efate, Vanuatu
Ch-24.38 to Ch70.43

Dwg. No. T02
Job No. 13012
Revision B

Date Plotted: Fri Sep 13 11:25:40 2013



LOCALITY PLAN
N.T.S.

LEGEND

- Survey Mark
- Hand Auger Test
- Scala Penetrometer Test
- Iron Spike (at proposed site)
- 100.84 Spot Level (at decimal point)
- Contour Minor
- 100 Contour Major (with text)
- Building Wall Line
- Stick Fence

PROPOSED BUILDING AND TEST SITES SCHEDULE

mE	mN	RL	Description
319698.59	7838261.35	101.61	ISa
319695.17	7838261.35	101.37	ISb
319695.15	7838256.35	101.24	ISc
319698.57	7838256.29	101.44	ISd
319695.24	7838260.95	101.34	SB03-HA1
319698.08	7838256.57	101.38	SB03-HA2
319697.10	7838258.76	101.41	SB03-SC1
319698.38	7838255.24	101.40	SB03-SC2

SSURVEY MARK SCHEDULE

mE	mN	RL	Description
318050.20	7839313.87	0.97	Benchmark (Wharf)
319619.82	7838317.68	94.43	ISCS B
319698.22	7838273.78	101.75	ISCS A
319692.20	7838254.62	101.15	OI Pipe (exposed)

NOTES:

Contours are at 0.2m intervals.

Information shown is based on a survey conducted on the 31st July 2013

Refer to Dwg T02 for cross section details

SURVEY DATUM UTM/WGS84/Zone 59
HEIGHT DATUM, BENCHMARK (wharf) RL 0.97m
HEIGHT ORIGIN MEASURED SEA LEVEL RL 0.00m

Revision	Description	Approved	Date
B	Hand Auger, Scala and Site Name Amended		13-09-13
A	Topographical Information		04-09-13

Client: Tonkin & Taylor

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Web Site: www.civilservices.co.nz
Email: admin@civilservices.co.nz

Drawn	JH
Designed	
Surveyed	Civil Services (HB) Ltd
Project	Tanna topo
Scale	1:150 (A1) 1:300 (A3)

Title: Plan View
Isangel,
Tanna,
Vanuatu.
Ch to Ch

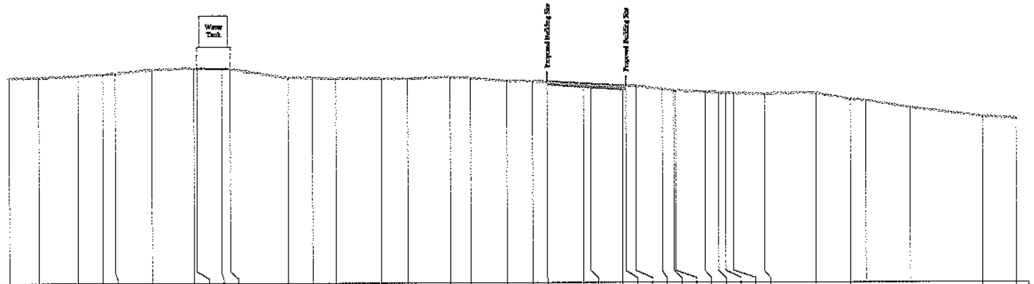
Dwg. No. T01
Job No. 13012
Revision B

Date Plotted: Fri Sep 13 14:59:42 2013

NOTES:

Information shown is based on a survey conducted on the 31st July 2013

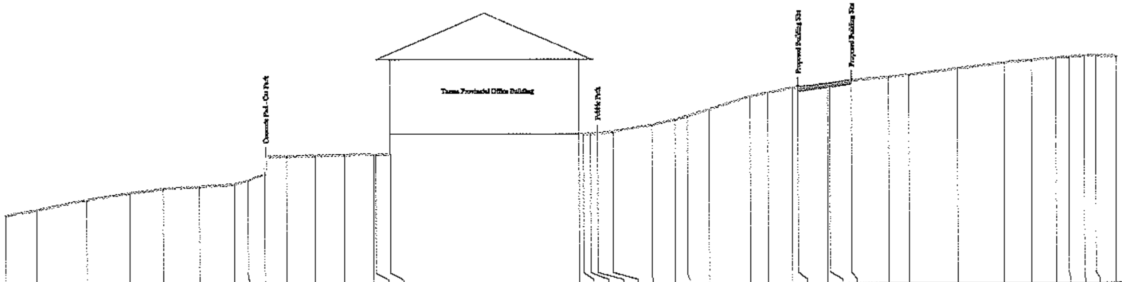
Refer to Dwg T01 for Plan View



Datum (m) 95

Distances	Existing Ground Levels
-14.16	101.60
-12.27	101.61
-9.76	101.67
-8.17	101.72
-7.37	101.75
-5.02	101.87
-2.32	101.92
-2.15	101.92
-0.55	101.90
0.00	101.89
3.68	101.61
5.27	101.60
6.77	101.58
9.66	101.58
11.36	101.57
14.08	101.62
15.39	101.59
17.69	101.50
19.36	101.50
20.28	101.47
22.60	101.40
23.07	101.40
25.12	101.34
25.31	101.34
25.95	101.34
27.64	101.24
28.38	101.20
28.50	101.20
30.39	101.15
31.26	101.13
31.70	101.11
32.20	101.10
34.19	101.07
37.49	101.11
39.70	100.91
40.69	100.87
43.52	100.63
48.15	100.34
50.31	100.28

Cross Section B-B



Datum (m) 95

Distances	Existing Ground Levels
-36.70	97.25
-34.72	97.43
-31.52	97.75
-28.77	97.96
-26.64	98.11
-24.29	98.17
-22.06	98.24
-21.18	98.37
-20.11	98.58
-18.73	99.12
-16.89	99.14
-15.02	99.16
-13.14	99.18
-13.01	99.18
-12.07	99.18
0.00	99.83
0.28	99.82
0.74	99.83
1.18	99.84
2.18	99.90
4.68	100.11
6.14	100.29
6.93	100.39
8.34	100.60
10.97	101.02
12.10	101.14
13.67	101.30
14.03	101.30
15.92	101.41
16.06	101.42
17.44	101.52
19.84	101.62
21.13	101.69
24.26	101.88
27.25	102.08
28.99	102.16
30.56	102.24
31.41	102.27
32.38	102.29
33.12	102.31
34.41	102.29

Cross Section A-A

SURVEY DATUM UTM/WGS84/Zone 59
HEIGHT DATUM, BENCHMARK (wharf) RL 0.97m
HEIGHT ORIGIN MEASURED SEA LEVEL RL 0.00m

Revision	Description	Approved	Date
B	Site Name Amended		13-09-13
A	Topographical Information		22-08-13

Client: Tonkin & Taylor

CIVIL SERVICES (HB) LTD

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PO Box 5011, NAPIER 4145
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Web Site: www.civilservices.co.nz
Email: admin@civilservices.co.nz

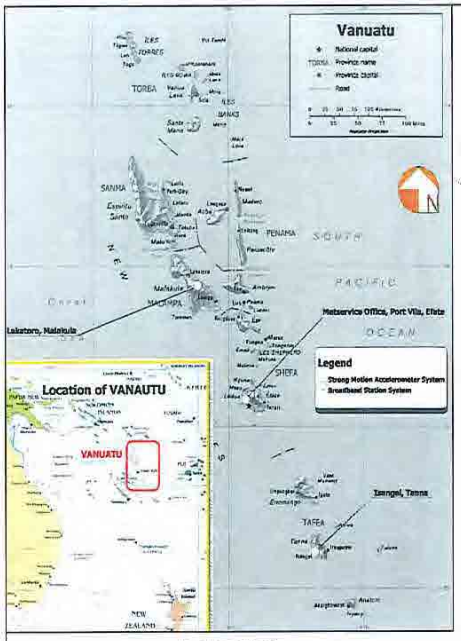
Drawn: JH
Designed:
Surveyed: Civil Services (HB) Ltd
Project: Tanna topo

Scale: H - 1:150 (A1) V - 1:75 (A1); H -1:300 (A3) V -1:150 (A3)

Title: Cross Sections Isangel, Tanna, Vanuatu.
Ch-36.70 to Ch34.41

Dwg. No. T02
Job No. 13012
Revision B

Date Plotted: Fri Sep 13 11:39:36 2013



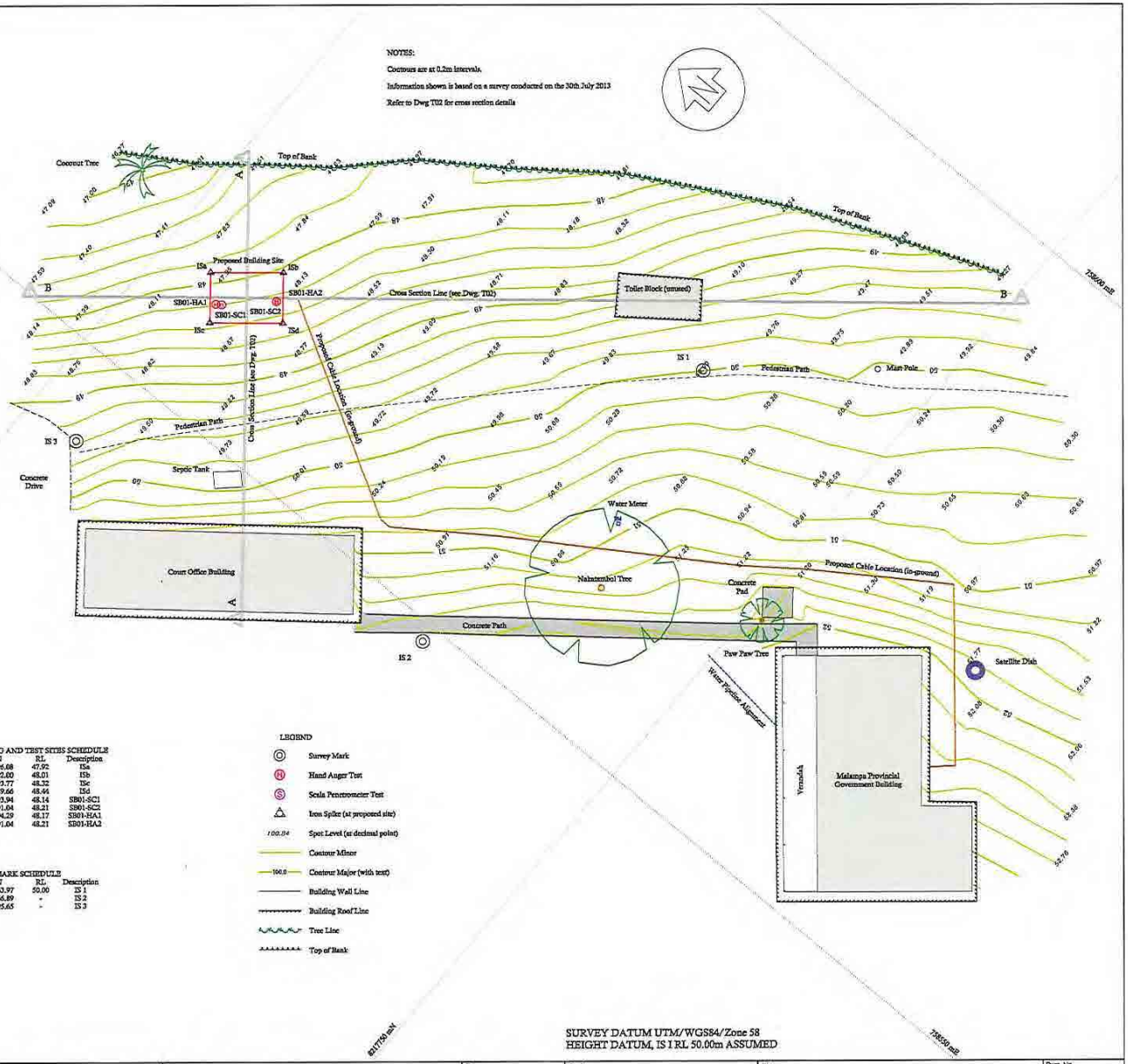
LOCALITY PLAN
N.T.S.

NOTES:

Contours are at 0.2m intervals.

Information shown is based on a survey conducted on the 30th July 2013

Refer to Dwg T02 for cross section details



PROPOSED BUILDING AND TEST SITES SCHEDULE

mE	mN	R.L.	Description
758559.60	8217796.68	47.92	ISa
758562.98	8217792.00	48.01	ISb
758556.74	8217793.77	48.32	ISc
758560.12	8217789.66	48.44	ISd
758558.29	8217793.94	48.14	SB01-SC1
758561.63	8217791.04	48.21	SB01-SC2
758558.05	8217794.29	48.17	SB01-HA1
758561.03	8217791.04	48.21	SB01-HA2

SURVEY MARK SCHEDULE

mE	mN	R.L.	Description
758577.04	8217763.97	50.00	IS 1
758548.71	8217766.89	-	IS 2
758543.83	8217795.65	-	IS 3

LEGEND

- Survey Mark
- Hand Auger Test
- Scala Penetrometer Test
- Iron Spike (at proposed site)
- 100.04 Spot Level (at decimal point)
- Contour Minor
- 100.0 Contour Major (with text)
- Building Wall Line
- Building Roof Line
- Tree Line
- Top of Bank

SURVEY DATUM UTM/WGS84/Zone 58
HEIGHT DATUM, IS 1 RL 50.00m ASSUMED

Revision	Description	Approved	Date
D	Hand Auger, Scala and Site Name Amended		13-09-13
C	Contours Text, Test Site Symbols and Survey Date Amended		05-09-13
B	Scala and Hand Auger Names Amended; Title Block Amended		29-08-13
A	Topographical Information		22-08-13

Client: Tonkin & Taylor

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PO Box 5011, NAPIER 4145
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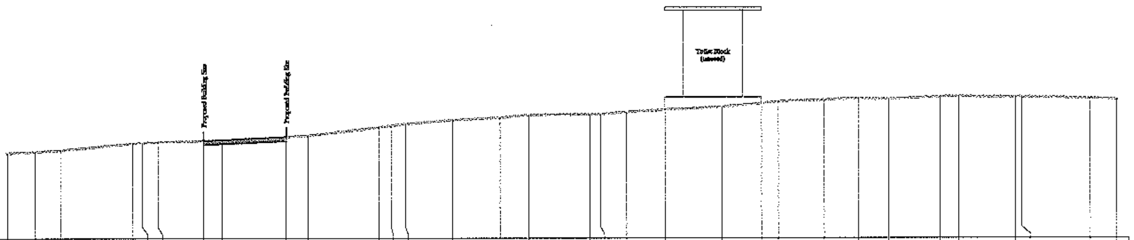
Web Site: www.civilservices.co.nz
Email: admin@civilservices.co.nz

Drawn	JH
Designed	
Surveyed	Civil Services (HB) Ltd
Project:	Malekula
Scale	1:150 (A1) 1:300 (A3)

Title: Plan View Lakatoro, Malekula, Vanuatu.
Ch to Ch

Dwg. No.	T01
Job No.	13012
Revision	D

Date Plotted: Fri Sep 13 13:52:23 2013



Datum (m) 45

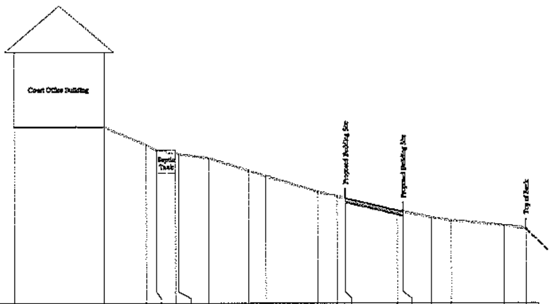
Existing Ground Levels	47.73	47.76	47.82	48.03	48.06	48.08	48.12	48.14	48.24	48.28	48.56	48.61	48.66	48.78	48.86	48.93	48.95	48.96	49.03	49.11	49.20	49.33	49.38	49.44	49.49	49.46	49.54	49.56	49.55	49.55	49.50	49.47
Distances	-42.12	-40.32	-38.72	-34.07	-33.46	-32.47	-29.53	-28.34	-24.25	-22.86	-18.33	-17.53	-16.61	-13.59	-10.56	-8.71	-4.82	-4.12	-2.45	0.00	3.66	6.20	7.26	10.21	12.40	14.34	17.62	18.81	22.46	22.88	27.27	28.97

Cross Section B-B

NOTES:

Information shown is based on a survey conducted on the 30th July 2013

Refer to Dwg T01 for Plan View



Datum (m) 45

Existing Ground Levels	50.70	50.70	50.14	49.95	49.85	49.83	49.70	49.30	49.12	48.62	48.46	48.40	48.00	47.96	47.78	47.69	47.54	47.43
Distances	-5.76	0.00	2.70	3.35	4.55	4.74	6.68	9.23	10.35	13.65	14.90	15.43	18.74	19.12	20.96	22.21	25.57	26.99

Cross Section A-A

SURVEY DATUM UTM/WGS84/Zone 58
HEIGHT DATUM, IS I RL 50.00m ASSUMED

Revision	Description	Approved	Date
D	Site Name Amended		13-09-13
C	Survey Data Amended		09-09-13
B	Title Block Amended		20-08-13
A	Topographical Information		22-08-13

Client

Tonkin & Taylor

CIVIL SERVICES (HB) LTD

Unit 8, 88 Taradale Road
PO Box 5011, NAPIER 4145
Phone/Fax: (06) 843 6996
Web Site: www.civilservices.co.nz
Email: admin@civilservices.co.nz

Drawn: JH

Designed:

Surveyed: Civil Services (HB) Ltd

Project: Malekula

Scale:
H - 1:150 (A1)
V - 1:75 (A1)

H - 1:300 (A3)
V - 1:150 (A3)

Title: Cross Sections
Lakatoro,
Malekula,
Vanuatu.

Ch-5.76 to Ch26.99

Dwg. No. T02

Job No. 13012

Revision D

Date Plotted: Fri Sep 13 13:54:08 2013

Appendix C: Investigation Logs

- **Hand auger borehole logs**
- **Scala Penetrometer results**

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:SB02-HA1
Hole Location: VMGD, Efate

SHEET 1 OF 1

PROJECT: Improvement of Equipment for Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES: 8035465.24 mN
215191.16 mE

R.L.: 13.38 m

DATUM: Set by surveyors, sea level = 0.00mRL.

DRILL TYPE: Hand Auger

DRILL METHOD: HA

DRILL FLUID: N/A

HOLE STARTED: 27/7/13

HOLE FINISHED: 27/7/13

DRILLED BY: SRS

LOGGED BY: SRS CHECKED: ADP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL		Dry	100	H/A		• UTP		13.38	0.0			M	VSt				Sandy SILT; dark brown, occasional whitish sand (limestone). Very stiff, moist; contains rootlets.
LIMESTONE						• UTP		13.0	0.5			HW	Wk				0.15m: Highly weathered, LIMESTONE, fractured, sand and silt infill, weak, moist. **END OF BOREHOLE AT 0.2m.** Unable to penetrate.

SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour.

ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.

SHEAR STRENGTH (kPa): 10 25 50 100 200

COMPRESSIVE STRENGTH (MPa): 1 5 20 50 100 250

DEFECT SPACING (mm): 50 250 1000 2000

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941.GPJ 17-Sep-2013

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:SB02-HA2
Hole Location: VMGD, Efate

SHEET 1 OF 1

PROJECT: Improvement of Equipment for Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES: 8035460.51 mN
215188.96 mE

R.L.: 13.50 m

DATUM: Set by surveyors, sea level = 0.00mRL.

DRILL TYPE: Hand Auger

DRILL METHOD: HA

DRILL FLUID: N/A

HOLE STARTED: 27/7/13

HOLE FINISHED: 27/7/13

DRILLED BY: SRS

LOGGED BY: SRS CHECKED: ADP

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m) / DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WEATHERING: MOISTURE CONDITION	WEATHERING: STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL		Dry	100	H/A		• UTP	1				M	VSt				Sandy SILT; dark brown, occasional white sand (limestone). Very stiff, moist; contains rootlets.
LIMESTONE											CW	Wk				0.1m: Completely to highly weathered, brown with white mottling (especially on fresh limestone surfaces) LIMESTONE with silty sand matrix, weak, moist, highly fractured. Trace rootlets.
											HW	Wk-Str				**END OF BOREHOLE AT 0.3m.**
																Auger refusing/bouncing on rock.

13.0 0.5
12.5 1.0
12.0 1.5
11.5 2.0
11.0 2.5
10.5 3.0
10.0 3.5
9.5 4.0
9.0 4.5
5

0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941.GPJ 17-Sep-2013

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:SB03-BH1
Hole Location: Isangel, Tanna

SHEET 1 OF 1

PROJECT: Improvement of Equipment for Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES: 7838260.95 mN
319695.24 mE

R.L.: 101.34 m

DATUM: Set by surveyors, sea level = 0.00mRL.

DRILL TYPE: Hand Auger

DRILL METHOD: HA

DRILL FLUID: N/A

HOLE STARTED: 31/7/13

HOLE FINISHED: 31/7/13

DRILLED BY: SRS

LOGGED BY: SRS CHECKED: ADP

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL						123/24kPa		101.0	0.5			M	St				0m: SILT, with trace sand, occasional gravel; dark brown. Stiff, moist; organic, contains rootlets.
VOLCANIC TUFF		Dry on completion	100	HAND AUGER		197/49kPa	1	100.5	1.0			D-M	VSt-H				0.4m: Organic SILT; dark orangey brown, with reddish fragments. Very stiff to hard, dry to moist. 0.6m: Changes to reddish brown with orange mottles. Moderate to low plasticity (due to dry state). 1.0m: Organic SILT, as at 0.4m.
						189/33kPa											
						205/41kPa		100.0	1.5								1.5m: Organic SILT; reddish brown to orange mottling. Very stiff to hard, dry to moist, moderate to low plasticity. 1.8m: As above at 0.4m??
						213/49kPa											
						197/33kPa	2	99.5	2.0								
						>230kPa											**END OF BOREHOLE AT 2.0m.** Too stiff to auger.
								99.0	2.5								
								98.5	3.0								
								98.0	3.5								
								97.5	4.0								
								97.0	4.5								
								96.5	5								

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941.GPJ 17-Sep-2013

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:SB03-BH2
Hole Location: Provincial Office, Isangel, Tanna
SHEET 1 OF 1

PROJECT: Improvement of Equipment for Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES: 7838256.57 mN, 319698.08 mE
R.L.: 101.38 m
DATUM: Set by surveyors, sea level = 0.00mRL.

DRILL TYPE: Hand Auger
DRILL METHOD: HA
DRILL FLUID: N/A

HOLE STARTED: 31/7/13
HOLE FINISHED: 31/7/13
DRILLED BY: SRS
LOGGED BY: SRS CHECKED: ADP

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m) / DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL		Dry on completion	100	HAND AUGER		115/24kPa		101.0 / 0.5			M	St				SILT, trace clay, organic; dark brown. Stiff; contains rootlets.
VOLCANIC TUFF						197/41kPa					D-M	VSt-H				0.5m: Organic SILT, occasional scoriaceous basalt gravel; dark reddish brown. Very stiff to hard, dry to moist, low to moderate plasticity; gravel, sub-angular. 0.8m: Grades to reddish brown.
						180/33kPa	1	100.5 / 1.0								
						189/24kPa					D	MD-D				1.3m: Sandy SILT, trace fine basalt gravel; light reddish brown. Medium dense to dense, dry, non-plastic. 1.5m: Gravelly SAND; brown. Medium dense to dense, dry, non-plastic.
						213/33kPa	2	100.0 / 1.5								
						205/33kPa		99.5 / 2.0								
						UTP										
								99.0 / 2.5								**END OF BOREHOLE AT 2.05m.** Too stiff to auger.
								98.5 / 3.0								
								98.0 / 3.5								
								97.5 / 4.0								
								97.0 / 4.5								
								96.5 / 5								

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941.GPJ 17-Sep-2013

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:SB01-HA1
Hole Location: Lakatoro, Malekula
SHEET 1 OF 1

PROJECT: Improvement of Equipment for Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES: 8217794.29 mN 758558.05 mE
R.L.: 48.17 m
DATUM: Set by surveyor, sea level = 0.00mRL

DRILL TYPE: Hand Auger
DRILL METHOD: HA
DRILL FLUID: N/A

HOLE STARTED: 30/7/13
HOLE FINISHED: 30/7/13
DRILLED BY: ADP
LOGGED BY: ADP CHECKED: SRS

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL		Dry	100	HAND AUGER	N/A			48.0	0.5								Clayey SILT, slightly sandy, with some roots and rootlets; dark brown.
COLLUVIUM								47.5					H				Clayey SILT, with many fine to coarse limestone gravel fragments; dark brown. 0.5
																	Clayey SILT, with occasional fine to coarse gravel sized limestone; brown.
								47.0	1.0								**END OF BOREHOLE AT 0.92m.** 1.0 Terminated at 0.92m on dense gravels/weathered bedrock.
								46.5	1.5								1.5
								46.0	2.0								2.0
								45.5	2.5								2.5
								45.0	3.0								3.0
								44.5	3.5								3.5
								44.0	4.0								4.0
								43.5	4.5								4.5
									5								

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941LAKATORO.GPJ 17-Sep-2013

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:SB01-HA2
Hole Location: Lakatoro, Malekula
SHEET 1 OF 1

PROJECT: Improvement of Equipment for Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES: 8217791.04 mN 758561.03 mE
R.L.: 48.21 m
DATUM: Set by surveyor, sea level = 0.00mRL

DRILL TYPE: Hand Auger
DRILL METHOD: HA
DRILL FLUID: N/A

HOLE STARTED: 30/7/13
HOLE FINISHED: 30/7/13
DRILLED BY: ADP
LOGGED BY: ADP CHECKED: SRS

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 60 250 1000 2000	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL		Dry	100	HAND AUGER	N/A			48.0	0.5				St				Clayey SILT, slightly sandy, with roots and rootlets; dark brown.
COLLUVIUM								47.5	1.0				VSt				Clayey SILT, with much fine to coarse gravel sized limestone gravel; dark brown. 0.5 Light brown. 1.0
								47.0	1.5								**END OF BOREHOLE AT 1.05m.** Auger terminated at 1.05m due to limestone gravels/weathered bedrock. 1.5
								46.5	2.0								2.0
								46.0	2.5								2.5
								45.5	3.0								3.0
								45.0	3.5								3.5
								44.5	4.0								4.0
								44.0	4.5								4.5
								43.5	5								

SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941LAKATORO.GPJ 17-Sep-2013

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:A02-HA1
Hole Location: Bauerfield Airport

SHEET 1 OF 1

PROJECT: Improvement of Equipment for Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES: 8041561.82 mN
214985.42 mE

R.L.:

DATUM: Set by surveyors, sea level = 0.00mRL.

DRILL TYPE: Hand Auger

DRILL METHOD: HA

DRILL FLUID: N/A

HOLE STARTED: 28/7/13

HOLE FINISHED: 28/7/13

DRILLED BY: SRS

LOGGED BY: SRS CHECKED: ADP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL												M	F				0-0.15m: SILT, trace sand, organic, contains rootlets; dark brown. Firm, moist.
FILL													MD-D				0.15m: Gravelly, fine SAND; brown. Medium dense to dense; gravels are fine to medium coarse, some limestone fragments.
						• 213/24kPa	1		0.5			M-W					0.5m: Changes to medium coarse SAND, with occasional fine gravels; brownish grey. Medium dense to dense, moist to wet.
						• UTP											0.8m: Becoming dark brown, wet.
ALLUVIAL SEDIMENTS																	0.9m: Becoming light brown.
									1.0			M	D				1.0m: Gravelly, medium coarse SAND; with grey mottling. Dense, moist, non-plastic.
						• UTP	2										1.1m: Becoming wet, reducing gravel.
																	1.2m: Becomes light brownish grey.
						• UTP	3		1.5			M-W	MD-D				1.5m: Gravelly, medium coarse to coarse SAND; light brownish grey. Moist to wet.
						• UTP											1.7m: Sandy, fine to medium coarse GRAVEL; gravels are sub-angular and of limestone origin.
							4		2.0			M					1.9m: Gravelly SAND; brownish grey with some dark mottling. Dense, moist.
						• UTP							D				2.2m: Gravelly, medium coarse to coarse SAND; brownish grey with dark mottling. Dense, moist.
						• UTP	5		2.5								2.4m: Increasing dark gravel fragments.
						• UTP											2.8m: Becoming dark brown/grey mottled.
						• UTP	6		3.0				MD-D				2.9m: Becomes light brownish grey.
						• UTP							D				3.3m: Medium coarse SAND, with occasional gravel; light brownish grey. Dense.
						• UTP			3.5								3.8m: Hole keeps collapsing (sand).
																	END OF BOREHOLE AT 3.9m. Unable to auger.
									4.0								
									4.5								
									5								

Dry on completion

100

HAND AUGER

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.

ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941.GPJ 17-Sep-2013

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:A02-HA2
Hole Location: Bauerfield Airport

SHEET 1 OF 1

PROJECT: Improvement of Equipment for Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES: 8041557.96 mN
214978.89 mE

R.L.:

DATUM: Set by surveyors, sea level = 0.00mRL.

DRILL TYPE: Hand Auger

DRILL METHOD: HA

DRILL FLUID: N/A

HOLE STARTED: 28/7/13

HOLE FINISHED: 28/7/13

DRILLED BY: SRS

LOGGED BY: SRS CHECKED: ADP

GEOLOGICAL / ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	DEPTH (m)	TESTS	SAMPLES	GRAPHIC LOG	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL					M	F	SILT; dark brown. Firm, moist, non-plastic. Contains rootlets, organic.
FILL						MD-D	0.2m: Silty, fine SAND, occasional fine gravel; dark brown, trace white grains. Medium dense to dense, non-plastic.
	0.5	>230kPa 189/33kPa	1			MD	0.5m: Changes toi fine to medium coarse SAND, occasional gravel; light brown, trace white and grey grains. Medium dense.
	1.0	180/16kPa 134/26kPa	2				1.0m: Increasing white and grey grains, grades to medium coarse.
ALLUVIAL SEDIMENTS					M-W		1.3m: Medium coarse SAND, occasional gravel; light grey. Moist to wet; gravel, fine to medium coarse, sub-angular.
	1.5	>230kPa			W	MD-D	1.5m: Gravelly, medium coarse SAND; light grey. Medium dense to dense, wet; gravels, fine to medium coarse, sub-angular.
		UTP				D	1.75m: Grades to dense.
	2.0	UTP					2.0m: Sandy, medium coarse GRAVEL. Dense; gravel, sub-angular, limestone origin. Very difficult to auger.
		UTP			M		2.3m: Gravelly, medium coarse to coarse SAND; brownish grey with occasional dark mottles. Dense, moist.
	2.5	UTP					2.7m: Grades to medium coarse.
	3.0	UTP					2.9m: Grades to medium coarse to fine, whitish grey.
		UTP			M-W		3.1m: Fine to medium coarse SAND, with occasional gravel; light brownish grey. Dense, moist to wet.
	3.5						**END OF BOREHOLE AT 3.4m.** Unable to auger.
	4.0						
	4.5						
	5						

Dry on completion
100
HAND AUGER

SHEAR STRENGTH (kPa): 10 25 50 100 200
COMPRESSIVE STRENGTH (MPa): 1 5 20 50 100 250
DEFECT SPACING (mm): 50 250 1000 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.

ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941.GPJ 17-Sep-2013

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:A01-HA1
Hole Location: Pekoa Airport, Santo
SHEET 1 OF 1

PROJECT: Improvement of Equipment of Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES:
R.L.:
DATUM: Set by surveyor, sea level = 0.00mRL

DRILL TYPE: Hand Auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 1/8/13
HOLE FINISHED: 1/8/13
DRILLED BY: ADP
LOGGED BY: ADP CHECKED: SRS

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 60 250 1000 2000	SOIL DESCRIPTION / ROCK DESCRIPTION
NON-ENGINEERED FILL		Dry		HAND AUGER	N/A	• 30/15kPa • 60/15kPa • >140kPa	D1 D2		0.5 1.0 1.5				St VSt				Silty CLAY, with some gravel and pockets of light brown material and rootlets; brown. Stiff. [Fill from adjacent excavation.] Very stiff. High plasticity.
									2.0 2.5 3.0 3.5 4.0 4.5 5								**END OF BOREHOLE AT 1.7m.** Terminated due to highly plastic soils. Unable to pull rods back out of the ground.

SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941PEKOA.GPJ 17-Sep-2013

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:A01-HA2
Hole Location: Pekoa Airport, Santo
SHEET 1 OF 1

PROJECT: Improvement of Equipment of Disaster Risk Management LOCATION: Vanuatu JOB No: 750941

CO-ORDINATES:
R.L.:
DATUM: Set by surveyor, sea level = 0.00mRL

DRILL TYPE: Hand Auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 1/8/13
HOLE FINISHED: 1/8/13
DRILLED BY: ADP
LOGGED BY: ADP CHECKED: SRS

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m) / DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
NON-ENGINEERED FILL		Dry	100	HAND AUGER	N/A	• UTP • 162/30kPa • 102/42kPa • 130/70kPa		0.5 1.0 1.5				St VSt	10 25 50 100 200	1 5 20 50 100 250	50 250 1000 2000	Silty CLAY, with some pockets of light brown sand/silt and coral; brown. Stiff, many roots in upper 0.5m. High plasticity, becomes very stiff. **END OF BOREHOLE AT 1.7m.** Refusal. Highly plastic clays.

2.0 2.5 3.0 3.5 4.0 4.5 5

T+T DATATEMPLATE.GDT cwm

Log Scale 1:25

BORELOG 750941PEKOA.GPJ 17-Sep-2013

TONKIN & TAYLOR

SCALA PENETROMETER LOG

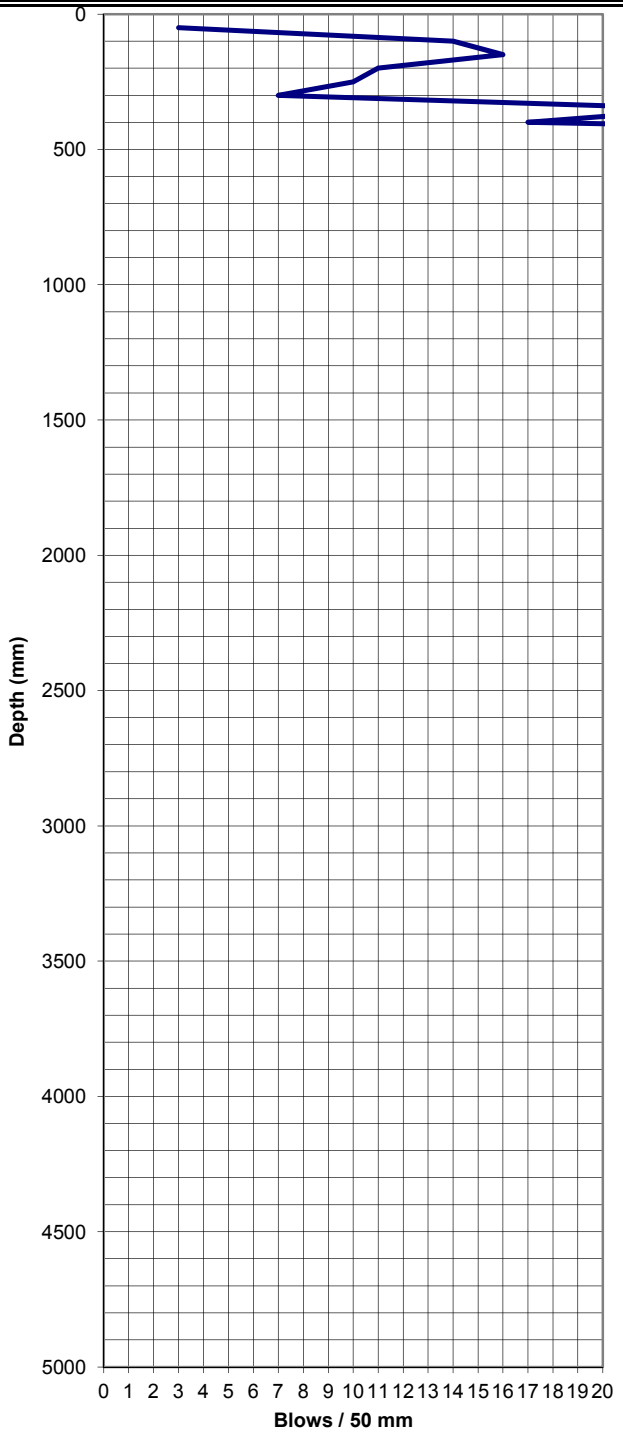
Job No: *750941*
Project: *Improvement of Equipment for Disaster Risk Management*
Location: *VMGD, Efate*

Date: *27/07/2013*
Operated by: *SRS*
Logged by: *SRS*
Checked by: *ADP*

Test No. *SB02-SC1*

Sheet *1*
of *1*

mm Driven	No. of Blows	mm Driven	No. of Blows
50	3	2550	
100	14	2600	
150	16	2650	
200	11	2700	
250	10	2750	
300	7	2800	
350	24	2850	
400	17	2900	
450	45	2950	
500	30	3000	
550		3050	
600		3100	
650		3150	
700		3200	
750		3250	
800		3300	
850		3350	
900		3400	
950		3450	
1000		3500	
1050		3550	
1100		3600	
1150		3650	
1200		3700	
1250		3750	
1300		3800	
1350		3850	
1400		3900	
1450		3950	
1500		4000	
1550		4050	
1600		4100	
1650		4150	
1700		4200	
1750		4250	
1800		4300	
1850		4350	
1900		4400	
1950		4450	
2000		4500	
2050		4550	
2100		4600	
2150		4650	
2200		4700	
2250		4750	
2300		4800	
2350		4850	
2400		4900	
2450		4950	
2500		5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

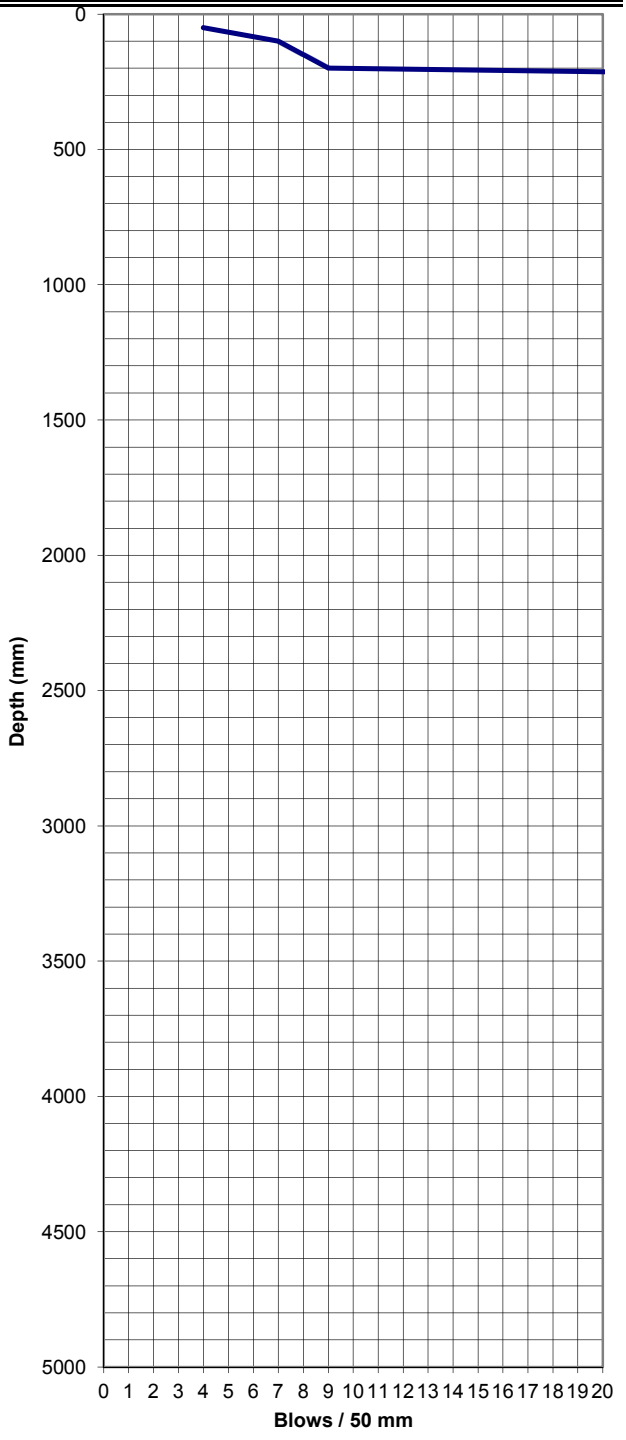
Job No: *750941*
Project: *Improvement of Equipment for Disaster Risk Management*
Location: *VMGD, Efate*

Date: *27/07/2013*
Operated by: *SRS*
Logged by: *SRS*
Checked by: *ADP*

Test No. *SC02-SC2*
Sheet *1*
of *1*

mm Driven	No. of Blows
50	*4*
100	*7*
150	*8*
200	*9*
250	*50*
300	
350	
400	
450	
500	
550	
600	
650	
700	
750	
800	
850	
900	
950	
1000	
1050	
1100	
1150	
1200	
1250	
1300	
1350	
1400	
1450	
1500	
1550	
1600	
1650	
1700	
1750	
1800	
1850	
1900	
1950	
2000	
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

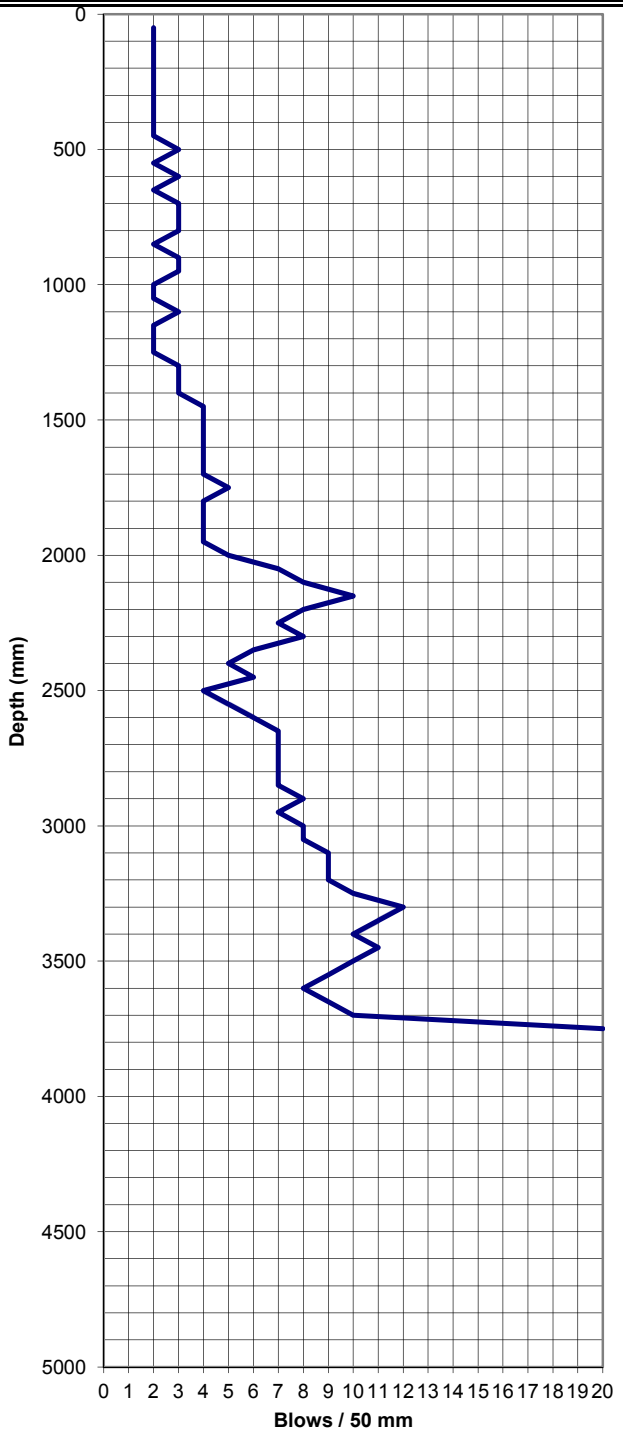
SCALA PENETROMETER LOG

Job No: *750941*
Project: *Improvement of Equipment for Disaster Risk Management*
Location: *Isangel, Tanna*

Date: *31/07/2013*
Operated by: *SRS*
Logged by: *SRS*
Checked by: *ADP*

Test No. *SB03-SC1*
Sheet *1*
of *1*

mm Driven	No. of Blows	mm Driven	No. of Blows
50	2	2550	5
100	2	2600	6
150	2	2650	7
200	2	2700	7
250	2	2750	7
300	2	2800	7
350	2	2850	7
400	2	2900	8
450	2	2950	7
500	3	3000	8
550	2	3050	8
600	3	3100	9
650	2	3150	9
700	3	3200	9
750	3	3250	10
800	3	3300	12
850	2	3350	11
900	3	3400	10
950	3	3450	11
1000	2	3500	10
1050	2	3550	9
1100	3	3600	8
1150	2	3650	9
1200	2	3700	10
1250	2	3750	20
1300	3	3800	
1350	3	3850	
1400	3	3900	
1450	4	3950	
1500	4	4000	
1550	4	4050	
1600	4	4100	
1650	4	4150	
1700	4	4200	
1750	5	4250	
1800	4	4300	
1850	4	4350	
1900	4	4400	
1950	4	4450	
2000	5	4500	
2050	7	4550	
2100	8	4600	
2150	10	4650	
2200	8	4700	
2250	7	4750	
2300	8	4800	
2350	6	4850	
2400	5	4900	
2450	6	4950	
2500	4	5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

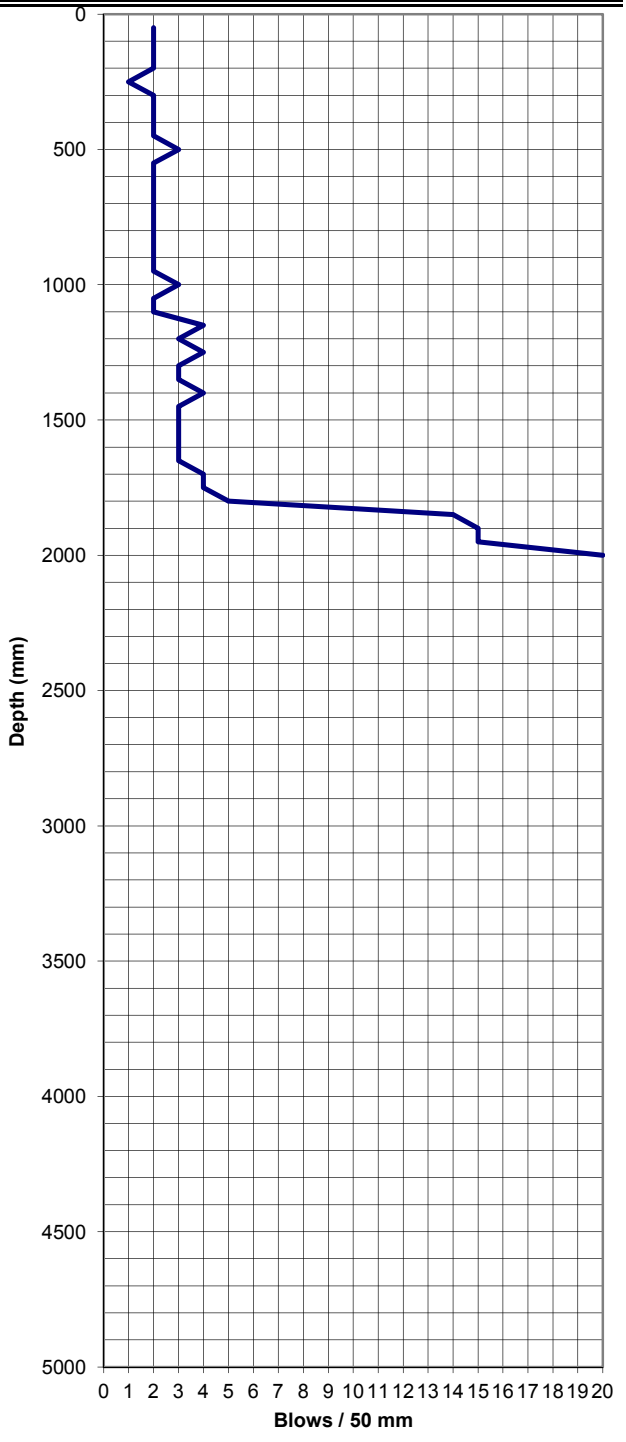
Job No: *750941*
Project: *Improvement of Equipment for Disaster Risk Management*
Location: *Isangel, Tanna*

Date: *31/07/2013*
Operated by: *SRS*
Logged by: *SRS*
Checked by: *ADP*

Test No. *SB03-SC2*
Sheet *1*
of *1*

mm Driven	No. of Blows
50	2
100	2
150	2
200	2
250	1
300	2
350	2
400	2
450	2
500	3
550	2
600	2
650	2
700	2
750	2
800	2
850	2
900	2
950	2
1000	3
1050	2
1100	2
1150	4
1200	3
1250	4
1300	3
1350	3
1400	4
1450	3
1500	3
1550	3
1600	3
1650	3
1700	4
1750	4
1800	5
1850	14
1900	15
1950	15
2000	20
2050	
2100	
2150	
2200	
2250	
2300	
2350	
2400	
2450	
2500	

mm Driven	No. of Blows
2550	
2600	
2650	
2700	
2750	
2800	
2850	
2900	
2950	
3000	
3050	
3100	
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

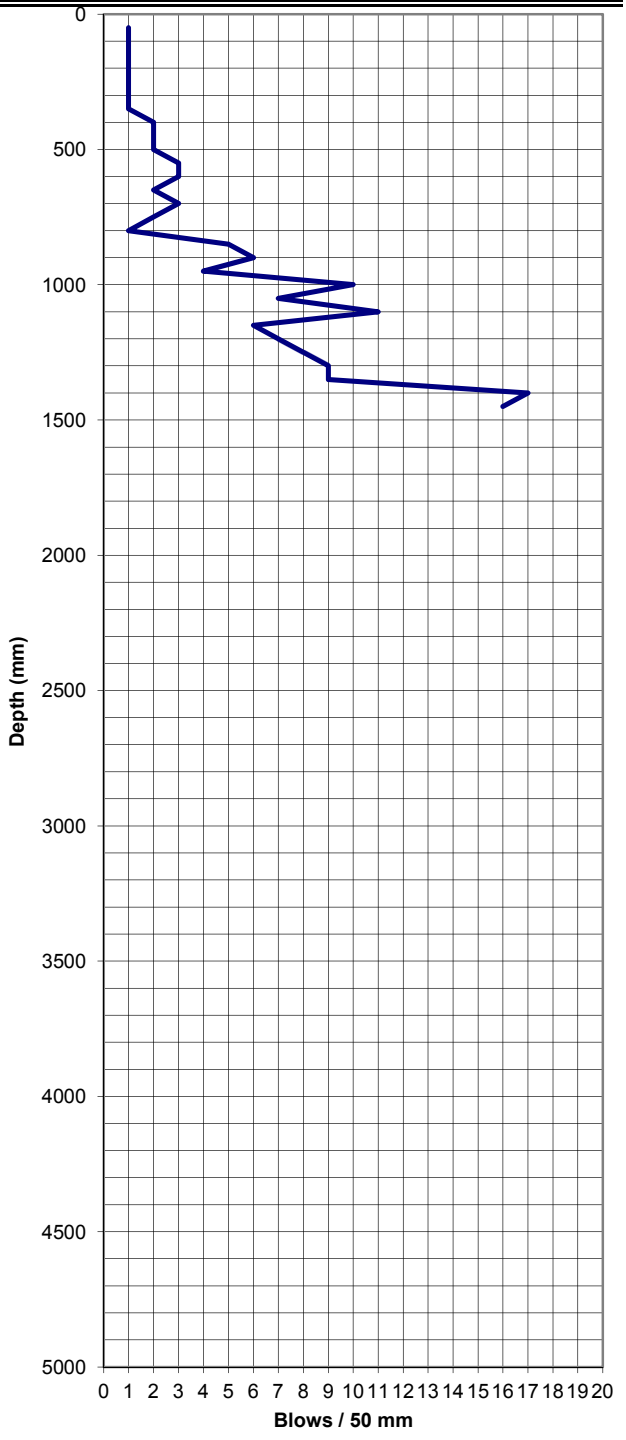
SCALA PENETROMETER LOG

Job No: *750941*
Project: *Improvement of Equipment for Disaster Risk Management*
Location: *Lakatoro, Malekula*

Date: *30/07/2013*
Operated by: *ADP*
Logged by: *ADP*
Checked by: *SRS*

Test No. *SB01-SC1*
Sheet *1*
of *1*

mm Driven	No. of Blows	mm Driven	No. of Blows
50	1	2550	
100	1	2600	
150	1	2650	
200	1	2700	
250	1	2750	
300	1	2800	
350	1	2850	
400	2	2900	
450	2	2950	
500	2	3000	
550	3	3050	
600	3	3100	
650	2	3150	
700	3	3200	
750	2	3250	
800	1	3300	
850	5	3350	
900	6	3400	
950	4	3450	
1000	10	3500	
1050	7	3550	
1100	11	3600	
1150	6	3650	
1200	7	3700	
1250	8	3750	
1300	9	3800	
1350	9	3850	
1400	17	3900	
1450	16	3950	
1500		4000	
1550		4050	
1600		4100	
1650		4150	
1700		4200	
1750		4250	
1800		4300	
1850		4350	
1900		4400	
1950		4450	
2000		4500	
2050		4550	
2100		4600	
2150		4650	
2200		4700	
2250		4750	
2300		4800	
2350		4850	
2400		4900	
2450		4950	
2500		5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

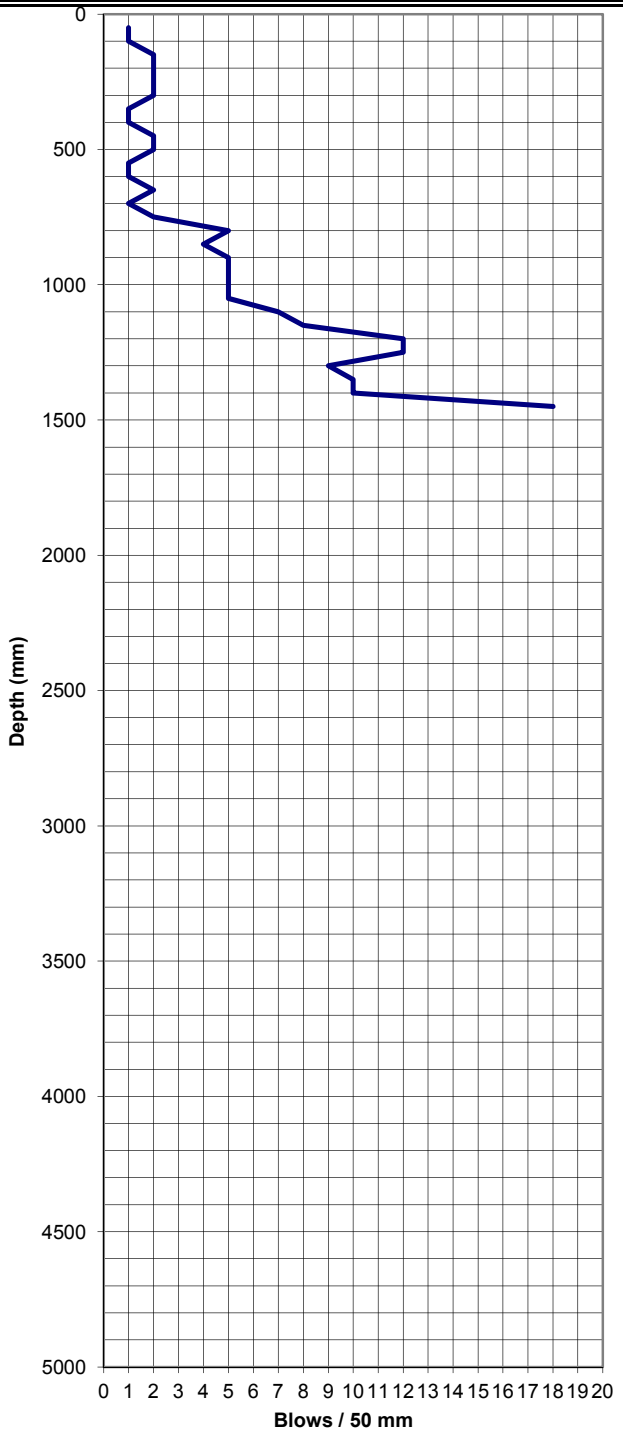
Job No: *750941*
Project: *Improvement of Equipment for Disaster Risk Management*
Location: *Lakatoro, Malekula*

Date: *30/07/2013*
Operated by: *ADP*
Logged by: *ADP*
Checked by: *SRS*

Test No. *SB01-SC2*

Sheet *1*
of *1*

mm Driven	No. of Blows	mm Driven	No. of Blows
50	1	2550	
100	1	2600	
150	2	2650	
200	2	2700	
250	2	2750	
300	2	2800	
350	1	2850	
400	1	2900	
450	2	2950	
500	2	3000	
550	1	3050	
600	1	3100	
650	2	3150	
700	1	3200	
750	2	3250	
800	5	3300	
850	4	3350	
900	5	3400	
950	5	3450	
1000	5	3500	
1050	5	3550	
1100	7	3600	
1150	8	3650	
1200	12	3700	
1250	12	3750	
1300	9	3800	
1350	10	3850	
1400	10	3900	
1450	18	3950	
1500		4000	
1550		4050	
1600		4100	
1650		4150	
1700		4200	
1750		4250	
1800		4300	
1850		4350	
1900		4400	
1950		4450	
2000		4500	
2050		4550	
2100		4600	
2150		4650	
2200		4700	
2250		4750	
2300		4800	
2350		4850	
2400		4900	
2450		4950	
2500		5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

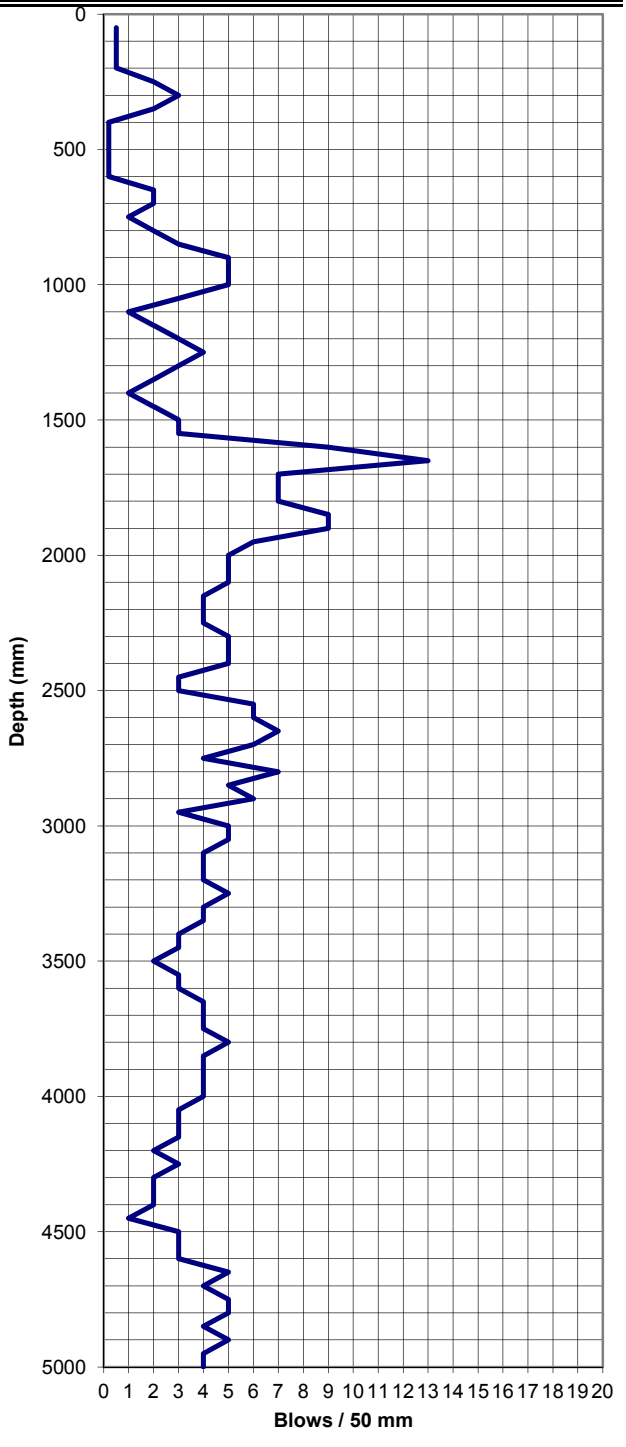
SCALA PENETROMETER LOG

Job No: *750941*
Project: *Improvement of Equipment for Disaster Risk Management*
Location: *Bauerfield Airport, Efate*

Date: *28/07/2013*
Operated by: *SRS*
Logged by: *SRS*
Checked by: *ADP*

Test No. ***A02-SC1***
Sheet ***1***
of ***1***

mm Driven	No. of Blows	mm Driven	No. of Blows
50	0.5	2550	6
100	0.5	2600	6
150	0.5	2650	7
200	0.5	2700	6
250	2	2750	4
300	3	2800	7
350	2	2850	5
400	0.2	2900	6
450	0.2	2950	3
500	0.2	3000	5
550	0.2	3050	5
600	0.2	3100	4
650	2	3150	4
700	2	3200	4
750	1	3250	5
800	2	3300	4
850	3	3350	4
900	5	3400	3
950	5	3450	3
1000	5	3500	2
1050	3	3550	3
1100	1	3600	3
1150	2	3650	4
1200	3	3700	4
1250	4	3750	4
1300	3	3800	5
1350	2	3850	4
1400	1	3900	4
1450	2	3950	4
1500	3	4000	4
1550	3	4050	3
1600	9	4100	3
1650	13	4150	3
1700	7	4200	2
1750	7	4250	3
1800	7	4300	2
1850	9	4350	2
1900	9	4400	2
1950	6	4450	1
2000	5	4500	3
2050	5	4550	3
2100	5	4600	3
2150	4	4650	5
2200	4	4700	4
2250	4	4750	5
2300	5	4800	5
2350	5	4850	4
2400	5	4900	5
2450	3	4950	4
2500	3	5000	4



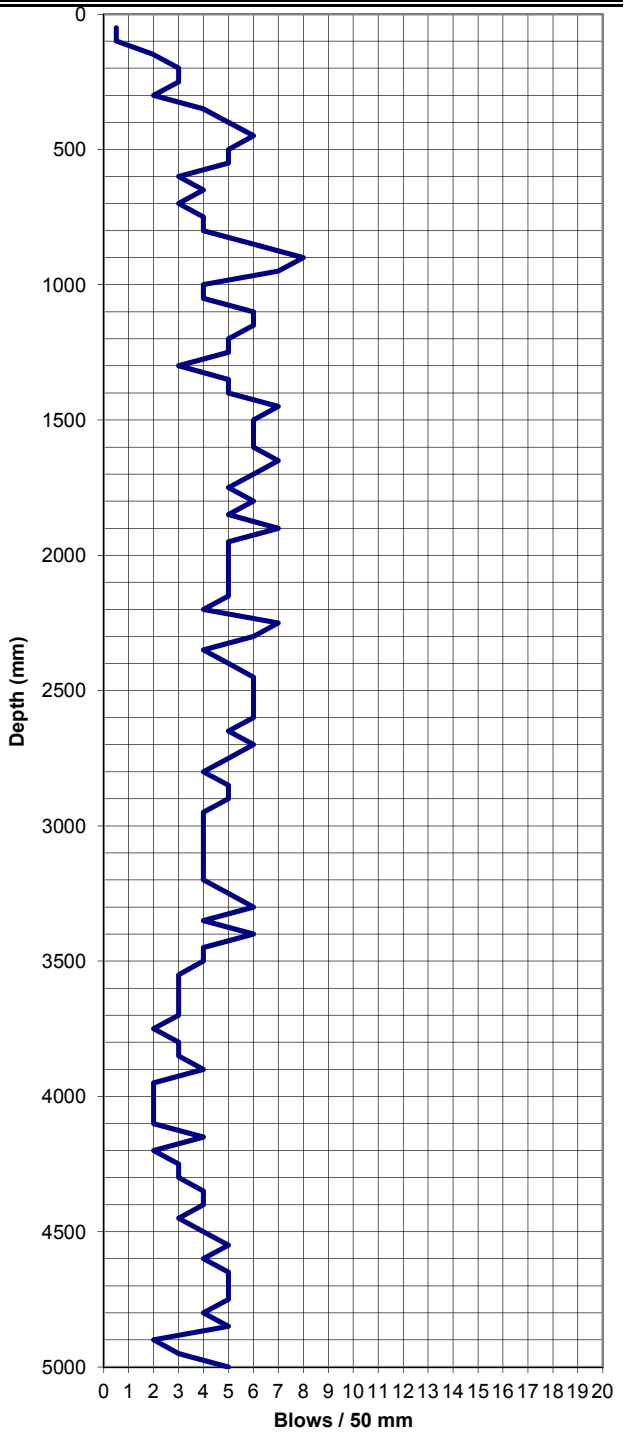
Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

Job No:	*750941*	Date:	*28/07/2013*	**Test No.**	***A02-SC2***
Project:	*Improvement of Equipment for Disaster Risk Management*	Operated by:	*SRS*		
		Logged by:	*SRS*	**Sheet**	***1***
Location:	*Bauerfield Airport, Efate*	Checked by:	*ADP*	**of**	***1***

mm Driven	No. of Blows	mm Driven	No. of Blows
50	0.5	2550	6
100	0.5	2600	6
150	2	2650	5
200	3	2700	6
250	3	2750	5
300	2	2800	4
350	4	2850	5
400	5	2900	5
450	6	2950	4
500	5	3000	4
550	5	3050	4
600	3	3100	4
650	4	3150	4
700	3	3200	4
750	4	3250	5
800	4	3300	6
850	6	3350	4
900	8	3400	6
950	7	3450	4
1000	4	3500	4
1050	4	3550	3
1100	6	3600	3
1150	6	3650	3
1200	5	3700	3
1250	5	3750	2
1300	3	3800	3
1350	5	3850	3
1400	5	3900	4
1450	7	3950	2
1500	6	4000	2
1550	6	4050	2
1600	6	4100	2
1650	7	4150	4
1700	6	4200	2
1750	5	4250	3
1800	6	4300	3
1850	5	4350	4
1900	7	4400	4
1950	5	4450	3
2000	5	4500	4
2050	5	4550	5
2100	5	4600	4
2150	5	4650	5
2200	4	4700	5
2250	7	4750	5
2300	6	4800	4
2350	4	4850	5
2400	5	4900	2
2450	6	4950	3
2500	6	5000	5



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

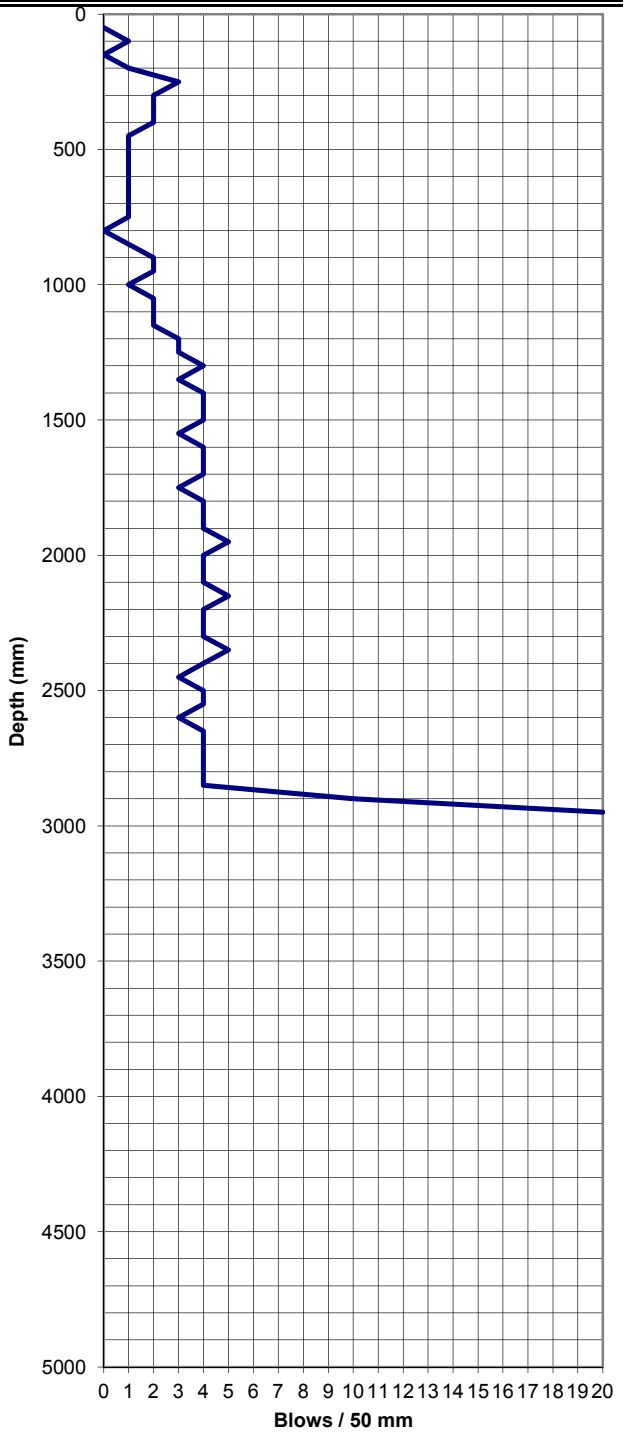
SCALA PENETROMETER LOG

Job No: *750941*
Project: *Improvement of Equipment for Disaster Risk Management*
Location: *Pekoa Airport, Santo*

Date: *1/08/2013*
Operated by: *ADP*
Logged by: *ADP*
Checked by: *SRS*

Test No. ***A01-SC1***
Sheet ***1***
of ***1***

mm Driven	No. of Blows	mm Driven	No. of Blows
50	0	2550	4
100	1	2600	3
150	0	2650	4
200	1	2700	4
250	3	2750	4
300	2	2800	4
350	2	2850	4
400	2	2900	10
450	1	2950	20
500	1	3000	
550	1	3050	
600	1	3100	
650	1	3150	
700	1	3200	
750	1	3250	
800	0	3300	
850	1	3350	
900	2	3400	
950	2	3450	
1000	1	3500	
1050	2	3550	
1100	2	3600	
1150	2	3650	
1200	3	3700	
1250	3	3750	
1300	4	3800	
1350	3	3850	
1400	4	3900	
1450	4	3950	
1500	4	4000	
1550	3	4050	
1600	4	4100	
1650	4	4150	
1700	4	4200	
1750	3	4250	
1800	4	4300	
1850	4	4350	
1900	4	4400	
1950	5	4450	
2000	4	4500	
2050	4	4550	
2100	4	4600	
2150	5	4650	
2200	4	4700	
2250	4	4750	
2300	4	4800	
2350	5	4850	
2400	4	4900	
2450	3	4950	
2500	4	5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

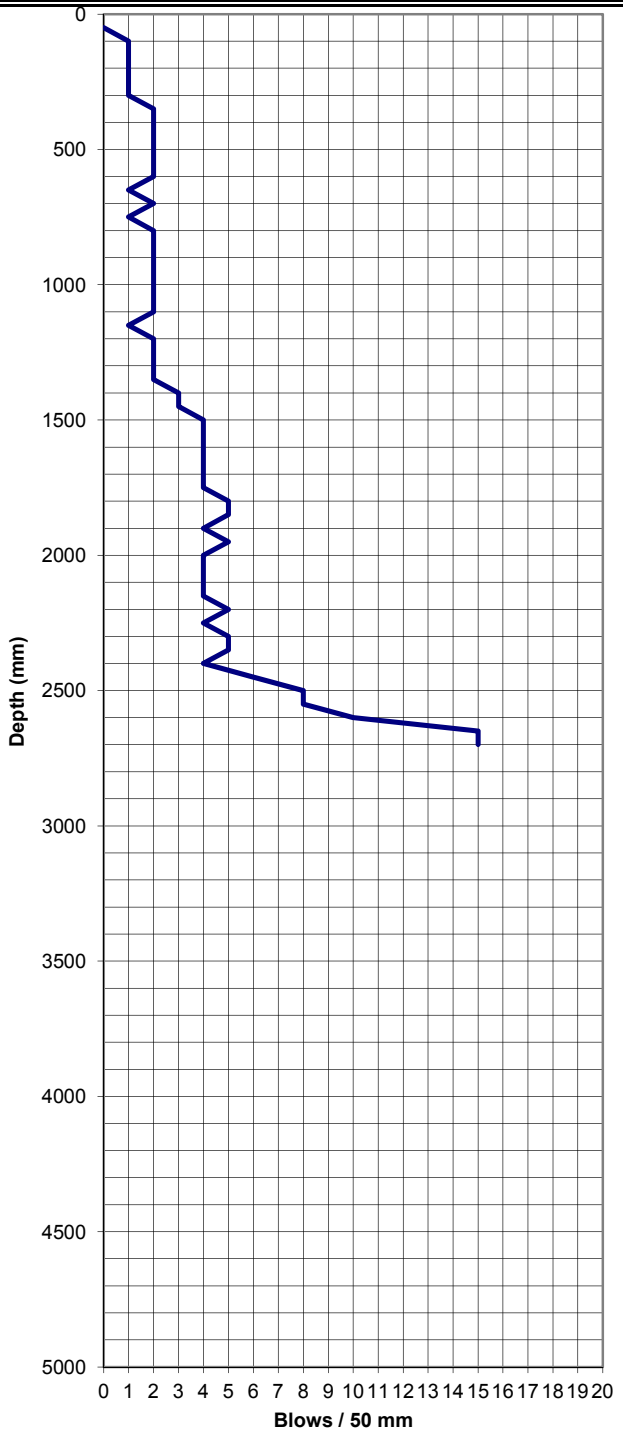
SCALA PENETROMETER LOG

Job No: *750941*
Project: *Improvement of Equipment for Disaster Risk Management*
Location: *Pekoa Airport, Santo*

Date: *1/08/2013*
Operated by: *ADP*
Logged by: *ADP*
Checked by: *SRS*

Test No. ***A01-SC2***
Sheet ***1***
of ***1***

mm Driven	No. of Blows	mm Driven	No. of Blows
50	0	2550	8
100	1	2600	10
150	1	2650	15
200	1	2700	15
250	1	2750	
300	1	2800	
350	2	2850	
400	2	2900	
450	2	2950	
500	2	3000	
550	2	3050	
600	2	3100	
650	1	3150	
700	2	3200	
750	1	3250	
800	2	3300	
850	2	3350	
900	2	3400	
950	2	3450	
1000	2	3500	
1050	2	3550	
1100	2	3600	
1150	1	3650	
1200	2	3700	
1250	2	3750	
1300	2	3800	
1350	2	3850	
1400	3	3900	
1450	3	3950	
1500	4	4000	
1550	4	4050	
1600	4	4100	
1650	4	4150	
1700	4	4200	
1750	4	4250	
1800	5	4300	
1850	5	4350	
1900	4	4400	
1950	5	4450	
2000	4	4500	
2050	4	4550	
2100	4	4600	
2150	4	4650	
2200	5	4700	
2250	4	4750	
2300	5	4800	
2350	5	4850	
2400	4	4900	
2450	6	4950	
2500	8	5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

Appendix D: Laboratory Testing

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Form No.: S4
Form Date: January 2004
File: P:\616139.000\Working Material\Water content_summary.xlsx

Page of

Your Job No.: 750941

Site : VMGD, Efate

Our Job No.: 616139.000

Test Method Used: NZS 4402:1986 Test 2.1 Determination of Water Content

WATER CONTENT TEST RESULTS

Table 1: Water Content

HA No.:	SB02-HA1	SB02-HA2
Sample No.:	1	1
Depth (m)	0.2	0.1
Water Content (%)	9.6	8.4

Tested by: ST Date: 10/9/13 Checked by: AJFC Date: 10/9/13

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Auckland 1023, New Zealand
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Form No.: S4
Form Date: January 2004
File: P:\616139.000_Solid density_Summary.xlsx

Your Job No.: 750941

Site : VMGD, Efate

Our Job No.: 616139.000

Test Method Used:NZS 4402:1986 Test 2.7.2 Determination of Solid Density of Soil Particles - Vacuum Method

SOLID DENSITY TEST RESULTS

Table 1: Solid Density

HA No.:		*SB02-HA1
Sample ID.:		1
Depth	(m)	0.2
Solid Density	(t/m^3)	2.70

Sample History: Oven-dried.

Remarks : Material >19mm test sieve was broken down and mixed back into the sample to perform a soild density test.

*As per the standard, two specimens required to perform a solid density, but due to insufficient sample mass obtained, it was performed on a single specimen as directed by the engineer. Therefore the test results are not IANZ endorsed.

Tested by: ST Date: 10/9/13 Checked by: ASFC Date: 10/9/13

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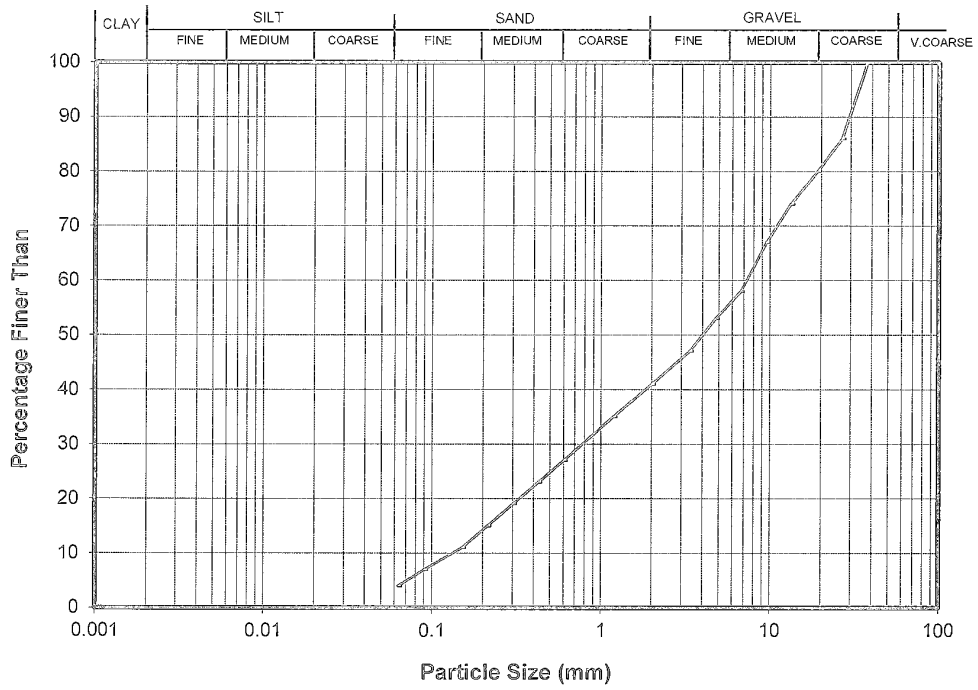
Form No.: S5
Form Date: JANUARY 2004
File: P:\616139.000\Working Material\SB02-HA2_1_0.1m_Wet Sieve.xlsx

Plate No.: Page of Your Job No.: 750941
Site : VMGD, Efate Our Job No.: 616139.000
HA No.: SB02-HA2 Sample ID: 1 Depth (m) 0.1
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	100
26.5	86
19.0	80
13.2	74
9.50	67
6.70	58
4.75	53
3.35	47

Sieve (mm)	Total % Passing
2.00	41
1.18	35
0.600	27
0.425	23
0.300	19
0.212	15
0.150	11
0.090	7
0.063	4

Sample history : As received.
Description : sandy GRAVEL with trace of silt, few rootlets, loose, dark brown with white.

Remarks: The minimum mass of sample required for sieving is 15 kg, but due to insufficient sample mass the sieving was carried out on ~ 0.42 kg.
Percentage passing the finest sieve was obtained by difference.
The classification of gravel and sand components were described on the basis of particle size analysis.
Sample description and test results are not IANZ endorsed.

Entered by : ST Date : 10/9/13 Checked by : ASFC Date : 10/9/13

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Form No.: S4
Form Date: January 2004
File: P:\616139.000\Working Material\Water content_summary.xlsx

Your Job No.: 750941

Site : Isangel, Tanna

Our Job No.: 616139.000

Test Method Used: NZS 4402:1986 Test 2.1 Determination of Water Content

WATER CONTENT TEST RESULTS

Table 1: Water Content

BH No.:	SB03-BH1	SB03-BH1	SB03-BH2	SB03-BH2
Sample No.:	2A	2A	2B	2B
Depth (m)	0.5	1.8	1.0	1.5
Water Content (%)	61.5	44.8	61.4	40.6

Tested by: SG Date: 10/9/13 Checked by: [signature] Date: 10/9/13

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Form No.: S4
Form Date: January 2004
File: P:\616139.000_Solid density_Summary.xlsx

Your Job No.: 750941

Site : Isangel, Tanna

Our Job No.: 616139.000

Test Method Used:NZS 4402:1986 Test 2.7.2 Determination of Solid Density of Soil Particles - Vacuum Method

SOLID DENSITY TEST RESULTS

Table 1: Solid Density

BH No.:		*SB03-BH1	*SB03-BH2
Sample ID.:		2	2
Depth	(m)	1.8	1.5
Solid Density	(t/m^3)	2.78	2.73

Sample History: Oven-dried.

Remarks : *As per the standard, two specimens required to perform a solid density, but due to insufficient sample mass obtained, it was performed on a single specimen as directed by the engineer. Therefore the test results are not IANZ endorsed.

Tested by: ST Date: 10/9/13 Checked by: AJFC Date: 10/9/13

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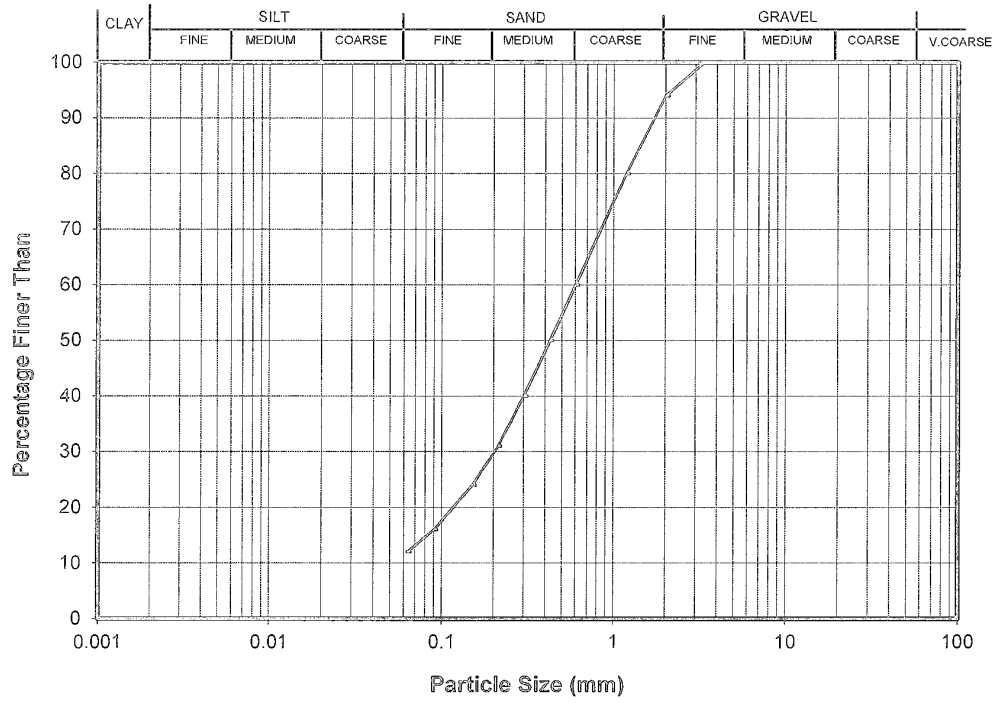
Form No.: S5
Form Date: JANUARY 2004
File: P:\616139.000\Working Material\SB03-BH1_1_0.5m_Wet Sieve.xlsx

Plate No.: Page of Your Job No.: 750941
Site : Isangel, Tanna Our Job No.: 616139.000
BH No.: SB03-BH1 Sample ID: 1 Depth (m) 0.5
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	---
6.70	---
4.75	100
3.35	100

Sieve (mm)	Total % Passing
2.00	94
1.18	80
0.600	60
0.425	50
0.300	40
0.212	31
0.150	24
0.090	16
0.063	12

Sample history : As received.
Description : SAND with minor gravel, minor silt and trace of clay, few rootlets, loose to stiff, dark brown.

Remarks: Percentage passing the finest sieve was obtained by difference.
The classification of gravel and sand components were described on the basis of particle size analysis.
Sample description is not IANZ endorsed.

Entered by : SJ Date : 10/9/13 Checked by : ASTC Date : 10/9/13

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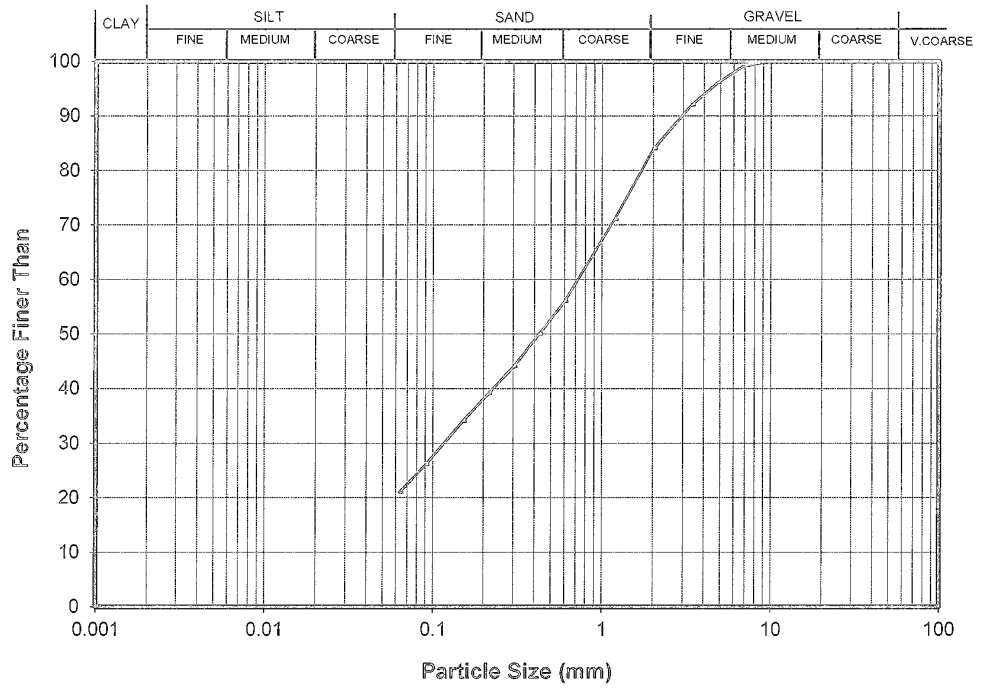
Form No.: S5
Form Date: JANUARY 2004
File: P:\616139.000\Working Material\SB03-BH2_1_1.0m_Wet Sieve.xlsx

Plate No.: Page of Your Job No.: 750941
Site : Isangel, Tanna Our Job No.: 616139.000
BH No.: SB03-BH2 Sample ID: 1 Depth (m) 1.0
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	100
6.70	99
4.75	96
3.35	92

Sieve (mm)	Total % Passing
2.00	84
1.18	71
0.600	56
0.425	50
0.300	44
0.212	39
0.150	34
0.090	26
0.063	21

Sample history : As received.
Description : SAND with some gravel, some silt and trace of clay, few rootlets, soft to stiff, dark brown.

Remarks: The minimum mass of sample required for sieving is 0.5 kg, but due to insufficient sample mass the sieving was carried out on ~ 0.19 kg.
Percentage passing the finest sieve was obtained by difference.
The classification of gravel and sand components were described on the basis of particle size analysis.
Sample description and test results are not IANZ endorsed.

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Form No.: S4
Form Date: January 2004
File: P:\616139.000\Working Material\Water content_summary.xlsx

Your Job No.: 750941

Site : Lakatoro, Malakula

Our Job No.: 616139.000

Test Method Used: NZS 4402:1986 Test 2.1 Determination of Water Content

WATER CONTENT TEST RESULTS

Table 1: Water Content

HA No.:	SB01-HA1	SB01-HA1	SB01-HA2	SB01-HA2
Sample No.:	1	2	1	2
Depth (m)	0.35-0.60	0.80-0.92	0.5-0.7	0.75-1.0
Water Content (%)	24.7	36.2	35.2	38.4

Tested by: SJ Date: 10/9/13 Checked by: ASFC Date: 10/9/13

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Form No.: S4
Form Date: January 2004
File: P:\616139.000_Solid density_Summary.xlsx

Your Job No.: 750941

Site : Lakatoro, Malakula

Our Job No.: 616139.000

Test Method Used:NZS 4402:1986 Test 2.7.2 Determination of Solid Density of Soil Particles - Vacuum Method

SOLID DENSITY TEST RESULTS

Table 1: Solid Density

HA No.:		*SB01-HA1	*SB01-HA2
Sample ID.:		1	2
Depth	(m)	0.80-0.92	0.75-1.0
Solid Density	(t/m^3)	2.80	2.81

Sample History: Oven-dried.

Remarks : Material >19mm test sieve was broken down and mixed back into the sample to perform a soild density test.

*As per the standard, two specimens required to perform a solid density, but due to insufficient sample mass obtained, it was performed on a single specimen as directed by the engineer. Therefore the test results are not IANZ endorsed.

Tested by: ST Date: 10/9/13 Checked by: ASTa Date: 10/9/13

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Form No.: S5
Form Date: JANUARY 2004
File: P:\616139.000\Working Material\SB01-HA1_1_0.35-0.60m_Wet Sieve.xlsx

Plate No.: Page of

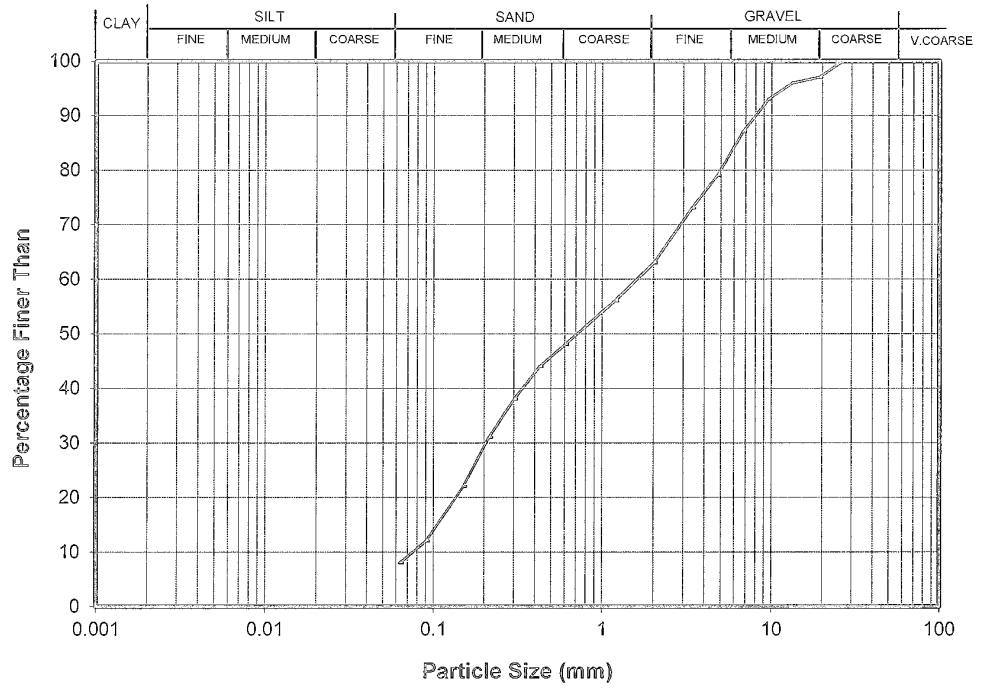
Site : Lakatoro, Malakula

HA No.: SB01-HA1 Sample ID: 1

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

Your Job No.: 750941
Our Job No.: 616139.000
Depth (m) 0.35-0.60

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	100
19.0	97
13.2	96
9.50	93
6.70	87
4.75	79
3.35	73

Sieve (mm)	Total % Passing
2.00	63
1.18	56
0.600	48
0.425	44
0.300	38
0.212	31
0.150	22
0.090	12
0.063	8

Sample history : As received.

Description : gravelly SAND with minor silt and trace of clay, few rootlets, loose, dark brown with white.

Remarks: The minimum mass of sample required for sieving is 5 kg, but due to insufficient sample mass the sieving was carried out on ~ 0.41 kg.
Percentage passing the finest sieve was obtained by difference.
The classification of gravel and sand components were described on the basis of particle size analysis.
Sample description and test results are not IANZ endorsed.

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Form No.: S5
Form Date: JANUARY 2004
File: P:\616139.000\Working Material\SB01-HA2_1_0.5-0.7m_Wet Sieve.xlsx

Plate No.: Page of

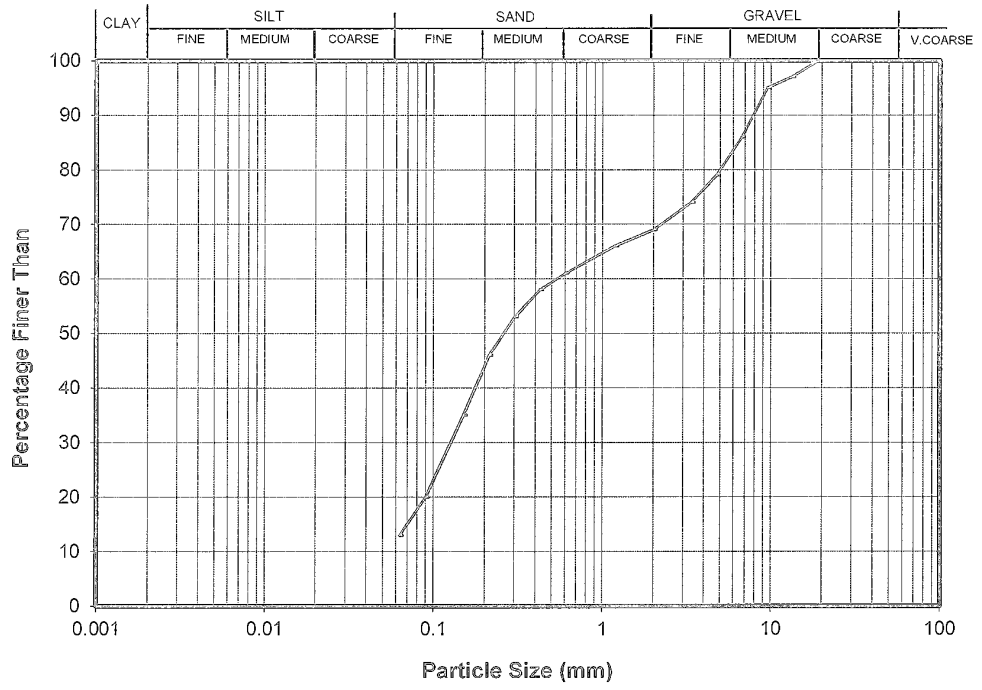
Site : Lakatoro, Malakula

HA No.: SB01-HA2 Sample ID: 1

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

Your Job No.: 750941
Our Job No.: 616139.000
Depth (m) 0.5-0.7

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	100
13.2	97
9.50	95
6.70	86
4.75	79
3.35	74

Sieve (mm)	Total % Passing
2.00	69
1.18	66
0.600	61
0.425	58
0.300	53
0.212	46
0.150	35
0.090	20
0.063	13

Sample history : As received.

Description : gravelly SAND with minor silt and trace of clay, few rootlets, loose, dark brown with white.

Remarks: The minimum mass of sample required for sieving is 2 kg, but due to insufficient sample mass the sieving was carried out on ~ 0.37 kg.
Percentage passing the finest sieve was obtained by difference.
The classification of gravel and sand components were described on the basis of particle size analysis.
Sample description and test results are not IANZ endorsed.

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Form No.: S4
Form Date: January 2004
File: P:\616139.000\Working Material\Water content_summary.xlsx

Your Job No.: 750941

Site : Bauerfield Airport, Efate

Our Job No.: 616139.000

Test Method Used: NZS 4402:1986 Test 2.1 Determination of Water Content

WATER CONTENT TEST RESULTS

Table 1: Water Content

HA No.:	A02-HA1	A02-HA1	A02-HA1	A02-HA2	A02-HA2
Sample No.:	4A	4A	4A	4B	4B
Depth (m)	0.5-0.7	1.0	1.5	1.1-1.3	2.0
Water Content (%)	34.0	39.3	37.9	32.2	17.2

Tested by: ST Date: 10/9/13 Checked by: AJFG Date: 10/9/13

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Form No.: S4
Form Date: January 2004
File: P:\616139.000_Solid density_Summary.xlsx

Page of Your Job No.: 750941

Site : Bauerfield Airport, Efate Our Job No.: 616139.000

Test Method Used:NZS 4402:1986 Test 2.7.2 Determination of Solid Density of Soil Particles - Vacuum Method

SOLID DENSITY TEST RESULTS

Table 1: Solid Density

HA No.:		*A02-HA1	*A02-HA1	*A02-HA2
Sample ID.:		4A	4A	4B
Depth	(m)	0.5-0.7	1.0	2.0
Solid Density	(t/m^3)	2.46	2.44	2.56

Sample History: Oven-dried.

Remarks : *As per the standard, two specimens required to perform a solid density, but due to insufficient sample mass obtained, it was performed on a single specimen as directed by the engineer. Therefore the test results are not IANZ endorsed.

Tested by: ST Date: 10/9/13 Checked by: ASFC Date: 10/9/13

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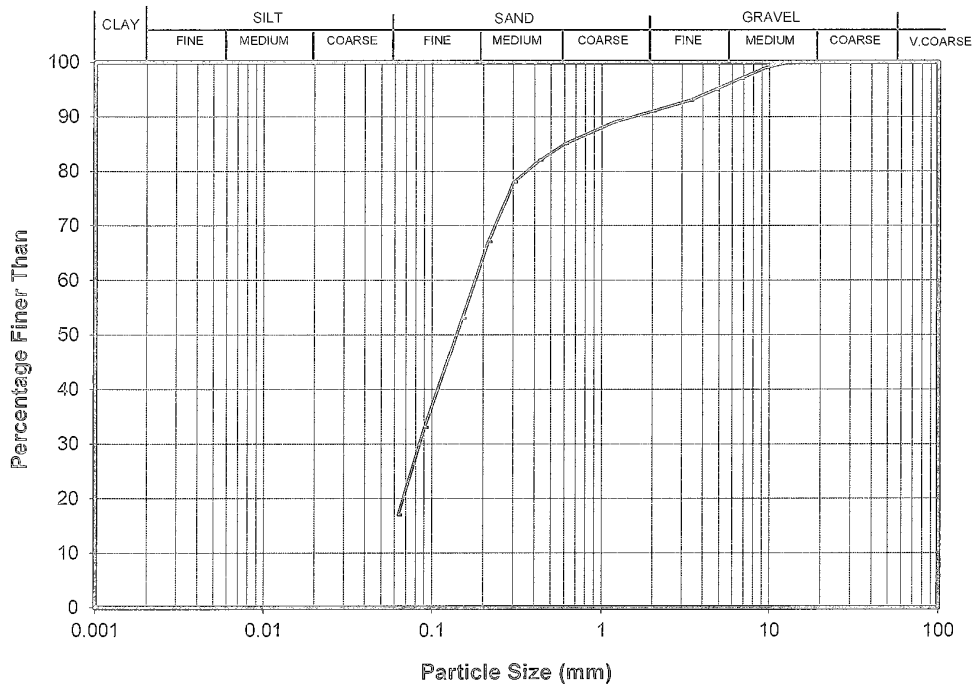
Form No.:	S5
Form Date:	JANUARY 2004
File:	P:\616139.000\Working Material\A02-HA1_4A_0.5-0.7m_Wet Sieve.xlsx

Plate No.: Page of Your Job No.: 750941
Site : Bauerfield Airport, Efate Our Job No.: 616139.000
HA No.: A02-HA1 Sample ID: 4A Depth (m) 0.5-0.7
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	100
9.50	99
6.70	97
4.75	95
3.35	93

Sieve (mm)	Total % Passing
2.00	91
1.18	89
0.600	85
0.425	82
0.300	78
0.212	67
0.150	53
0.090	33
0.063	17

Sample history : As received.
Description : SAND with minor gravel - Pumiceous?, some silt and trace of clay, few rootlets, loose/soft, medium brown with white.
Remarks: The minimum mass of sample required for sieving is 1 kg, but due to insufficient sample mass the sieving was carried out on ~ 0.22 kg.
Percentage passing the finest sieve was obtained by difference.
The classification of gravel and sand components were described on the basis of particle size analysis.
Sample description and test results are not IANZ endorsed.

Entered by : ST Date : 10/9/13 Checked by : ASFa Date : 10/9/13

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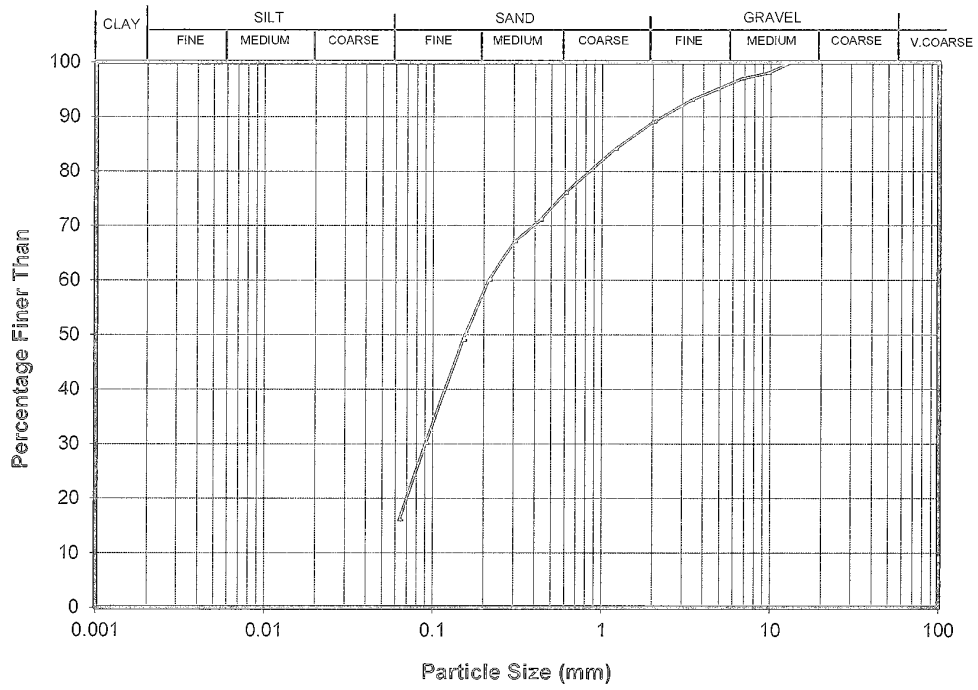
Form No.: S5
Form Date: JANUARY 2004
File: P:\616139.000\Working Material\A02-HA1_4A_1.5m_Wet Sieve.xlsx

Plate No.: Page of Your Job No.: 750941
Site : Bauerfield Airport, Efate Our Job No.: 616139.000
HA No.: A02-HA1 Sample ID: 4A Depth (m) 1.5
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	100
9.50	98
6.70	97
4.75	95
3.35	93

Sieve (mm)	Total % Passing
2.00	89
1.18	84
0.600	76
0.425	71
0.300	67
0.212	60
0.150	49
0.090	30
0.063	16

Sample history : As received.
Description : SAND with minor gravel-Pumecious?, some silt and trace of clay, loose/soft, light brown with light to dark grey/white.
Remarks: The minimum mass of sample required for sieving is 1 kg, but due to insufficient sample mass the sieving was carried out on ~ 0.11 kg.
Percentage passing the finest sieve was obtained by difference.
The classification of gravel and sand components were described on the basis of particle size analysis.
Sample description and test results are not IANZ endorsed.

Entered by : SJ Date : 10/9/13 Checked by : AJFa Date : 10/9/13

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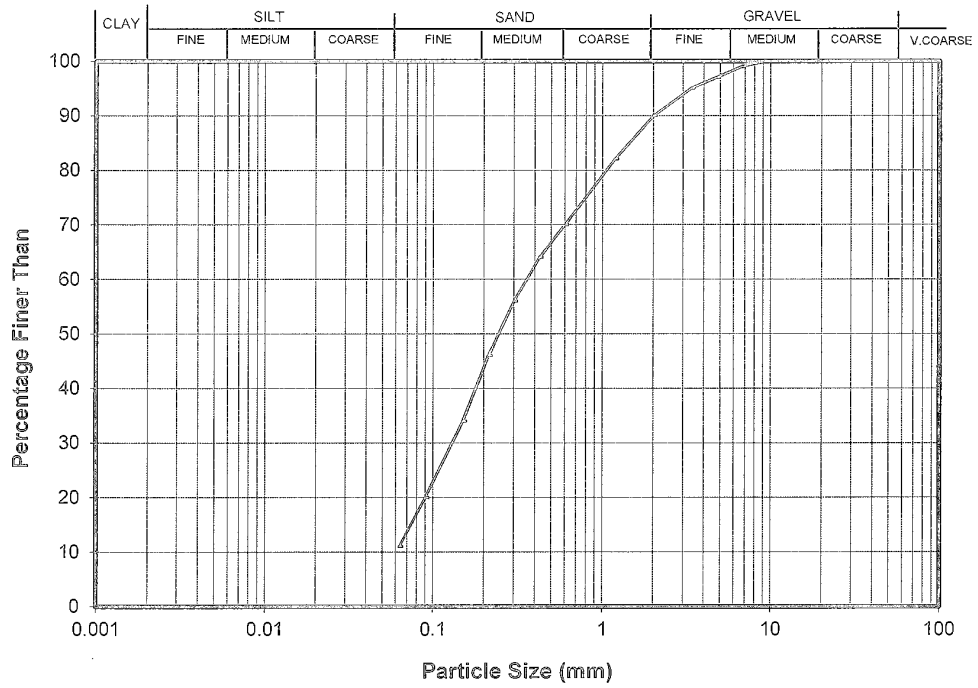
Form No.: S5
Form Date: JANUARY 2004
File: P:\616139.000\Working Material\A02-HA2_4B_1.1-1.3m_Wet Sieve.xlsx

Plate No.: Page of Your Job No.: 750941
Site : Bauerfield Airport, Efate Our Job No.: 616139.000
HA No.: A02-HA2 Sample ID: 4B Depth (m) 1.1-1.3
Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	100
9.50	100
6.70	99
4.75	97
3.35	95

Sieve (mm)	Total % Passing
2.00	90
1.18	82
0.600	70
0.425	64
0.300	56
0.212	46
0.150	34
0.090	20
0.063	11

Sample history : As received.
Description : SAND with minor gravel-Pumecious?, minor silt and trace of clay, loose, light brown with light grey/white.
Remarks: The minimum mass of sample required for sieving is 1 kg, but due to insufficient sample mass the sieving was carried out on ~ 0.16 kg.
Percentage passing the finest sieve was obtained by difference.
The classification of gravel and sand components were described on the basis of particle size analysis.
Sample description and test results are not IANZ endorsed.

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Form No.: S4
Form Date: January 2004
File: P:\616139.000\Working Material\Water content_summary.xlsx

Your Job No.: 750941

Site : Pekoa Airport, Santo

Our Job No.: 616139.000

Test Method Used: NZS 4402:1986 Test 2.1 Determination of Water Content

WATER CONTENT TEST RESULTS

Table 1: Water Content

HA No.:	A01-HA1	A01-HA1	A01-HA2	A01-HA2
Sample No.:	1	2	2	3
Depth (m)	0.5-0.8	1.25-1.50	1.05-1.25	1.5
Water Content (%)	54.5	51.5	63.6	65.3

Tested by: ST Date: 10/9/13 Checked by: AJEC Date: 10/9/13

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Form No.: S4
Form Date: January 2004
File: P:\616139.000_Solid density_Summary.xlsx

Your Job No.: 750941

Site : Pekoa Airport, Santo

Our Job No.: 616139.000

Test Method Used:NZS 4402:1986 Test 2.7.2 Determination of Solid Density of Soil Particles - Vacuum Method

SOLID DENSITY TEST RESULTS

Table 1: Solid Density

HA No.:		*A01-HA1	*A01-HA2
Sample ID.:		1	2
Depth	(m)	0.5-0.8	1.05-1.25
Solid Density	(t/m^3)	2.87	2.93

Sample History: Oven-dried.

Remarks : *As per the standard, two specimens required to perform a solid density, but due to insufficient sample mass obtained, it was performed on a single specimen as directed by the engineer. Therefore the test results are not IANZ endorsed.

Tested by: ST Date: 10/9/13 Checked by: ASFa Date: 10/9/13

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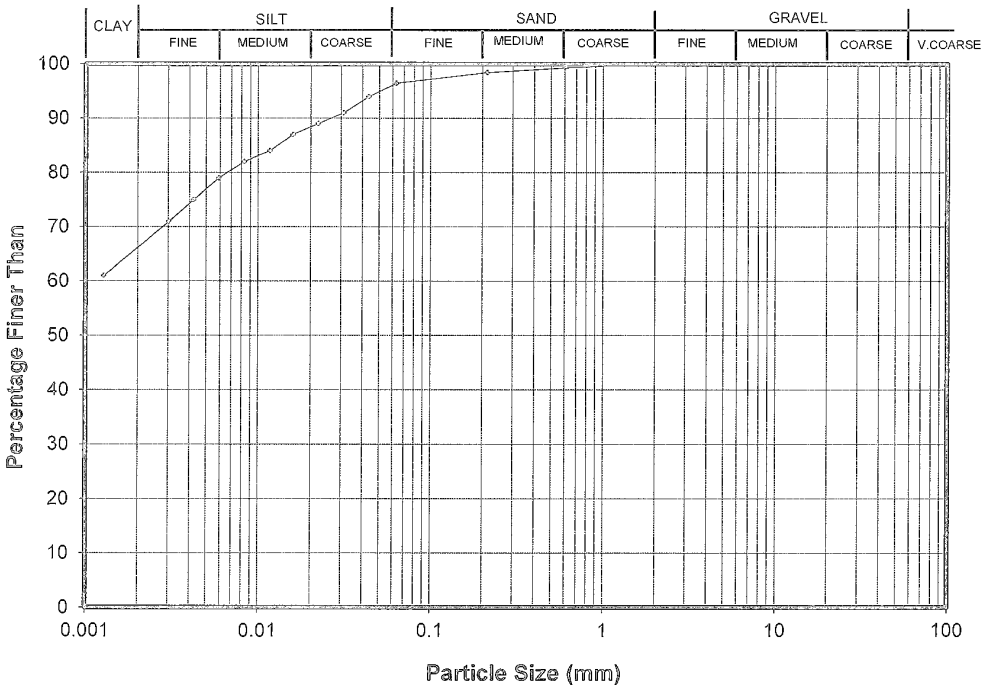
Form No.: P6
Form Date: January 2004
File: P:\616139.000\Working material\Hydro_Pekoa_santo_A01-HA1_2_1.25-1.50m.xlsx

Plate No.: Page of Your Job No.: 750941
Site : Pekoa Airport, Santo Our Job No.: 616139.000
HA No.: A01-HA1 Sample ID.: 2 Depth: 1.25-1.50 (m)
Test Method Used : NZS 4402:1986 Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
2.00	100		
0.600	99		
0.212	98		
0.063	96		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0436	94
0.0311	91
0.0221	89
0.0158	87
0.0116	84
0.0083	82
0.0059	79
0.0042	75
0.0030	71
0.0013	61

Sample history : As received.
Description: silty CLAY with trace of sand, very stiff, dark brown, high plasticity.

Solid Density (assumed) : 2.75 t/m^3

Remarks : A sub sample was split from the original sample for hydrometer analysis. This sample was soaked with a dispersing agent (~4 hour), then the mechanical shaker was used, until the material was brought into suspension, before proceeding with the test.
Suspension pH 8.0
Sample description is not IANZ endorsed.

Entered by : ST Date : 10/9/13 Checked by : [signature] Date : 10/9/13

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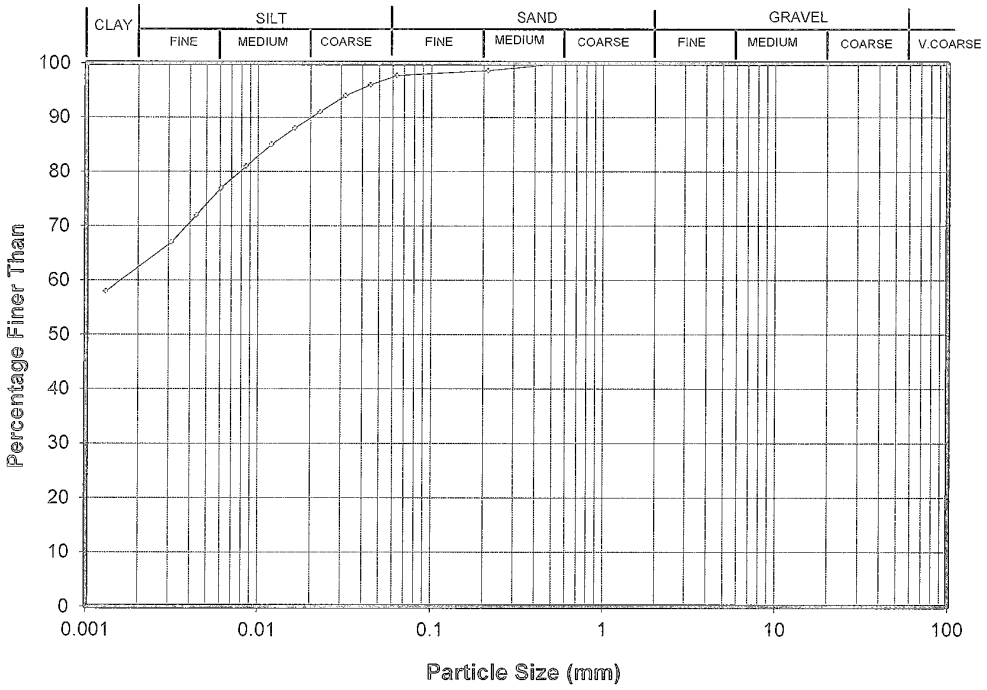
Form No.: P6
Form Date: January 2004
File: P:\616139.000\Working material\Hydro_Pekoa_santo_A01-HA2_3_1.50m.xlsx

Plate No.: Page of Your Job No.: 750941
Site : Pekoa Airport, Santo Our Job No.: 616139.000
HA No.: A01-HA2 Sample ID.: 3 Depth: 1.50 (m)
Test Method Used : NZS 4402:1986 Test 2.8.4 Hydrometer

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
2.00	100		
0.600	100		
0.212	99		
0.063	98		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0446	96
0.0318	94
0.0227	91
0.0161	88
0.0119	85
0.0085	81
0.0061	77
0.0044	72
0.0031	67
0.0013	58

Sample history : As received.
Description: silty CLAY with trace of sand, very stiff, dark brown, high plasticity.

Solid Density (assumed) : 2.75 t/m^3

Remarks : A sub sample was split from the original sample for hydrometer analysis. This sample was soaked with a dispersing agent (~4 hour), then the mechanical shaker was used, until the material was brought into suspension, before proceeding with the test.
Suspension pH 8.0
Sample description is not IANZ endorsed.

Entered by : SY Date : 10/9/13 Checked by : ASFa Date : 10/9/13