Bureau of Public Works
Ministry of Public Infrastructure, Industries and Commerce
Republic of Palau

PREPARATORY SURVEY
ON
THE PROJECT FOR THE CONSTRUCTION OF NATIONAL LANDFILL IN THE REPUBLIC OF PALAU

FINAL REPORT

April 2018

JAPAN INTERNATIONAL COOPERATION AGENCY

CTI ENGINEERING INTERNATIONAL CO., LTD.
EX RESEARCH INSTITUTE LTD.
EIGHT-JAPAN ENGINEERING CONSULTANTS INC.

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All US dollar amounts including project costs shown in this report are stated in 2017 prices unless otherwise indicated. The amounts are estimated on the basis of foreign prices by applying the interbank currency exchange rates as of 1st of June 2017, namely; USD1 = JPY 112.84.

SUMMARY

1. OUTLINE OF PALAU

The Republic of Palau, with a population of approximately 20,000 people, is located in Western Micronesia and has rich natural resources including coral reefs as the most attractive tourism resources. Annual average precipitation in Palau is approximately 3,000mm to 4,000mm, which is higher than annual average precipitation in Japan (1,700mm). Palau has two seasons: dry season from December to June and wet season from July to November. Annual average temperature is 25 to 27ºC and the difference in temperature through all season is little.

2. BACKGROUND OF THE PROJECT

Due to rapid increase in the number of tourists and the development of the tourism industry, appropriate solid waste management (hereinafter referred to as "SWM") and minimization of environmental impacts are urgent issues requiring prompt solution.

The existing landfill site in Palau called M-Dock Landfill, on the other hand, will reach full capacity because the volume of waste generated from disasters has been increasing due to recurrent damage caused by typhoons.

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency implementing the Japanese Government's technical assistance and expediting proper execution of Japan's Grant Aid, has been improving the existing landfill sites as well as conducting institutional strengthening and capacity development of the agencies related to SWM through the "Project for Improvement of Solid Waste Management" (year 2005-2008) and the "Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries (hereinafter referred to as "J-PRISM")" (year 2011-2016). Simultaneously, support for the improvement of the waste collection and transportation system in Koror State has been carried out under the Grant Aid for Grassroots Human Security by the Government of Japan (hereinafter referred to as "GOJ").

The Government of Palau has formulated Palau's National Solid Waste Management Plan and the strategy of solid waste management based on that plan are presented as follows:

1) To promote the participation of stakeholders through activities, such as planning policy, capacity development, information sharing and education for residents;
2) To promote the reduction of solid waste; and
3) To improve the framework of the existing solid waste management and disposal.

Strategy number 3 above will be the overall goal of the Project. The construction of the new national landfill and procurement of equipment, implementation of sanitary landfill and improvement of the collection and transportation of solid waste will contribute to the achievement of the overall goal.

Hence, the objective of the Project is set out as "To improve collection, transportation and disposal of the solid waste properly in Koror State and ten (10) States in Babeldaob Island".

3. OUTLINE OF THE SURVEY / DESIGN AND CNTENTS OF THE PROJECT

JICA dispatched the Preparatory Survey Team to Palau for three times as follows:

1st Survey: 22nd April to 1st June 2017
2nd Survey: 25th June to 9th July 2017
3rd Survey: 20th January to 30th January 2018

The survey team conducted Site survey, Social condition survey, Topographic survey, Geotechnical survey, Environmental and social consideration survey and survey for equipment procurement.

3.1 Solid Waste Management Status in Palau

Operation and maintenance (hereinafter referred to as "O&M") of new landfill and equipment will be implemented by the Division of Solid Waste Management (hereinafter referred to as "DSWM") under the BPW. DSWM plans to increase the number of staff after commencement of new landfill operation for the purpose of organizational strengthening.

The household waste is managed by each state in Palau and the condition of facilities and equipment is different in each state. Household waste generated in Koror State is collected everyday and transported to the M-Dock Landfill. Enough equipment is owned by Koror State; however, an important issue is the capacity of the M-Dock Landfill. The household waste generated in Babeldaob Island is collected once per week by each state and transported to the dumping site in each state. The sanitary environment at dumping site is not good and the equipment for the collecting and landfilling waste has deteriorated.

3.2 Environmental and Social Considerations

3.2.1 Baseline of the Environmental Condition

The proposed landfill site is located in a hilly area of Aimeliik State in Babeldaob Island, the north side from Koror State downtown. The downstream river flows down the waterway in a jungle northward from the site, it is a route leading to the Ngeremeduu Bay through the Tabechding River. The river basin is roughly covered with a jungle or a mangrove forest, but there are places that are used as farmland along the main road. The water intake facilities for settlements are located in a water system completely different from the one used for discharging leachate from the landfill site.

The current situation of the site is a secondary vegetated grassy land with tall trees. It is not included in nature reserves and other development restricted areas. In addition, the site is not a designated area such as an environmental preservation area and a historical district.

3.2.2 Baseline of the Social Condition

Aimeliik State including the site is a state located on the south side of Babeldaob Island, with a population of 327 as of 2015. While most of the State is a forested area and there are small farms where fruits etc. are cultivated here and there, there are no large establishments other than power plants.

There is a main road called Compact Road which was constructed with support from United States Aid. The road is maintained in a good condition and it is about 30 minutes' drive from Koror State.

Japanese firearm gun pedestals used in the World War II were identified in the site. Prior to the commencement of the project, the Historic Office of Palau will investigate this in accordance with the laws of Palau and take measures properly, such as relocation of the pedestals to the museum, etc. There are no cultural assets affected by the project and no residential areas near the project site.

3.2.3 Organizations and Regulations regarding Environmental and Social Considerations

In Palau, the Environmental Quality Protection Board (hereinafter referred to as "EQPB") is responsible for Environmental Impact Statement (hereinafter referred to as "EIS") and the process of EIS is defined by the EQPB Regulations, Chapter 2401-61 Environmental Impact Statement Regulations.

3.2.4 Results of Environmental and Social Considerations Survey

Based on the result of the environmental and social consideration survey, the environmental assessment is summarized in Table S1 below.

Table S1 Summary of the Result of the Environmental and Social Considerations Survey

No	Item	During Construction	During Operation
1	Air Quality	Although the local air quality may temporarily be affected by the emission of gas from construction vehicles and dust from construction works, it is predicted that air pollutants do not exceed the environmental standards in the living areas.	Heavy equipment will be operated at the site. As a result of the prediction calculation, the level of impact to the air quality will not exceed the air quality standards. In addition, although methane generation will occur after landfill operation, the generation amount will be minimized by adopting the Fukuoka Method.

No	Item	During Construction	During Operation
2	Water Quality	The local water quality may temporarily be affected by the runoff from the construction site; however, installation of a temporary sediment pond and implementation of environmental monitoring will mitigate the impacts.	There is no water usage at the site downstream. As a result of the prediction calculation, impacts on agriculture are not expected because the discharged water will be diluted by rainfall.
3	Wastes	Waste related to the construction work including waste by operators, labors and administrative staff in the project, and the green waste, such as cutting plants and stumps, will be generated during the construction phase. However, this waste will be reused. The residual soil by excavation work will also be generated but reused as cover soil for the new landfill site and land reclamation in the public works projects in Palau.	No secondary waste will be brought from the site
4	Soil Contamination	No construction work that brings soil contamination will be conducted.	Cracks of tuff breccia (foundation rock) will be permeable condition of the site while the permeability of coefficient of the site is in order of 10^{-7}m/s as a result of geological survey.
5	Noise and Vibration	The noise and vibration will be generated by construction vehicles, but their level will affect only a small area (inside of the 200m diameter from the generation sources) around the construction site.	The noise and vibration will be generated by heavy equipment and vehicles, but their level will affect only a small area (inside of the 100m diameter from the generation sources) around the construction site.
6	Odor	No construction work that generates offensive odor can be seen.	Offensive odor will be generated from the disposed waste; however, it will be mitigated by adopting the Fukuoka Method, discharge of leachate and installation of gas pipes.
7	Protected Areas / Ecosystem	The proposed site is not located within the Conservation Area, and Natural forests, tropical natural forests, ecologically important habitats such as coral reefs, mangrove swamps, tidal flats and so on do not exist in the proposed site	
8	Management of Abandoned Site		Management of abandoned site will be needed until the disposed waste layer is stabilized.
9	Resettlement	No resettlement will be made because nobody lives inside of the site.	
10	Living	The influence on the living environment along the roadside by construction vehicles seems to be negligible.	Traffic congestion is predicted on public roads near the disposal site by visitors of waste collection and transport vehicles.
11	Livelihood	Employment opportunities will be created in the State and surrounding areas because of the construction work and increase of sales for restaurants and shops will be expected near the site.	
12	Heritage	Gun bases in the World War II were identified in the site. Other ruins, cultural heritage, etc. do not exist in the planned area.	
13	Landscape	There is no major impact to the landscape around the site. Although the site is visible from the Compact Road, the change of the landscape will be limited and few.	The site will not expand during the service period. Although the site seen from the view point is only a part of the landscape, the impact on the landscape will be minimized by covering the landfill waste with soil.
14	Working Conditions	Although there are some possibilities of occurrence of labor accidents, it is considered that the working environment will not be lower than the current level in Palau.	Although there are some possibilities of occurrence of labor accidents, since the final disposal site is safe to arrange conducting wires and facilities, it is unlikely that the safety level and working environment will be lower than, for example, the present disposal site of M-Dock.
15	Accidents	There are some possibilities of occurrence of landslides; however, they are not particularly in danger considering the construction contents.	Although there are some possibilities of occurrence of waste collapse, it is a range that can be handled by ordinary occupational safety and health, traffic safety measures.
16	Effects by Transboundary and Climate Change	Effects by transboundary and climate change are not expected due to the scale of the Project.	

3.3 Design Policy

Design policy of the Project is established through results of the Survey and discussions between the Team and the Palauan side, as follows:

- High emergency and necessary facilities and equipment are targeted for the Project based on a solid waste management plan in Palau;
- The target area of the Project is Koror State and Babeldaob Island;
- Data of the projected population and amount of solid waste are prepared by the Survey;
- The proposed landfill is to be a site in Aimeliik State selected by the Palauan side with required procedures such as holding stakeholders' meetings;
- The life span of the new landfill site is more than 20 years in accordance with the Palauan request; and
- Residual soil generated by construction work from the landfill site will be carried to a site secured by BPW and stored temporarily.

3.4 Basic Plan

3.4.1 Facility Plan

The "semi-aerobic landfill structure (Fukuoka Method)" is adopted for the structure of the new landfill as a standard landfill structure for municipal solid waste in Japan. This "semi-aerobic landfill structure" has also been adopted for the improvement work of existing M-Dock Landfill. Since the semi-aerobic landfill structure not only accelerates stabilization but also promotes aerobic decomposition of disposal waste, it can reduce the emission of greenhouse gases (hereinafter referred to as "GHGs") such as methane. This landfill structure is also called "Fukuoka Method" because the technology was developed jointly by Fukuoka University and Fukuoka City

(1) Disposal Objects

As the summarized result of the projection of the amount of solid waste generated, if the landfill period of this new landfill is designed for 20 years from 2020 to 2039, the generated waste amount during this period is projected to be 210,608 t. and the required landfill capacity of waste is about 273,800m^3. Therefore, the landfill capacity should be at least 273,800m^3. This is in consideration to the request from Palauan side that the landfilling period of the new landfill site should be at least 20 years or more.

(2) Waste Retaining Structure

As the result of boring survey conducted near the proposed location of waste retaining structure, a concrete type of the retaining structure like a gravity type of concrete dam will require pile foundation. Additionally, considering the landscape after completion of landfilling, an earth dam will be preferable because a slope of the earth dam can be greening.

(3) Leachate Control Work

Since the geological condition at the project site can be evaluated as low permeability, installation of seepage control sheets is not required in the new landfill. However, in order to prevent the leakage of leachate from the crack of tuff breccia under the clay layer, the crack area should be replaced by low permeability cement improved soil. In addition, leachate control work is conducted in the landfill site and the leachate pond to prevent groundwater pollution.

(4) Leachate Treatment System

The circulation type semi-aerobic landfill structure will be adopted to the new landfill. Leachate generated from the landfill site is thus circulated or returned to the landfill in principle. The returned leachate will evaporate at the landfill, so the amount of leachate generated will be reduced. The leachate quality will be stabilized through purification by aerobic microbes in the landfill layer and filtration by landfill layer, gas ventilation shaft, and gravel filter layer over the leachate collection pipe.

In case the leachate pond fills up to full capacity due to continuous rainfall and increase in the amount of leachate generated, the leachate will overflow and be discharged downstream of the site.

(5) Gas Exhausted Pipe

Since the gas exhausted pipe has a function of exhausting methane gas from the landfill layer to outside and taking air from outside into the landfill layer, it is important facility for semi-aerobic structure. Gas exhausted pipes are to be installed at thirteen (13) points according to the Japanese guideline for the performance of waste disposal site.

(6) Gas Exhausted Pipe

Since the gas exhausted pipe has a function of exhausting methane gas from the landfill layer to outside and taking air from outside into the landfill layer, it is important facility for semi-aerobic structure. Gas exhausted pipes are to be installed at thirteen (13) points according to the Japanese guideline for the performance of waste disposal site.

(7) Ancillary Facilities

An administration building is constructed for O&M of the landfill. This building has an office space for conducting the management of delivered waste and recording the monitoring data, etc., a storage room for keeping tools and equipment and other facilities. In addition, a truck scale is also constructed next to the administration building to measure the amount of waste delivered to the landfill and collect the disposal fee.

A garage is to be built for parking of heavy machine and vehicles such as Bulldozer, Excavator, Wheel Loader and Dump Truck. This garage is a steel frame structure same as the administration building.

Two (2) wells will be constructed for groundwater monitoring: one for the upstream and the other for the downstream of the landfill site.

Since the Palauan side requested to set up a stockyard as a space for storage of recyclable materials, a recyclable material stockyard is constructed.

Maintenance roads are to be constructed for maintaining the leachate pond and desilting from two (2) rain water retention ponds. In addition, other maintenance roads will be built at the crown of the retaining structure.

Access roads will be planned to transport the waste into the landfill site, connecting from the entrance of the site through the weighing building to the northern direction at the western side of the site and finally reaching at the landfilling area near the retaining structure. Fences and a gate are to be installed.

3.4.2 Equipment Plan

A list of selected equipment is shown in Table S2 below.

Table S2 List of Equipment to be Procured

No.	Equipment	Specification	Quantity	Purpose of the operation
1	Bulldozer	Operation Weight: 21t For dry land	1	For levelling and compaction of waste and soil and making embankment
2	Excavator	Bucket capacity: 0.8m^3	1	For excavating and collecting waste and soil and shaping slope
3	Wheel Loader	Bucket capacity: 1.3m^3	1	For loading cover soil and recyclable garbage and delivering woodchips
4	Dump Truck	Loading Weight: 8t	1	For delivering and covering soil and materials
5	Compactor Truck	Loading Weight 2t	2	For collecting and delivering solid waste from public facilities in Babeldaob Island

4. IMPLEMENTION PERIOD AND PROJECT COST

Implementation period of the Project is estimated to be four (4) months for detailed design, three (3) months for tender and contract and 18 months for construction work including procurement of equipment.

The project cost to be borne by the recipient country is estimated to be about USD25,100 (2,820 thousand Japanese Yen, USD1.0 = JPY112.84). The cost to be borne by the Japan's Grant Aid is not shown in this report due to the confidentially.

5. PROJECT EVALUATION

Relevance and *Effectiveness* are to be prospected as following reasons:

5.1 Relevance

The Project contributes to the solid waste management and environmental sanitary improvement through the development of the landfill and relevant equipment; thus, relevance of the Project is high. Additionally, synergistic effects are expected through the cooperation with the present technical assistance, J-PRISM Phase2.

5.2 Effectiveness

Effectiveness is evaluated by both quantitative effect and qualitative effect.

As a quantitative effect, landfilling capacity of M-Dock is already exceeded, and life span is extended by the bulk up of embarkment. The capacity of the M-Dock Landfill is expected to be full in few years; thus, quantitative effect is equal to the receiving capacity of the landfill. The operation rate of the heavy machine for the landfill O&M is also one of the quantitative effects. Amount of the delivering waste in the target year (2023) is more than 27 t per day. Operation time in 2023 is to be two (2) hours/day if operation time in 2020, base year, is zero (0) hour/day.

As a qualitative effect, adequate disposal of the waste which had been dumped openly in Babeldaob Island contributes to improving sanitary environment in Babeldaob Island and conserving the environment in Palau.

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ABBREVIATIONS AND ACRONYMS

A/P	:	Authorization to Pay
B/A	:	Banking Arrangement
BOD	:	Biochemical Oxygen Demand
BPW	:	Bureau of Public Works
BTU	:	British Thermal Unit
COD	:	Chemical Oxygen Demand
DO	:	Dissolved Oxygen
DSWM	:	Division of Solid Waste Management
EA	:	Environmental Assessment
EC	:	Electrical Conductivity
EIA	:	Environmental Impact Assessment
EIS	:	Environmental Impact Statement
EMP	:	Environmental Management Plan
EMoP	:	Environmental Monitoring Plan
E/N	:	Exchange of Notes
EQPB	:	Environmental Quality Protection Board
GDP	:	Gross Domestic Products
GHGs	:	Greenhouse Gases
GOJ	:	The Government of Japan
GOP	:	The Government of Palau
IC/R	:	Inception Report
JICA	:	Japan International Cooperation Agency
J-PRISM	:	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries
MPIIC	:	Ministry of Public Infrastructure, Industries and Commerce
NPA	:	Norwegian People's Aid
NPO	:	Non-Profit Organization
NSWMP	:	National Solid Waste Management Plan
O&M	:	Operation and Maintenance
SWM	:	Solid Waste Management
SPM	:	Suspended Particulate Matter
SS	:	Suspended Solids
USD	:	United Sates Dollar
UXO	:	Unexploded Ordinance
WACS	:	Waste Amount and Composition Survey

1. BACKGROUND OF THE PROJECT

1.1 Background of the Project

The Republic of Palau, with a population of approximately 20,000 people, has rich natural resources including coral reefs as the most attractive tourism resources. Due to rapid increase of the number of tourists and development of the tourism industry, appropriate solid waste management (SWM) and minimization of environmental impacts are urgent issues requiring prompt solution. The Government of Palau (hereinafter referred to as "GOP") has formulated Palau's National Solid Waste Management Plan (hereinafter referred to as "NSWMP"), and one of the action plans under the NSWMP is to develop a new landfill utilizing the Fukuoka Method (semi aerobic type of landfill: a typical landfill type in Japan).

The Japan International Cooperation Agency (JICA), the official agency implementing the Japanese Government's technical assistance and expediting proper execution of Japan's Grant Aid, has been improving the existing landfill sites as well as conducting institutional strengthening and capacity development of the agencies related to SWM through the "Project for Improvement of Solid Waste Management" (year 2005-2008) and the "Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries (J-PRISM)" (year 2011-2016). Simultaneously, support for the improvement of the waste collection and transportation system in Koror State has been carried out under the Grant Aid for Grassroots Human Security by the Government of Japan (GOJ).

The existing landfill site in Palau called M-Dock Landfill, on the other hand, will reach full capacity because the volume of waste generated from disasters has been increasing due to recurrent damage caused by typhoons. Under the circumstances, the GOP has requested Japan's Grant Aid for the Project for the Construction of Palau New National Landfill (hereinafter referred to as "the Project"). In response, the GOJ entrusted JICA the task of examining the viability of the Project. Hence, JICA dispatched a survey team (hereinafter referred to as "the Team") to conduct the present Preparatory Survey (hereinafter referred to as "the Survey"). The Team was led by Dr. Mimpei Ito, Director, Environmental Management Division 1, Environmental Management Group, Global Environment Department, JICA. A member list of the Survey Team and the Survey schedule are presented in **Appendix1** and **Appendix2**, respectively.

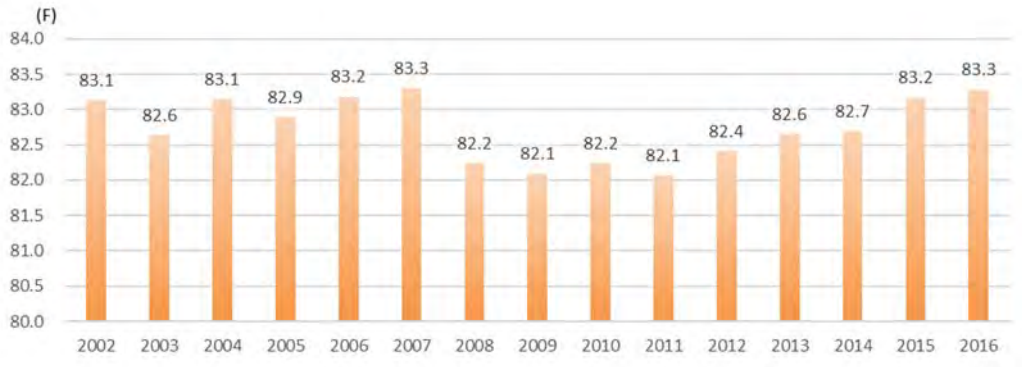
1.2 Natural Conditions

1.2.1 Temperature

The annual averaged temperature for the past 15 years according to the National Centers for Environmental Information (hereinafter referred to as "NCEI") of the National Ocean and Atmospheric Administration (hereinafter referred to as "NOAA") is shown in **Figure 1.1**. The figure shows that the annual average temperature in 2007 and 2016 was 83.3ºF (28.5ºC) and it also shows an increasing trend in temperature from 2011.

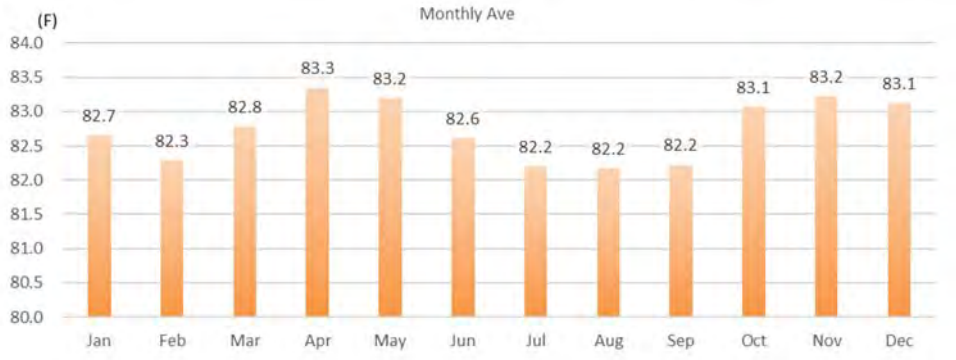
The monthly averaged temperature for the past 15 years is shown in **Figure 1.2**. The figure shows that temperature is high between October and December, April and May and that the difference in temperature through all season is little, which is only 1.1ºF (0.6ºC) deference. The Fahrenheit degree of temperature is converted to Celsius by using the following equation:

$$\text{Celsius (ºC)} = (5 / 9) \times [\text{Fahrenheit (ºF)} - 32]$$



Source: NCEI

Figure 1.1 Annual Averaged Temperature for the Past 15 Years



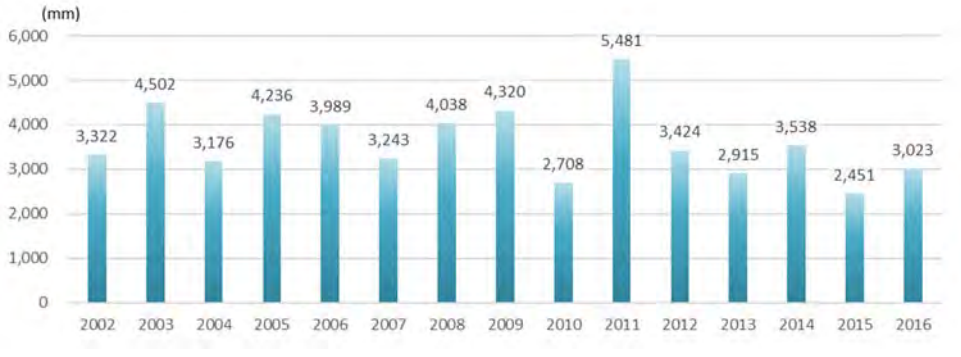
Source: NCEI

Figure 1.2 Monthly Averaged Temperature for the Past 15 Years

1.2.2 Precipitation

The annual averaged precipitation for the past 15 years according to NCEI is shown in **Figure 1.3**. The precipitation was mostly more than 3,000mm for the past 15 years. Within these years, the year of 2011 had the highest amount at 5,481mm.

The monthly averaged precipitation for the past 15 years is shown in **Figure 1.4**. The figure shows that the precipitation tends to be high between June and September and it is highest or more than 400mm per month recorded in June and July. (Note: 1inch = 25.4mm)



Source: NCEI

Figure 1.3 Annual Averaged Precipitation for the Past 15 Years

Source: NCEI

Figure 1.4 Monthly Averaged Precipitation for the Past 15 Years

The maximum daily precipitation in past 15 years is presented in **Table 1.1**. The daily precipitation in 2011 was very high, which was recorded as the maximum annual precipitation and, in particular it was more than 250mm per day on 24th September 2011.

Table 1.1 Maximum Daily Precipitation for the Past 15 Years

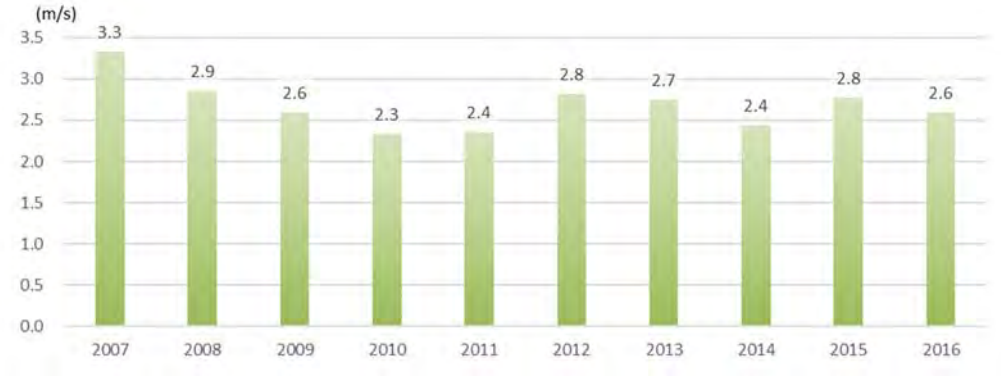
No.	Date	Precipitation
1	September 24, 2011	254.3 mm
2	February 15, 2004	202.9 mm
3	December 5, 2005	192.0 mm
4	January 20, 2006	186.4 mm
5	May 23, 2011	174.8 mm

Source: JICA Survey Team calculated the precipitation by using data of NCEI.

1.2.3 Wind

The annual averaged wind velocity for the past 10 years is shown in **Figure 1.5**. Wind velocity was approximately 3m/s in most of the years, so it is said that it is not windy in Palau.

The monthly average wind velocity for the past 10 years is shown in **Figure 1.6**. It shows that the wind velocity between January and March was more than 3.0m/s; however, there is no windy season.



Source: Weather Underground

Figure 1.5 Annual Averaged Wind Velocity for the Past 10 Years

Source: Weather Underground

Figure 1.6 Monthly Averaged Wind Velocity for the Past 10 Years

There were five (5) days when the maximum instantaneous wind velocity or maximum wind velocity was beyond 120 miles per hour (or 53.6m/s), as shown in **Table 1.2**. The wind velocity of 120 mile per hour (or 53.6m/s) is regarded as the standard value allowable for construction work in Palau.

Table 1.2 Maximum Instantaneous Wind Velocity for the Past 10 Years

No.	Date	Wind Velocity	Remarks
1	September 17, 2014	62.5 m/s	Maximum Instantaneous Wind Velocity
2	March 11, 2015	60.3 m/s	Maximum Instantaneous Wind Velocity
3	January 19, 2012	60.0 m/s	Maximum Instantaneous Wind Velocity
4	August 19, 2016	56.7 m/s	Maximum Wind Velocity
5	October 23, 2008	56.7 m/s	Maximum Wind Velocity

Source: Weather Underground

1.3 Environmental and Social Consideration Study

1.3.1 Project Components Relating to Environment and Social Considerations

The environmental and social considerations necessary for the construction and operation of the waste disposal facility or landfill site are discussed in this Section. An environmental assessment (hereinafter referred to as "EA") is required for any development projects that may affect the surrounding environment and social conditions. Result from EA are submitted to the Environmental Quality Protection Board (hereinafter referred to as "EQPB"). The EQPB examines the EA and judges the necessity of an environmental impact statement (hereinafter referred to as "EIS"). The EA, in this sense, seems to be equivalent to an ordinary initial environmental examination (hereinafter referred to as "IEE") and the EIS is a like environmental impact assessment (hereinafter referred to as "EIA").

1.3.2 Baseline of the Environmental and Social Condition

The proposed landfill site is located in a hilly area of Aimeliik State in Babeldaob Island, the north side from Koror State downtown. The proposed area is considered to be the land that had been used during the period of World War II. Although the site of the former Japanese troops and bullets were found in the ground, currently the area is covered by shrubs with a small number of tall trees. It is a grassland consisting of secondary vegetation. In this section, the baseline of the environment and social situation around the planned project site is presented

North direction view from the site taken by JICA Survey Team

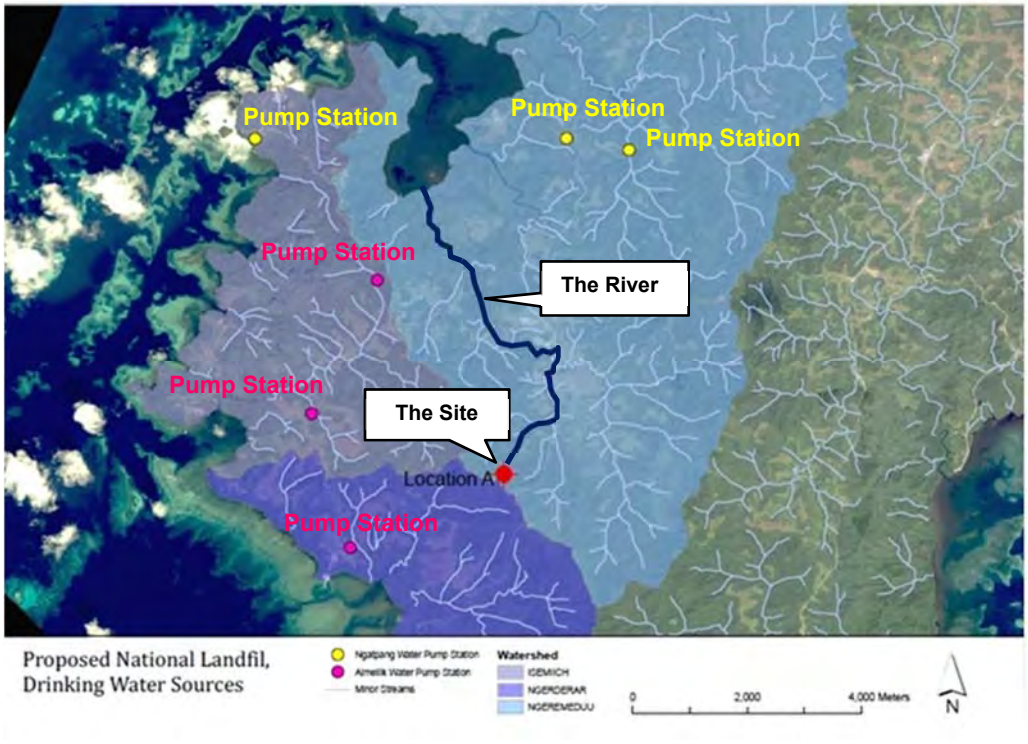
Photo 1.1 Route of Downstream River

mainly based on data and information obtained from literature review and conversation with other stakeholders.

(1) Environmental Condition

(a) Water

The planned site is in a gentle hilly area, and the downstream river flows down the waterway in a jungle northward from the planned site (see **Photo 1.1**), it is a route leading to the Ngeremeduu Bay through the Tabechding River. The river basin is roughly covered with a jungle or a mangrove forest, but there are places that are used as farmland along the main road. The distribution of settlements will be detailed in the social situation later. **Figure 1.7** shows the positional relationship of the proposed landfill site, the downstream river and water intake facilities. The water intake facilities for settlements are located in a water system completely different from the one used for discharging leachate from the landfill site.



Source: BPW
Note: The blue line indicates "River".

Figure 1.7 Location of the Landfill Site, the River and Pump Stations

(b) Biodiversity

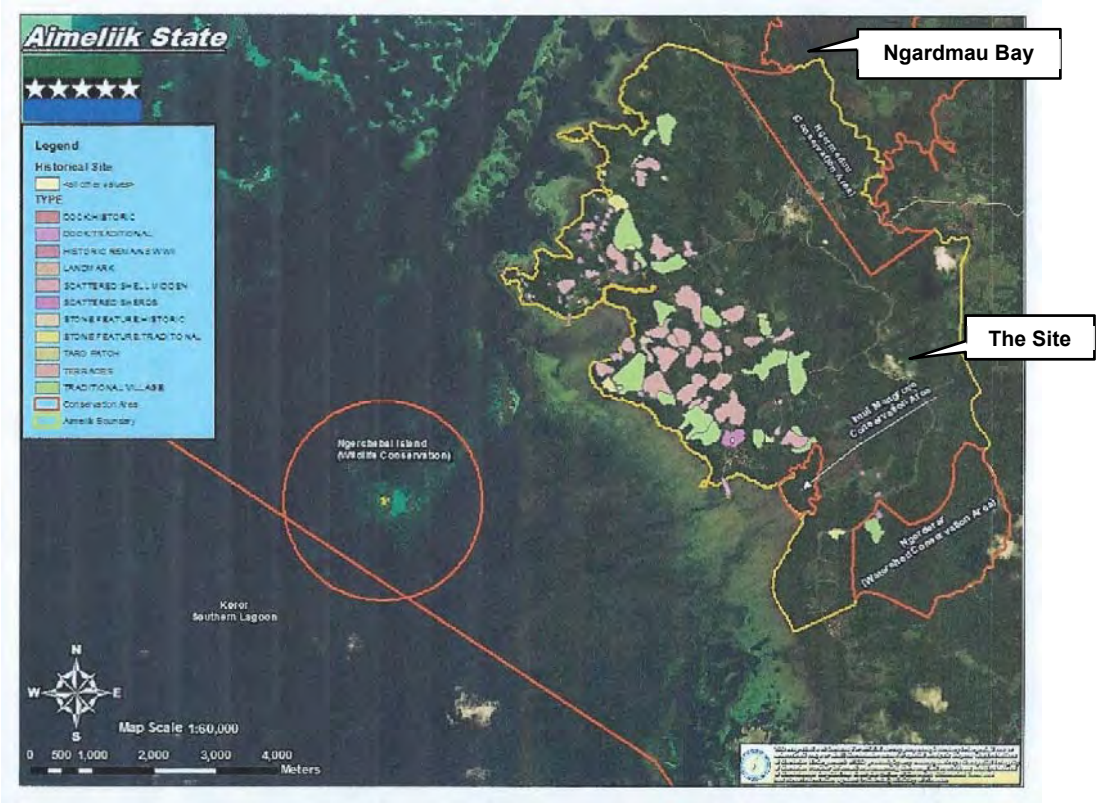
The current situation of the proposed area is a secondary vegetated grassy land with tall trees such as Finschia chloroxantha and Timonius timon, and shrubs like Leucaena leucocephala[1]. It is not included in nature reserves and other development restricted areas. In the ecosystem investigation conducted in 2009 and 2016[2], no higher threatened species in the rank of the International Union for Conservation Nature (hereinafter referred to as "IUCN") Red List[3] inhabit the proposed area.

[1] The Environmental Inc., *Environmental Impact Statement for Proposed National Landfill*, March 2017, pp.30-31.
[2] ditto, p. 44.
[3] International Union for Conservation Nature (IUCN), *The IUCN Red List of Threatened Species*, 2017-3, (http://www.iucnredlist.org/)

(c) Environmental Conservation Area

Figure 1.8 shows the designation of the environmental preservation district acquired locally. According to this, the planned area is not a designated area such as an environmental preservation area and a historical district.

There are several environmental conservation areas near the proposed site. Also, in the section from the most downstream part of the Tabechding River, which is the planned subsurface drainage basin to the Ngeremeduu Bay, the Bay and the vicinity of the estuary are designated as conservation areas.



Source: Bureau of Arts & Culture
Legend: Yellow Line: State Boarder, Red Line: Conservation Area

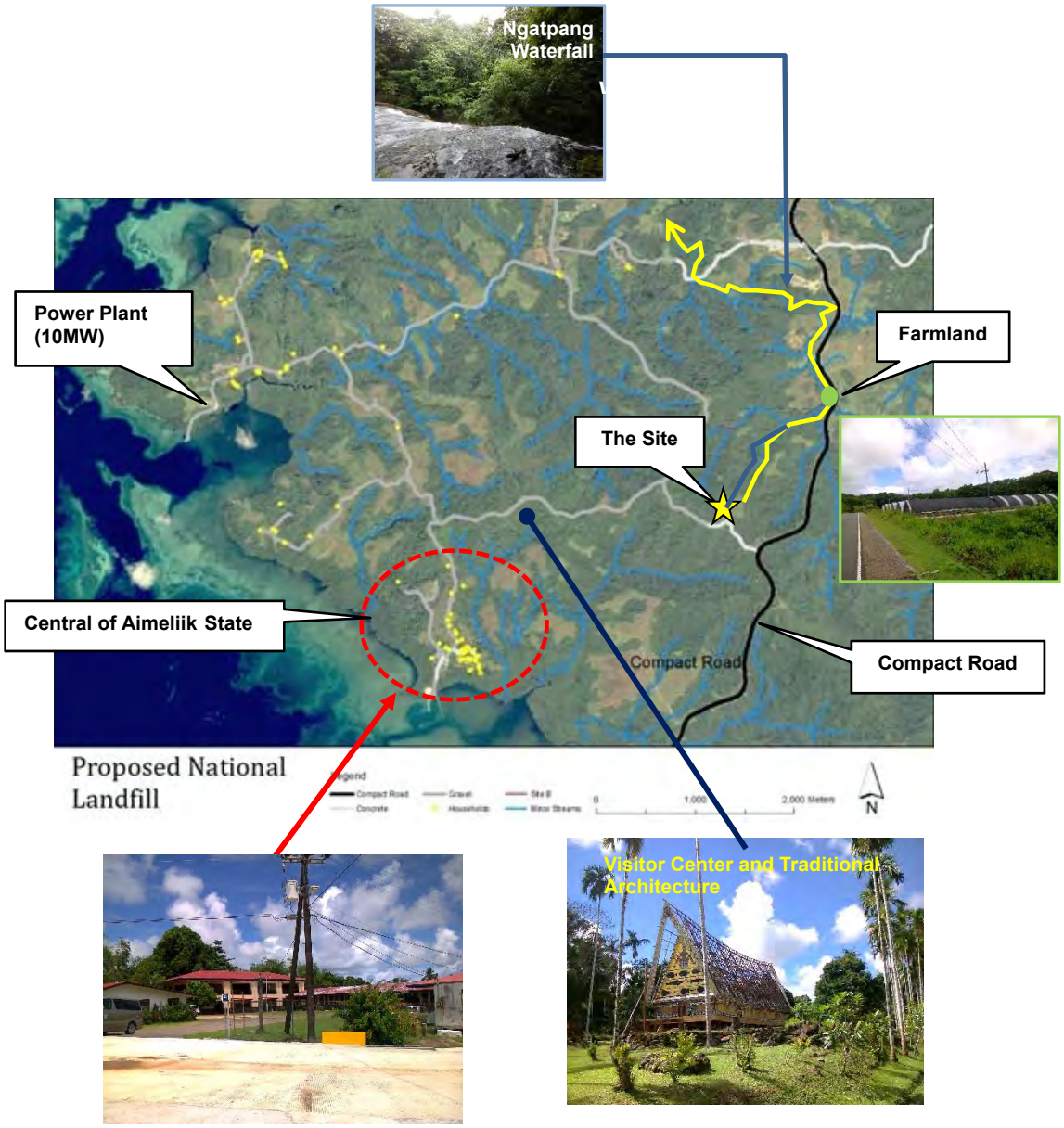
Figure 1.8 Location of the Conservation Area around Aimeliik State

(2) Social Condition

Aimeliik State including the proposed area is a state located on the south side of Babeldaob Island, with a population of 327 as of 2015[4]. While most of the State is a forested area and there are small farms where fruits etc. are cultivated here and there, there are no large establishments other than power plants (total of 10MW diesel generator type). The state has places where traditional buildings and villages are preserved, and the Visitor Center is located about 1.5km from the planned site. The Center of the state with state buildings etc. is about 2km away from the planned site (see **Figure 1.9** below).

Along the river flowing downstream just from the planning site, two farmlands along the main road and a waterfall called Ngatpang Waterfall were identified. Other residences, facilities, etc. are not confirmed along the river course.

[4] Bureau of Budget & Planning, Republic of Palau, *Census of Population and Housing*, April 13, 2015.



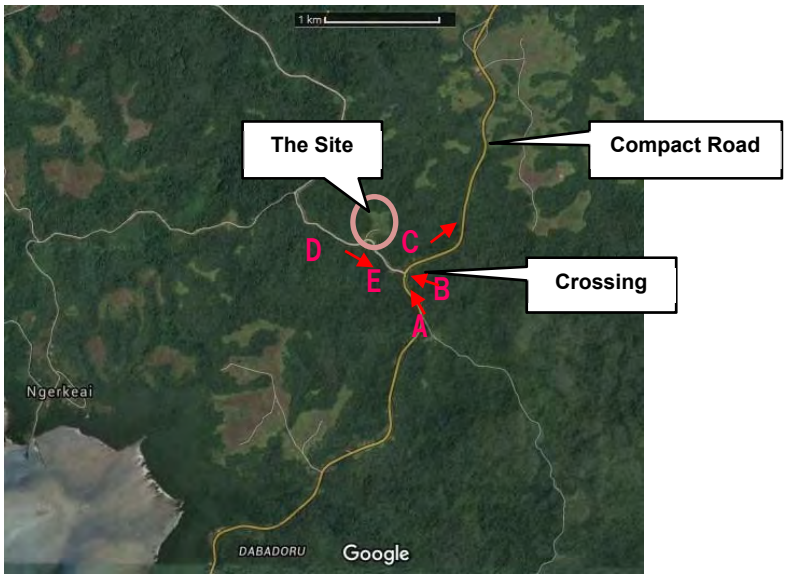
Source: BPW, Photo: JICA Survey Team

Figure 1.9 Location Map of the Proposed Site (Star mark), River (Yellow), Facilities (Yellow Points)

(3) Traffic

There is a main road called Compact Road which was constructed with support from United States Aid. The road is maintained in a good condition and it is about 30 minutes' drive from Koror State. On the other hand, roads in the settlements deviating from the main road are still not paved. Pavement work is currently taking place in various places.

Although the planned site is located at a branch from the main road, the intersection is maintained after consideration of lanes and linearity, and the road to the planning site is paved by concrete and is in a relatively good condition (see **Figure 1.10**). However, caution is required for passage of large vehicles since the width of the road near the planning site is narrow and steep. Traffic volume has been observed to be relatively small, and at present it is not expected that exhaust gas, noise and vibration due to vehicle traffic may interfere with the living environment.



View at the crossing from Compact Road to the Site (Photos: JICA Survey Team, May 2017)

View of the road conditions near at the Site (Photos: JICA Survey Team, May 2017)

Figure 1.10 Current Condition of the Crossing from the Compact Road to the Site

(4) Historical Heritage

Japanese firearm gun pedestals used in the World War II were identified in the proposed site. Prior to the commencement of the project, the Historic Office of Palau will investigate this in accordance with the laws of Palau and take measures properly, such as relocation of the pedestals to the museum, etc. There are no cultural assets affected by the project and no residential areas near the project site.

1.3.3 Organizations and Regulations regarding Environmental and Social Considerations

In Palau, the EQPB is responsible for EIS and the process of EIS is defined by the EQPB Regulations, Chapter 2401-61 Environmental Impact Statement Regulations.

(1) Environmental Impact Assessment

(a) Projects Subject to Environmental Impact Assessment

Except as otherwise provided, an EIA or EIS shall be required for any actions which propose the following:

- The use of national or state lands;
- The use of national or state funds, unless the funds are to be used for:
  - Feasibility or planning studies for possible future programs or projects which the applicant has not yet approved, adopted, or funded, provided however, that the applicant shall specifically consider environmental factors and available alternatives in its feasibility or planning studies, or;
  - The acquisition of unimproved real property.
- Any use within any land which has been or may be classified as conservation district by the Republic or one of its state's land use commissions;
- Any use directly or indirectly impacting "coastal waters" and "wetlands" as defined in the Republic of Palau Marine and Fresh Water Quality Regulations;
- Any use within any historic site as designated by the Palau Historic Preservation Office; and
- Any proposed action which the Board determines may have a significant impact on the environment.

(b) Procedures of EIS

Processes of the EIS on the Project have been conducted under initiative of Palauan National Government. According to the EQPB Regulations, the EIS process is generally shown below.

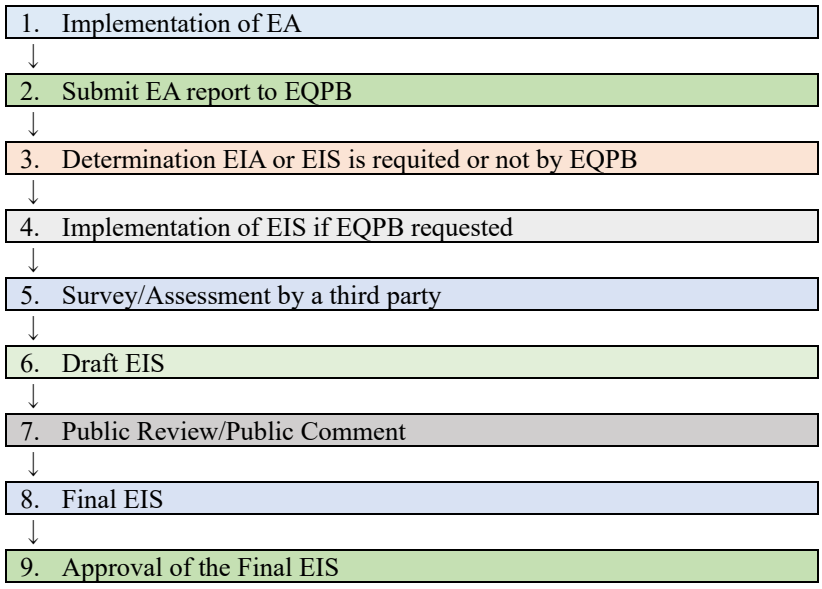


Figure 1.11 EIS Procedures in Palau

(c) Approval Agency of EA/EIS

The EA/EIS is approved by the EQPB.

(d) Registered Research Agencies on EA/EIS

The EIS's research agency will be appointed from those previously registered in the EQPB. A list of registrants as of May 2016 provided by EQPB is presented as follows:

Table 1.3 List of Registered Research Agencies on EA/EIS

No.	Name of Agencies	Contact
1.	The Environment Inc.	P.O. Box 1696 Tel: (680) 587-3451 Email: kitalong@palaunet.com
2.	Melekau Environmental	P.O. Box 6064 Tel: (680) 488-5825 Fax: (680) 488-4650 Email: jon@melekau.com
3.	NECO Environmental Consulting Services	NECO Marine P.O. Box 129 Tel: (680)488-1755/2009 Fax: (680)488-5245 Email: je_basco@yahoo.com
4.	PlanPoin	732 Iyebukel Road Mechebechubel, Ngadpang Tel: (680)535-0009 Mobile: (680)775-0009 Email: lee@surangel.com
5.	Theofanes Isamu	Tel: (680) 488-5352
6.	Marhence Madranchar	Tel: (680) 488-1744
7.	Sith Consultancy	Email: gsisior07@gmail.com

(e) Contents of EA/EIS Report

Contents of EA/EIS report is summarized as shown in **Table 1.4**.

Table 1.4 Contents of EA/EIS Report (EIS Regulation 2401-61-05, 12 and 13)

Item	Content Requirements
EA	1. Identification of applicant 2. Identification of agencies and organizations consulted in making assessment 3. General description of the action's technical, economic, social, and environmental characteristics 4. Summary description of the affected environment, including suitable and adequate location and site maps 5. Identification and summary of major impacts and alternatives considered, if any 6. Proposed mitigation measures, if any
Draft EIS	1. Summary Sheet (1) Brief description of the action (2) Significant beneficial and adverse impacts (3) Proposed mitigation measures (4) Alternatives considered (5) Unresolved issues (6) Compatibility with land use plans and policies, and listing of permits or approvals 2. EIS Report (1) Table of Contents (2) Statement of purpose and need for action (3) Project description (a) A detailed map (preferably United States Geological Survey topographic map) and related regional map (b) Statement of objectives (c) General description of the action's technical, economic, social, and environmental characteristics (d) Use of public funds or lands for the action (e) Phasing and timing of action (f) Summary technical data, diagrams, and other information necessary to permit an evaluation of potential environmental impact by commenting agencies and the public (g) Historic perspective (4) Any known alternatives for the action (5) Description of environmental setting, including a description of the environment in the

Item	Content Requirements
	vicinity of the action, from both a local and regional perspective (6) Statement of the relationship of the proposed action to land use plans, policies, and controls for the affected area on both the national and state government levels as well as land policies and land uses under traditional Palauan law (7) Statement of the probable impact of the proposed action on the environment (8) Relationship between local short term uses of the environment and the maintenance and enhancement of long-term productivity (9) All irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented (10) All probable adverse environmental effects which cannot be avoided (11) Mitigation measures proposed to minimize impact. (12) Summary of unresolved issues and either a discussion of how such issues will be resolved prior to commencement of the action, or what overriding reasons there are for proceeding without resolving the problems (13) List identifying all governmental agencies, other organizations and private individuals consulted in preparing the statement, and the identity of the persons, firms, or agencies preparing the statement, by contract or other authorization, shall be disclosed (14) Reproductions of all substantive comments and responses made during the consultation process
Final EIS	1. The draft environmental impact statement or a revision of the draft 2. Comments and recommendations received on the draft environmental impact statement either verbatim or in summary 3. A list of persons, organizations and public agencies commenting on the draft environmental impact statement 4. The responses of the applicant to significant environmental points raised in the review and consultation process

(2) National Regulations related to EIA

Table 1.5 shows those related to the plan within the legal system based on the Palau EQPB Regulations (2401).

Table 1.5 National Legal System in accordance with EQPB Regulations (2401)

Chapter	Title of Regulation
2401- 1	Earthmoving Regulations
2401-11	Marine and Fresh Water Quality Regulations
2401-13	Toilet Facilities and Wastewater Disposal Systems Regulations
2401-31	Solid Waste Management Regulations
2401-61	Environmental Impact Statement Regulations
2401-71	Air Pollution Control Regulations

(a) Air Quality

(i) Air Quality Standards

The environmental standards on Air Quality are specified by EQPB Regulations 2401-71-05 as presented in **Table 1.6**.

Table 1.6 Air Quality Standards (EQPB Regulations 2401-71-05)

Pollutants	Standards	Remarks
Sulfur Oxides	60 μg/m^3 (0.02ppm)	Annual arithmetic mean
	365μg/m^3 (0.12ppm)b	Maximum 24-hour concentration no to be exceeded more than once a year.

Pollutants	Standards	Remarks
	1,300μg/m^3 (0.5ppm)e	Maximum 1-hour concentration not to be exceeded more than once a year.
	650μg/m^3 (0.25ppm)	Maximum 4-hour concentration not to be exceeded more than once a year.
Particulate Matter	60μg/m^3	Annual geometric mean
	150μg/m^3	Maximum 24-hour concentration no to be exceeded more than once a year.
	360μg/m^3	Maximum 8-hour concentration not be exceeded more than once a year.
Carbon Monoxide	10μg/m^3 (9ppm)	Maximum 8-hour concentration not be exceeded more than once a year.
	40μg/m^3 (35ppm)e	Maximum 1-hour concentration not to be exceeded more than once a year
Photochemical Oxidants	160μg /m^3 (0.08ppm)	Maximum 1-hour concentration not to be exceeded more than once a year
Hydrocarbon	160μg /m^3 (0.24ppm)	Maximum 3-hour concentration not to be exceeded more than once a year.
Nitrogen Oxides	160μg /m^3 (0.05ppm)	Maximum 24-hour concentration no to be exceeded more than once a year.

(ii) Regulations at Pollution Source

The air quality is regulated at source in accordance with EQPB Regulations 2401-71 as shown in **Table 1.7**. In terms of dusts and odor generated by construction work, it is regulated to avoid the generation at source.

Table 1.7 Standards for Prevention of Air Pollution

Chapter	Descriptions
2401-71-32 to 39	Control of Fugitive Dust
2401-71-40	Control of Open Burning
2401-71-46	Control of Particulate Emission Process weight rate in tons per hour E: Emissions in pounds per hour, P: Process weight rate in tons per hour $E=3.59P^{0.62}$ P<30 t/h $E=17.31P^{0.16}$ P>30 t/h
2401-71-46	Control of Particulate Emission from Incinerator: Design and Operation Y: Allowable rate of emission in pounds per million BTU's X: Operating rate in million BTU's per hour Y=1.02X-0.231 BTU: British Thermal Unit
2401-71-49	Standards for Incinerators Particulate matter in the exhaust gases: 0.2 Pounds per 100 pounds
2401-71-52	Control of Visible Emissions of Particulates for Stationary Sources Equal to or darker than that designated as No. 1 on the Ringlemann Chart of 20 percent opacity Up to more than 3 minutes in any 60 minutes, air contaminants of a shade of density darker than No. 3 on the Ringlemann Chart, or 60 percent opacity
2401-71-53	Control of Odors in Clean Air

Chapter	Descriptions
2401-71-55	Control of Sulfur Dioxide Emissions Sulfur content in Fuel: 3.14% at any time, 2.84% average over the immediate past twelve month

Source: EQPB Regulations

(b) Water Quality

The water quality environmental standards are stipulated in **Table 1.8** and **Table 1.9** by EQPB Regulations 2401-11.E According to the interview from the EQPB, natural water Class 1 is applied to the downstream river. In Palau's legal system, no wastewater standards are established, but in EQPB Regulations 2401-11-20 (E), for wastewater, the treatment is required for not only the water beneath the discharge point but also the downstream water area taking into consideration the protection of these areas.

Table 1.8 Water Use Classification

A) Coastal Water Uses

Class	Descriptions
Class AA	The uses to be protected in this class of water are oceanographic research, the support and propagation of shellfish and other marine life, conservation of coral reefs and wilderness areas, compatible recreation and other aesthetic enjoyment.
Class A	The uses to be protected in this class of waters are recreational (including fishing, swimming, bathing, and other water contact sports), aesthetic enjoyment, and the support and propagation of aquatic life.
Class B	The uses to be protected in this class of waters are small boat harbors, commercial and industrial shipping, bait fishing, compatible recreation, over-water commercial or residential structures for recreational or domestic use, the support and propagation of aquatic life, and aesthetic enjoyment.

B) Fresh Water Uses

Class	Descriptions
Class 1	The uses to be protected in this class of waters are drinking water supply, food processing, the support and propagation of aquatic life, and compatible recreation.
Class 2	The uses to be protected in this class of waters are bathing, swimming, the support and propagation of aquatic life, compatible recreation, and agricultural water supply.

C) Groundwater

Class	Descriptions
Class I	Special Groundwater are those that are highly vulnerable to contamination
Class II	Current and potential sources of drinking water and waters having other beneficial uses and all other groundwater that are currently used or are potentially available for drinking water or other beneficial use.
Class III	Groundwater not considered potential sources of drinking water and of limited beneficial uses are groundwater that are heavily saline

Table 1.9 Environmental Water Quality Standards

D) Microbiological Standards

Regulation	Class
The median total or fecal coliform bacteria count shall not exceed 70/100ml for any 10 consecutive samples nor shall any single sample exceed 230/100 ml.	AA and 1
Fecal Coliform count shall not exceed a geometric mean of 200/100ml for any 10 consecutive samples nor shall any single sample exceed 400/100 ml.	A, B and 2
Enterococci count shall not exceed a geometric mean of 33/100ml for any 5 samples in a given 30-day period nor shall any single sample shall exceed 60/100ml.	AA and A
In areas where shellfish are harvested for human consumption, the micro-biological standards for Class AA and 1 Waters shall apply.	A, B and 2

E) pH

Regulation	Class
7.7 – 8.5	AA, A and B
6.5 – 8.5: pH variation shall not be greater than 0.2 pH units from natural	1
6.5 – 8.5: pH variation shall not be greater than 0.5 pH units from natural conditions	2

F) Nutrient Material

Regulation		Class
T-N: T-P Ratio	11.1 – 27.1	AA and A
	6.1 – 18.1	B
	10% variation of the naturally occurring ratio	1 and 2
The concentration of total nitrogen and total phosphorus shall not vary by more than 10% from the natural conditions.		All waters
T-P (Except for concentrations attributable to natural causes nutrient concentration shall not exceed.)	0.025mg-P/L	AA and A
	0.500mg-P/L	B
	0.200mg-P/L	1 and 2
	0.050mg-P/L	Fresh Waters entering lakes or reservoirs (at a point of entry) and lakes and reservoirs
T-N (Except for concentrations attributable to natural causes nutrient concentration shall not exceed.)	0.400mg-N/L	AA and A
	0.800mg-N/L	B
	0.750mg-N/L	1
	0.500mg-N/L	2

G) Dissolved Oxygen (DO)

Regulation		Class
Dissolved oxygen concentrations shall not vary by more than 25% from natural conditions.		All waters
DO (Except for concentrations attributable to natural causes nutrient concentration shall not exceed.)	6.0mg/L 75%	AA and 1
	5.0mg/L	A and 2
	4.5mg/L	B

H) Total Dissolved Solids (TDS), Salinity, Currents

Regulation	Class
10% from natural conditions or change in salinity outside the range of 29-35 parts per thousand or which would otherwise adversely affect the indigenous biota and natural sedimentary patterns.	All waters

I) Temperature

Regulation	Class
Temperature shall not vary by more than 1.5-degree Fahrenheit (0.9 degree Celsius) from the natural conditions in marine and fresh waters.	All waters

J) Turbidity

Regulation		Class
Turbidity	1 NTU	AA and A
	2NTU	B
Greater than 5% above natural conditions		1
Greater than 10% above natural conditions		2

K) Radioactive Materials

Regulation	Class
The concentration of radioactive materials in water shall not exceed 1/30th of the maximum permissible limits established for continuous occupational exposure given in the latest edition of the U.S. standards[5].	All waters
No radionuclides shall be present in amounts that would exceed the maximum permissible levels established in the Republic of Palau Public Water Supply Regulations.	All waters
The concentration of radioactive materials in water shall not result in the accumulation of radioactivity in plants or animals that would result in a hazard to humans or aquatic life	All waters

L) Oil and Petroleum Products

Regulation	Class
Be detectable as a visible film sheen or discoloration of the surface or cause an objectionable odor.	All waters
Cause tainting of fish or other aquatic life, be injurious to the indigenous biota, or cause an objectionable taste in drinking water	All waters
Form an oil deposit on beaches or shorelines or on the bottom of a body of water.	All waters

M) Toxic Substances

Some 126 chemical substances are defined for toxic substances, and chronic toxicity to aquatic organisms and criteria for human health protection are stipulated. Among these, the reference values of heavy metals etc. are listed in **Table 1.10**.

[5] The latest edition of the U.S. National Bureau of Standards Handbook No. 69.

Table 1.10 Standards for Heavy Metals

unit: μg/L

Substances	Chronic Aquatic Life Criteria (Instantaneous Maximum)		Human Health Criteria (30 Day Average)	
	Fresh Waters	Marine Waters	Fresh Waters	Marine Waters
Cd	1.1	9.3	10	-
Cr	11	50	50	-
CN	5.2	1.0	200	-
Pb	3.2	5.6	50	-
Hg	0.012	0.025	0.14	0.15
Zn	110	86	5000	-

N）Toilet Facilities and Wastewater Disposal Systems Regulations

In EQPB Regulations 2401-13, requirements for general toilets and wastewater treatment facilities are stipulated. Since this regulation is a presumption assuming wastewater discharge from general households, hotels, commercial facilities and the like, and it is not mentioned that wastewater/leachate treatment on waste treatment is applied, it is not appropriate to apply it as it is. However, it is a great reference to knowing Palauan ideas on wastewater treatment. Regarding the leachate treatment facility, it is stipulated that waste management regulation 2401-31-17 of the EQPB Regulations requires application to EQPB to obtain permission, and careful consultation with EQPB in the design of leachate treatment facility. The provision of points for leachate treatment facility planning and design are organized as shown in **Table 1.11**.

Table 1.11 Toilet Facilities and Wastewater Disposal Systems Regulations

Chapter	Descriptions
2401-13-04	All public and commercial residences, buildings and structures and all private residences, buildings and structures shall have toilet facilities and wastewater systems as described in these regulations.
2401-13-10	No building construction, public or private, may commence without first obtaining a permit from the Board certifying.
2401-13-11	Plans and specifications shall contain the following as a minimum: (A) Vicinity Map (B) Plot Plan (C) Description of the complete installation (D) Regardless of the type of disposal system applied for (E) Design calculation of the proposed private wastewater disposal system is required, and the design must be done by a licensed specialty contractor or registered professional engineer. (F) Percolation and water table tests for private wastewater disposal systems
2401-13-13 to 2401-13-27	Standards on the structure of the facility, guidelines for setting sizes such as domestic wastewater treatment (sludge tank, trench etc.) are set.
2401-31-17	The disposal of solid waste in mangroves areas, or other areas subject to flooding or leachate generation shall be allowed only in conjunction with special procedures approved by the Board.

(3) Strategic Environmental Assessment (SEA)

Strategic Environmental Assessment has not been institutionalized in Palau.

1.3.4 Comparison with Alternatives including Zero Option

(1) Comparison with Alternatives

After many twists and turns, a plan for the new landfill construction has been decided to be the current location plan, and many studies have also been conducted so far. The outline of the process is summarized as follows:

- The M-Dock Landfill (area about 5ha) managed by the central government has been inappropriate landfill management for decades since the 1950s, and because it is adjacent to the city area of the capital, complaints have been received from surrounding residents and commercial facilities, additionally tourism, which is an important industry as a national finance source, also had negative influences such as deterioration of landscape and damage of the scenery. In addition, since there was no prospect of construction of a new landfill site, there were no options other than continuing to use the existing disposal site, but there was concern about future landfill capacity due to increased amounts of waste.
- Under these circumstances, the Palau government independently entrusted consultants in the United States to evaluate the environmental impact of the site where the disposal site is located, and in 2003 requested grant aid including construction of new disposal sites and intermediate treatment facilities (20 billion-yen scale) to the Japanese government. However, as a result of consultation with the Japanese side, from the viewpoint of vulnerability of technical infrastructure and sustainability of operation and management, the request for a grant aid was changed to a request for technical cooperation, and this was adopted in 2004.
- Based on the request from the Palauan side for new technical cooperation, JICA implemented a waste management improvement project (technical cooperation project) from 2005 to 2008 and improved the M-Dock repository to semi-aerobic sanitary landfill. While the lifetime of the M -Dock repository at this point was estimated to be 4 to 5 years, the construction of a new landfill was urgently required in the national waste management plan formulated as a part of the activities of the project. However, the site for the disposal site could not be secured and was changed again and again.
- After that, in J-PRISM (Phase 1: 2011-2015) which is a technical cooperation project implemented by JICA, expansion of the embankment was conducted in 2013 due to the burden of Palauan side to extend the lifespan and expand the landfill capacity. Other efforts to improve the maintenance technology of M-Dock were conducted. In parallel with such activities, construction plans for new disposal sites were continuously examined.
- In order to overcome this situation, a task force was set up to discuss new disposal sites in August 2013 by the presidential decree, the candidate sites for the new disposal site were examined mainly by Governors and the Bureau of Public Works (hereinafter referred to as “BPW”). As the result, the Aimeliik State Governor and the central government side agreed to establish a national landfill site in Aimeliik State.
- The Palauan government requested Japan for technical and financial support relating to the construction of a new landfill site in 2014-2015.
- The Palauan government contracted out a survey on the basic design and environmental impact assessment of the new landfill site for the two candidate sites in Aimeliiik State using financial assistance from Taiwan.

In the above examination process, both "a plan to build a landfill in each state or in a block comprising some states" and "a plan to establish a single national level landfill" were compared. Also, the proposed location of the disposal site was selected as the current candidate site after considering multiple candidate sites. Although the strategic environmental assessment is not institutionalized in Palau, as far as the above process is concerned, discussion on site selection was

made at the planning stage. It is thought that it is effective to review this process and summarize the result of multiple alternative study examination.

Based on the survey conducted by the Palauan side, a comparative study on two places in Aimeliik State and its outcomes of the study is summarized in **Table 1.12**.

In the zero option, since there is a limit to the processing of solid waste at the current M-Dock Landfill, no disposal site will be placed around the center of the country as well as dense areas of Palau in the nearest future. Moreover, if the alternative place cannot be secured, illegal dumping site will come out not only in Koror State but also in other states in Palau. Additionally, it would not be appropriate to continue the state level disposal sites of the current states of Babeldaob Island. Considering these issues, the zero option will result in a serious effect on solid waste management in Palau as a whole, and consequently there is certain validity in Palau's judgment that this should absolutely be avoided. To properly implement the long-term maintenance and management of the landfill site, it is understood that the option of a single disposal site managed under the initiative of the National Government or BPW would be better than construction of disposal sites dispersed in state or block units from an economic, technical and environmental view point. This is because know-how of past technical cooperation projects and experience with technology transfer has accumulated in the government or BPW. That is, in Palau, the current candidate site is determined taking into consideration the size of the degree of influence on the environment and the cost of construction etc. on the location side.

Table 1.12 Results of Comparison with Landfill Site Alternatives in the Planning Stage

Option	Evaluation
Zero Option	Since there is no final disposal site of a comprehensive size other than the M-Dock Landfill, it is difficult to receive in-coming garbage after the Landfill is full and will seriously affect waste management of Palau. In addition, no improvement will be carried out for the current inappropriate dumpsites in each state other than Koror State. As a result, the nationwide waste problem becomes more serious. The M-Dock Landfill is hardly expanded on a large scale and therefore its capacity is limited.
The option to construct landfill sites in each state or block (combining some of states)	Even if a landfill site is built in each state, the problem will be long-term maintenance and management. The reasons are as follows: To allocate the lowest level of facilities and equipment etc. at each site, the total number of heavy machinery required will increase; that is, it is disadvantageous in cost. In addition, it is necessary to place management staff at each dumpsite, causing concern about securing human resources. In order to manage state level disposal sites by the state government, it is difficult for human resources development and staffing at the current state government level. Also, the burden of equipment management and heavy machinery fuels etc. will be borne by the state where the disposal site is operated. If the state government manages the landfill site, in conclusion, it will be impossible to maintain and manage the site properly, and there is a high possibility that it will be a hindrance on the environment.
The option to construct a national landfill site	The BPW of the national institution has accumulated experiences and implementation of technical cooperation projects in the long term and has the know-how of maintenance and management of the repository. Also, the financial basis of the recycling fund is relatively well-established. This option will be to concentrate on investment for one place of the landfill site, and it will bring to efficient and intensive management of the site. It will therefore result in higher environmental and safety circumstances. It is efficient to use heavy machinery at one disposal site and secure it. Because BPW, a national organization, has experience, it is most likely to secure maintenance personnel and to ensure long-term maintenance and management of the site

Source: Discussion result of the Task Force Meeting

In terms of selection of the landfill site, various places in Palau were examined. Although there are several candidate sites, the selection process was quite difficult because severe construction due to

natural conditions can be foreseen, or political understanding could not be gained. Eventually land secured in a place that is not in conservation areas was selected in Aimeliik State since political understanding of the Governor and others was obtained. **Table 1.13** outlines the reasons for its selection.

According to the Environmental Assessment Survey conducted by BPW using a Taiwan fund in 2016, two candidate sites in Aimeliik State were studied. As a result of the Survey, there was a significant difference between the landfill capacity that can be secured, the area of deforestation, the construction of roads to be introduced, and the accessibility from arterial roads, etc. It also showed that there was superiority in the current candidate site. **Table 1.14** presents the results of the items with significant differences between the two candidate sites in Aimeliik State.

Table 1.13 Discussions during the Selection Process of the New Landfill Site

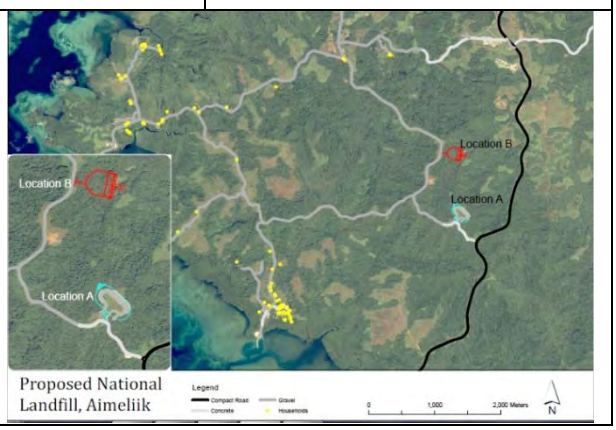
Options		Evaluation results on the siting process
	**A.** Ngatpang State	There were many rivers, wetlands, mangrove forests, coastal areas in the State, and it was judged not to be suitable for construction because there are multiple places designated as environmental conservation areas.
	B. Ngchesar State	It was abandoned because a political agreement could not be made.
	C. Airai State	There were two or more places designated as environmental conservation areas in the province, and it was also taken into consideration as a suitable place for disposal, considering the fact that suitable sites could not be found and that there were publicly important airports in the State.
	D. Aimeliik State	Two candidate sites were selected and examined in the state. The candidate site could be secured outside the environmental conservation area and was selected as a candidate site because the political environment such as the agreement to the construction was agreed between the State Governor and BPW.
	Other Four (4) States in Babeldaob	Since the states other than the above four states are located somewhat to the north side of Babeldaob Island, transportation efficiency from Koror State and Airai State, which has relatively large population, is low, so it was excluded as a candidate site.

Source: Interview from BPW

Table 1.14 Result of Environmental Assessment for Comparison with Two Candidate Sites in Aimeliik State

Item for Comparison	Option A (Location A)	Option B (Location B)
Landfill Capacity	200,000m^3 *	142,000m^3 **
Life Span	20 years *	10 years **
Area of Forest in the Developed Area	1,584.6m^2	5,702m^2
Road condition between the Compact Road and the site	Paved	1.8km of pavement is needed
Distance between the Compact Road and the Site	430m	2,130m

Note:
* Values predicted by this survey
**Values in Environmental Impact Statement for the Proposed National Landfill



Source: Environmental Impact Statement for the Proposed National Landfill

(2) JICA Guidelines for Environmental and Social Considerations

JICA guidelines for environmental and social considerations and World Bank Safeguard Policy are shown below. The EIA is required to be conducted in accordance with these guidelines.

Table 1.15 Requirements for EIA Report by JICA Guidelines, World Bank and EQPB Regulations

Contents	Item	JICA Guidelines for Environmental and Social Considerations	World Bank Safeguard Policy	EQPB Regulations 2401-61	Gaps
Principles of EIA Report	Compliance with Domestic Laws	When assessment procedures already exist in host countries, and projects are subject to such procedures, project proponents etc. must officially finish those procedures and obtain the approval of the government of the host country.	(Same with the left column)	EQPB Regulations 2401-61 covers the items indicated in the left columns.	No gap
	Language	EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.	(Same with the left column)	EQPB Regulations 2401-61-14 stipulates “preparers shall make every effort to convey the required information succinctly in a form easily understood”.	No gap
	Disclosure	EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	For a Category A project, the borrower makes the draft EA report available at a public place accessible to project-affected groups and local NGOs.	The information disclosure process is included in EQPB Regulations 2401-61-17.	No gap
Principles of EIA Report	Consultation	In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared.	Consultation with stakeholders and public information disclosure should be conducted.	Public hearing must be organized in accordance with EQPB Regulations 2401-61-17.	No Gap
	Time of Consultation	Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared	For all Category A and B projects, the borrower initiates consultations with project-affected groups and local NGOs about the project's environmental aspects and takes their views into account as early as possible.	EQPB Regulations 2401-61-09 and 2401-61-17 stipulates Public Consultation and Disclosure Process.	No Gap

Contents	Item	JICA Guidelines for Environmental and Social Considerations	World Bank Safeguard Policy	EQPB Regulations 2401-61	Gaps
Contents of EIA Report	Executive Summary	This concisely discusses significant findings and recommended actions.	Concisely discusses significant findings and recommended actions.	EQPB Regulations 2401-61-12 covers the items indicated in the left columns.	No gap.
Contents of EIA Report	Policy, Legal, and Administrative Framework	The EIA report describes policy, legal and administrative framework when a project is carried out.	Discusses the policy, legal, and administrative framework within which the EA is carried out. Explains the environmental requirements of any co-financers. Identifies relevant international environmental agreements to which the country is a party.	EQPB Regulations 2401-61-12 covers the items indicated in the left columns.	No gap
	Project description	This describes the proposed project and its geographic, ecological, social and temporal context, including any off-site investments that may be required (e.g. dedicated pipelines, access roads, power plants, water supply, housing, or raw material and product storage facilities). It also indicates the need for any resettlement or social development plan. It normally includes a map showing the project site and the area affected by the project.	Concisely describes the proposed project and its geographic, ecological, social, and temporal context, including any offsite investments that may be required (e.g., dedicated pipelines, access roads, power plants, water supply, housing, and raw material and product storage facilities). Indicates the need for any resettlement plan or indigenous people's development plan. Normally includes a map showing the project site and the project's area of influence.	EQPB Regulations 2401-61-12 covers the items indicated in the left columns.	No gap
Contents of EIA Report	Baseline Data	This assesses the dimensions of the study area and describes relevant physical, biological, and socio-economic conditions, including all changes anticipated to occur before the project commences. Additionally, it considers current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project site, design, operation, or mitigation measures, and it is necessary to indicate the accuracy, reliability, and sources of the data.	Assesses the dimensions of the study area and describes relevant physical, biological, and socioeconomic conditions, including any changes anticipated before the project commences. Also considers current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project location, design, operation, or mitigatory measures. The section indicates the accuracy, reliability, and sources of the data.	EQPB Regulations 2401-61-12 covers he items indicated in the left columns.	No gap

Contents	Item	JICA Guidelines for Environmental and Social Considerations	World Bank Safeguard Policy	EQPB Regulations 2401-61	Gaps
	Environmental Impacts	This predicts and assesses the project's likely positive and negative impacts in quantitative terms, to the extent possible. It identifies mitigation measures and any negative environmental impacts that cannot be mitigated and explores opportunities for environmental enhancement. It identifies and estimates the extent and quality of available data, essential data gaps and uncertainties associated with predictions, and it specifies topics that do not require further attention.	Predicts and assesses the project's likely positive and negative impacts, in quantitative terms to the extent possible. Identifies mitigation measures and any residual negative impacts that cannot be mitigated. Explores opportunities for environmental enhancement. Identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specifies topics that do not require further attention.	EQPB Regulations 2401-61-12(l) covers he items indicated in the left columns.	No gap
	Analysis of alternatives	This systematically compares feasible alternatives to the proposed project site, technology, design, and operation including the "without project" situation in terms of the following: the potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, it quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. It also states the basis for selecting the particular proposed project design and offers justification for recommended emission levels and approaches to pollution prevention and abatement.	Systematically compares feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. States the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.	EQPB Regulations 2401-61-12(F) covers he items indicated in the left columns.	No gap.
Contents of EIA Report	Environmental Management Plan (EMP)	This describes mitigation, monitoring, and institutional measures to be taken during construction and operation in order to eliminate adverse impacts, offset them, or reduce them to acceptable levels.	Covers mitigation measures, monitoring, and institutional strengthening	EQPB Regulations 2401-61-12(M) covers he items indicated in the left columns.	No gap

Contents	Item	JICA Guidelines for Environmental and Social Considerations	World Bank Safeguard Policy	EQPB Regulations 2401-61	Gaps
	Consultation	This includes a record of consultation meetings (date, venue, participants, procedures, opinions of major local stakeholders and responses to them, and other items), including consultations for obtaining the informed views of the affected people, local NGOs, and regulatory agencies.	Record of interagency and consultation meetings, including consultations for obtaining the informed views of the affected people and local nongovernmental organizations (NGOs). The record specifies any means other than consultations (e.g., surveys) that were used to obtain the views of affected groups and local NGOs.	EQPB Regulations 2401-61-12(o) and (p) covers he items indicated in the left columns. The minutes of public consultation meetings held on November 2016 and July 2017 were made and filed appropriately.[67]	No gap

Note: * If gaps exist, measures to fill the gaps.

1.3.5 Scoping

The result of the preliminary scoping of the environmental and social impacts of implementing this project is shown in the following **Table 1.16**. The items for which impacts were reviewed are the items listed in the "Environmental Check List: 13. Waste Management" which is a reference document of the *JICA Guidelines for Environmental and Social Considerations* (published in April 2010).

Table 1.16 Scoping

Category	Item	Evaluation based on the survey results		Reasons
		Construct-ion Phase	Operation Phase	
Pollution Prevention	Air Quality	B-	B-	Construction Phase: The local air quality may temporarily be affected by the emission of gas from construction vehicles and dusts from construction works. Operation Phase: Gas emission from heavy equipment and vehicles, and dust and methane generation will be predicted.
	Water Quality	B-	B-	Construction Phase: The local water quality may temporarily be affected by the runoff from the construction site. Operation Phase: The local water quality may temporarily be affected by the runoff from the site.
	Waste	B-	D	Construction Phase: The green waste, such as cutting plants and stumps, will be generated during the construction phase. The residual soil by excavation work will also be generated. Operation Phase: No harmful substances and secondary waste will be brought from the site.
	Soil Contaminat ion	D	C	Construction Phase: No construction work that brings soil contamination will be conducted. Operation Phase: Since the waterproof works are maintained during operation phase, adverse effects on leaching water and soil are not expected, but it is necessary to evaluate its reliability.
	Noise and Vibration	B-	B-	Since there are no environmental standards on noise and vibration in Palau, it is evaluated by comparison with Japan's environmental standards. Construction Phase: The noise and vibration will be generated by construction vehicles. Operation Phase: The noise and vibration will be generated by heavy equipment and vehicles.

[6] The Environmental Inc., *Environmental Impact Statement for Proposed National Landfill, Appendix 2 "Aimeliik Landfill Town Hall Meeting, November 15, 2016"*, March 2017.

[7] Although the minutes of the consultation meeting held on July 2017 have not been provided for JICA Survey Team, it was confirmed that BPW was responsible for preparation and filing of the minutes.

Category	Item	Evaluation based on the survey results		Reasons
		Construct-ion Phase	Operation Phase	
	Odor	D	B-	Construction Phase: No construction work that generates offensive odor can be seen. Operation Phase: Offensive odor will be generated from the disposed waste.
Natural Environment	Conservation Areas	D	D	The proposed site is not located within the Conservation Area. Although the Ngerderar Conservation Area is the nearest conservation area, it is located in about 1km far from the proposed site and belonging in a different watershed from that of the proposed site.
	Ecosystem	C	C	Alteration of land within the planned area is assumed. However, there are no primary forests, tropical natural forests, ecologically important habitats (coral reefs, mangrove swamps, tidal flats, etc.) in the site of the project and surrounding areas.
	Management of Abandoned Site	D	B-	Management of abandoned site will be needed until the disposed waste layer is stabilized.
Social Environment	Resettlement	D	D	No resettlement will be made because nobody lives inside of the site.
	Living	B-	B-	Construction Phase: Concentration of construction vehicles is expected to cause traffic jams on public roads near the site. Operation Phase: Due to concentration of waste collection vehicles, traffic jams on public roads near the site are expected to occur.
	Livelihood	B+	B+	Construction Phase: Employment opportunities will be created in the State and surrounding areas because of the construction work and increase of sales for restaurants and shops will be expected near the site. Operation Phase: Operation of the new landfill will result in creation of employment opportunities and increase of sales for restaurants and shops near the site.
	Water Usage	C	C	Water usage downstream of the site should be identified during both construction and operation phases.
	Heritage	B-	D	Gun bases in the World War 2 were identified in the site. Apart from this, there are no heritage or historic landmarks in and around the site from archaeological, historical, cultural and religious points of view.
	Landscape	D	D	There is no major impact to the landscape around the site.
	Minorities and Natives	D	D	There are no minorities and natives in and around the site.
	Working Conditions	B-	B-	Construction Phase: There are some possibilities of occurrence of labor accidents. Operation Phase: There are some possibilities of occurrence of labor accidents.
Others	Accidents	B-	B-	Construction Phase: There are some possibilities of occurrence of landslides. Operation Phase: There are some possibilities of occurrence of waste collapse.
	Effects by Transboundary and Climate Change	D	D	Effects by transboundary and climate change will not be expected due to a scale of the Project.

Legend: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses.)
D: No impact is expected.

1.3.6 Terms of Reference for Environmental and Social Considerations Survey

As a result of the preliminary scoping of impacts, the draft terms of reference (TOR) for the environmental and social considerations survey was elaborated as shown in **Table 1.17**. The scope of the survey covers basically the Aimeliik State where the project planned site exists.

Table 1.17 Terms of Reference for Environmental and Social Considerations Survey

Category	Survey Item	Survey Methodology
Consideration of Alternative Options	Type of the facilities and scale	Examination of site location, cost of construction and operation, and impacts on environment and social matters
Air Quality	Criteria Current status around the site	Review of current laws and regulations Review of the construction plans (work items, time schedule and project scale)
Water Quality Water Usage	Criteria Current water quality at downstream rivers Current status of water usage Impact of the project	Review of current laws and regulations Review of current documents and water testing Hearing to the Stakeholders Review of the construction plans (work items, time schedule and project scale)
Waste	Impact of the project	Review of the construction plans (work items, time schedule and project scale)
Soil Contamination	Performance of the bottom liner	Evaluation of the bottom liner
Noise and Vibration	Impact of the project	Review of the construction plans (work items, time schedule and project scale) Review of the design
Odor	Related laws and regulations	Review of current laws and regulations
Eco System	Current status of wildlife in the site	Review of previous studies
Management of Abandoned Site	Management plan for the abandoned site	Review of the monitoring plan
Livelihood (Local Economy)	Impact on the local economy	Review of previous studies Interview survey
Heritage	Current status of heritage	Review of previous studies Field survey
Landscape	Current landscape	Field survey and review of previous studies
Working Condition	Regulations on work safety Impact of the project on work safety	Identification of relevant laws and regulations Identification of risks at work
Accidents	Potential risk of accidents	Identification of risks of accident
Effects by Transboundary and Climate Change	Scale of the project	Identification of project scope
Stakeholder Consultation	The results of scoping, TOR of the environmental and social consideration, comments from the stakeholders	Result of stakeholder communication regarding the results of scoping, impact and mitigation on the environment and social issues, consultation of the Draft EIA Communication regarding draft EIA

1.3.7 Results of Environmental and Social Considerations Survey

(1) Air Quality

(a) Impact during Construction Phase

Impact for air quality was estimated because the local air quality may temporarily be affected by the emission of gas from construction vehicles and dust from construction works.

(i) Prerequisites of the Estimation

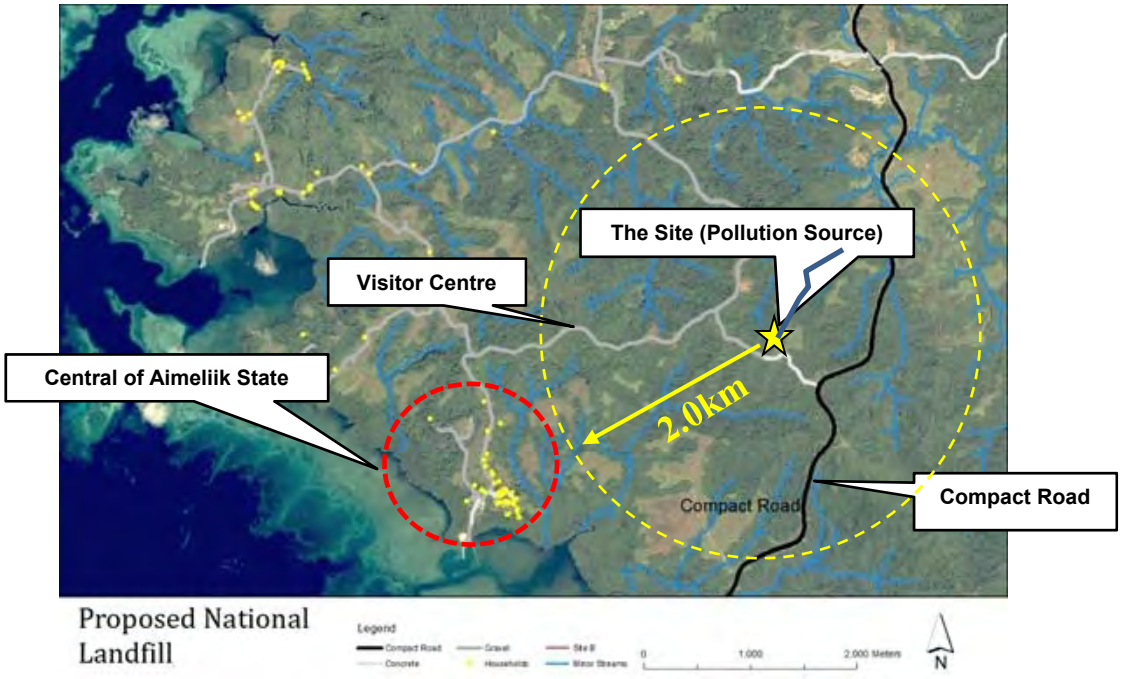
The source of the exhaust gas under construction was organized as follows. Based on the construction plan during construction, it was set based on the number of times of operation at the time when the number of operating units was the maximum. Estimation conditions during the height of construction during construction phase that the discharge load during construction is the largest.

Table 1.18 Sources of Gas Exhausted during Construction Phase

Phase	Quantities of Heavy Equipment	Reasons
Construction	Two (2) Bulldozers (21t) One (1) Excavator (1.2m^3) Seven (7) Excavators (0.8m^3) Two (2) Excavators (0.45m^3) One (1) Excavator (0.28m^3) Six (6) Dump Trucks (in one-hour average) One (1) Motor Grader One (1) Road Roller Six (6) Vibration Roaders Two (2) Rammers Two (2) Diesel Generators	The kinds and quantities of heavy machine are determined based on a construction plan. The largest number of machine will be operated in the 9th month of total 18 months.

(ii) Area of the Estimation

As for the estimating range, think about up to a radius of 2km centered on the site as the source. The peripheral position relation is shown in **Figure 1.12** on the next page.



Source: made by JICA Survey Team based on a map of catchment basins provided by BPW

Figure 1.12 Location Map of the Pollution Source and Its Affected Area on Air Quality

(iii) Method of the Estimation

Air pollutant emissions were calculated based on the past calculation formula based on the number of heavy machinery mentioned in **Table 1.18** above. Also, the influence of these emissions on air quality was predicted by a prediction formula. The air pollutants to be calculated are nitrogen oxide (Palau's environmental standard: 0.05ppm) and suspended particulate matter (SPM: 60μg/m^3 in Palau as "dust and dirt"), which are representative air pollutants.

For the prediction, Sutton's formula is used. This formula is versatile and used by an administrative agency for examination at the time of reporting establishment of facilities in the air pollution control law of Japan. It is a reliable method and it is possible to know the relationship between the maximum landing concentration and the distance and concentration after release to the atmosphere.

Sutton's Formula:

$$C(x,0)=\frac{2\cdot q\cdot \eta}{\pi\cdot C_y\cdot C_z\cdot U\cdot X^{2-n}}\cdot \exp\left(-\frac{1}{X^{2-n}}\cdot\frac{H_e^{\,2}}{C_z^{\,2}}\right)$$

$$C_{\max}=0.234\,\frac{C_z}{C_y}\cdot\frac{q}{U\cdot H_e^{\,2}}\cdot\eta$$

$$X_{\max}=\left(\frac{H_e}{C_z}\right)^{\frac{2}{2-n}}$$

Legend:

C（X , 0）	Surface concentration at the distance X (m) on the leeward axis (ppm)
X	Leeward distance from smoke source (m)
q	Quantity of the pollutants (m^3/s , at 15℃)
Cy	Horizontal diffusion coefficient (=0.07)
Cz	Vertical diffusion coefficient (=0.07)
U	Wind Velocity (m/s)
n	Air turbulence factor (=0.25)
He	Effective height of stack (m)
η	Time correction factor 1 hour＝3minutes value×0.15

Emissions of nitrogen oxides (NOx) and SPMs were calculated using the known emission intensity units for each model shown in the following table to calculate the amount of nitrogen oxide emissions, the amount of exhaust gas, etc. during the peak period of construction. Under this calculation condition, a total of 35 heavy machinery and vehicles are in operation, but they are calculated by modeling as total emissions of all heavy machinery discharged from one point.

Table 1.19 Calculation of Generation of Nitrogen Oxides and SPM from Heavy Machine during Construction Phase

(NOx)

Type	NOx emission intensity units a	Number of equipment b	Intensity × Number c=a×b	Fuel consumption rate d	Powers e	Fuel Consumption rate × power f = d×e	g = b×f
	m^3_N/h		m^3_N/h	L/kw/h	kw	L/h	L/h
Bulldozers 21t	0.1360	2	0.2720	0.175	100	17.5	35.0
Excavators 1.2m^3	0.1578	1	0.1578	0.175	124	21.7	21.7
0.8m^3	0.1578	7	1.1046	0.175	108	18.9	132.3
0.45m^3	0.0871	2	0.1742	0.175	64	11.2	22.4
0.28m^3	0.0871	1	0.0871	0.175	41	7.175	7.175
Dump Trucks 8t	0.0937	6	0.5622	0.044	107	4.708	28.248
Motor Grader	0.0965	1	0.0965	0.108	115	12.42	12.42
Road Roller	0.0552	1	0.0552	0.1	71	7.1	7.1
Vibration Rollers	0.0871	6	0.5226	0.175	116	20.3	121.8
Compaction Machines	0.0871	2	0.1742	0.175	3	0.525	1.05
Diesel Generators	0.0871	2	0.1742	0.175	64	11.2	22.4
Total		31	3.3806				411.593

(SPM)

Type	SPM emission intensity units a	Number b	Intensity × Number c = a×b
	kg/h		kg/h
Bulldozers 21t	0.0073	2	0.0146
Excavators 1.2m^3	0.0132	1	0.0132
0.8m^3	0.0132	7	0.0924
0.45m^3	0.0132	2	0.0264
0.28m^3	0.0132	1	0.0132
Dump Trucks 8t	0.0056	6	0.0336
Motor Grader	0.0081	1	0.0081
Road Roller	0.0046	1	0.0046
Vibration Rollers	0.0132	6	0.0792
Compaction Machines	0.0132	2	0.0264
Diesel Generators	0.0132	2	0.0264
Total		35	0.3381

Calculation Method: Highway Environment Research Institute, Japan, *"Technical Method of Road Environmental Impact Assessment"* (2007 revision)
Source: Nagoya City Government, Emission Intensity Units, June 2013.
Ministry of Land, Infrastructure, Transport and Tourism, Japan Construction Machinery Loss Calculation Table

Calculation is made by substituting the numerical values obtained from the above table into the Sutton equation.

Numbers assigned:
q: Emissions of nitrogen oxides from 3.3806m^3/h to 0.0009m^3/s (from **Table 1.19**)
SPM emissions: 0.3381kg/h → 0.093g/m^3/s (from **Table 1.19**)
U: Wind velocity 3.5m/s, maximum monthly average value according to natural environment survey results
He: Height of stack 2.0m, expected exhaust height of heavy equipment

The calculation results of nitrogen oxides and SPM are summarized below and shown in **Figure 1.13**.

Nitrogen Oxides (NOx)

The maximum landing concentration is 0.29ppm on the leeward side from 0.11km and then declined sharply at the leeward side, 0.008ppm at the 1.5km leech point where the visitor center is located, 0.005ppm at the leeward side with 2.0km in the village edge. The highest concentration is 0.11km on the leeward side from the source, and since heavy machinery is the mobile emission source, it is almost restricted within and around the construction site. A certain area such as a visitor center or village is expected to have a sufficiently small contribution concentration against Palau's environmental standard of 0.05ppm.

Suspended Particulate Matter (SPM)

The maximum landing concentration of SPM is 29μg/m^3 at the leeward side of 0.11m from the emission source, but then declined sharply at the leeward side, 0.80μg/m^3 at the 1.5km leech point with the visitor center and 2.0km leech with village side is 0.49μg/m^3. The highest concentration is 0.11km on the leeward side from the source, and since heavy machinery is the mobile emission source, it is almost restricted within and around the construction site. A certain area such as a visitor center or village is expected to have a sufficiently small concentration against Palau's environmental standard 60μg/m^3.

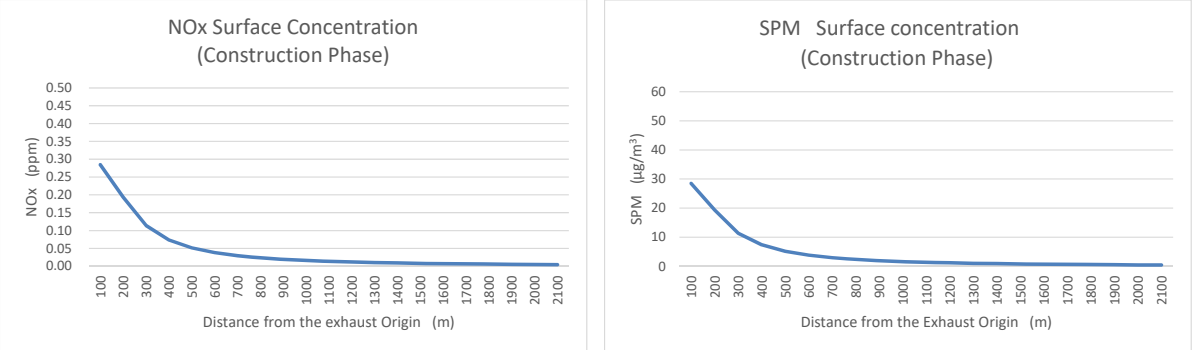


Figure 1.13 Result of Prediction for Air Quality (NOx & SPM) during Construction Phase

Dust

Generally, at the final disposal site, dust is generated due to earthwork under construction, landfill operation during landfill operation, soil covering work and the like. However, as is clear from the survey of natural environment, Palau, where this project is being implemented, is in an environment where rainfall is heavy, hence dust is not a major problem. For this reason, it is predicted that the risk of dust is small. Also, as shown above, since the project is more than 2km away from the settlement, the possibility of causing hindrance to the living environment is very low.

(b) Impact during Operation Phase

Impact for air quality was estimated because the local air quality may temporarily be affected by emission of gas from equipment and vehicles in the operation phase.

(i) Prerequisites of the Estimation

Based on the assumed number of heavy machinery being operated and the number of vehicles delivered during service, set as shown in the following table.

Table 1.20 Sources of Gas Exhausted during Operation Phase

Phase	Quantities of Heavy Equipment	Reasons
Operation	One (1) Bulldozers (21t) One (1) Excavator (0.8m^3) One (1) Wheel Loader (1.3m^3) One (1) Dump Truck	Based on the Equipment Plan
	Number of vehicles delivered 81 vehicles/day (2015) to 120 vehicles/day (2020: 1.5 times compared to 2015) Assuming that operation duration of each carried-in vehicle is 10 minutes, the number of stayed for one hour is calculated at: 120 units ÷ 8 hours × 10/60 = 2.5 units/hour	Based on the result of waste survey

(ii) Area of the Estimation

As for the forecasting range, think about up to the radius of 2km centered on the repository as the source as it is under construction.

(iii) Method of the Estimation

The prediction method is the same as the effect prediction under construction. Emissions of nitrogen oxides and SPM were calculated by using the known emission unit per model, etc. shown in the table below, and the emission of nitrogen oxides at the time of use, the amount of exhaust gas, etc. were calculated. Under this calculation condition, a plurality of heavy

machinery and vehicles were operated, but they were calculated by modeling as summing exhaust gas of all heavy machinery from one point.

Table 1.21 Calculation of Generation of Nitrogen Oxides and SPM from Heavy Machine during Operation Phase

(NOx)

Type	NOx emission intensity units a	Number of equipment b	Intensity × Number c=a×b	Fuel consumption rate d	Powers e	Fuel Consumption rate × power f = d×e	g = b×f
	m^3_N/h		m^3_N/h	L/kw/h	kw	L/h	L/h
Bulldozer 21t	0.1360	1	0.2720	0.175	100	17.5	17.5
Excavator 0.8m^3	0.1578	1	1.1046	0.175	108	18.9	18.9
Dump Trucks 8t	0.0937	2.5	0.5622	0.044	107	4.708	11.77
Wheel Loader 1.3m^3	0.0965	1	0.0965	0.108	115	12.42	12.42
Total		5.5	0.624				60.59

(SPM)

Type	SPM emission intensity units a	Number b	Intensity × Number c = a×b
	kg/h		kg/h
Bulldozer 21t	0.0073	1	0.0073
Excavators 0.8m^3	0.0132	1	0.0132
Dump Trucks 8t	0.0056	2.5	0.014
Wheel Loader	0.0081	1	0.0081
Total		5.5	0.426

Calculation Method: Highway Environment Research Institute, Japan, *"Technical Method of Road Environmental Impact Assessment"* (2007 revision)
Source: Nagoya City Government, Emission Intensity Units, June 2013.
Ministry of Land, Infrastructure, Transport and Tourism, Japan Construction Machinery Loss Calculation Table

Calculation is made by substituting the numerical values obtained from the above table into the Sutton equation.

Numbers assigned:
q: Emissions of nitrogen oxides from 0.624m^3/h to 0.0002m^3/s (from **Table 1.21**)
SPM emissions: 0.426kg/h → 0.0119g/m^3/s (from **Table 1.21**)
U: Wind velocity 3.5m/s, maximum monthly average value according to natural environment survey results
He: Height of stack 2.0m, expected exhaust height of heavy equipment

The calculation results of nitrogen oxides and SPM are summarized below and shown in **Figure 1.14**.

Nitrogen Oxides (NOx)

The maximum landing concentration is 0.07km from the emission source and 0.14ppm at the leeward side, then declined sharply at the leeward side, 0.0018ppm at the 1.5km leech point where the visitor center is located, 0.001ppm at the downwind side with 2.0km in the village edge. The highest concentration is 0.07km on the leeward side from the source, and since heavy machinery is the mobile emission source, it is almost restricted within the construction

site and its boundary. A certain area such as a visitor center or village is expected to have a sufficiently small concentration against Palau's environmental standard of 0.05ppm.

SPM

The maximum landing concentration of SPM was 0.07km from the source and 8.5μg/m^3 at leeward side, but then declined sharply at leeward side, 0.11μg/m^3 at the 1.5km leech point with the visitor center and 2.0km leech with village side is 0.06μg/m^3. The highest concentration is 0.07km on the leeward side from the source, and since heavy machinery is the mobile emission source, it is almost restricted within and around the work site. In certain areas such as visitor centers and settlements, are expected to have significantly small concentration against Palauan environmental standards 60μg/m^3.

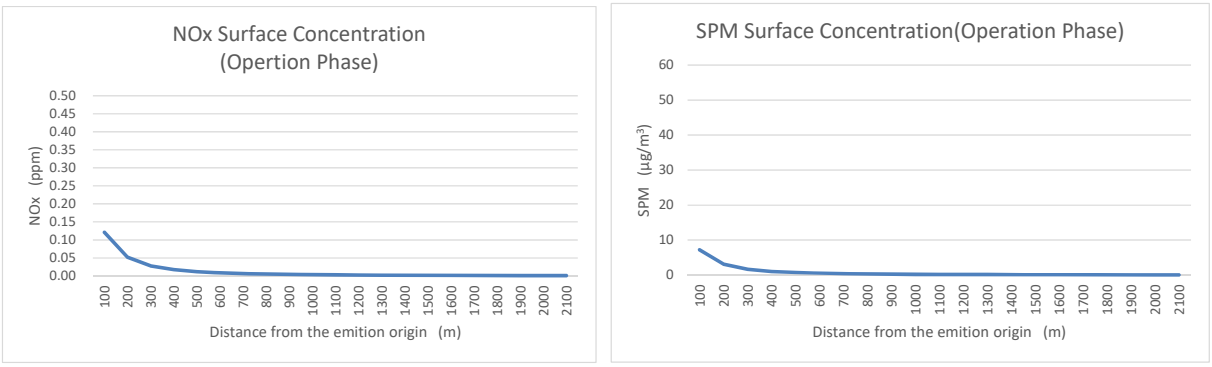


Figure 1.14 Result of Prediction for Air Quality (NOx & SPM) during Operation Phase

Dust

Same as the construction phase.

Methane Gas

Methane gas is generated by the decomposition and fermentation of the waste under the anaerobic conditions when organic waste such as garbage from the kitchen is landfilled. Methane is an important substance from the point of climate change though it is not regulated by the environmental standards in Palau.

Semi aerobic type of landfill is to be adopted in the Project. In this type, a landfill layer is kept under semi aerobic atmosphere as a result of introduction of leachate pipes and gas exhausted pipes and the landfilled waste is then promoted to decomposition. Thus, this system is evaluated as the most regardful technology of all the final disposal systems to reduce the methane gas. The reduction of Greenhouse Gases (hereinafter referred to as "GHGs") by the differences of landfill structure are predicted by the formula as shown in **Table 1.22** below.

Table 1.22 Model Formula of Prediction of Gasification Rate (Fukuoka Model 2007)

Landfill Structure	Decomposition Period	Model
Aerobic	0-	y=7.08ln(x)+17.01
Semi aerobic	0-48 months	y=0.82x-0.94
	49-	y=24.12ln(x)-54.74
Anaerobic	0-30 months	y=0.22x+0.12
	31-96 months	y=0.30x+1.16
	97-	y=26.04ln(x)-88.91

Note X: Passed Period (Month) (x>1), y: Gas (%)
Source: Osamu Hirata, Yasushi Matsufuji, et al., Estimation method of GHGs emission by large lysimeters with different landfill types, *Proceedings of the 23rd Annual Conference of Japan Society of Material Cycles and Waste Management*, 2012.

Prediction Criteria:

- Landfill Area: 8ha
- Landfill Period: 20 years
- Waste Generation: 27 t/day from 0 to 10 years and 30 t/day from 10 to 20 years
- Waste Composition: Garbage: 35%, Paper: 6%, Plant: 2%, Bone and Shell: 12%, Plastic: 10%, Metal: 6%, Glass: 6%, Oil: 4%, Leather and Rubber: 1%, Others: 17%

  Source: It is estimated based on "Prompt report for waste survey in Palau" (Amita, 2014) and results of waste composition survey in Koror and Airai.
- Water Content: Garbage = 80%, Paper = 20%, Plant = 50%
- Gas Composition: CH_4: CO_2 = 0.3:0.7 (Semi aerobic), Anaerobic: 0.6:0.4
- Predicting landfill period: for 10 years, 20 years and 30years
- Final landfill volume: Approx. 300,000 m^3

Result of the Prediction:

Generation of Bio Degradable Waste (garbage, paper and plant)

Each waste generation is calculated as dry weight by multiplication between the whole waste volume and its composition and then subtraction of water content.

[Period from 0 to 10 years]

Total waste volume: 365 days × 27 t/day = 9,855 t/year
Garbage: 9,855 × 0.35 × (1-0.8) = 690 t-dry/year
Paper: 9,855 × 0.06 × (1-0.2) = 473 t-dry/year
Plant: 9,855 × 0.02 × (1-0.5) = 99 t-dry/year
Total: 690 + 473 + 99 = 1,262 t-dry/year

[Period from 10 to 20 years]

Total waste volume: 365 days × 30 t/day = 10,950 t/year
Garbage: 10,950 × 0.35 × (1-0.8) = 767 t-dry/year
Paper: 10,950 × 0.06 × (1-0.2) = 526 t-dry/year
Plant: 10,950 × 0.02 × (1-0.5) = 110 t-dry/year
Total: 767 + 526 + 110 = 1,403 t-dry/year

Calculation Method of Gas Generation

Based on the assumption that the waste is decomposed according to Fukuoka Model Prediction, gas generation is calculated by multiplication between decomposition rate and annual landfill volume.

Calculation Method of Methane Gas Generation

Composition of generated gas is 30% of Methane and 70% of CO_2 under the semi aerobic condition and 60% of Methane and 40% of CO_2 under the anaerobic one. Therefore, the weight rate is calculated as follows:

Generation under semi aerobic: Gasification × 0.3 × [16g/mol/ (16×0.3+44×0.7)]
Generation under anaerobic: Gasification × 0.6 × [16g/mol/ (16×0.6+44×0.4)]

Calculation Method of GHGs Generation during the Landfilling Period:

Annual GHGs generation is calculated by multiplication between Global Warming Potential (hereinafter referred to as "GWP", GWP = 21 for methane) and methane gas generation and then CO_2 generation is finally added. Calculated GHGs generation is shown in **Table 1.23**.

GHGs generation = Methane generation × GWP + CO_2 generation

Table 1.23 GHGs Generation by Landfill Structure

Years of Landfill	GHGs Generation (t)			
	Generation of Bio Degradable Waste: Case of 1,262t-dry/year		Generation of Bio Degradable Waste: Case of 1,403t-dry/year	
	Semi aerobic	Anaerobic	Semi aerobic	Anaerobic
1	406	254	451	283
2	854	498	949	554
3	1302	1220	1447	1357
4	1749	1587	1945	1764
5	2018	1953	2244	2171
6	2222	2319	2471	2578
7	2395	2685	2663	2985
8	2545	3051	2829	3392
9	2676	3329	2975	3701
10	2794	3608	3107	4011
Sub-total (1)	**18962**	**20504**	**21080**	**22795**
11	2901	3860	3225	4291
12	2999	4090	3334	4547
13	3088	4302	3433	4782
14	3171	4498	3525	5000
15	3248	4680	3611	5203
16	3321	4851	3692	5393
17	3389	5011	3767	5571
18	3453	5162	3838	5739
19	3513	5305	3906	5898
20	3570	5441	3969	6049
Sub-total (2)	**32653**	**47199**	**36301**	**52472**
21	3625	5570	4030	6192
22	3677	5693	4088	6329
23	3727	5810	4143	6459
24	3775	5923	4196	6585
25	3820	6031	4247	6705
26	3864	6134	4296	6820
27	3906	6234	4343	6931
28	3947	6330	4388	7038
29	3987	6423	4432	7141
30	4024	6513	4474	7241
Sub-total (3)	**38353**	**60662**	**42638**	**67439**

Calculation Method of Reduction Rate of GHGs

GHGs is generated from the waste in the landfill. Thus, GHGs generation is to be estimated by Sub-total (1) in a case of 1,262t-dry/year for Generation of Bio Degradable Waste, as mentioned above Table 1.23, in the first 10 years from commencement of the landfill; for example, the GHGs generation is to be 18,962t-dry in the case of semi aerobic. In addition, since the waste generation is to be changed in 20 years, GHGs generation for 20 years of landfill is to be the sum of Sub-total (1) in a case of 1,403t-dry/year for Generation of Bio Degradable Waste and Sub-total (2) in a case of 1,262t-dry/year for Generation of Bio Degradable Waste; for example, the GHGs generation is to be 21,080 + 32,653 = 53,733t-dry in the case of semi aerobic.

Based on the assumption that the waste is not landfilled after 20 years, the GHGs generation for 30 years is to be the sum of Sub-total (2) in a case of 1,403t-dry/year for Generation of Bio Degradable Waste and Sub-total (3) in a case of 1,262t-dry/year for Generation of Bio Degradable Waste; for example, the GHGs generation is to be 36,301 + 38,353 = 74,654t-dry in the case of semi aerobic.

As a result of the above prediction, the reduction rate of GHGs is summarized in **Table 1.24**. In this project adopted by the Fukuoka Method (semi aerobic type of landfill), the reduction

rate of GHGs is predicted at 8% in the first 10 years, 23% for 20 years at the end of landfilling and 34% for 30 years.

Table 1.24 Reduction Rate of GHGs Adopted by the Fukuoka Method

		Years of Landfill		
		10 years	20 years	30 years
GHGs (t-CO_2)	Semi aerobic	18,962	53,733	74,654
	Anaerobic	20,504	69,994	113,134
Reduction Rate of GHGs		8%	23%	34%

(2) Water Quality

(a) Impact during Construction Phase

Since excavation and embankment of approximately six (6) hectares (ha) of land will be carried out in the heavy rain region, a large amount of turbid water will be generated. To minimize impacts on the downstream by the outflow during the construction phase, a water treatment facility will be temporarily installed at the site.

(i) Estimation of Turbid Water Generation

The amount of turbid water is calculated using the following equation:

The maximum design amount of turbid water (Q)

$$Q = \frac{1}{1{,}000} \times C \cdot I \cdot A \ (m^3/hr)$$

C: Runoff Coefficient, I: Average Rainfall Intensity, A: Basin Area (m^2)

Considering each condition of C, I and A,

The maximum hourly amount of turbid water (Qh):

Qh = 1/1000 × 0.5 × 10 × 56,000 = 280m^3/hr

The maximum daily amount of turbid water (Qd):

Qd = 1/1000 × 0.5 × 30 × 56,000 = 840m^3/d

Runoff Coefficient: C

The runoff coefficient during construction is to be 0.5 as a standard value for open cutting area or bare ground during construction.[8]

Rainfall Intensity: I

The maximum rainfall year for the past 12 years is year 2011 and the maximum rainfall month of 2011 is September; therefore, the maximum hourly rainfall at 10mm and the maximum daily rainfall at 30mm will be applied for the rainfall intensity in the equation because the rainfall amount of September 2011 was 796.8mm/month, i.e. 796.8/30=26.6, the daily rainfall is around at 30mm.

Basin Area: A

The basin area is to be equivalent to the construction area; therefore, it is 56,000m^2.

[8] Isao Kobayashi, et al., Turbid Water and Muddy Water Treatment in Construction Work (revised edition), April 1983.

(ii) Quality of Turbid Water

Suspended solids (SS) in turbid water is ranging from 100 to 1,000mg/L in general, and therefore the maximum value of 1,000mg/L will be applied.

(iii) Mitigation Measures of Turbid Water

Temporary retarding basins and a sedimentation pond will be installed to mitigate the impact by turbid water. Silt fences will be equipped additionally with the sedimentation ponds to treat the turbid water and make the efficiency of sedimentation higher. Consequently, target values of SS should be set at less than or equal to 200mg/L at just the outlet of the pond and less than or equal to 25mg/L at the junction of the downstream river. Concentration of SS will be measured during the construction phase at both the outlet of the pond and the junction of the downstream river.

(b) Impact during Operation Phase

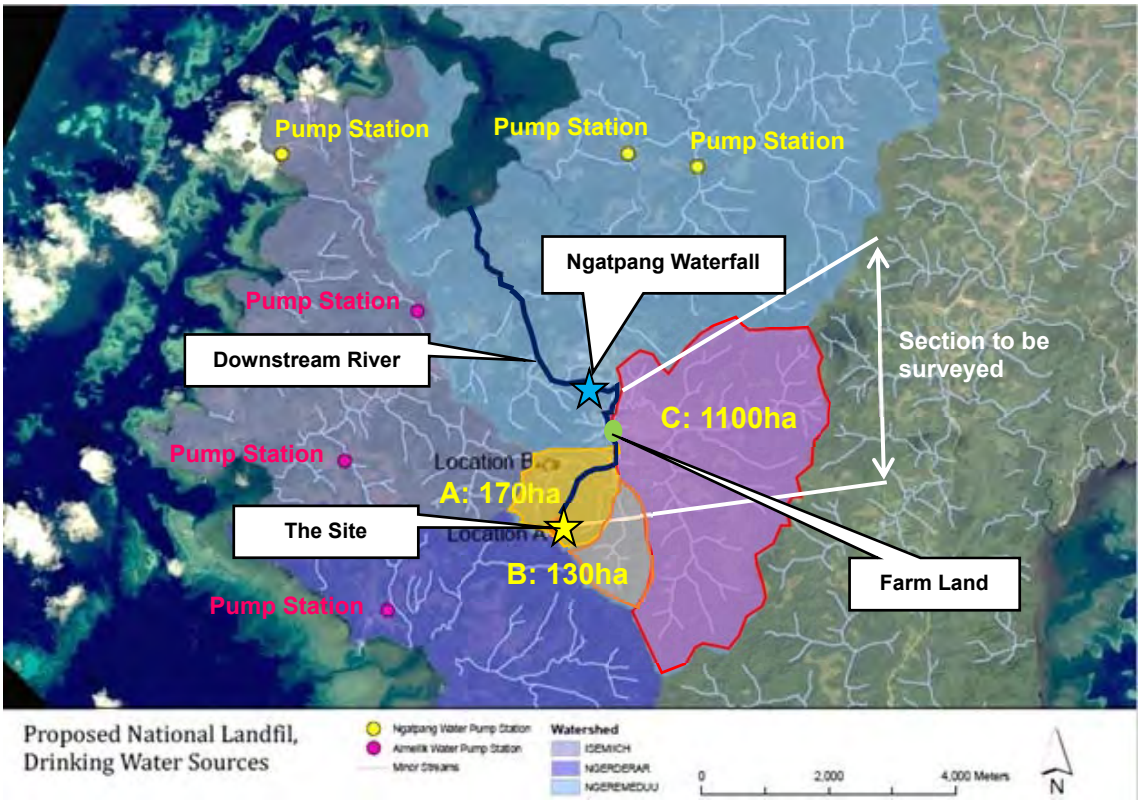
(i) Impact Area of Water Quality

The extent to which the discharged water from the site affects the downstream area will be identified. Since there are no guidelines for investigation according to the size of the disposal site, standards or guidelines used in Japan will be applied in this case. The area of new disposal site is 8ha; this is not the scale to which the environmental impact assessment law or environmental impact assessment ordinance of Japan is applied. Because the law and ordinance are generally applied for areas from 15 to 30ha, "Living Environmental Impact Survey Guidelines" based on the law concerning processing and cleaning of solid waste in Japan will be used. According to the guidelines, the target areas surveyed for the influx of permeating water and the effect of discharged water from the facility (or landfill site) should be determined considering the range assumed to affect a certain degree or more of the concentration of the water quality. In other words, the impact area in this case will be a basin including a point where the discharged water is diluted 100 times in a low water duration. Additionally, the guidelines also stipulate that not only the water condition in the area should be taken into consideration, but also administrative boundary, topography, land use, water use situation in the area. To comply with this, the range to be investigated was set up to the point where dilution of the discharged water is 100 times. Although the flow data etc. of the river are not maintained at the site, leachate water is generated by rainfall, so it can be obtained by proportional calculation from the catchment area. Since the area of the disposal site is 8ha, the point where the downstream catchment area of 800ha of the discharge point is equivalent to the 100-fold dilution point. By reading the catchment map, the range that satisfies the catchment area of 800ha along the discharge route from the site was specified. As a result, as shown in **Figure 1.15**, there are three (3) watersheds of A, B and C, and their total area is 1,400ha. The range up to the confluence point of these three watersheds from A to C is specified as the investigation target range of the influence, and the dilution magnification at this point is estimated at 175 times. The end (downstream side) of the scope of influence investigation is a river confluence along the main road. In addition, all sections of the river to be investigated are within Aimeliik State.

(ii) Water Usage

As shown in **Figure 1.15**, all the water intake facilities (Pumping Stations) for household water are in a totally different watershed from the basin of the discharge destination, and they are located far away from each other. Also, the waterfall of Ngatpang which is one of the tourist resources is out of the influence of what is located downstream of the destination river. On the other hand, within the scope of the investigation, one agricultural land which operated in vinyl houses was found. According to an interview with stakeholders concerned

with this farmland, they pump up the water from the river and use it for agriculture and their products are rapeseed, capsicum and eggplant.



Source: made by JICA Survey Team based on a map of catchment basins provided by BPW
Note: Yellow = Pump Station in Ngatpang, Red = Pump Station in Aimeliik

Figure 1.15 Downstream River and the Watershed

(iii) Results of Prediction

The results of quantitatively predicting the influence on the downstream river by the discharged water from the repository are as follows.

Calculation was made by the fully mixed formula commonly used for environmental assessment and others. However, since the river flow data was not well developed in Palau, it was calculated by replacing the river flow rate with the catchment area ratio. Since the leachate at the disposal site is generated by rainfall, it can be substituted for calculation using the basin area ratio.

Complete mixing formula (unit: water quality is mg/L, area is ha):

$$\text{Water quality at the predicted point} = \frac{(\text{Landfill area size} \times \text{Discharged water quality}) + (\text{Basin area} \times \text{River water quality})}{(\text{Area of source}) + (\text{Catchment area})}$$

The discharged water quality was set up based on the design value and the leachate treatment method and design is as described in **Chapter 2, Subsection 2.2.2, (2)(d)**.

If the landfill area is 2.5ha, the discharge water quality is set as shown in **Chapter 2, Table 2.9** and the river water quality is calculated as the actual measured values, the results at the end of the basin subject to the influence range are obtained as shown in **Chapter 2, Table 2.12 and Figure 2.8**. The changes from the current river water quality to the predicted value

at the time of use will be from 0.6mg/L to 0.81mg/L for BOD, from 2.8mg/L to 2.9mg/L for COD, from 0.10mg/L to 0.21mg/L for T-N, and from 0.007mg/L to 0.009mg/L for T-P, respectively.

Although there are no standard values for BOD and COD in Palau, the change in each item is minor. As for T-N and T-P that have Palauan environmental standard values, the calculated values of those are lower than this standard, and it is regarded as the same level as natural variation. Therefore, it can be evaluated that there is no effect on water quality brought by the project. Along the river there is a land for agriculture, and leafy vegetables, capsicum, eggplant, etc. are cultivated in vinyl houses. By applying the agricultural water standards in Japan[9] for example, the standard value of T-N is 1mg/L in the case of paddy fields and 2mg/L when the pollution degree is negligible[10]. Since the predicted value of this time is sufficiently lower than these standards, it is predicted that there is no influence on agriculture in the area.

(3) Wastes

(a) Impact during Construction Phase

Wastes from construction work, such as logged vegetation, residual soil and so forth will come out. The waste will be carried into the M-Dock Landfill, and plants and grass waste will be utilized as a temporary material under the construction as much as possible. The surplus will be composted at the Koror State recycling center. The remaining soil will be transported to a temporary storage place prepared by the Palauan side and then planned to be utilized for covering materials at the time of service, covering of existing repositories scattered in Palau, and public works projects. For this reason, no secondary influence due to waste caused by construction will be estimated.

(b) Impact during Operation Phase

The new landfill site constructed in this project is for general waste and hazardous waste will not be accepted, so there are no harmful residues from the site. Also, since this will be the final disposal site, secondary waste will not be generated, and it can be predicted that there is no effect from waste.

(4) Soil Contamination

(a) Impact during Construction Phase

Soil contamination is generally attributed to volatile organic compounds, metals and pesticides. Since there are no works and equipment using these hazardous materials in the construction, it can be predicted that there is no effect on soil contamination.

(b) Impact during Operation Phase

There is some possibility of diffusion of leachate into the ground through cracked layers although the site is impermeable, and the leachate therefore barely penetrates the ground. In case of diffusion of leachate, impacts on surrounding environment will be minimal since waste filled in the sites will not include hazardous materials but organic matter that decomposes naturally. To minimize the impact, cracked layers on the bottom of the site will be improved by replacing cement soil to prevent the leachate from infiltrating the ground. The following are examination of the impact on soil contamination by the leachate.

Figure 1.16 illustrates the design cross section of the landfill and permeability of coefficient of the ground. Tb-w (weathered portion of Tuff breccia), Tb-CL and Tb-CM (unweathered portion of Tuff breccia) that will be the bottom of the landfill site have low permeability of the order of 1×10^{-7}m/s on average and therefore it is judged that the leachate will hardly infiltrate the ground.

[9] Study Group for Environmental Pollution, Ministry of Agriculture, Forestry and Fisheries, Japan, *Agricultural Water Standards*, 1970.
[10] Chiba Prefectural Government, *Handbook on Pollution in Agriculture and Forestry*, 1990.

Assuming that the hydraulic gradient is one to ten, the diffusion distance of the leachate will be estimated at 0.3m/year by using the Darcy's law, i.e. actual velocity = permeability of coefficient × hydraulic gradient. It means that the leachate will reach to about 6m in 20 years that is planned landfill duration, and the distance will not be beyond the boundary of the site. In addition, since the leachate quality will be improved by decomposition of wastes, it can be predicted that there is no effect on soil contamination.

The permeability of Tb-CL is relatively low as rocks; however, there are many cracks and it looks permeable layer. To minimize the diffusion of the leachate outside the site, cracked area will be improved by using cement soil although impacts on the surrounding environment will be small even if the leachate is leaking because the wastes to be filled are not harmful.

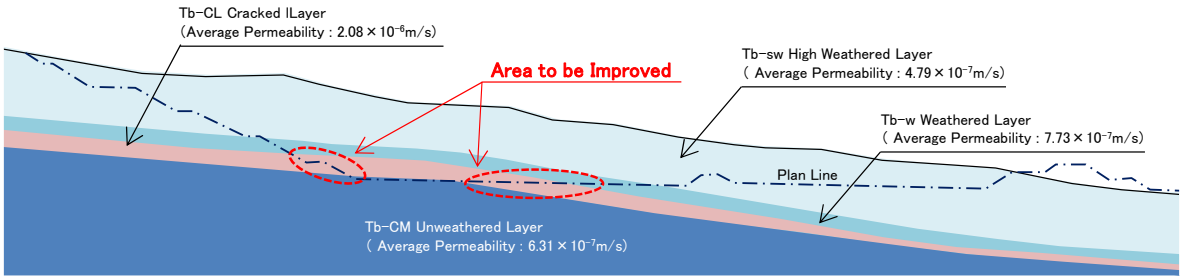


Figure 1.16 Area to be Improved and Permeability of the Layers

(5) Noise and Vibration

(a) Impact during Construction Phase

(i) Standard Value for Reference

Since there is no environmental standard and regulatory standard related to noise and vibration in Palau, the Project referred to Japanese standards. **Table 1.25** shows the Japanese environmental standards related to noise. In Japan, the specific allocation of regional type is to be decided by the prefectural level, but the planned area of Aimeliik State and its surrounding area is considered to be equivalent to urbanization adjustment area in Japan, the middle row of the table below. It is understood that the criteria of "A and B" are equivalent and it is appropriate to consider 55dB in the daytime and 45dB in the night as the reference value. Even in Japan, it is often compared with equivalent environmental standards in the environmental impact assessment of the final disposal site.

Table 1.25 Environmental Standards related to Noise in Japan

Type of Area	Environmental Standards	
	Day time 6am to 10pm	Night time 10pm to 6am
AA: Regions required for particularly silence, such as areas in which medical care facilities, social welfare facilities, etc. are collectively established	Not more than 50dB	Not more than 40dB
A and B: Regions to use for residence	Not more than 55dB	Not more than 45dB
C: Regions to be provided for commercial, industrial purposes etc. together with considerable number of residences	Not more than 60dB	Not more than 50dB

Source: Basic Environment Law, Article 16, Item 1, 1993.

(ii) Method of Prediction

It is calculated and predicted that how the noise from the sources of heavy machinery, etc. during construction and operation phases of the landfill will decay and affect the surrounding area.

(iii) Results of Prediction

The type and number of operating heavy machinery are identified as the same as those shown in **Table 1.19**. In terms of the heavy machinery used in the site, the sound source from the machine varies depending on the work contents and the work position. The backhoe is selected as the main heavy equipment concerned about the generation of large noises, and it is assumed that the occurrence of 87dB per a single unit (when measured at 1m away from the machine) is generated.[11]

When there are several identical sound sources, calculation of the magnitude of the noise is performed by the following formula (Unit: dB):

Multiple noise levels = Noise level at a single time + 10 $\log_{10}$ [number of units]

Therefore, since the number of heavy machinery is 31 as shown in **Table 1.19**, assuming that these 31 heavy machines operating as the excavator are operating at the same time, the number of units will be 31 in this equation and the noise levels are calculated as follows:

87 + 10 log $_{10}$31 = 102dB

Therefore, it is assumed that the source generates 102dB of noise. Based on this calculation, the degree of the noise that can be observed in accordance with the distance is estimated by using the formula of distance attenuation. The formula for the distance attenuation representing decays of the noise at the point of L2 where the noise level is Lr_1 (dB) at the point of L1 is as follows:

$$Lr_2 = Lr_1 - 20 \log_{10} (r_2/r_1)$$

Legend r_1, r_2: Distance from the noise source (m)
Lr_1, Lr_2: Noise levels at L1and L2 (dB)

Calculating Lr_1 of this equation as 102dB, it attenuates to about 55dB at a distance of 0.2km and falls below 45dB at a distance of 0.8km. Since the visitor center is about 1.5km from the planned site and the settlement is about 2.0km or more away from the planned site, it is unlikely that it will hinder the living environment even if the construction is in the peak period. Regarding the vibration, the vibration reduction is equivalent to that of noise, and the characteristic of the distance attenuation is the same, so it is predicted that the vibration will not hinder the living environment as well as the result of noise calculation. **Figure 1.17** shows the estimation result of the noise level according to the distance from the noise source under construction.

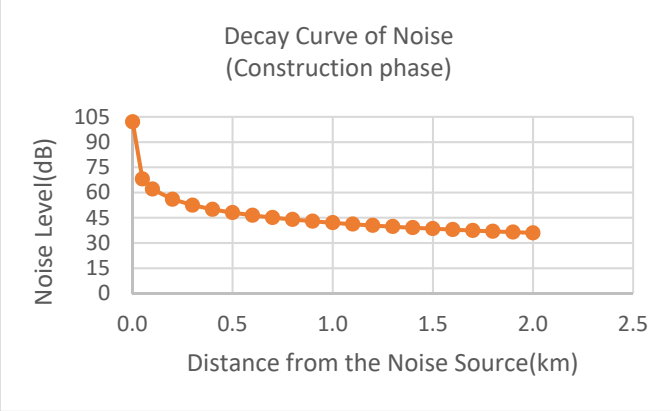


Figure 1.17 Results of Prediction on Noise Attenuation in accordance with the Distance from the Noise Source during Construction

[11] Kenichi Takahashi, et al., Results of Noise and Vibration to Construction Works, *Civil Engineering Support and Training Center, Annual Report*, Tokyo Metropolitan Government, 2010.

(b) Impact during Operation Phase

As the same as the case of construction phase, prediction is made using the distance attenuation formula for the noise at service.

The generated noise level was estimated based on the number of heavy machines and the number of vehicles carried in at the operation phase by applying the distance attenuation formula. As shown in **Table 1.21**, since it is assumed that three (3) heavy machines are used at the time of service, and some 5.5 vehicles per hour are delivered, the source is estimated by the same prediction method as during construction.

$$87 + 10 \log_{10} 5.5 = 94\text{dB}$$

Therefore, the source noise level is 94dB. Substituting this in the distance attenuation formula resulted in 55dB at a distance of 0.1km and 45dB at a distance of 0.3km. As a result, it is predicted that the noise at service will not affect the visitor center 1.5km away from the planned site and the village 2.0km away. Also, it is predicted that the vibration having attenuation characteristics similar to the noise will not hinder the living environment as well as the result of noise calculation. **Figure 1.18** illustrates the estimation result of the noise level according to the distance from the noise source when the disposal facility is being operated.

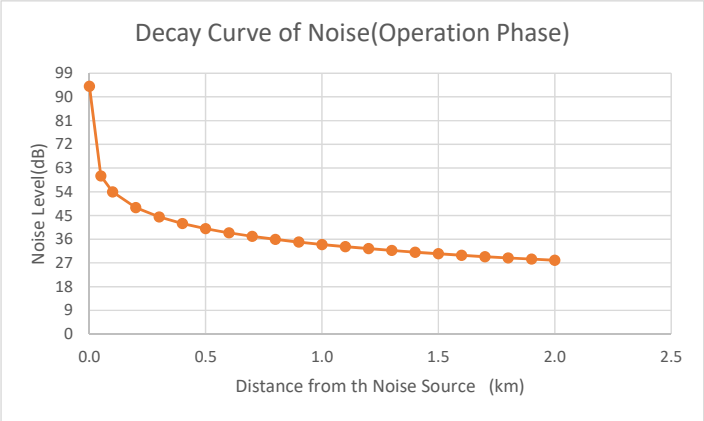


Figure 1.18 Results of Prediction on Noise Attenuation in accordance with the Distance from the Noise Source during Operation

(6) Odor

(a) Impact during Construction Phase

Since there is no such process as to generate offensive odor during construction, no influence of offensive odor is estimated during construction.

(b) Impact during Operation Phase

Since the waste is carried into the landfill site during operation phase, the waste becomes a source of offensive odors. The carried waste is planned to be rolled and covered with soil periodically. In addition, it is possible to avoid the anaerobic and perishable state in the landfill layer by securing drainage of leachate and installing venting pipes. Therefore, it is predicted that there is no obstacle to the living environment due to the offensive odor since the structure of the landfill site and the landfill construction method are considered to prevent the odors.

(7) Ecosystem

(a) Impact during Construction Phase

As shown in **Figure 1.8**, the land for the project site is not an area designated as a protected area under laws and international treaties of Palau. The nearest protected area is "Ngerderar Reserve", however it is located in about 1km south of the proposed site, and the water system is totally different. Natural forests, tropical natural forests, ecologically important habitats such as coral reefs, mangrove swamps, tidal flats and so on do not exist in the proposed site and the surrounding areas. Moreover, as stated in **Subsection 1.3.2 (1) (b)**, according to the existing EIA survey report, rare species of rank that should be specially preserved along with construction in

the project site, i.e. those of rank higher than semi-endangered species in IUCN Red List, have not been confirmed. In the construction work, no serious impact on ecosystems can be foreseen because logging will be minimized and a plan for landscaping and planting as much as possible will be made at the site.

(b) Impact during Operation Phase

Since large-scale land modifications are completed at the time of construction phase, the impact on ecosystems does not increase at the time of service.

(8) Management of Abandoned Site

A project of final disposal site starts from the construction phase, and it is a long-term project going through the operation phase and leading to the site usage after completion of the landfill. Although there is no specific decision on the utilization of the site after the operation period, a plan that the site will be used for a park after confirmation of the site stabilization are being debated. Since the generated gas, leachate, etc. are monitored continuously at the site management stage, there is no obstacle to the living environment.

(9) Living

(a) Impact during Construction Phase

Traffic jams may occur in public roads during this time by construction vehicles like dump trucks going back and forth between the site and the stockpile yard for sediment transport. However, as shown in **Table 1.22** it is thought that the number of vehicles traveling is about 5 to 6 units per hour, and the stockpile yard will be established at a distance within 2km from the site, so that the influence on the living environment along the roadside seems to be negligible.

(b) Impact during Operation Phase

In the operation phase, traffic congestion is predicted on public roads near the disposal site by visitors of waste collection and transport vehicles. Up to 120 vehicles are expected to be delivered per day during service as set in **Table 1.21**. This means that 15 vehicles per hour will visit the site during the operation hours, i.e. 8 hours a day, and it is therefore considered that the living environment along the entry road will not be significantly impaired. In addition, there are no private houses in the section from the branch point from the main road to the repository as well. Although it may be thought that the incoming vehicles temporarily concentrate, in this case, it can be mitigated by preventing the stagnation in the vicinity of the repository or near the gate by appropriate guidance or the like.

(10) Livelihood

(a) Impact during Construction Phase

Employment opportunities will be created in the State and surrounding areas because of the construction work and increase of sales for restaurants and shops will be expected near the site.

(b) Impact during Operation Phase

Operation of the new landfill will result in creation of employment opportunities and increase of sales for restaurants and shops near the site.

(11) Heritage

(a) Impact during Construction Phase

In the planned area there are old military high fire aircraft gun pedestals, but these are being studied in accordance with the Palauan law in the direction that the historic office will investigate and relocate to the museum to preserve it. Therefore, there is no disappearance of cultural heritage etc. by this project. Other ruins, cultural heritage, etc. do not exist in the

planned area.

(b) Impact during Operation Phase

Measures for anti-aircraft guns are limited to the construction phase, so no new obstacles will occur during the service.

(12) Landscape

(a) Impact during Construction Phase

Because earthmoving work will be carried out along with construction, changes in the landscape are estimated. There is no scenery that will become a tourist resource around the planned area. As a viewing point, there are places where the planned area is visible from the Compact Road as shown in the figure below. While the proposed site is only a part of the whole landscape, and high trees at the viewing point and the surrounding area are obstructing the visibility, so the impact on the landscape would be minor.

Source: Taken on May 2017 and made by JICA Survey Team

Figure 1.19 Landscape of the Site from the Viewing Point

(b) Impact during Operation Phase

The alteration of the land will be completed at the construction phase. Landfill is carried out within the premises that is built, so the site will not expand during the service period. Although the site seen from the view point is only a part of the landscape, the impact on the landscape will be minimized by covering the landfill waste with soil.

(13) Working Conditions

(a) Impact during Construction Phase

From the viewpoint of business characteristics, as long as it is implemented under a modern and safe construction system by Japanese companies, it is considered that the working environment will not be lower than the current level in Palau.

(b) Impact during Operation Phase

Since the final disposal site is safe to arrange conducting wires and facilities, it is unlikely that the safety level and working environment will be lower than, for example, the present disposal site of M-Dock.

(14) Accidents

(a) Impact during Construction Phase

Construction work in this project does not include contents of construction which is high and difficulty and causes danger to the surrounding area. Earth works are only cuts and embankments with a safe gradient. But since it is a large-scale excavation work, it is necessary to

secure an appropriate construction period so as not to cause landslides and slope failures, etc. In addition, sufficient attention is needed especially in rainy days. Although accidents while at work and traffic due to the construction are also expected, it is not particularly dangerous considering the construction contents. It is a range that can be handled by ordinary occupational safety and health, traffic safety measures.

(b) Impact during Operation Phase

In the operation phase, waste is carried in, landfilled and compacted. Because the waste is filled and compacted with a safe gradient, there is no risk that the waste layer collapses and leaks out of the site. Occupational and traffic accidents accompanying the waste carry-in are also presumed, but in view of the work contents it is not particularly dangerous, it is a range that can be handled by ordinary occupational health and safety, traffic safety measures, etc.

(15) Effects by Transboundary and Climate Change

Since the landfill site constructed in this project has a scale of 8 hectares of land and the waste handled is also limited to municipal waste, it is considered to be a scale that will not affect transboundary and climate change.

1.3.8 Environmental Assessment

Based on the result of the environmental and social consideration survey, the environmental assessment is summarized in **Table 1.26**.

Table 1.26 Environmental Assessment based on Results of Environmental and Social Considerations Survey

Category	Item	Evaluation based on the scoping		Evaluation based on the survey results		Reasons
		During Construction	During Operation	During Construction	During Operation	
Pollution Prevention	Air Quality	B-	B-	B-	B-	During construction phase: Although the local air quality may temporarily be affected by the emission of gas from construction vehicles and dust from construction works, it is predicted that air pollutants do not exceed the environmental standards in the living areas. During operation phase: Heavy equipment will be operated at the site. As a result of the prediction calculation, the level of impact to the air quality will not exceed the air quality standards. In addition, although methane generation will occur after landfill operation, the generation amount will be minimized by adopting the Fukuoka Method.
	Water Quality	B-	B-	B-	B-	During construction phase: The local water quality may temporarily be affected by the runoff from the construction site; however, installation of a temporary sediment pond and implementation of environmental monitoring will mitigate the impacts. During operation phase: There is no water usage at the site downstream. As a result of the prediction calculation, impacts on agriculture are not expected because the discharged water will be diluted by rainfall.

Category	Item	Evaluation based on the scoping		Evaluation based on the survey results		Reasons
		During Construction	During Operation	During Construction	During Operation	
	Wastes	B-	D	B-	D	During construction phase: Waste related to the construction work including waste by operators, labors and administrative staff in the project, and the green waste, such as cutting plants and stumps, will be generated during the construction phase. However, this waste will be reused. The residual soil by excavation work will also be generated but reused as cover soil for the new landfill site and land reclamation in the public works projects in Palau. During operation phase: No secondary waste will be brought from the site.
	Soil Contamination	D	C	D	B-	During construction phase: No construction work that brings soil contamination will be conducted. During operation phase: Cracks of tuff breccia (foundation rock) will be permeable condition of the site while the permeability of coefficient of the site is in order of 10^{-7}m/s as a result of geological survey.
	Noise and Vibration	B-	B-	D	D	The environmental standards on noise and vibration in Japan are applied for the assessment. During construction phase: The noise and vibration will be generated by construction vehicles, but their level will affect only a small area (inside of the 200m diameter from the generation sources) around the construction site. During operation phase: The noise and vibration will be generated by heavy equipment and vehicles, but their level will affect only a small area (inside of the 100m diameter from the generation sources) around the construction site.
	Odor	D	B-	D	B-	During construction phase: No construction work that generates offensive odor can be seen. During operation phase: Offensive odor will be generated from the disposed waste; however, it will be mitigated by adopting the Fukuoka Method, discharge of leachate and installation of gas pipes.
Natural Environment	Protected Areas	D	D	D	D	The proposed site is not located within the Conservation Area. Although the Ngerderar Conservation Area is the nearest conservation area, it is located in about 1km far from the proposed site and belonging in a different watershed from that of the proposed site.
	Ecosystem	C	C	D	D	Natural forests, tropical natural forests, ecologically important habitats such as coral reefs, mangrove swamps, tidal flats and so on do not exist in the proposed site and the surrounding areas. According to the Environmental Impact Study (2017), rare species of wild animals/trees/plants were not identified in the proposed site.
	Management of Abandoned Site	D	B-	D	B-	Management of abandoned site will be needed until the disposed waste layer is stabilized.
Social Environment	Resettlement	D	D	D	D	No resettlement will be made because nobody lives inside of the site.
	Living	B-	B-	D	B-	During construction phase: The influence on the living environment along the roadside by construction vehicles seems to be negligible. During operation phase: Traffic congestion is predicted on public roads near the disposal site by visitors of waste collection and transport vehicles.

Category	Item	Evaluation based on the scoping		Evaluation based on the survey results		Reasons
		During Construction	During Operation	During Construction	During Operation	
	Livelihood	B+	B;	B+	B+	During construction phase: Employment opportunities will be created in the State and surrounding areas because of the construction work and increase of sales for restaurants and shops will be expected near the site. During operation phase: Operation of the new landfill will result in creation of employment opportunities and increase of sales for restaurants and shops near the site.
	Water Usage	C	C	D	D	No water usage downstream area of the site is identified during both construction and operation phases.
	Heritage	B-	D	B-	D	During construction phase: Gun bases in the World War 2 were identified in the site. Other ruins, cultural heritage, etc. do not exist in the planned area.
	Landscape	D	D	D	D	During construction phase: There is no major impact to the landscape around the site. Although the site is visible from the Compact Road, the change of the landscape will be limited and few. During operation phase: The site will not expand during the service period. Although the site seen from the view point is only a part of the landscape, the impact on the landscape will be minimized by covering the landfill waste with soil.
	Minorities and Natives	D	D	D	D	There are no minorities and natives in and around the site.
	Working Conditions	B-	B-	B-	B-	During construction phase: Although there are some possibilities of occurrence of labor accidents, it is considered that the working environment will not be lower than the current level in Palau. During operation phase: Although there are some possibilities of occurrence of labor accidents, since the final disposal site is safe to arrange conducting wires and facilities, it is unlikely that the safety level and working environment will be lower than, for example, the present disposal site of M-Dock.
Others	Accidents	B-	B-	B-	B-	During construction phase: There are some possibilities of occurrence of landslides; however, they are not particularly in danger considering the construction contents. During operation phase: Although there are some possibilities of occurrence of waste collapse, it is a range that can be handled by ordinary occupational safety and health, traffic safety measures.
	Effects by Transboundary and Climate Change	D	D	D	D	Effects by transboundary and climate change are not expected due to the scale of the Project.

Legend: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses.)
D: No impact is expected.

1.3.9 Mitigation Measures and Their Costs

For items that may be subject to negative impact listed in the above **Table 1.26**, the possible mitigation measures and their costs have been summarized in **Table 1.27.**

Table 1.27 Mitigation Measures and Their Costs

No.	Item		Mitigation Measures	Implementing Organization	Responsible Organization	Cost
During Construction Phase						
1	Pollution Prevention	Air Quality	• Construction vehicles will be operated efficiently by adjusting construction planning and schedule to minimize the number of vehicles and the operation duration.	Contractor for construction work	BPW	Included in the Construction Cost
2		Water Quality	• A temporary reservoir and a fence for stockyard of residual soil will be constructed during the construction phase; therefore, muddy water will be trapped by the pond and the fence.			
3	Pollution Prevention	Wastes	• Wastes generated by the construction work (including waste by construction workers and supervising staff) will be disposed properly in M-Dock Landfill. • The green waste will be generated during construction phase and utilized as compost materials. • Cover soil will be transported to a stockpile site which is prepared by the Palauan National Government and disposed properly by using cover soil for other landfill sites and embankments for public works projects.			
4	Social Environment	Heritage	• War Historical Site will be handled in conformity with Palauan Law by Palauan Government.			BPW
5		Working Conditions	• Work safety measures will be carried out. (see **Table 1.28** in detail.)			Included in the Construction Cost
6	Others	Accidents	• Safe slope for cut and embankment work will be determined. • Construction duration will be secured appropriately. • Construction work during rain will be carefully conducted.			
During Operation Phase						
1	Pollution Prevention	Air Quality	• Dust generation will be prevented by implementation of cover soil. • Air quality will be monitored by using a gas analyzer. • Methane generation volume will be minimized by adopting a semi-aerobic type landfill (Fukuoka Method).	Operator and DSWM	BPW	Included in the Operation Cost
2		Water Quality	• Organic pollution in leachate will be minimized by adopting a semi-aerobic type landfill. • Leachate will be circulated from a leachate pond to the landfill site to reduce the volume and improve the quality. • Leachate treatment facilities will be maintained properly at the site to minimize the impacts on the water quality downstream area of the site. • Rain water in the site except for leachate will be retained in a pond and then discharged downstream.			
3		Soil Contamination	• Cracks of the foundation rock and embankments will be improved by replacing cement soil to secure the impermeability of the site.			

No.	Item		Mitigation Measures	Implementing Organization	Responsible Organization	Cost
4		Odor	• Odor generation will be minimized by adopting a semi-aerobic landfill, such as implementation of regular cover soil, and installation of leachate collection pipes and gas exhausted pipes to accelerate decomposition of waste. • Proper landfill management like regular cover soil and addition of gas exhausted pipes will result in prevention of offensive odor.			
5	Social Environment	Management of Abandoned Site	• Proper management of gas generation and leachate will be made to minimize impacts on the environment.			
6		Working Conditions	• Work safety measures will be carried out. (see **Table 1.28** in detail.)			
7	Others	Accidents	• Proper landfill management like regular cover soil and waste compaction, and securement of embankment with safe slope will result in prevention of collapse of waste. • Work safety measures will be carried out. (see **Table 1.28** in detail.)			

Table 1.28 Work Safety Measures to be Taken

Period	Facility	Possible Accidents at Work	Work Safety Measures to be Taken
During Construction Phase	General	Falling from scaffolding	• Enough width and slope of walkways and stairs should be designed to enable people to walk on them easily. • Signs to show walkways and stairs, and handrails will be installed to prevent people from falling.
		Contact with trucks and heavy machine	• The traffic line should be designed to prevent contact between the workers and trucks and heavy machine.
		Falling/flying of work pieces	• The workers should wear helmets in the site.
During Operation Phase	Landfill Site	Inhaling of dust and poisonous gas	• The water should be sprinkled to avoid scattering the dust in the site. The gas analyzer should be used to detect the poisonous gas.
		Heat stroke	• Duration of outdoor work should be shortened as much as possible by taking moderate rest and drinking water.
		Slips, falls	• Enough width and slope of walkways and stairs should be designed to enable people to walk on them easily. • Signs to show walkways and stairs, and handrails will be installed to prevent from falling.
		Contact with trucks or heavy machine	• Places that rotate, move, or stick out should be covered or colored for watching out. • Signs should be placed to show that the places that rotate or move are in operation. • The height of the floor should be appropriate and secured to keep enough space between the machine and hand rails.
		Noise and vibration	• Anti-vibration devices should be installed to prevent noise/vibration that would be hazardous to the workers.
		Explosion and fire	• Flammable material should be kept away from fire in the site. • Fire extinguishers or sand for extinguisher should be installed in the site.

Period	Facility	Possible Accidents at Work	Work Safety Measures to be Taken
		Electrification	• Signs should be put on the places with high voltage. • Electric system should be designed to prevent electric leakage and electrification. • Water pipes should be put below the electric lines if the water pipes cross the electric lines.

1.3.10 Environmental Monitoring Plan

Environmental management will be appropriately fulfilled by applying the same system based on a BPW monitoring plan after the facilities start their operation. For items that may be negatively impacted, monitoring would be conducted as shown in **Table 1.29** below.

Table 1.29 Environmental Monitoring Plan

Item	Monitoring Item		Location	Method	Frequency	Responsible Organization	Cost (USD)
During Construction Phase							
Air Quality	Dust		Around the construction site	Visual Inspection	Once a day	MPIIC	Included in the Construction Cost
Water Quality	SS (Suspended Solids)	(Criteria) 200mg/L	At discharge point to outside the site boundary	Portable SS meter	Once a day	MPIIC	Included in the Construction Cost
		25mg/L	Sampling spots at the river (SW-B and RW-A)				
Wastes	Wastes generated by the construction work		M-Dock Landfill	Report from the Construction Contractor	Once a month	MPIIC	Included in the Construction Cost
	Residual Soil		Stockpile site prepared by the Palauan National Government				
Livelihood	Based on A-RAP***		N/A	Based on A-RAP***	Based on A-RAP***	Based on A-RAP***	Based on A-RAP***
Heritage	Relocation of War Historical Site		Construction site	Report from BPW or a sub-contractor of BPW	Before commencement of the Project	MPIIC	BPW
Working Conditions	Items shown in **Table 1.28**		Construction site	Report from the Construction Contractor	Once a month	MPIIC	Included in the Construction Cost
Accidents	Slope for cut and embankment work		Construction site and construction plan	Construction plan/drawings/ Bill of Quantities	Properly conducted	MPIIC	Included in the Construction Cost
	Construction duration						
	Construction work during rain						
During Operation Phase							
Air Quality	Dust		Around the site	Visual Inspection	Once a day	MPIIC	Included in the Operation Cost
	Methane and Hydrogen Sulfide		Inside the site (Gas exhausted pipes)	Gas Analyzer			
Water Quality	Transparency		At discharge point to outside the site boundary	Transparency meter	Time of discharge from the leachate pond	MPIIC	Included in the Operation Cost
	Temperature	(Criteria) -	Sampling spot at the river (SW-B and RW-A)	Sampling test	Once a half year (from completion of landfill		
	Color	-					
	pH	6.5-8.5					

Item	Monitoring Item		Location	Method	Frequency	Responsible Organization	Cost (USD)
	COD	3.0 mg/L			up to stabilization of leachate quality)		
	Transparency	5% change to natural condition					
	pH	Detection of abnormal value	Leachate Pond	pH meter	Once a week		
	EC			EC meter			
	pH		Monitoring wells (No. 1 & No. 2)	pH meter	Once a month		
	EC			EC meter			
	pH		Rain Ponds (No. 1 & No. 2)	pH meter	Once a month		
	EC			EC meter			
Soil Contamination	pH (same as "Water Quality")		Monitoring wells (No. 1 & No. 2)	pH meter	Once a month	MPIIC	Included in the Operation Cost
	EC (same as "Water Quality")			EC meter			
Odor	Number of complaints about odor from residents		N/A	Report by BPW	Properly conducted	MPIIC	Included in the Operation Cost
Management of Abandoned Site	Including the above items "Air Quality" and "Water Quality"		Same as on the left	Same as on the left	Same as on the left	Same as on the left	Same as on the left
Working Conditions	Items shown in **Table 1.28**		Inside the site	Report from BPW	Once a month	MPIIC	Included in the Operation Cost
Accidents	Number of reported accidents		Inside the site	Report from BPW	Once a month	MPIIC	Included in the Operation Cost

Legend: N/A: Not applicable

Note: * When the project is made more specific, monitoring items will be determined after further identification of waste composition.

** When required treatment methods for hazardous wastes are determined, monitoring methods will be considered.

*** The Abbreviated Resettlement Action Plan (A-RAP) for Project for Construction on New National Landfill in the Republic of Palau which was prepared by Bureau of Public Works, Ministry of Public Infrastructure, Industry and Commerce on 13th April, 2018. .

1.3.11 Stakeholder Meetings

Total of two stakeholder meetings was held for the residents of Aimeliik State. The contents of the two meetings are summarized in **Table 1.30**.

Table 1.30 Summary of Stakeholder Meetings

No.	Contents
The 1st Meeting	Date and Time: November 15, 2016, 6:00PM – 9:00PM Location: Community Center, Aimeliik State Number of Participants: 26 residents Discussions: BPW explained the conceptual design of the New National Landfill. Residents asked questions such as processes of siting and others. BPW answered to the questions. As a result, consensus was made for construction of the new landfill between BPW and the residents.
The 2nd Meeting	Date and Time: July 4, 2017, 6:00PM – 9:00PM Location: Community Center, Aimeliik State Number of Participants: Governor and 21 residents Explained by: Minister and director of BPW, Japanese Consultant Team Witness: EQPB Discussions: The Japanese Consultant Team explained the design concept of the New National Landfill. The residents commented to the processes of siting to select the location of new landfill in Aimeliik and requested to keep good environment and living conditions in Aimeliik State. The requests from the residents can be achieved as well by introducing mitigation measures which is included in the project concepts. No objection to the project was raised.

Photo 1.2 The Second Stakeholder Meeting Held on July 4, 2017

2. CONTENTS OF THE PROJECT

2.1 Basic Concept of the Project

2.1.1 Overall Goal and Project Objective

The strategy of SWM based on the NSWMP are presented as follows:

1) To promote the participation of stakeholders through activities, such as planning policy, capacity development, information sharing and education for residents;

2) To promote the reduction of solid waste; and

3) To improve the framework of the existing solid waste management and disposal.

Strategy number 3 above will be the overall goal of the Project. The construction of the new national landfill and procurement of equipment, implementation of sanitary landfill and improvement of the collection and transportation of solid waste will contribute to the achievement of the overall goal.

Hence, the objective of the Project is set out as "To improve collection, transportation and disposal of the solid waste properly in Koror State and ten (10) States in Babeldaob Island".

2.1.2 Basic Concept of the Project

To achieve the objective mentioned above, the Project shall consist of construction of the new national landfill and procurement of equipment. It is expected that the solid waste generated in Koror State and ten (10) States in Babeldaob Island will be collected, transported and disposed properly. The facilities and the equipment under the Japan's Grant Aid are proposed as follows:

Table 2.1 Specifications of the Facilities and the Equipment under the Japan's Grant Aid

Classification	Facilities and Equipment	Quantity	Specifications
Waste Disposal Facility	Sanitary Landfill	One Set	Fukuoka-Method (semi-aerobic landfill) Area: 8ha, Capacity: for 20 years
	Office and Garage	Each	Total floor area: Approximately 380m^2
Operation and Maintenance of the Landfill	Bulldozer	One	For Dry Land Operation Weight: 21t class
	Excavator	One	Bucket Capacity: 0.8m^3
	Wheel Loader	One	Bucket Capacity: 1.3m^3
	Dump Truck	One	Loading Weight: 8t
Collection and Transportation of the Solid Waste	Compactor Truck	Two	Loading Weight: 2t
Environmental Measurement of the Landfill	pH meter	One	Portable type
	Gas Analyzer	One	Analyzing item: Methane and Hydrogen Sulfide Portable type

2.2 Outline Design of the Japanese Assistance

2.2.1 Design Policy

(1) Basic Policy

Basic policy for the design of the Project is established through results of the Survey and discussions between the Team and the Palauan side, as follows:

1. High emergency and necessary facilities and equipment are targeted for the Project based on a solid waste management plan in Palau;
2. The target area of the Project is Koror State and Babeldaob Island;
3. Data of the projected population and amount of solid waste are prepared by the Survey;
4. The proposed landfill is to be a site in Aimeliik State selected by the Palauan side with required procedures such as holding stakeholders' meetings;
5. The life span of the new landfill site is more than 20 years in accordance with the Palauan request; and
6. Residual soil generated by construction work from the landfill site will be carried to a site secured by BPW and stored temporarily.

(2) Policy on Natural Conditions

(a) Consideration for Precipitation

Precipitation in Palau is more than from 3,000mm to 4,000mm per year. Since main construction works of the new landfill are excavation and embarkment of hilly area, safe management and prevention of muddy water flow during the construction phase should be considered seriously.

(b) Consideration for Earthquake

The earthquake that occurred on December 18, 2016 caused serious damage in Palau. The structure of buildings for the new landfill should follow the Japanese design standards of seismic structure in principle.

(3) Policy on Socio-Economic Conditions

EIA is required for the Project because of the requirement for EIS under the EQPB regulations. EA should therefore be finalized and submitted to the EQPB based on the result of the Survey and a draft design plan.

(4) Policy on Construction and Procurement

Since there are no standards of planning, designing or construction for architecture and civil engineering in Palau, the Japanese design standards are adopted in the Project.

Construction materials such as sand, aggregates, reinforcing bars and concrete are basically procured from Palau. However, some materials that are not available in Palau such as pipes, impervious sheets and drainage pumps are procured from Japan considering these quality and delivery date. In terms of labors, local contractors can provide them in Palau.

(5) Policy on the Applicability of Palauan Company

Since there are some local contractors in Palau that have experience in construction works involving Japan's Grant Aid Projects, they can provide adequate skilled labors for construction works, such as foreman, operator, carpenter and so on.

(6) Policy on Operation and Maintenance Condition of Implementing Agency

(a) Operation and Maintenance of New Landfill

Operation and maintenance (hereinafter referred to as "O&M") of new landfill and equipment will be implemented by the Division of Solid Waste Management (hereinafter referred to as "DSWM") under the BPW. DSWM plans to increase the number of staff after commencement of new landfill operation for the purpose of organizational strengthening. In addition, since high quality skills will be required for O&M of the landfill, such as measurement of waste amount, landfilling, leachate circulation and storage inside the landfill site, capacity development of those skills will be indispensable. This capacity development will be conducted by on-going J-PRISM Phase 2.

(b) Operation and Maintenance of Waste Collection and Transportation Vehicles

O&M of compactor trucks for the waste collection and transportation will also be conducted by DSWM. DSWM has been using construction equipment and some trucks in M-Dock Landfill and has a plan for increasing mechanics, and therefore, they already have maintenance skills for equipment procured under the Project.

(7) Policy on the Determination of Planning Scale of the Objective Facilities and Equipment

(a) Facilities

(i) Specifications of New Landfill

The "semi-aerobic landfill structure (Fukuoka Method)" is adopted for the structure of the new landfill as a standard landfill structure for municipal solid waste in Japan. This "semi-aerobic landfill structure" has also been adopted for the improvement work of existing M-Dock Landfill. Since the semi-aerobic landfill structure not only accelerates stabilization but also promotes aerobic decomposition of disposal waste, it can reduce the emission of greenhouse gases (GHGs) such as methane.

The semi-aerobic landfill structure is a structure that allows air to flow into the landfill layer by opening the outlet of the leachate collection pipe to the air in order to make the aerobic atmosphere inside the landfill. This landfill structure is also called "Fukuoka Method" because the technology was developed jointly by Fukuoka University and Fukuoka City. An image figure of the semi-aerobic landfill structure is shown in **Figure 2.1**. The Project was conducted with the support and cooperation of Professor Matsufuji who is studying Fukuoka method in Fukuoka University.

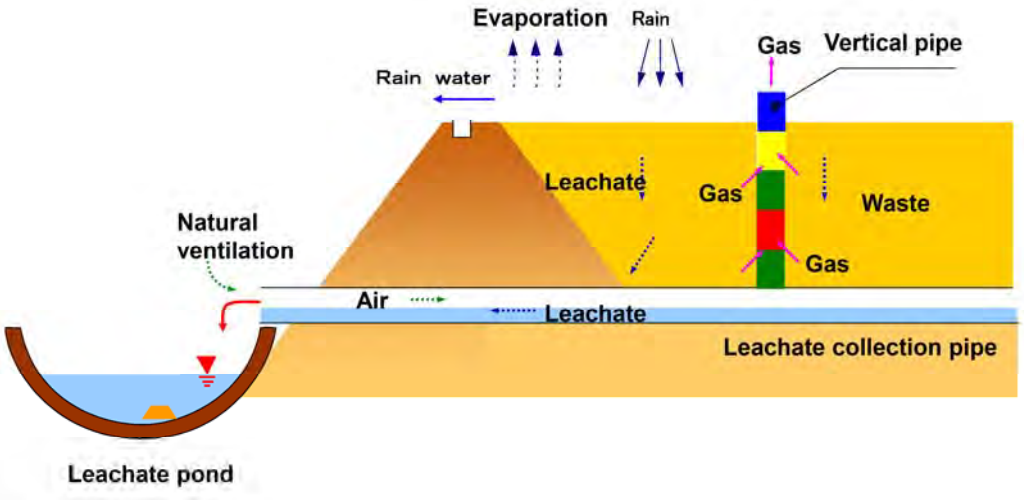


Figure 2.1 Conceptual Figure of Semi-Aerobic Landfill Structure

(ii) Landfill Location

The layout plan of the new landfill is decided based on the concept of securing at least 273,800m^3 of capacity of new landfill that is equivalent to the landfill volume for twenty years from year 2020 to year 2039. The basic concept for decision of layout plan is mentioned as follows:

- To build the landfill area at the center of the premises, and allocate the facilities by optimizing the use of the site to ensure the landfill capacity as much as possible;
- To utilize a hilly area located on the south side of the premises for landfilling because of securing a disposal site for the residual soil generated through construction work by Palauan side within 2km from the planned site;

- To allocate an administration building (including a weighing building) near the entrance of the site;
- To allocate a heavy machine garage near the landfill area;
- To divide a rainwater control pond into the northern side and the southern side of the landfill area since the land on the northern side of the landfill is limited;
- To allocate a leachate control pond on the downstream (northern side) of the landfill area and a leachate treatment facility is allocated further downstream of the pond; and
- To reduce the amount of leachate by dividing the landfill area into four (4) sectional cells and discharging the rainfall, which is fallen to the cell without the landfill waste, as rainwater downstream.

(iii) Leachate Control Work

Leachate control work is conducted in the landfill site and the leachate pond to prevent groundwater pollution.

(iv) Leachate Treatment

The basic policy of leachate treatment in the new landfill is depicted as follows:

- Normally, all amount of collected leachate is returned to the landfill site (leachate is circulated in the site, as illustrated in **Figure 2.2**), aiming to stabilize the characteristics of the leachate by efficient use of purification function in the landfill site;
- In case the leachate pond fills up to full capacity due to continuous rainfall and increase in the amount of leachate generated, the leachate will overflow and be discharged downstream of the site; and
- It will be confirmed that the effect of the leachate to the river water quality is minimal at the point which is holding the watershed area of 800ha (first water utilization point of the river) located downstream of discharging point of the landfill site (landfill area = 8ha)*.

* According to the *Guidelines of Living Environmental Impact Survey for Construction of Final Disposal Facility* (Ministry of the Environment, Japan, September 2006), the reference point along the river is to be a point that discharging water will be 100-fold dilution during low water level.

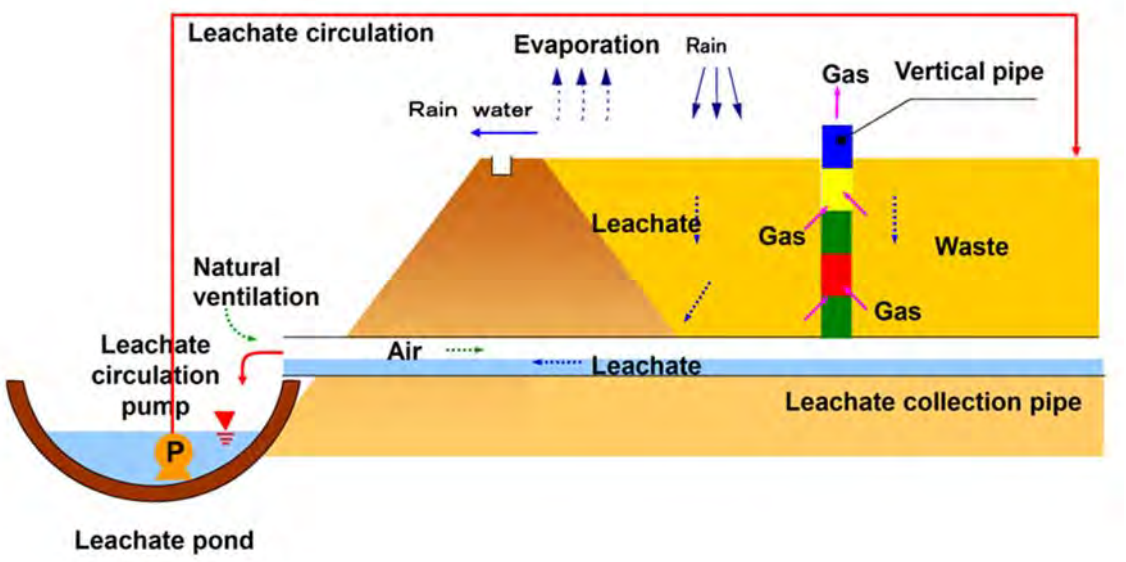


Figure 2.2 Conceptual Figure of Circulation Type Semi-Aerobic Landfill Structure

(v) Building

An administration building is constructed for O&M of this landfill. In addition, a heavy machine garage is constructed for parking and maintenance of heavy machine and vehicles. The basic policy of construction of the buildings is as follows:

- Many buildings in Palau are constructed as block masonry structure or steel frame structure. In the Project, the steel frame structure is adopted for the following reasons:
  - The N-value of the ground on the site is approximately five (5), so that building weight should be light as much as possible; and
  - The steel frame structure is easily applicable to earthquake-resistant construction.
- In the administration building, a room for the control of carrying solid waste and compilation of monitoring data is allocated. A bathroom, a shower room and a warehouse are also allocated; and
- The heavy machine garage is to be roofed to protect people, machine and vehicles from rain during maintenance work, and a storage room is allocated to store some tools.

(b) Equipment

Equipment are selected considering their usage, present conditions of the existing heavy machine, staff and budget.

(8) Policy on Construction/Procurement Method and Implementation Schedule

(a) Construction Method and Implementation Schedule

Since a special construction method is not required for the civil works and architecture of the Project, the conventional method of construction is adopted.

Construction duration are 18 months in total including preparation work, temporary work, earthwork and construction of the administration building and the heavy machine garage.

(b) Procurement Method and Implementation Schedule

(i) Production Period of the Materials and Equipment

The production period of materials for construction and procured equipment is from two (2) to four (4) months and from four (4) to seven (7) months, respectively.

(ii) Transportation Period

Transportation periods of procured materials and equipment are two (2) months and the inspection of these materials and equipment requires another one month.

(iii) Procurement Period

The total duration of the procurement is estimated at from four (4) to eleven (11) months including two (2) to seven (7) months for placing order and production, and two (2) to four (4) months for transportation and some inspection.

2.2.2 Basic Plan

(1) General Plan

(a) Transition of the Contents of the Requested Plan

The contents of the original request from the Palauan side on August 2015 were compiled and examined, and confirmed in the course of discussions between the Palauan side and the Team on April 2017 (see **Appendix 4**). Based on the discussions, the contents of the Basic Plan were revised in consideration of the appropriateness of the requested facility and equipment in the Survey, and the revision is shown in **Table 2.2**.

Table 2.2 Comparison between the Original and Revised Request

Facilities/Equipment	Requested Quantity		Remarks
	Original	Revised	
A Waste Disposal Facility (including an administration building, a heavy equipment garage and a truck scale)	1	1	
B Heavy Equipment for O&M of the Landfill			
1. Bulldozer	1	1	
2. Excavator	1	1	
3. Wheel Loader	1	1	
4. Dump Truck	1	1	
C Vehicles for Collection and Transportation of the Solid Waste			
1. Compactor Truck	3	2	Refer to the following Item (a)
D Equipment for Environmental Measurement of the Landfill			
1. BOD meter	1	None	Refer to the following Item (b)
2. COD meter	1	None	Refer to the following Item (c)
3. pH meter	1	1	
4. Turbidity meter	1	None	Refer to the following Item (d)
5. Gas Analyzer	1	1	

(i) Revised Quantity of Compactor Trucks

Although the compactor truck is necessary for waste collection and transportation, two (2) trucks are enough to handle the waste generated from public facilities in Babeldaob Island.

(ii) Revised Quantity of BOD Meter

The Biochemical Oxygen Demand (BOD) has not been measured in Palau, and its instrument and chemical for measurement are expensive; therefore, the BOD meter is out of scope of the Project since skill and budget constraints will result in interference with sustainability of the measurement.

(iii) Revised Quantity of COD Meter

The DSWM has measured the Chemical Oxygen Demand (COD) by using an inexpensive simplified water inspection product at M-Dock Landfill. The COD meter, therefore, can be introduced without any technical and financial problems. However, since the meter itself is not costly instrument but consumable equipment under the limited term, it would be unsuitable to be procured by the Japan's Grant Aid Scheme.

(iv) Revised Quantity of Turbidity Meter

It is confirmed that the DSWM keeps using a transparency meter instead of a turbidity meter because the Palauan environmental standards regulate to apply evaluation of transparency for the measurement of a degree of muddy water. Currently, the transparency meter can still be utilized for the measurement, so that it is judged that additional meter is not required.

(b) Classification of the Planning Facilities

The final disposal facility of the Project is classified into main facilities, administration facilities and ancillary facilities, as enumerated in **Table 2.3**.

Table 2.3 Classification of the Final Disposal Facility of the Project

Classification of Facility		Name of Facilities subject to the Construction Work	Demarcation of Work
Main Facilities			
	Landfill		Civil Work
	• Waste Retaining Structure	Earth dike	
	• Leachate Control Work	Cement improved soil, Seepage control sheets	
	• Leachate Collection Facility	Leachate collection pipes	
	Stormwater Drainage Facility	Stormwater drain, Rain water collection pipes, Rain ponds	
	Gas Exhausted Pipe System	Gas exhausted pipes (Slope-type and Vertical-type)	
	Leachate Treatment Facility	Leachate pond, Leachate circulation system, Leachate treatment methods	
Administration Facilities			
	Administration Facility	Administration building, Heavy machine parking garage	Architectural Work
	Waste Weighing Facility	Truck scale	Civil Work
	Monitoring Facility	Monitoring wells	
	Others	Recyclable material stockyard, Maintenance roads	
Ancillary Facilities			
	Access Road	Access Road	Civil Work
	Shatter Proof Fence	Shatter Proof Fence	
	Gate and Fence	Gate and Fence	

(c) Planning Scale and Quantity of the Facility

The planning scale of each facility and quantity of main works are described as follows:

Planning scale

Total Area : 8ha
Landfill Area : approximately 2.6ha
Landfill Volume : approximately 298,000 m^3 (waste volume)
Landfill Duration : approximately 20 years

Civil Work

Embankment : approximately 210,000m^3
Residual Soil : approximately 150,000m^3
Logging/Weeding : approximately 58,000m^2
Slope Shaping : approximately 53,000m^3
Groundwater Collection Pipes : approximately 1,100m
Rainwater collation Pipes : approximately 1,500m
Rain Pond : 2 locations
Leachate collection Pipes : approximately 940m
Leachate Pond : 1 location
Leachate Treatment Facility : 1set (Leachate circulation system and other treatment facilities)
Gas Exhausted Pipes : approximately 240m
Maintenance Roads : approximately 9,200m^2

Architectural Work

Administration Building : Steel structure, Floor area 194.76m^2
Heavy Machine Parking Garage: Steel structure, Floor area 196.56m^2

(2) Facility Plan

(a) Disposal Objects

Disposal objects are solid waste generated from 10 states in Babeldaob Island in addition to Koror State, and the disposal waste is combustible waste without intermediate treatment.

(i) Prediction of Waste Generation Amount

Prediction of the waste generation amount shall be conducted in accordance with the method commonly used in Japanese waste management plans by the following calculation formulas. The life span of the landfill site is to be set at 20 years from year 2020.

Household Waste: Waste Generation Ratio × Expected Population × 20 years
Commercial Waste: Predicted Daily Waste Generation Amount × 20 years

The results of previous years' waste amount and composition survey (hereinafter referred to as "WACS") have been used in this prediction. In addition, the population prediction frame was formulated with reference to existing demographics and survey results. The prediction of commercial waste generation ratio including waste generated by tourists is made based on a result of the Project for Improvement of Water Supply System in Palau.

(ii) Household Waste

Waste Generation Ratio

The base year is assumed to be 2015 with the existing population data. Taking into consideration the differences in regional characteristics, waste generation ratios are determined by dividing the projected area into two locations: Koror State where comparatively urbanized area and tourism facilities exist and Babeldaob Island where there are many comparatively undeveloped regions.

As a result, the generation ratio of Koror State is estimated at 0.473kg/Capita/day. Since the generation ratio in Airai State has an extremely lower value than that of the other states in Babeldaob Island, the generation ratio for Babeldaob is estimated excluding the value in Airai. Therefore, the results of Ngaraard, Ngchesar and Ngardmau where the survey of garbage generation by J-PRISM was conducted was used for the estimation and set to 0.407 kg/Capita/day.

Prediction of Household Waste Generation Amount

Estimated examples of existing survey results etc. are summarized based on population as this is a factor particularly influencing the transition of household waste. The population in Palau is decreasing from 2005 due to the background of population outflow caused by adolescents' advancement and employment. The population transition from year 1980 to 2015 is shown in **Table 2.4**.

Table 2.4 Trends of Population in Koror and Babeldaob

Area	1980	1990	1995	2000	2005	2012	2015
Koror	7,625	10,501	12,299	13,303	12,676	11,665	11,723
Babeldaob	3346	3594	3903	4867	5877	5125	5234
Total	10,971	14,095	16,202	18,170	18,553	16,790	16,957

Source: Bureau of Budget & Planning, Republic of Palau

Assuming that the demographic projection is made based on a frame showing a decreasing trend in the long term, it would result in shortage of landfill capacity in the future. To avoid this, it is predicted that the population will remain flat at 2015 level after 2020. Consequently, the household waste generation amount is assumed to be flat at the level of 2015, and the household waste generated in Koror State will be 5.54t/day and that of the 10 States in

Babeldaob Island will be 2.13t/day, therefore, a total will be 7.67t/day from the year 2020 to 2044, as shown in **Table 2.5**.

Table 2.5 Projection of Household Waste Generation Amount

Year	Daily Household Waste Generation Amount (t/day)		
	Koror (a)	Babeldaob (b)	Total (c)
2020	5.54	2.13	7.67
2021	5.54	2.13	7.67
2022	5.54	2.13	7.67
2023	5.54	2.13	7.67
2024	5.54	2.13	7.67
2025	5.54	2.13	7.67
2026	5.54	2.13	7.67
2027	5.54	2.13	7.67
2028	5.54	2.13	7.67
2029	5.54	2.13	7.67
2030	5.54	2.13	7.67
2031	5.54	2.13	7.67
2032	5.54	2.13	7.67
2033	5.54	2.13	7.67
2034	5.54	2.13	7.67
2035	5.54	2.13	7.67
2036	5.54	2.13	7.67
2037	5.54	2.13	7.67
2038	5.54	2.13	7.67
2039	5.54	2.13	7.67
2040	5.54	2.13	7.67
2041	5.54	2.13	7.67
2042	5.54	2.13	7.67
2043	5.54	2.13	7.67
2044	5.54	2.13	7.67
Remarks	J-PRISM	J-PRISM	(a)+(b)

(iii) Commercial Waste

Waste Generation Ratio

The value obtained from the WACS conducted by J-PRISM Phase 2 in June 2017 will be used for the current basic amount of waste generated from the commercial sector in Palau. The amount of commercial waste is calculated as the total amount of waste excluding households waste. In addition, although commercial waste includes green waste like cutting plants and leaves, the green waste will promote composting for agricultural purposes. As for used tires, they are being recycled and converted to fuel after the crushing process; this has been promoted since year 2016. In consultation with BPW, the green waste and used tires should be excluded from the prediction amount delivered to the landfill site. The generation ratio of commercial waste, therefore, is estimated as shown in **Table 2.6**.

Table 2.6 Generation Ratio of Commercial Waste

Item	Data from J-PRISM**
Daily Amount (a)	27.05 t/day
Ratio of Household Waste	36.7% (Compactor19.6% + Household17.1%)
Ratio of Commercial Waste (b)	63.3%
Daily Amount of Commercial Waste (c) = (a) × (b)	17.12 t/day
Coefficient of Variation of Number of Visitors (d) *	0.99 (June 2016)
(c) ÷ (d)	17.29 t/day

Item	Data from J-PRISM**
Amount after Reduction of Recyclables Amount (0.61 t/day)**	16.68 t/day
Amount after Reduction of Green Waste Amount (7.5%) and Tires (3.2%) (×0.893)	14.89 t/day

Source: * Calculated on the data of Visitor Arrival Statistic, Palau Visitors Authority 2008-2016
** J-PRISM Phase 2 (June 2017)

Prediction of Amount of Commercial Waste

Since the contribution rate of tourism industry is considered to be very large in the Palauan economy, the future forecast of commercial waste generation is considered to reflect appropriately the future estimation of the number of tourists. The J-PRISM forecast value as shown in **Figure 2.3** is adopted as judging that the predicted value based on the GDP (Gross Domestic Products) properly represents the Palauan economic index including tourist waste.

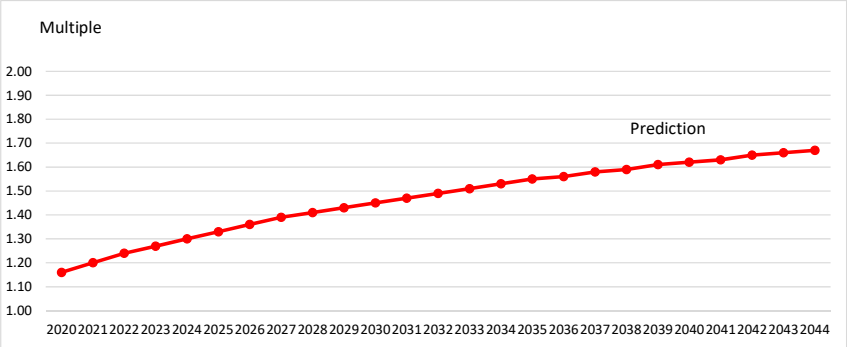


Figure 2.3 Prediction of Commercial Waste

Source: J-PRISM Phase 2 (June 2017)

Based on the J-PRISM forecast value, the number of tourists and business garbage in 2044 will be 1.67 times as of 2017, and the amount of commercial waste generated is estimated to be 24.9t/day as shown in **Table 2.7**.

Table 2.7 Prediction of Amount of Commercial Waste

Year	Multiple (a)	Predicted Amount of Commercial Waste (t/day)
2020	1.16	17.3
2021	1.20	17.9
2022	1.24	18.5
2023	1.27	18.9
2024	1.30	19.4
2025	1.33	19.8
2026	1.36	20.3
2027	1.39	20.7
2028	1.41	21.0
2029	1.43	21.3
2030	1.45	21.6
2031	1.47	21.9
2032	1.49	22.2
2033	1.51	22.5
2034	1.53	22.8
2035	1.55	23.1
2036	1.56	23.2
2037	1.58	23.5
2038	1.59	23.7
2039	1.61	24.0
2040	1.62	24.1

Year	Multiple (a)	Predicted Amount of Commercial Waste (t/day)
2041	1.63	24.3
2042	1.65	24.6
2043	1.67	24.7
2044	1.67	24.9
Remarks	As the value of 2015 is to be 1.00.	14.89 t/day as of 2015×(a)

(iv) Total Predicted Amount of Waste Generation

As the results of estimation of the household waste and business waste amounts, the total amount of waste generated during the service period is shown in **Table 2.8**.

The annual amount of waste generated is 9,114t/year in 2020, but it is expected to exceed 10,000t/year in 2025 and 11,596t/year in 2040. Also, the cumulative amount of garbage generated during the 15 years from 2020 to 2040 is 222,204 t, and the cumulative amount of garbage generated in 20 years from 2020 to 2044 is estimated to be 269,355 t.

Table 2.8 Total Predicted Amount of Waste Generation

Year	Daily House-hold Waste (t/day)	Daily Commercial Waste (t/day)	Daily Waste Generation (t/day)	Annual Waste Generation (t/year)	Accumulated Waste Amount (t)
2020	7.67	17.3	24.97	9,114	9,114
2021	7.67	17.9	25.57	9,333	18,447
2022	7.67	18.5	26.17	9,552	27,999
2023	7.67	18.9	26.57	9,698	37,697
2024	7.67	19.4	27.07	9,881	47,578
2025	7.67	19.8	27.47	10,027	57,605
2026	7.67	20.3	27.97	10,209	67,814
2027	7.67	20.7	28.37	10,355	78,169
2028	7.67	21.0	28.67	10,465	88,634
2029	7.67	21.3	28.97	10,574	99,208
2030	7.67	21.6	29.27	10,684	109,892
2031	7.67	21.9	29.57	10,793	120,685
2032	7.67	22.2	29.87	10,903	131,588
2033	7.67	22.5	30.17	11,012	142,600
2034	7.67	22.8	30.47	11,122	153,722
2035	7.67	23.1	30.77	11,231	164,953
2036	7.67	23.2	30.87	11,268	176,221
2037	7.67	23.5	31.17	11,377	187,598
2038	7.67	23.7	31.37	11,450	199,048
2039	7.67	24.0	31.67	11,560	210,608
2040	7.67	24.1	31.77	11,596	222,204
2041	7.67	24.3	31.97	11,669	233,873
2042	7.67	24.6	32.27	11,779	245,652
2043	7.67	24.7	32.37	11,815	257,467
2044	7.67	24.9	32.57	11,888	269,355
Remarks	Table 2.5	Table 2.7	Household + Commercial	×365days	Accumulated

(v) Required Capacity of New Landfill

Since the Palauan side requested that the landfilling period of the new landfill site should be at least 20 years or more, the necessary landfill capacity secures more than 20 years from 2020 to 2039.

As the summarized result of projection of solid waste generation amount, if the landfill period of this new landfill is designed for 20 years from 2020 to 2039, the generated waste amount during this period will be projected to be 210,608 t refer to **Table 2.7**. Therefore, the landfill amount of the waste is calculated here which is necessary for landfill disposal for 20 years from 2020.

The apparent specific gravity of landfill waste is different depending on the type of waste, a degree of compaction at the time of landfilling, and the situation of decomposition or consolidation settlement after disposal, etc. Here, the volume conversion factor (m^3/t) is designated for conversion of the necessary landfill amount calculated on a weight basis into the capacity basis.

With reference to Japanese literature and since the landfill waste of this new landfill is combustible waste, the required landfill capacity of waste is about 273,800m^3 (210, 608 t × 1.3m^3/t = 273,790m^3) if the volume conversion factor is set as 1.3m^3/t. For this reason, the landfill capacity should be at least 273,800m^3 in the consideration of the layout plan of the new disposal site.

(b) Waste Retaining Structure

As the result of boring survey conducted near the proposed location of waste retaining structure, the geological condition at the waste retaining structure site seems to be soft ground that is spreading a layer of 10 m thick indicating less than five (5) of N-Value. Therefore, a concrete type of the retaining structure like a gravity type of concrete dam will require pile foundation. Additionally, considering the landscape after completion of landfilling, an earth dam will be preferable because a slope of the earth dam can be greening.

(c) Leachate Control Work

As the result of boring survey conducted at eight (8) points in the project site of the new landfill, the geological condition at the project site came out as follows:

- From ground surface up to 10-20m depth, there is a red-brown/yellow-brown colored clay layer formed by rock weathering;
- Under the clay layer is approximately 1-5m thickness tuff breccia with crack; and
- Further lower layer is hard tuff breccia without crack.

Since the coefficient of permeability of these all layers are below 1×10^{-5}m/s and the geological condition at the project site can be evaluated as low permeability, installation of seepage control sheets is not required in the new landfill. However, in order to prevent the leakage of leachate from the crack of tuff breccia under the clay layer, the crack area should be replaced by low permeability cement improved soil. The longitudinal section drawing of the new landfill is presented in **Figure 2.4**. The colored layer shown in this drawing is the tuff breccia with crack. The area indicated by a red colored dot line is excavated approximately 5m thick and replaced by cement improved soil.

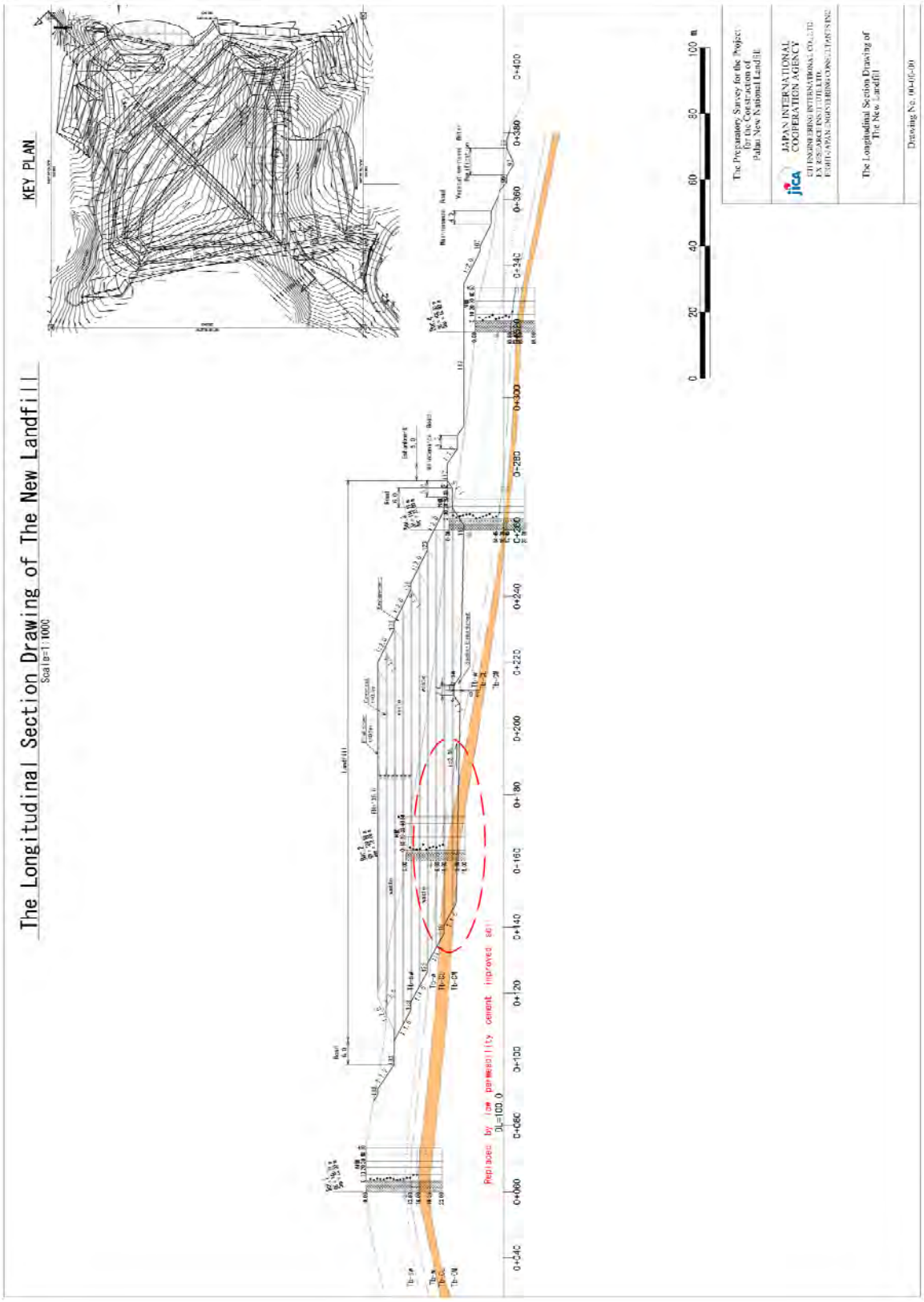


Figure 2.4 Replacement Area of Improved Cement Soil

(d) Leachate Treatment System

(i) Leachate Treatment System in the New Landfill

As mentioned in the basic policy of the leachate treatment, the circulation type semi-aerobic landfill structure will be adopted to the new landfill as illustrated in **Figure 2.2**. Leachate generated from the landfill site is thus circulated or returned to the landfill in principle as shown in **Figure 2.5**. The returned leachate will evaporate at the landfill, so the amount of leachate generated will be reduced. The leachate quality will be stabilized through purification by aerobic microbes in the landfill layer and filtration by landfill layer, gas ventilation shaft, and gravel filter layer over the leachate collection pipe.

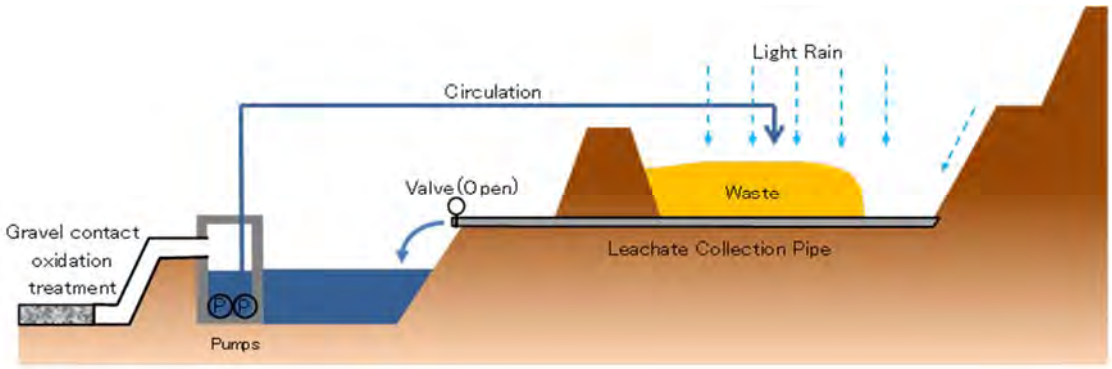


Figure 2.5 Circulation of Leachate to the Landfill Site

However, in case of rising of water level in the leachate pond due to increase in rainfall amount, outlet valves must be closed to store the leachate within the landfill site temporarily. Simultaneously the leachate retained in the pond will be discharged downstream by a pump for treatment by gravel contact oxidation canal etc. then discharged outside the project site (see **Figure 2.6**).

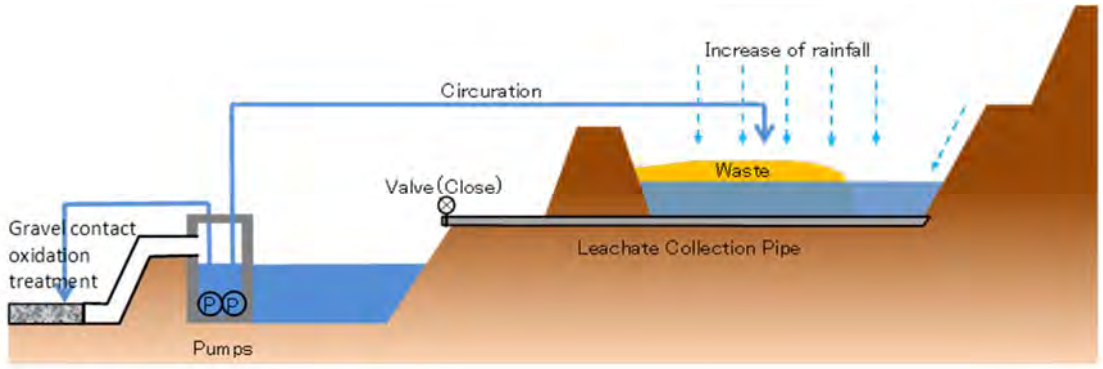


Figure 2.6 Temporary Storage of Leachate within the Landfill and Leachate Treatment

Moreover, in case of further continuous rainfall and the rising of leachate water level in the landfill as well, the leachate will overflow from the pit of leachate pond and discharged downstream (see **Figure 2.7**).

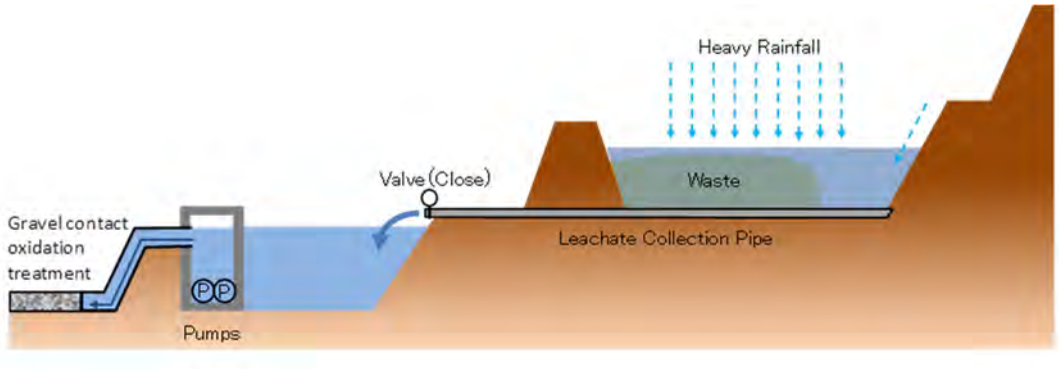


Figure 2.7 Situation of Leachate in Heavy Rainfall

(ii) Leachate Treatment Method

Assumed Treatment Capacity of the Leachate Treatment Method adopted to the New Landfill

As the result of water quality analysis of the leachate from M-Dock Landfill, it was found that the leachate water quality had approximately 5 to 10 times lower concentration than the common value shown in the design guideline of landfill site in Japan. It is assumed that this is caused by a lot of rainfall amount in Palau.

In addition, the result of water quality analysis of the leachate from a landfill in Solomon conducted by Professor Matsufuji had also lower value than the common value in Japan same as the result of M-Dock Landfill. Therefore, the leachate quality from the new landfill is assumed to be as shown in **Table 2.9.**

Table 2.9 Assumed Leachate Quality from the New Landfill

Item	Water Quality (mg/L)			
	BOD	COD	T-N	T-P
Measured value at M-Dock Landfill	30-40	83-160	42-130	1-1.1
One-Fifth of Water Quality shown in the Design Guideline in Japan	240	100	100	-
Assumed Value	240	160	130	1.1

To estimate the purification effect on the leachate by circulation of stored leachate in the leachate pond to the landfill site, a simplified circulation treatment model is considered as below:

Total Accumulated Load in the Leachate Pond
= [Accumulated Load from the Previous Day + Influent Load of the Day – Removal Load of the Day]

Influent Load = Influent Quality × Influent Quantity
Removal Load = Circulated Quantity × Removed Pollution Concentration (removal efficiency)

Note: Concentration of the leachate in the leachate pond can be calculated as accumulated load in the leachate pond divided by capacity of the pond.

As the result of daily in and out (repetitive) calculation by using of this model, it is assumed that the leachate can be purified up to the level of water quality shown in **Table 2.10** through circulation of leachate to the landfill.

Table 2.10 Calculation Result of Circulation Treatment Effect

Quality Indicator	Assumed Leachate Quality	Leachate Quality after Circulation
BOD	240 mg/L	120 mg/L
COD	160 mg/L	70 mg/L
T-N	130 mg/L	60 mg/L
T-P	1.1 mg/L	0.5 mg/L

In addition, since there is no standard for effluent after the treatment of leachate in Palau, effluent standards in Japan, World Bank, and US-EPA are comparatively listed up in **Table 2.11** as a reference.

Table 2.11 Comparison of Effluent Standards in Different Guidelines

Unit: mg/L

Item	Ministerial Ordinance in Japan[*1]	World Bank Guidelines[*2]	US-EPA Guidelines[*3]
BOD	60	30	140 (daily max) 37 (monthly average)
COD	90	125	
T-N	120 (max) 60 (daily average)	10	
T-P	16 (max) 8 (daily average)	2	

Source: [*1] Prime Minister's Office, Ministry of Health and Welfare, *Ministerial Ordinance for Technical Guidelines of Final Disposal Site for Municipal Waste and Industrial Waste*, No. 1, 1977
[*2] International Finance Corporation, *Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Environmental Wastewater and Ambient Water Quality, Table 1.3.1 Indicative Values for Treated Sanitary Sewage Discharges,* 2007.
[*3] Environmental Protection Agency, *40 CFR Parts 136 and 445 Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards for the Landfills Point Source Category: Final Rule,* 2000.

Table 2.10 and **Table 2.11** shows that the effluent quality, after these treatments can almost comply with effluent standards in other guidelines.

Projection of Impact on the Downstream Watershed Area by the Leachate

As mentioned previously in **Subsection 2.2.2(2)(d)**, in case of heavy rain and the rising of leachate water level in both the leachate pond and the landfill, the leachate will overflow from the leachate pond and be discharged downstream. Although the discharged leachate will flow into the canal and pond, the function of the purification in each treatment process is not to be expected due to a large flow rate.

Therefore, the projection of the impact of discharging the overflowing leachate from the leachate pond as is the original quality to the downstream watershed area is conducted. The projection complies with the projection method of evaluating the impact on surrounding environment based on Japanese laws and regulations.

According to the Japanese guidelines, the survey target area of the impact of the discharge from the landfill is an area (particularly, the watershed area including the point where the effluent is diluted a hundred times) supposed to be affected by the concentration of water quality above a certain level of impact. Accordingly, the projection of the impact on the river water quality should be conducted at the point which is holding 800ha watershed area downstream (2-3km downstream from the landfill, refer to **Figure 2.8**) in regard to the new

landfill area (8ha). The leachate quality discharged downstream is also assumed as water quality after circulation treatment shown in **Table 2.10**.

Under the above assumptions, the result of projection is presented in **Table 2.12**. From this, it is evaluated that the impact at the projection point can be neglected because of the dilution effect of river water. In other words, even if the leachate from the leachate pond overflowed due to heavy rain, the impact on the river water quality will be negligible.

Table 2.12 Result of the Projection of River Water Quality

Item	Assumed effluent leachate quality (Unit: mg/L)	Current river water quality (Unit: mg/L)	Projected river water quality in case of leachate overflow (Unit: mg/L)	Effluent standard in Palau (Unit: mg/L)	Ratio of projection against current quality
BOD	120	0.6	0.81	None	1.4
COD	70	2.8	2.9	None	1.0
T-N	60	0.1	0.21	0.75	2.1
T-P	0.5	0.007	0.009	0.2	1.3

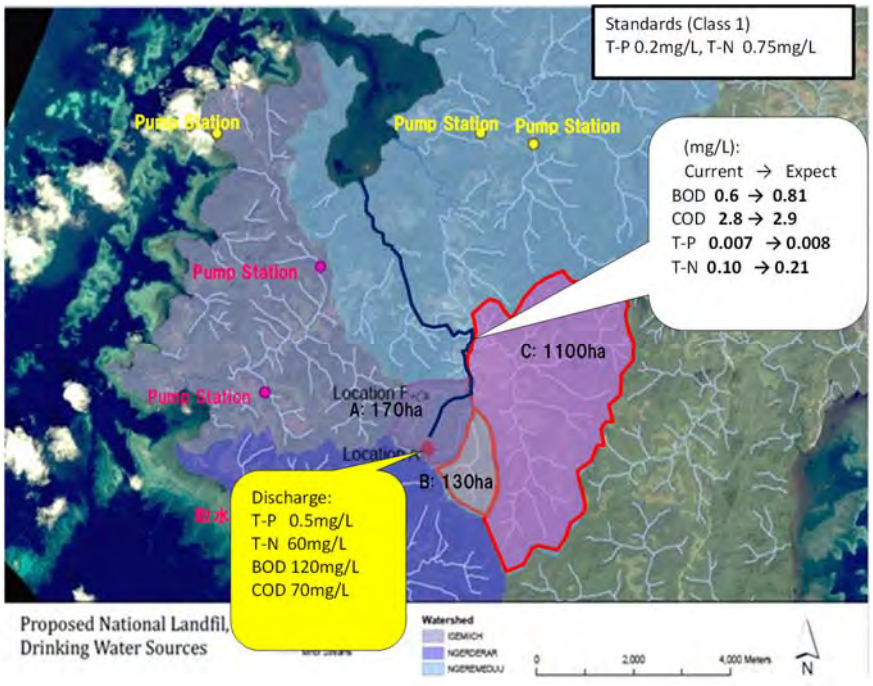


Figure 2.8 Projected Water Quality at Discharging of Leachate and Confluent to the Downstream River

Moreover, it is calculated that 21 times of overflow of the leachate from the pond in a year would occur under the same rainfall conditions of 2011 which had the largest rainfall amount, i.e. 5,481.3mm/year during the past 20 years. The capacity of the leachate pond, however, is designed as not to overflow under the rainfall conditions of 2014 which had an average rainfall amount of 3,537.7mm/year during the past 20 years.

Measures for Mitigation of the Impact on the Downstream of Watershed Area by the Leachate

As mentioned previously, leachate generated from the landfill basically returns to the landfill site. However, in case of rising of water level in the leachate pond due to an increase in rainfall amount, the leachate will be discharged downstream of the site. Although the discharged leachate does not affect the river water quality, the impact should be minimized as much as possible through installed treatment facilities before being discharged downstream.

Leachate treatment method to be adopted for the new landfill is a combination of three (3) treatment methods suggested by Professor Matsufuji of Fukuoka University, Japan. Each method is described as follows:

1) Gravel Contact Oxidation Treatment

Gravel contact oxidation method is a treatment method that aims at leachate purification by utilizing the activity of microbes attached on the surface of gravel. It is excellent at removal of BOD, SS, and T-N etc. In the method, the purification effect will be increased if the surface area of attached microbes becomes large. Since purification effect will be increased as well if the contact time of leachate with the gravel becomes longer, some partition walls are installed in the gravel filling canal for longer contact time of leachate with gravel.

2) Sand Filtration

Coral sands are filled up into a canal. SS in the leachate will be removed through flowing of leachate in this canal.

3) Vegetation-Based Water Purification

Vegetation-based water purification is a treatment method for the removal of contamination in the leachate by sedimentation, absorption to the soil, absorption and decomposition by the plants through the vegetated pond. In this method, BOD, SS, and nutrient such as N, P can be expected to be removed as well. Of this, since BOD and SS is removed in the previous process - gravel contact oxidation treatment and sand filtration -, removal of N and P is the main purpose of this process.

(e) Gas Exhausted Pipe

Since the gas exhausted pipe has a function of exhausting methane gas from the landfill layer to outside and taking air from outside into the landfill layer, it is important facility for semi-aerobic structure. Gas exhausted pipes are to be installed at thirteen (13) points according to the Japanese guideline for the performance of waste disposal site.

(f) Ancillary Facilities

(i) Administration Building

An administration building is constructed for O&M of this landfill. This building has an office space for conducting the management of delivered waste and recording the monitoring data, etc., a storage room for keeping tools and equipment for O&M of the landfill, and other facilities, such as toilets, shower rooms and locker rooms. The number of people working in the administration building is supposed to be 16 people including new staff to be assigned after starting the operation of new landfill. A truck scale is also constructed next to the administration building to measure the amount of waste delivered to the landfill and collect the disposal fee. The floor plan and elevation of the administration building are illustrated as shown in **Figure 2.9** and **Figure 2.10**, respectively.

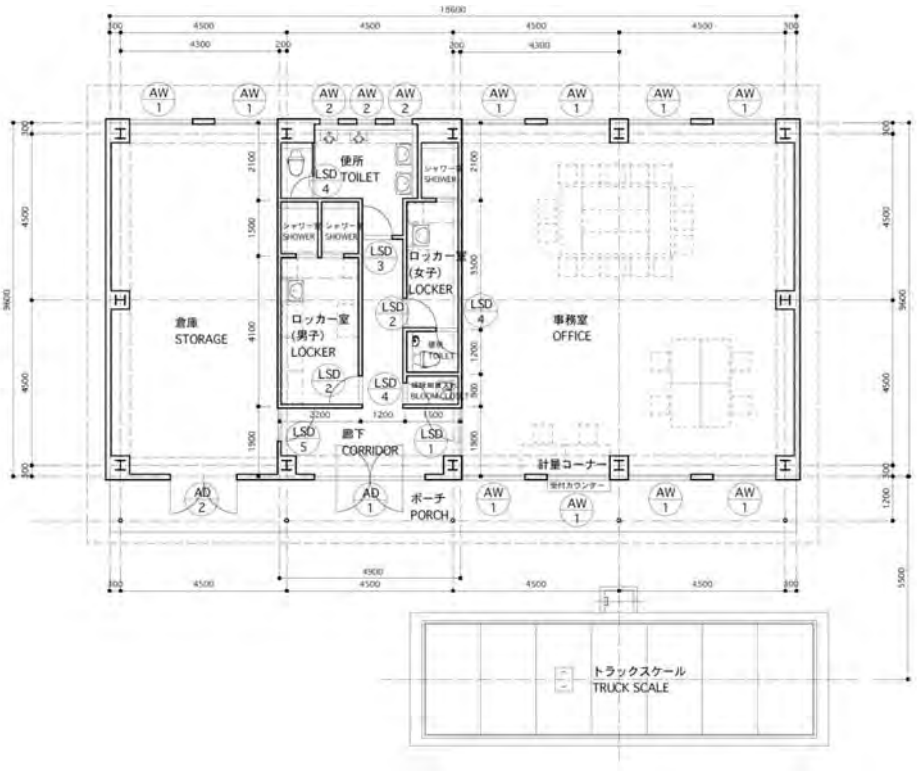


Figure 2.9 Floor Plan of the Administration Building

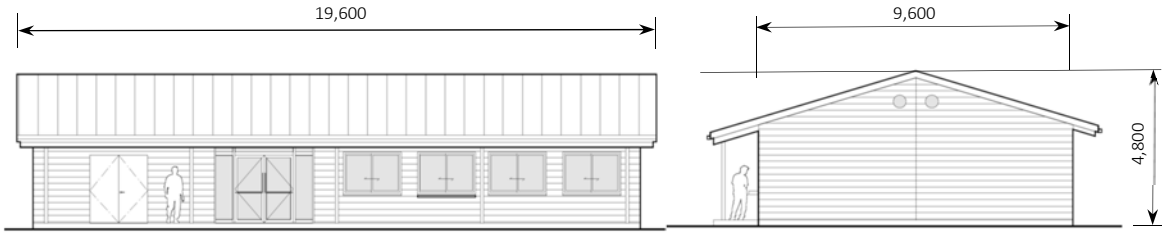


Figure 2.10 Elevation of the Administration Building

(ii) Heavy Machine Parking Garage

A garage is to be built for parking of heavy machine and vehicles such as Bulldozer, Excavator, Wheel Loader and Dump Truck. Roofing and the walls in three sides are installed also in order to inspect and maintain the vehicles in this garage. A warehouse is also constructed in the garage to store materials used for landfill operations. This garage is a steel frame structure same as the administration building. The floor plan and elevation of the heavy machine parking garage are presented in **Figure 2.11** and **Figure 2.12**, respectively.

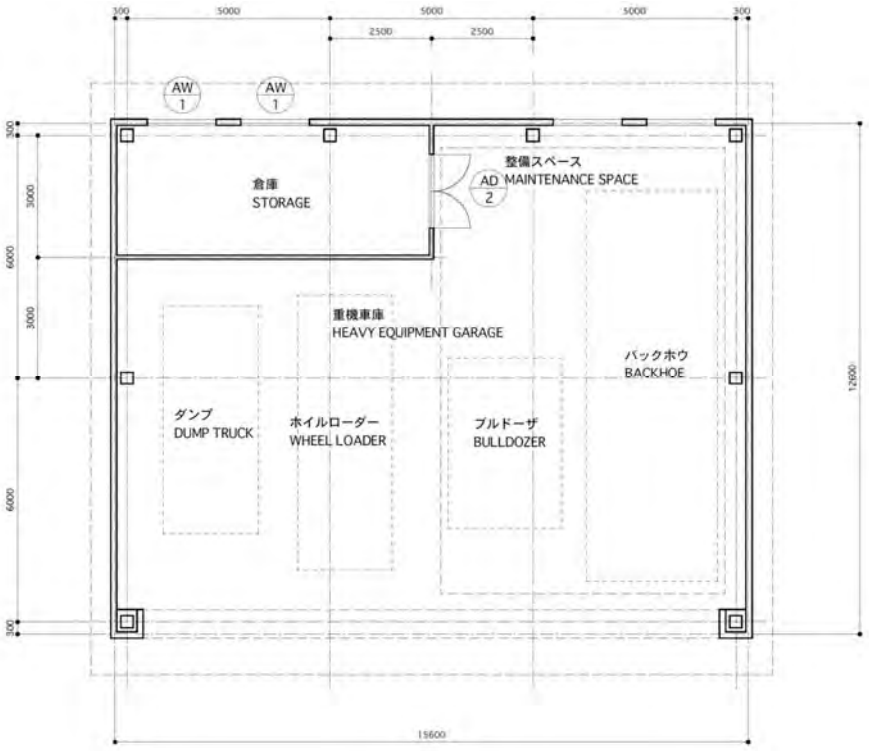


Figure 2.11 Floor Plan of the Heavy Machine Parking Garage

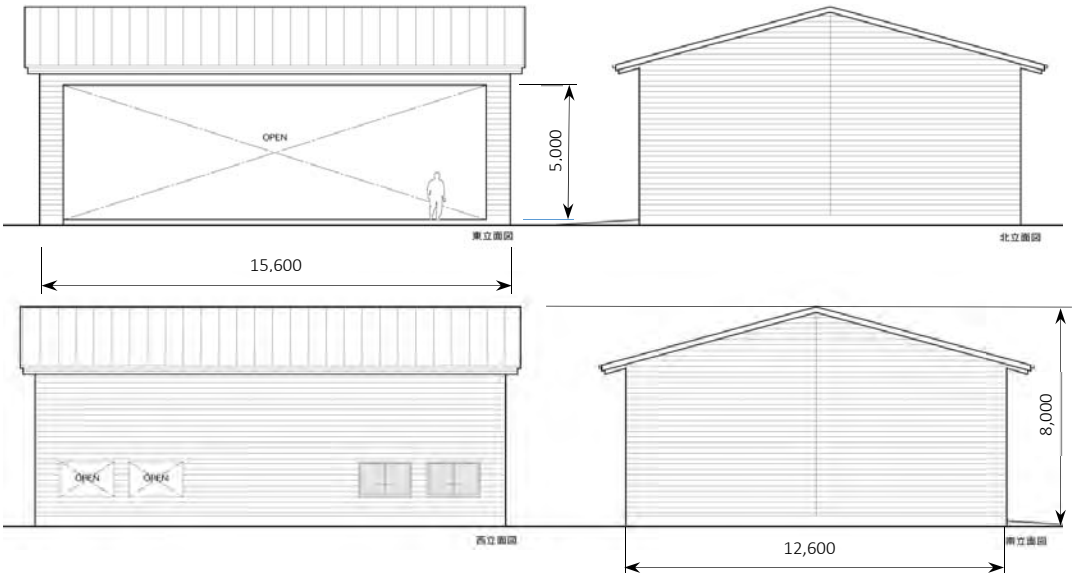


Figure 2.12 Elevation of the Heavy Machine Parking Garage

(iii) Waste Weighing Facility

The weight of waste carried into the landfill site should be measured and recorded by a truck scale installed near the gate. This is a principle management of the landfill site (refer to **Subsection 2.4.1, (2)(b)**). Considering the weight of waste collection vehicles currently used in Palau, the truck scale to be installed will have 40t measuring capacity.

(iv) Monitoring Facility

Two (2) wells will be constructed for groundwater monitoring: one for the upstream and the other for the downstream of the landfill site. The well at the upstream will be used the same well installed in the geological survey; on the other hand, the downstream well will be new since the well installed in the geological survey will be demolished during construction of the landfill. **Figure 2.13** shows the location of these monitoring wells.

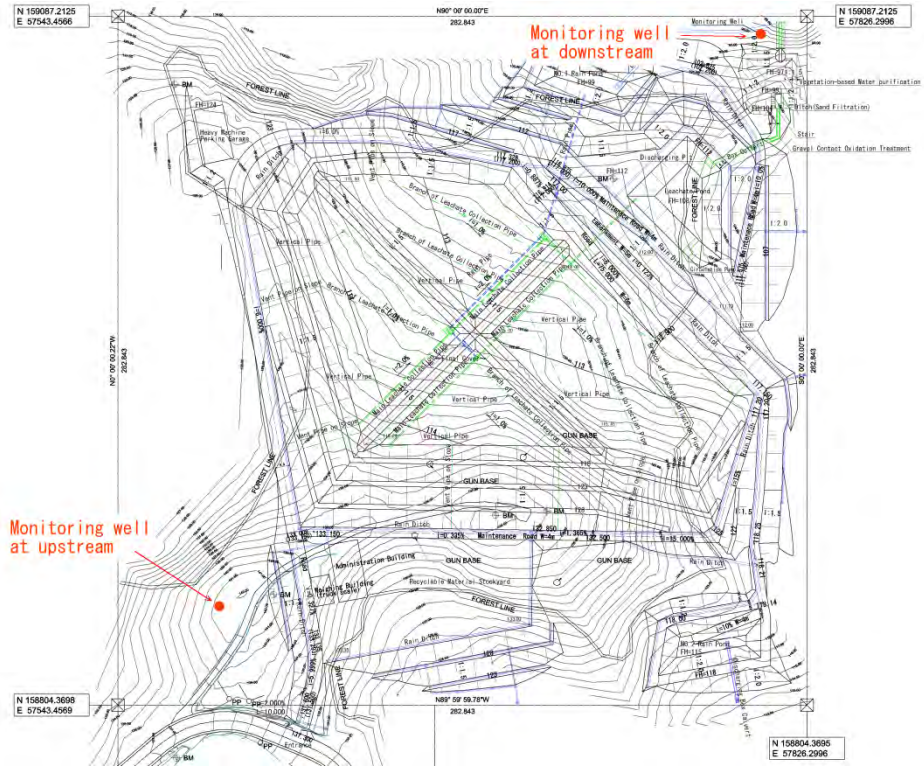


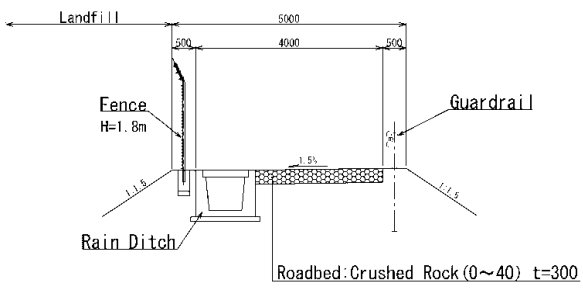
Figure 2.13 Location of Monitoring Wells

(v) Recyclable Material Stockyard

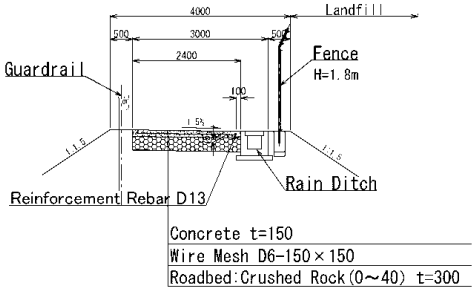
Currently, a private company contracted with Palauan Government is collecting iron mixed in the waste at M-Dock Landfill, and the Palauan side wants to continue this activity at the new landfill site. Also, since the Palauan side requested to set up a stockyard as a space for storage of recyclable materials other than iron mixed in the waste and to crush logged timber to be delivered in, a recyclable material stockyard is thus constructed including some working space for recovery of iron by a private company.

(vi) Maintenance Road

Maintenance roads are to be constructed for maintaining the leachate pond and desilting from two (2) rain water retention ponds. In addition, other maintenance roads will be built at the crown of the retaining structure, and the east and west side of the landfill site that are in circumference of the site without any accessibility. Typical cross sections of the maintenance road are presented in **Figure 2.14**.



Crown of the Earth Dam



Circumference of the Site (Eastern Side)

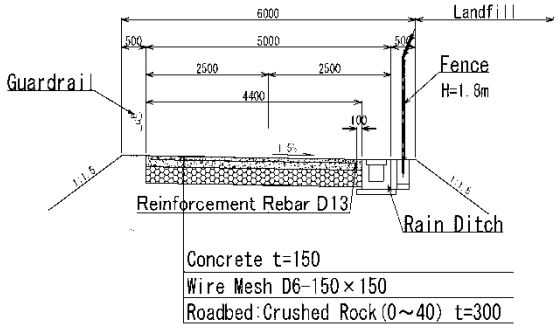
Figure 2.14 Typical Cross Section of Maintenance Road

Vehicles allowed to pass through the maintenance roads will be subject solely to maintain the landfill site and facilities; therefore, crushed rock pavement will be applied since the number of these vehicles is expected to be few. Concrete pavement, however, will be applied on the eastern side road to prevent rain from discharging the surface rock because of its steep slope at 15%.

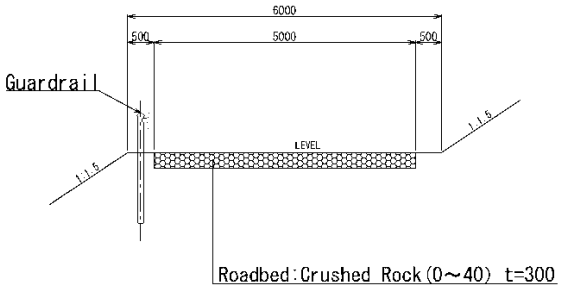
(vii) Access Road

Access roads will be planned to transport the waste into the landfill site, connecting from the entrance of the site through the weighing building to the northern direction at the western side of the site and finally reaching at the landfilling area near the retaining structure. Since the waste collection vehicles use the road on a daily basis, the slope should be less than 6.0%, two-way traffic should be secured, and concrete pavement should be made.

Only roads laying inside the landfilling area will be a crushed rock pavement type because these roads will be buried by the waste afterwards. **Figure 2.15** shows typical cross sections of the access road.



Outside the Landfilling Area



Inside the Landfilling Area

Figure 2.15 Typical Cross Section of Access Road

(viii) Shatter Proof Fence

Shatter proof fences are to be installed to stop wind from blowing the waste outside the site. Since it is expected that the wind blows ordinary from the downstream to the upstream of the site, the fence of 1.8m high will be built on the boundary between the site and the administration building. **Figure 2.16** shows an image of the shatter proof fence for reference.

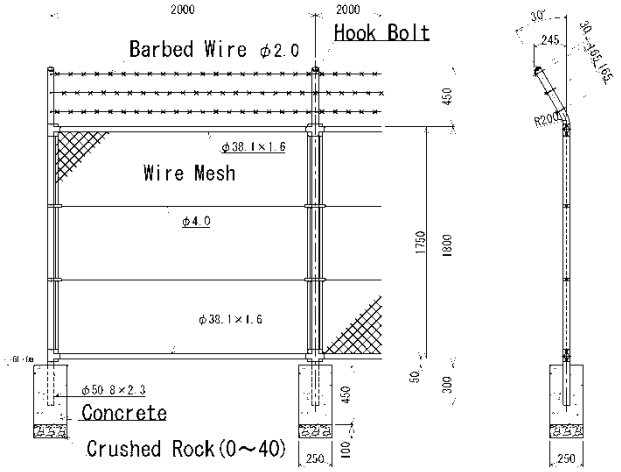


Figure 2.16 Image of Shatter Proof Fence

(ix) Gate and Fence

There are many high trees surrounding the proposed landfill site and it seems to be difficult for outsiders to enter the site due to its topographic conditions. Therefore, the whole fences will not be necessarily made but a gate as shown in **Figure 2.17** will be installed at the entrance of the site.

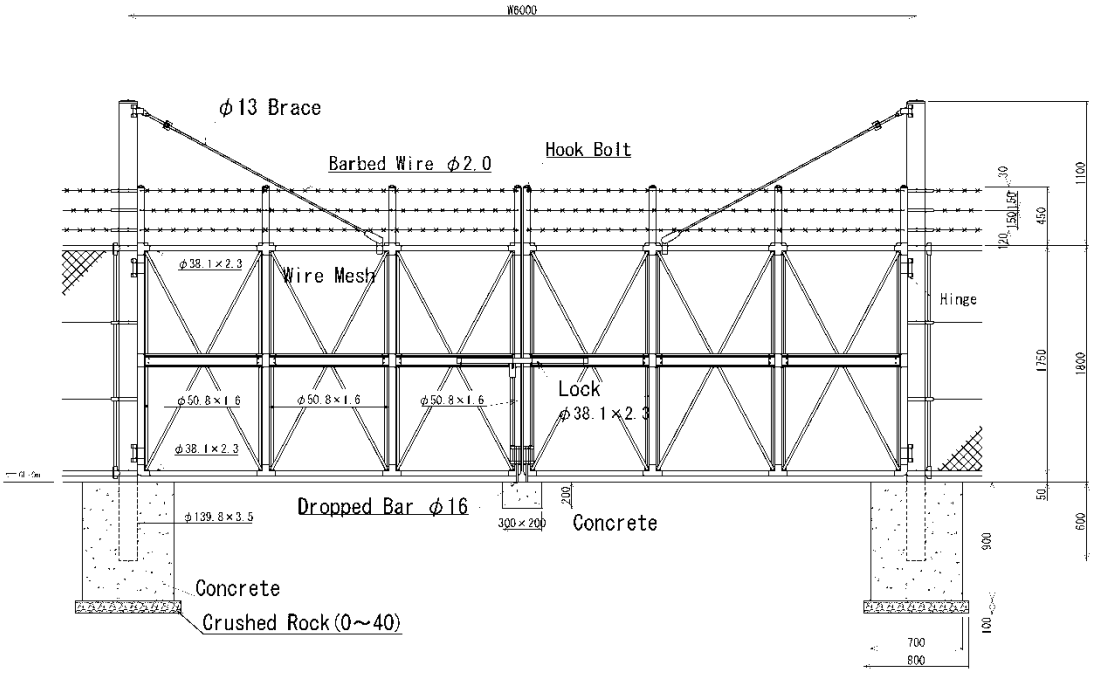


Figure 2.17 Image of Gate

At the leachate pond and rain water retention ponds, fences of 1.2m high as shown in **Figure 2.18** will be built to prevent people from falling into the ponds.

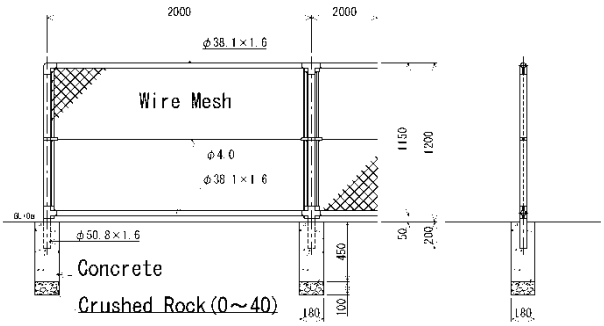


Figure 2.18 Image of Fence

The location of the gate and fences is presented in **Figure 2.19**.

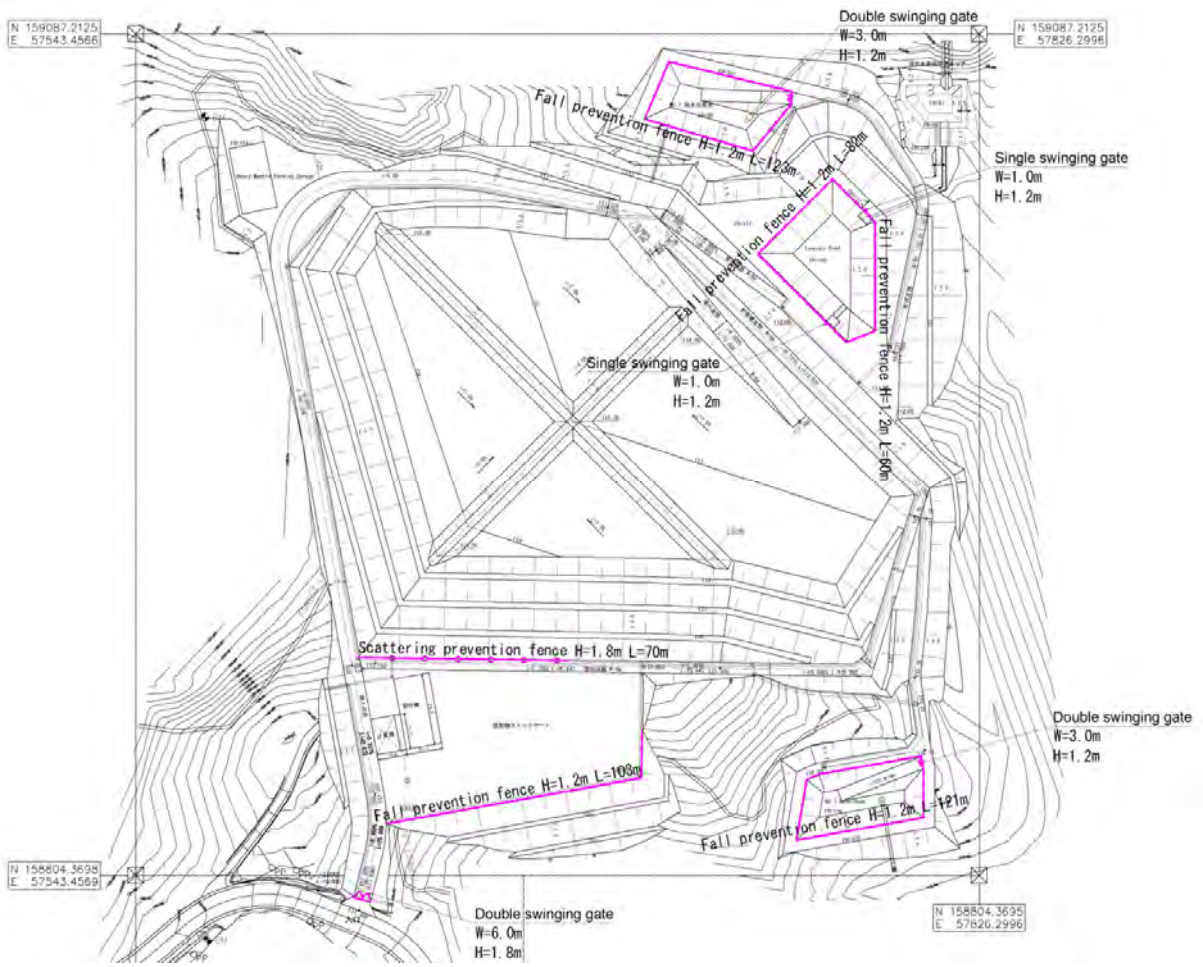


Figure 2.19 Location of Gate and Fence

(3) Equipment Plan

(a) Present Condition of the Existing Equipment

(i) Condition of Equipment for the O&M of the Exiting Landfill

One bulldozer and one excavator have been used for the O&M in the M-Dock Landfill. These machines were purchased few years ago as secondhand and their condition does not

look good recently. The current condition of each equipment is summarized as follows. Since the M-Dock Landfill is to be operated as a transfer station for collected waste after construction of the new landfill, the existing equipment is to be operated continuously in the M-Dock Landfill according to BPW.

Existing Excavator

Name: Komatsu PC120
Bucket Capacity: 0.5m^3
Used Period: Approx. 2 years (Purchased in 2015)
Condition: Good
Remarks:
It seems that the equipment capacity is not enough and 0.8m^3 bucket capacity may be appropriate.

Existing Bulldozer

Name: CAT D6
Machine Weight: 21t
Used Period: 4 years (Purchased in 2013)
Condition: Repair needed
Remarks:
Repairing is conducted by mechanic belonging to BPW

(ii) Condition of Equipment for the Waste Collection and Transportation

Koror State

Most of the waste carried into the M-Dock Landfill is generated in Koror State. Koror State has four (4) compactor trucks for the waste collection and transportation. The present condition of waste collection in Koror State is summarized in **Table 2.13**.

Table 2.13 Present Condition of Waste Collection in Koror State

Collection method	Collecting from 16 waste stations and each household by compactor trucks	
Personnel	Approx. 20 staff in Division of SWM, Bureau of Public Works, Koror State	
Collection frequency	Everyday Once per week at some waste station	
Collection charge	None	
Equipment	Four new compactor trucks purchased in 2017 One truck is for the reserve.	
Kinds of waste	Household: 25% and Commercial: 75%	

Babeldaob Island

Waste in each state of Babeldaob Island is collected from each household once a week. Each state has collection vehicles, but the condition of some vehicles is not good.

Table 2.14 Present Condition of Waste Collection of Each State in Babeldaob Island

State	Airai	Aimeliik	Ngadpang
Collection method	Directly from each household	Directly from each household	Directly from each household
Collection frequency	Once/week	Once/week	Once/week
Collection fee	None	None	$5/month/household
Collection vehicle	One used Compactor Truck (3t) operated for 4 years donated by Taiwan and One used Dump Truck (4t) operated for 8 years 	One used Compactor Truck donated by Koror State in 2017 with good condition 	One used Compactor Truck operated for 3 years with good condition 
State	Ngeremlengui	Ngardmau	Ngchesar
Collection method	Directly from each household	Directly from each household	Directly from each household
Collection frequency	Once/week	Once/week	Once/week
Collection fee	None	None	None
Collection vehicle	One used Compactor Truck donated by Koror State with good condition 	One used Dump Truck operated for 9 years which needs to repair 	One used Compactor Truck donated by Koror State in 2015 with good condition 

State	Melekeok	Ngiwal	Ngaraard	Ngarchlong
Collection method	Directly from each household		Directly from each household	Directly from each household
Collection frequency	Once/week	Once/week	Once/week	Once/week
Collection fee	None	None	None	None
Collection vehicle	One used Compactor Truck operated for 10 years with repairing		One used Compactor Truck operated for 3 years 	One used Compactor Truck operated for 10 years and One used Dump Truck operated for 10 years

Future Plan of Waste Collection and Transportation

Household waste in Koror State is to be collected the same as before by Koror State. According to BPW, household waste in Babeldaob Island is to be collected by private sector consigned by BPW and waste generated from government and public facilities is to be collected by BPW. This waste collection and transportation plan is to be finalized and confirmed by J-PRISM Phase 2.

(iii) Condition of Equipment for Environmental Measurement

There is no pH meter and gas analyzer owned by BPW.

(b) Selection of the Equipment Procured under the Project

(i) Bulldozer

Bulldozers are operated for levelling and compaction of waste and soil, and making embankment. One bulldozer with 21t operating weight and dry land type is currently operated in the M-Dock Landfill; therefore, the same type of bulldozer should be selected for easy O&M.

(ii) Excavator

Excavators are operated for excavating and collecting waste and soil and shaping slopes. Assumed volume of solid waste carried into the new site is 38m^3 per day and the volume of cover soil is 23m^3 per day, and the volume of solid waste and cover soil is thus 61m^3 per day in total. In addition to this ordinary work, the excavator will be used for embankment of retaining structures on upper layers. Considering these handling volumes, the bulldozer in the new site should be a type of bucket capacity of 0.8m^3, and this enables to work for 250m^3 waste and soil daily.

(iii) Wheel Loader

Wheel loaders are operated for loading cover soil and recyclable garbage and delivering woodchips. A wheel loader with 1.3m^3 bucket capacity should be selected to load wastes onto the 8t dump truck.

(iv) Dump Truck

Dump trucks are operated for delivering and covering soil and materials. Assumed cover soil volume is 23m^3 per day; therefore, a middle-size truck is enough for working and 8t dump truck should be selected to work effectively.

(v) Compactor Truck

Compactor trucks are operated for collecting and transporting solid waste from government offices and public facilities in each state of Babeldaob Island. A 2t-class truck should be selected for the effective work for the following reasons:

Existing volume of waste in each state of Babeldaob Island is less than 2t and volume of the waste generated at the public facilities in two states is to be delivered by one compactor truck (2t) per day. Therefore, waste collection days in 10 states in Babeldaob is to be 5 days and one compactor truck can collect and transport all the waste in Babeldaob in one week. Two compactor trucks are to be procured: one for operation and the other for reserve for repair and maintenance.

(vi) pH Meter

pH is useful indicator for measuring organic matter volume, aerobic/anaerobic condition and acid/alkaline condition. In addition, Electrical Conductivity (hereinafter referred to as "EC") is also useful indicator for measuring the amount of pollutant in water. Therefore, a handy type pH meter which can measure both pH and EC at the same time should be selected with considering usability at the site.

(vii) Gas Analyzer

Gas analyzing such as methane and hydrogen sulfide is necessary for worker's safety. For example, hydrogen sulfide is very poisonous and sometimes kills workers in Japan. A handy type gas analyzer should be selected with considering usability at the site.

(c) List of Equipment to be Procured

A list of selected equipment is shown in **Table 2.15**.

Table 2.15 List of Equipment to be Procured

No.	Equipment	Specification	Quantity	Purpose of the operation
1	Bulldozer	Operation Weight: 21t For Dry land	1	For levelling and compaction of waste and soil and making embankment
2	Excavator	Bucket capacity: 0.8m^3	1	For excavating and collecting waste and soil and shaping slope
3	Wheel Loader	Bucket capacity: 1.3m^3	1	For loading cover soil and recyclable garbage and delivering woodchips
4	Dump Truck	Loading Weight: 8t	1	For delivering and covering soil and materials
5	Compactor Truck	Loading Weight 2t	2	For collecting and delivering solid waste from public facilities in Babeldaob Island

Note: The equipment with more than one million Japanese yen for a single unit is listed up in the above table.

(d) Procurement Plan of the Spare Parts and Consumables

It seems to be difficult to procure the spare parts and consumables of the equipment in Palau because there are no agencies of the equipment in Palau. Therefore, spare parts and consumables for once or twice exchange (for 1 year) should be procured in the Project for the maintenance of the procured equipment.

2.2.3 Outline Design Drawings

A list of outline design drawings is presented in **Table 2.16**. Each drawing is shown in the following pages.

Table 2.16 List of Outline Design Drawings

Category	Title of Drawing	Number
Civil	Layout Plan of New Landfill	Figure 2.20
	Completed Landfill Plan	Figure 2.21
	Completed Landfill Longitudinal Section	Figure 2.22
Architectural	Office Floor Plan	Figure 2.23
	Office Elevation Plan	Figure 2.24
	Heavy Equipment Garage Floor Plan	Figure 2.25
	Heavy Equipment Garage Elevation Plan	Figure 2.26
Electrical and Mechanical Facilities	Electrical Facilities External Wiring Plan	Figure 2.27
	Electrical Facilities in Administration Building Feeder and Power Wiring Plan	Figure 2.28
	Electrical Facilities in Administration Building Lighting and Ventilation Wiring Plan	Figure 2.29
	Mechanical Facilities in Administration Building Piping Plan	Figure 2.30
	Mechanical Facilities in Administration Building Ventilation Plan	Figure 2.31
	Mechanical Facilities in Heavy Equipment Garage Power and Receptacle Wiring Plan	Figure 2.32
	Electrical Facilities in Heavy Equipment Garage Lighting and Ventilation Wiring Plan	Figure 2.33

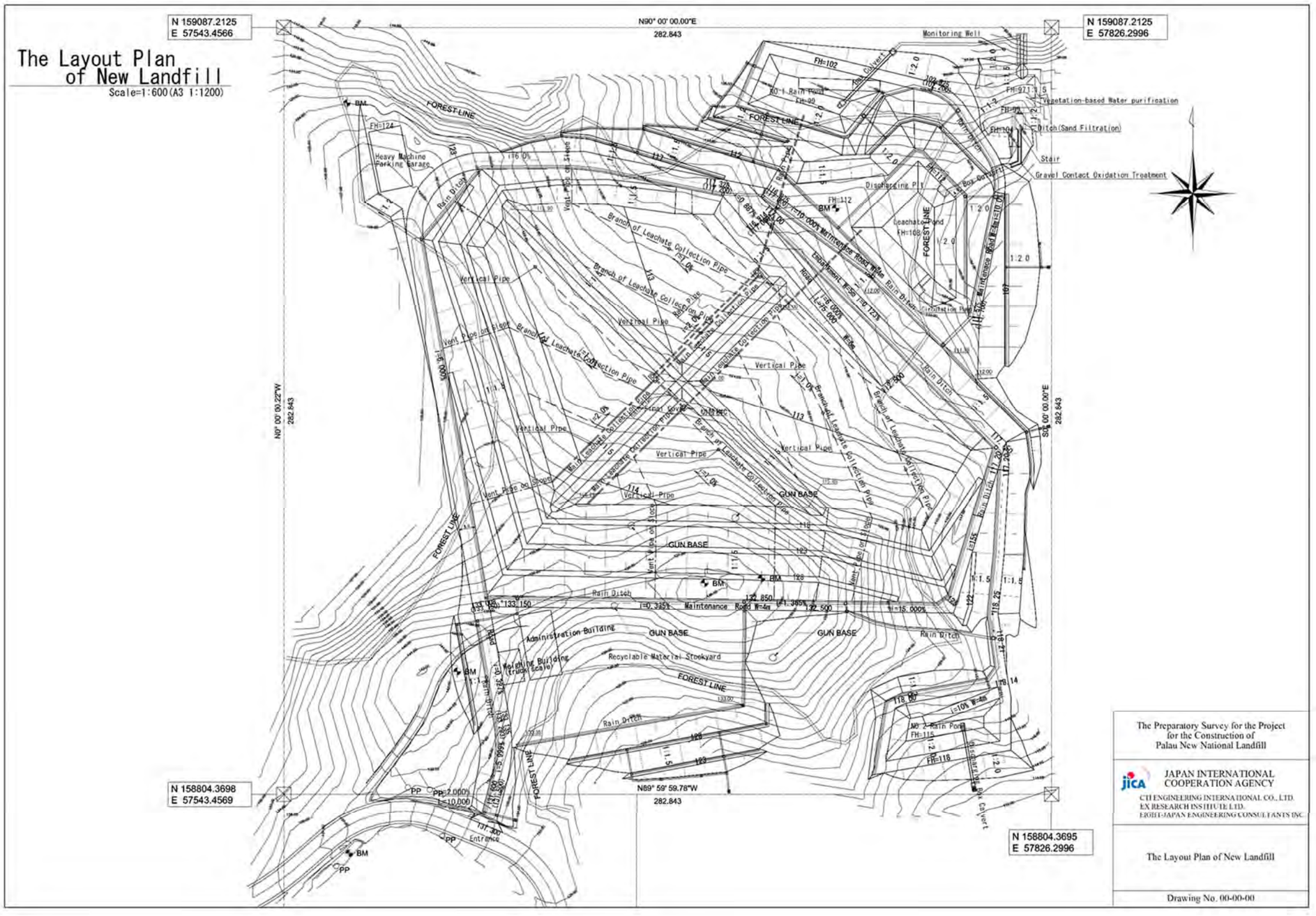


Figure 2.20 Layout Plan of New Landfill

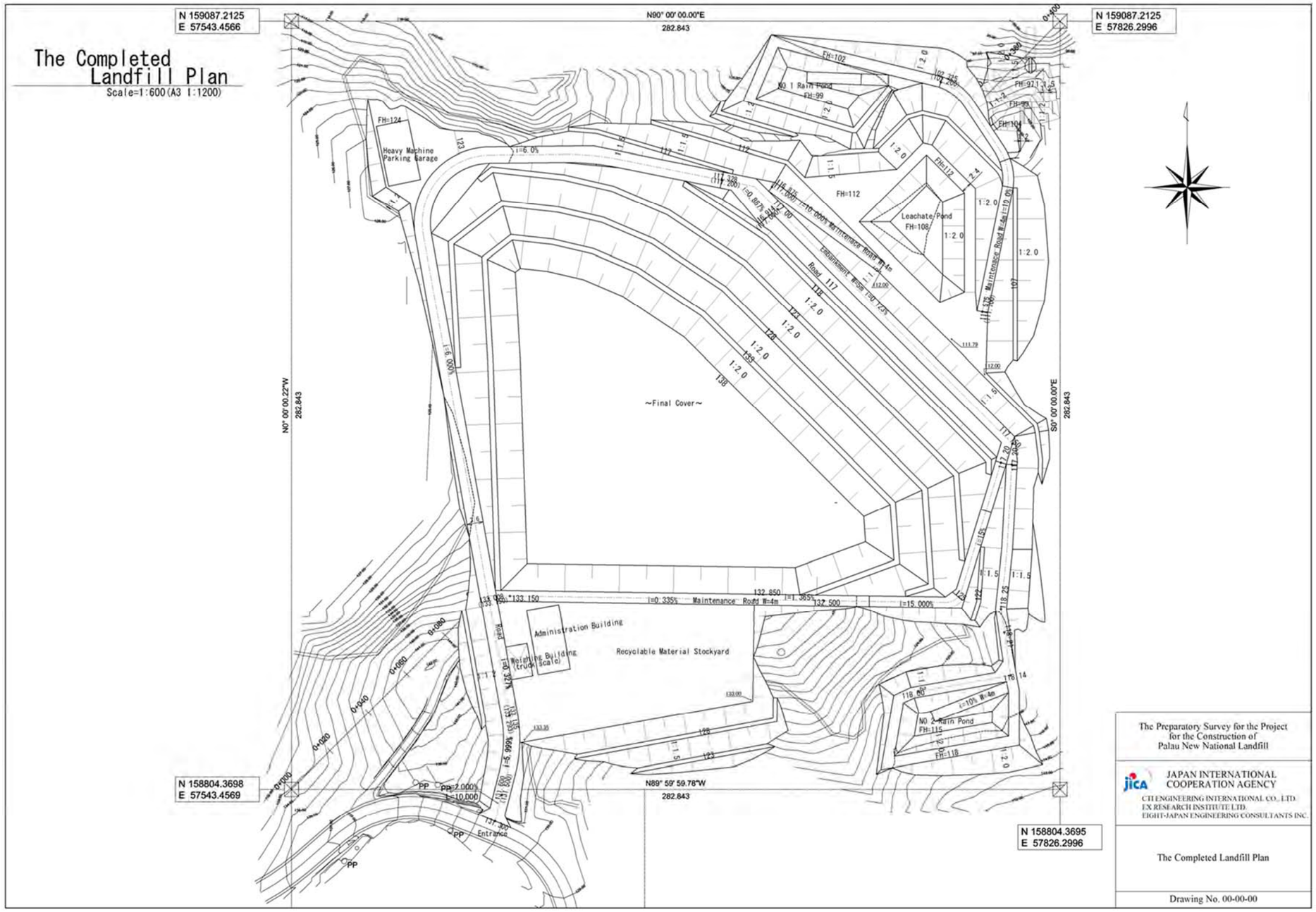


Figure 2.21 Completed Landfill Plan

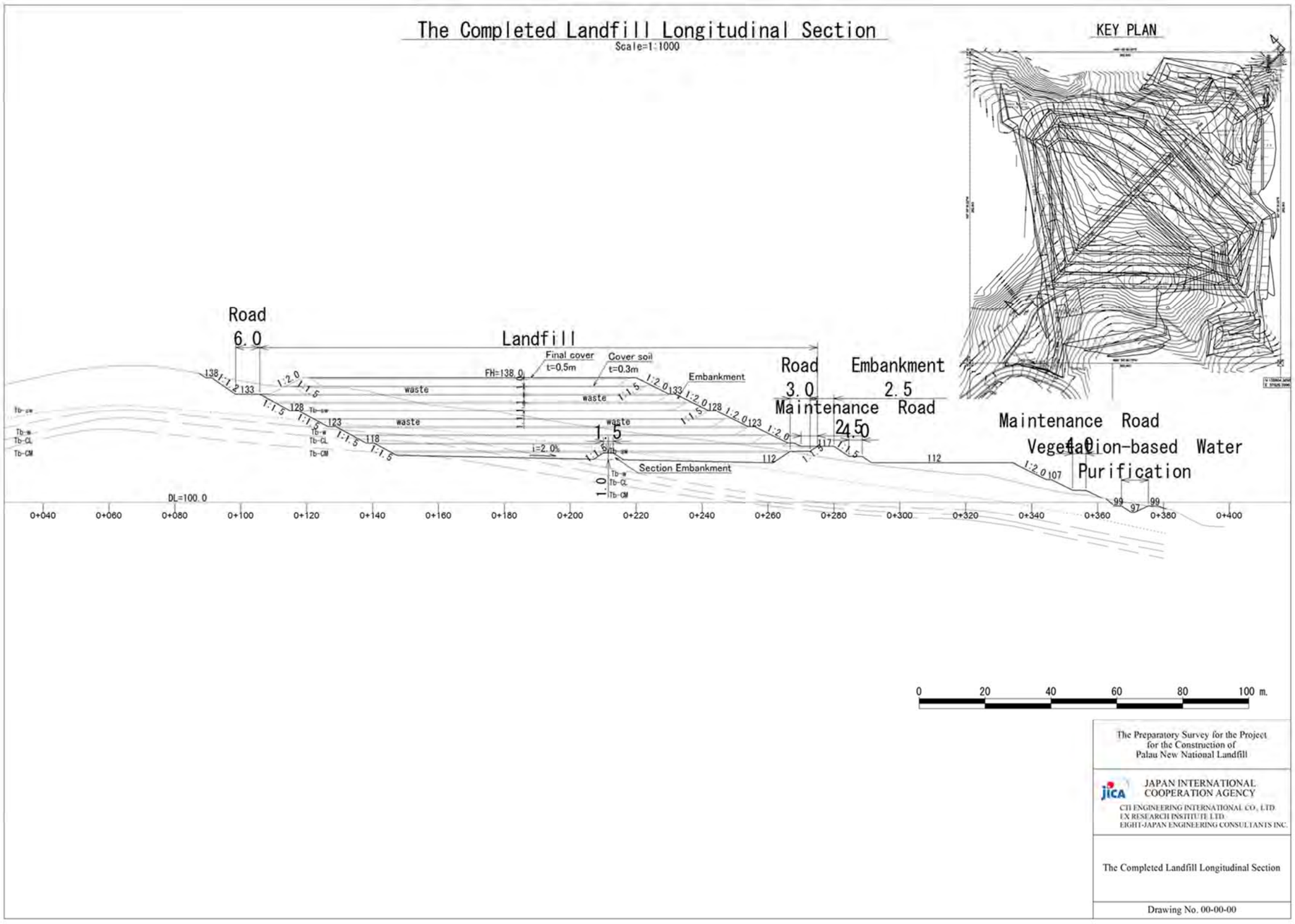


Figure 2.22 Completed Landfill Longitudinal Section

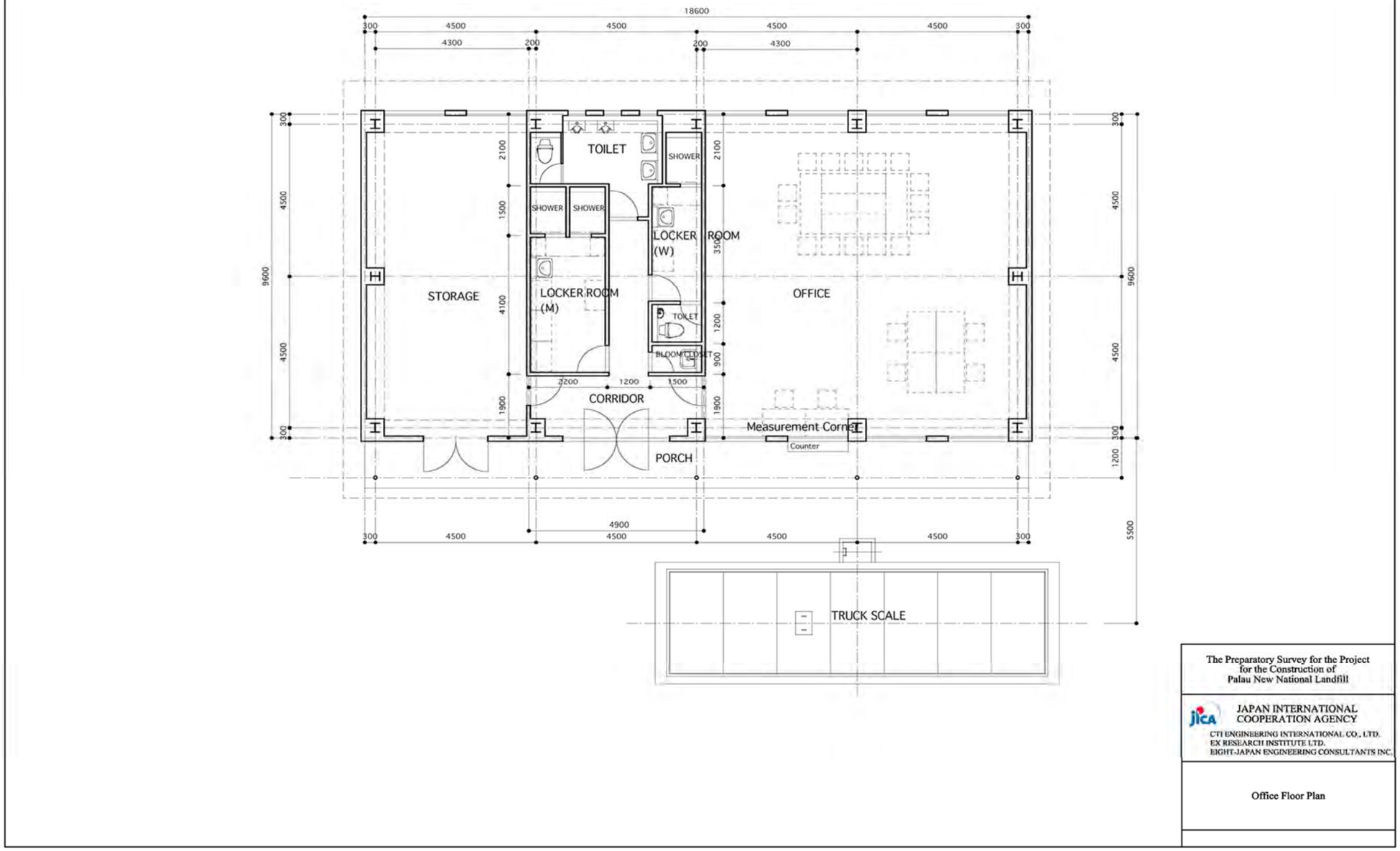


Figure 2.23 Office Floor Plan

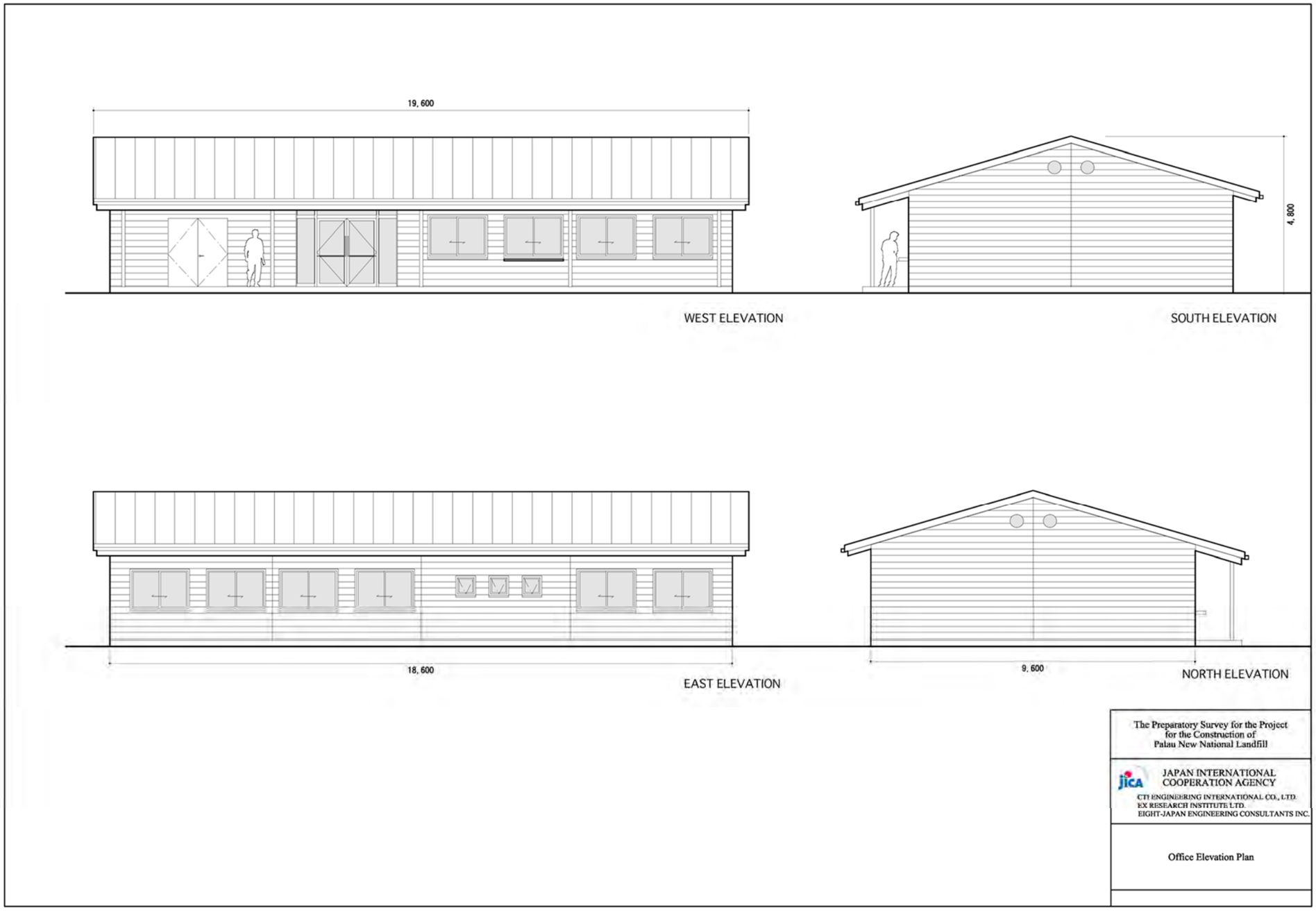


Figure 2.24 Office Elevation Plan

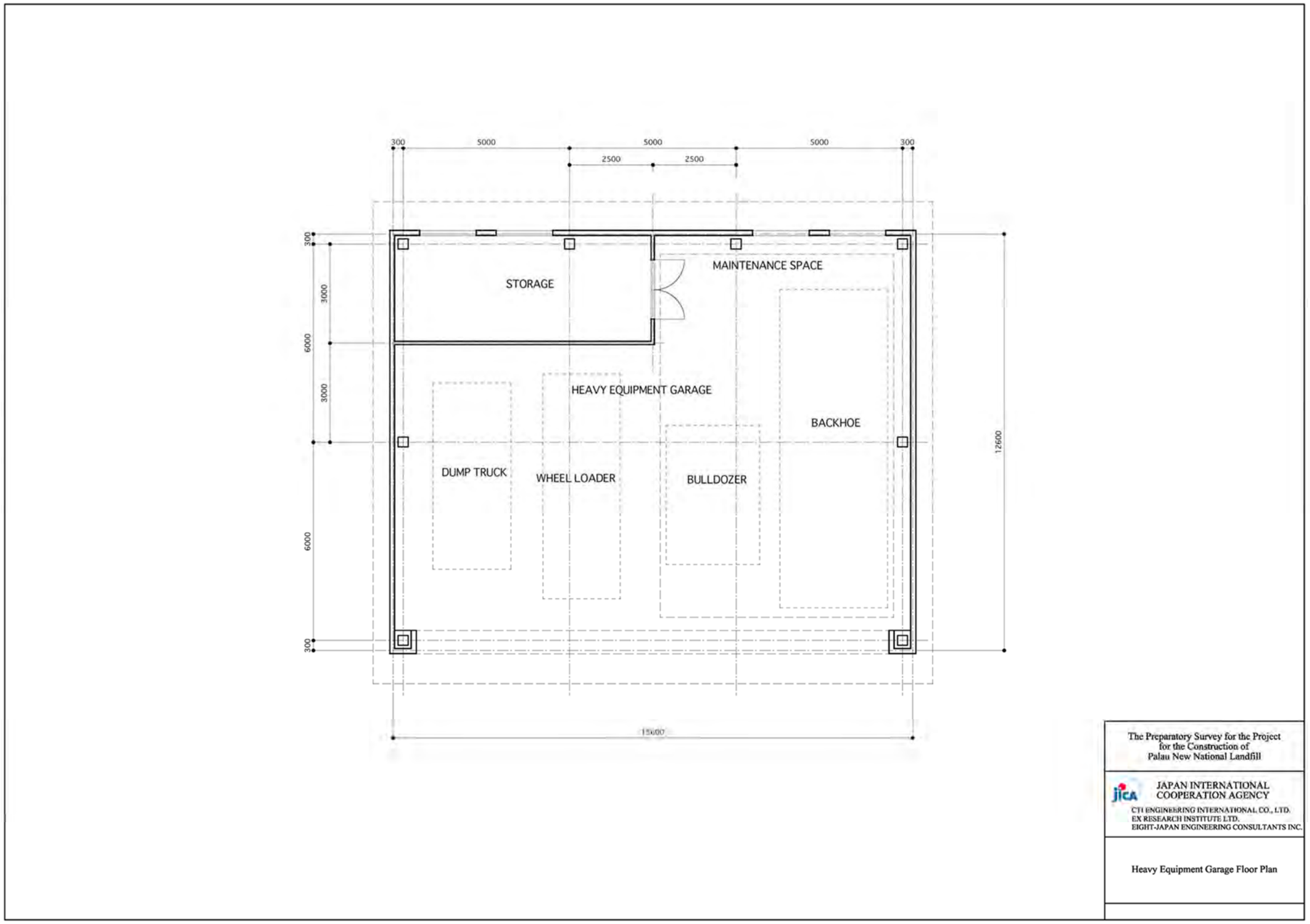


Figure 2.25 Heavy Equipment Garage Floor Plan

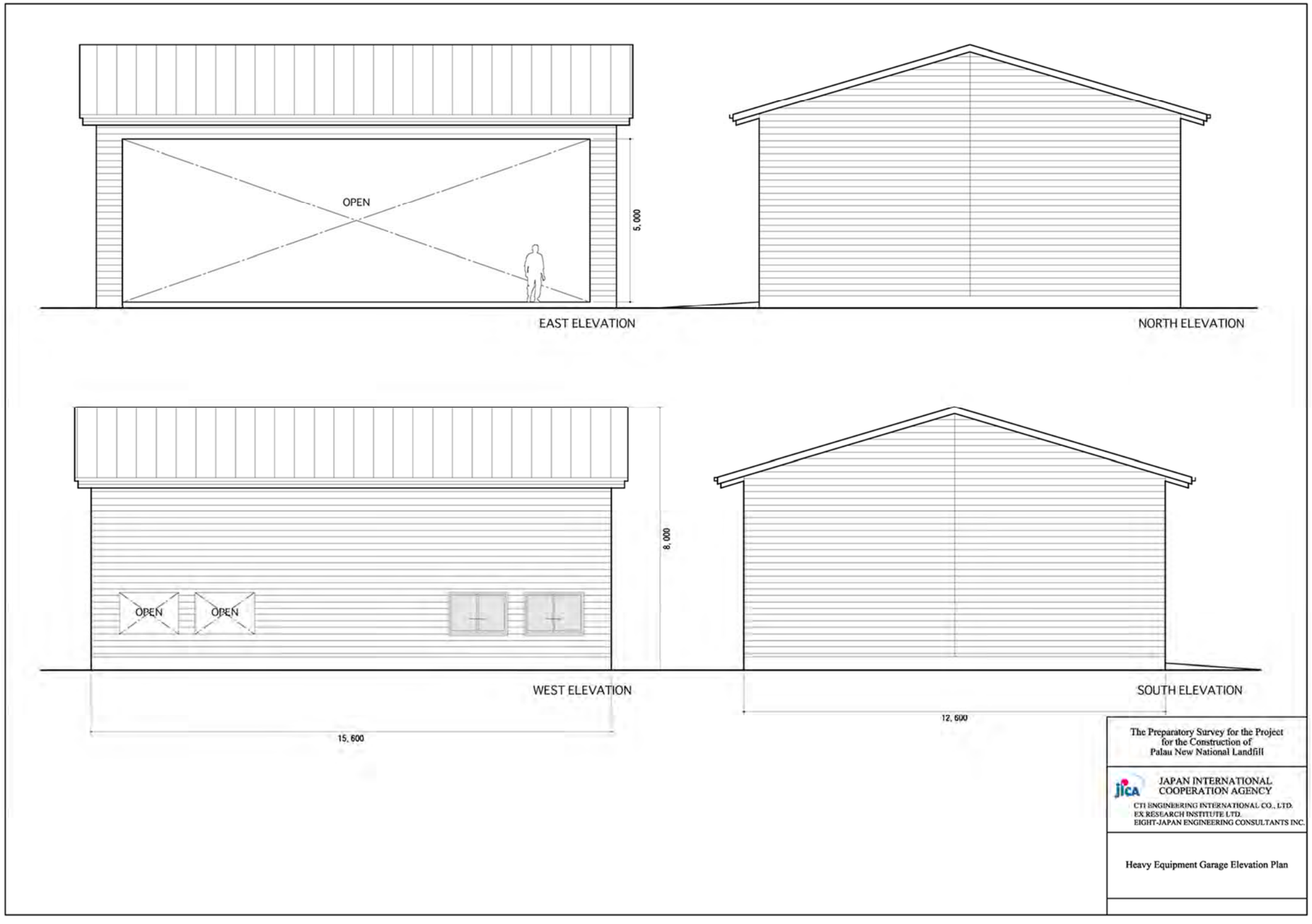


Figure 2.26 Heavy Equipment Garage Elevation Plan

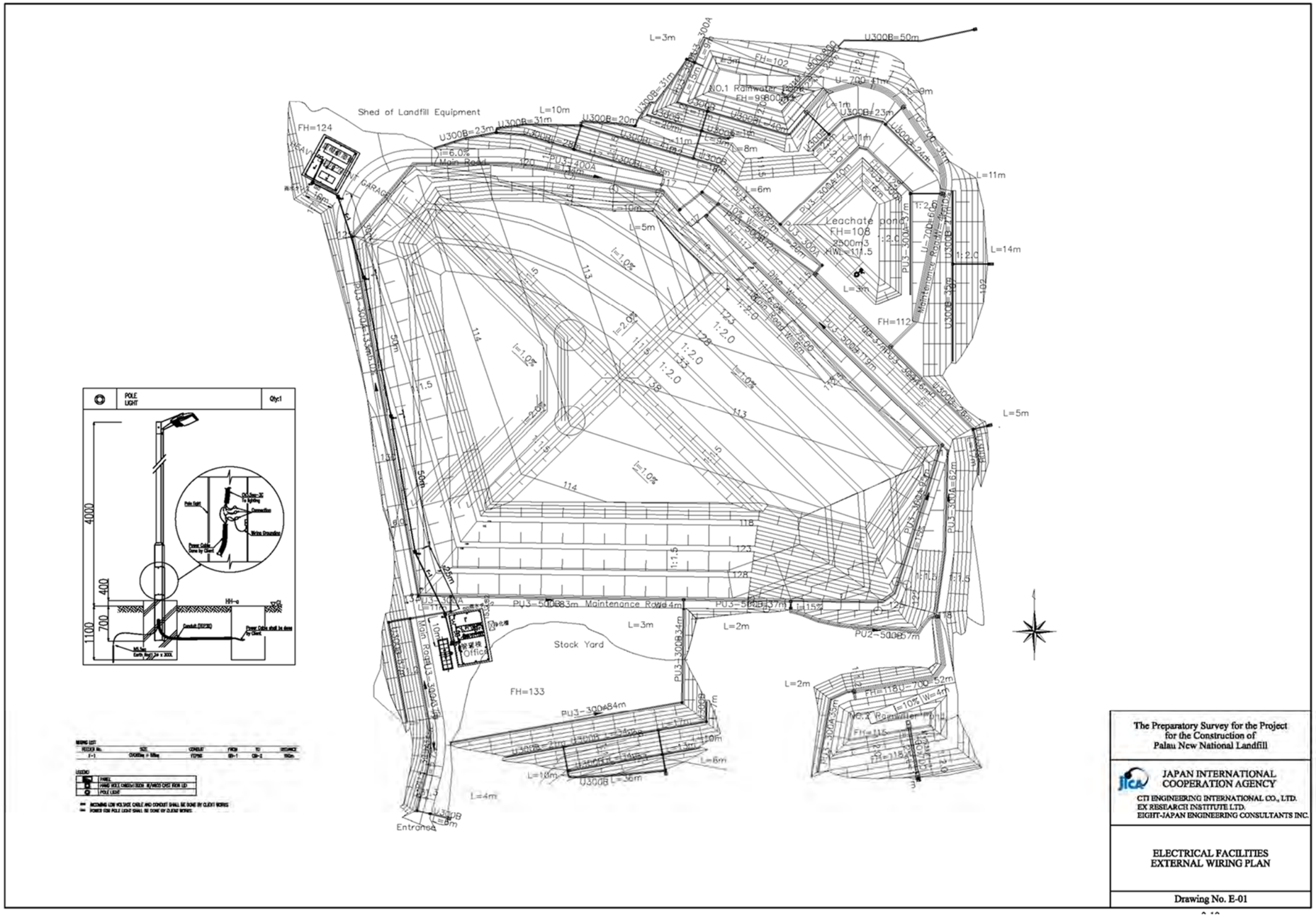


Figure 2.27 Electrical Facilities External Wiring Plan

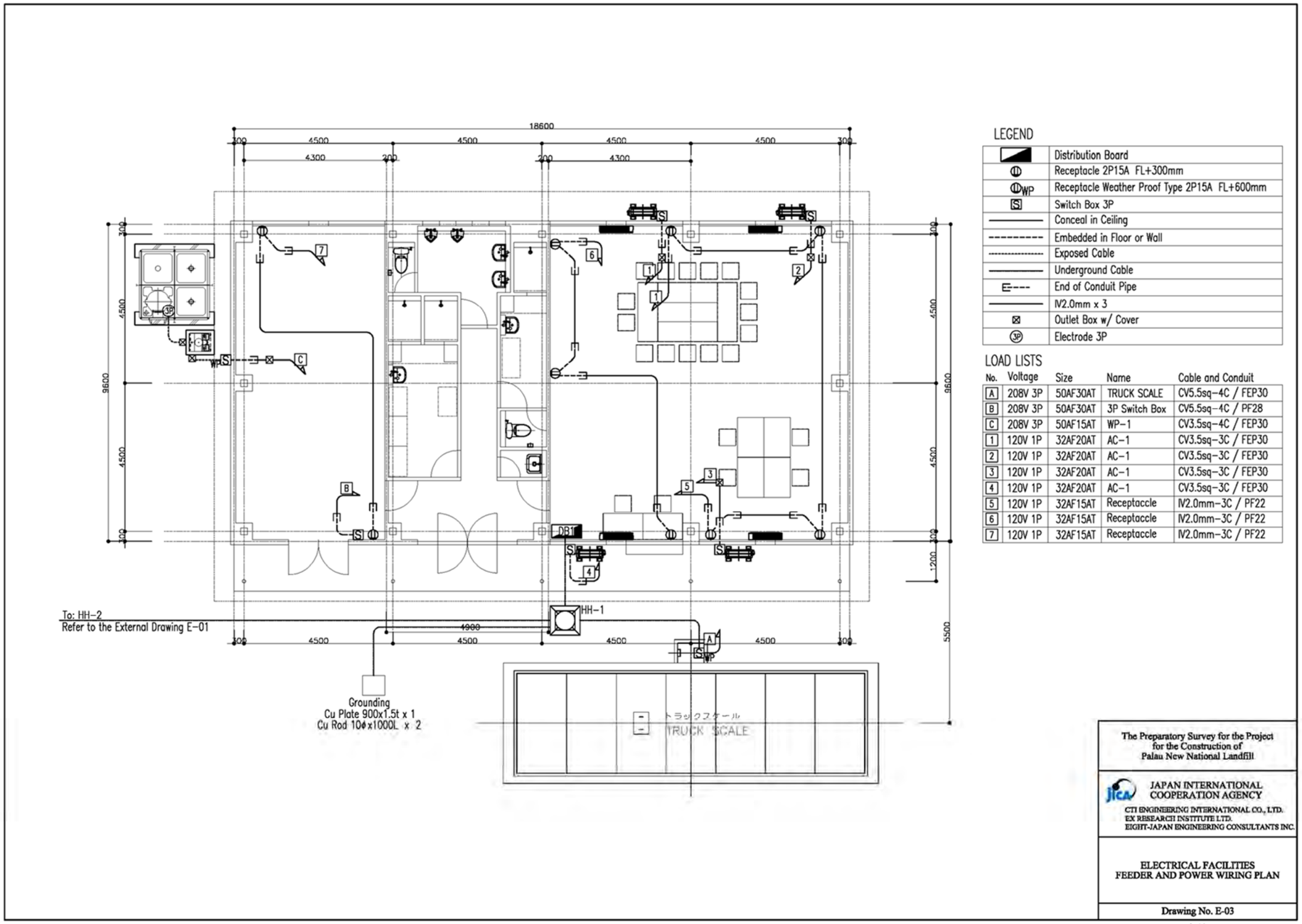


Figure 2.28 Electrical Facilities in Administration Building Feeder and Power Wiring Plan

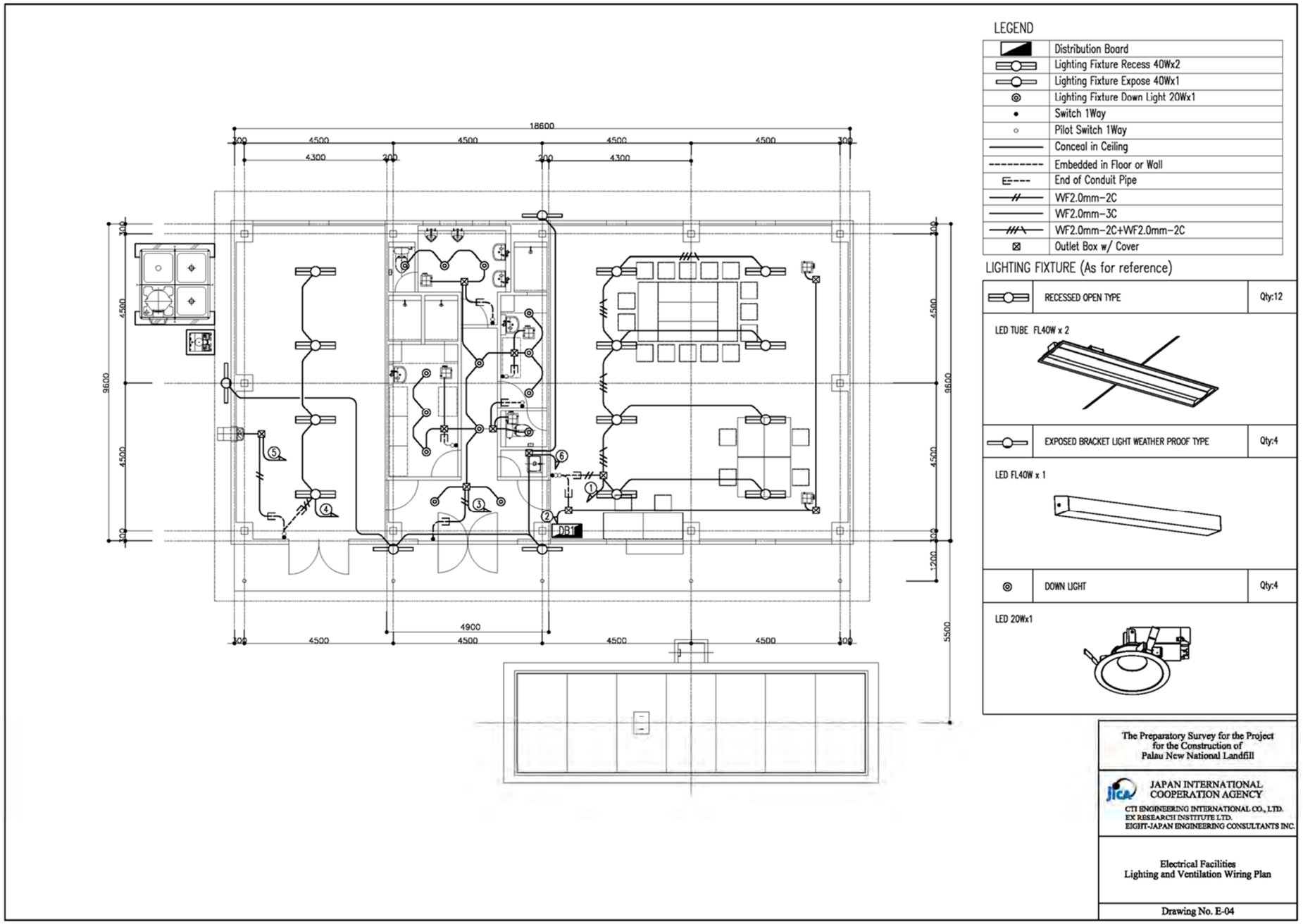


Figure 2.29 Electrical Facilities in Administration Building Lighting and Ventilation Wiring Plan

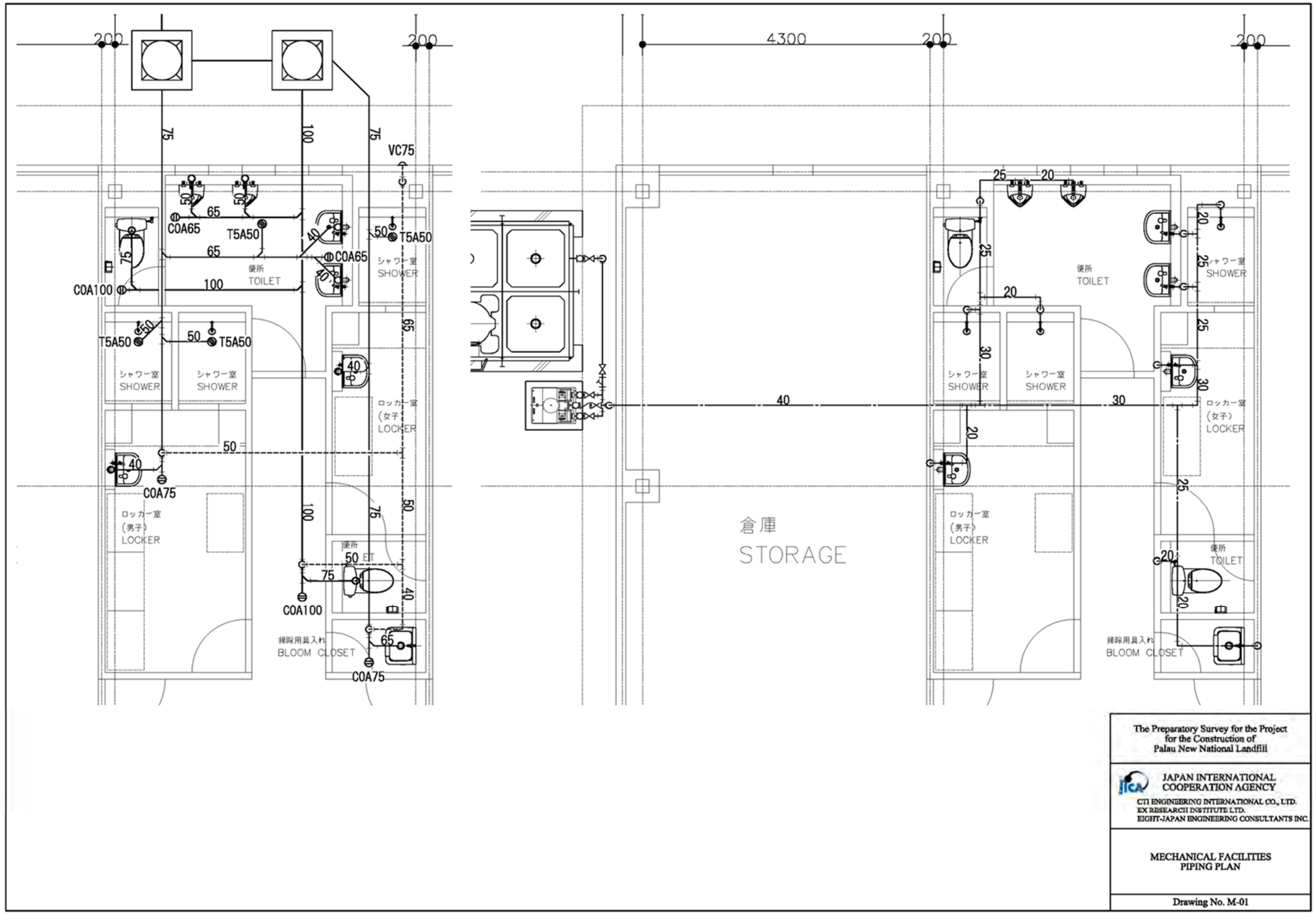


Figure 2.30 Mechanical Facilities in Administration Building Piping Plan

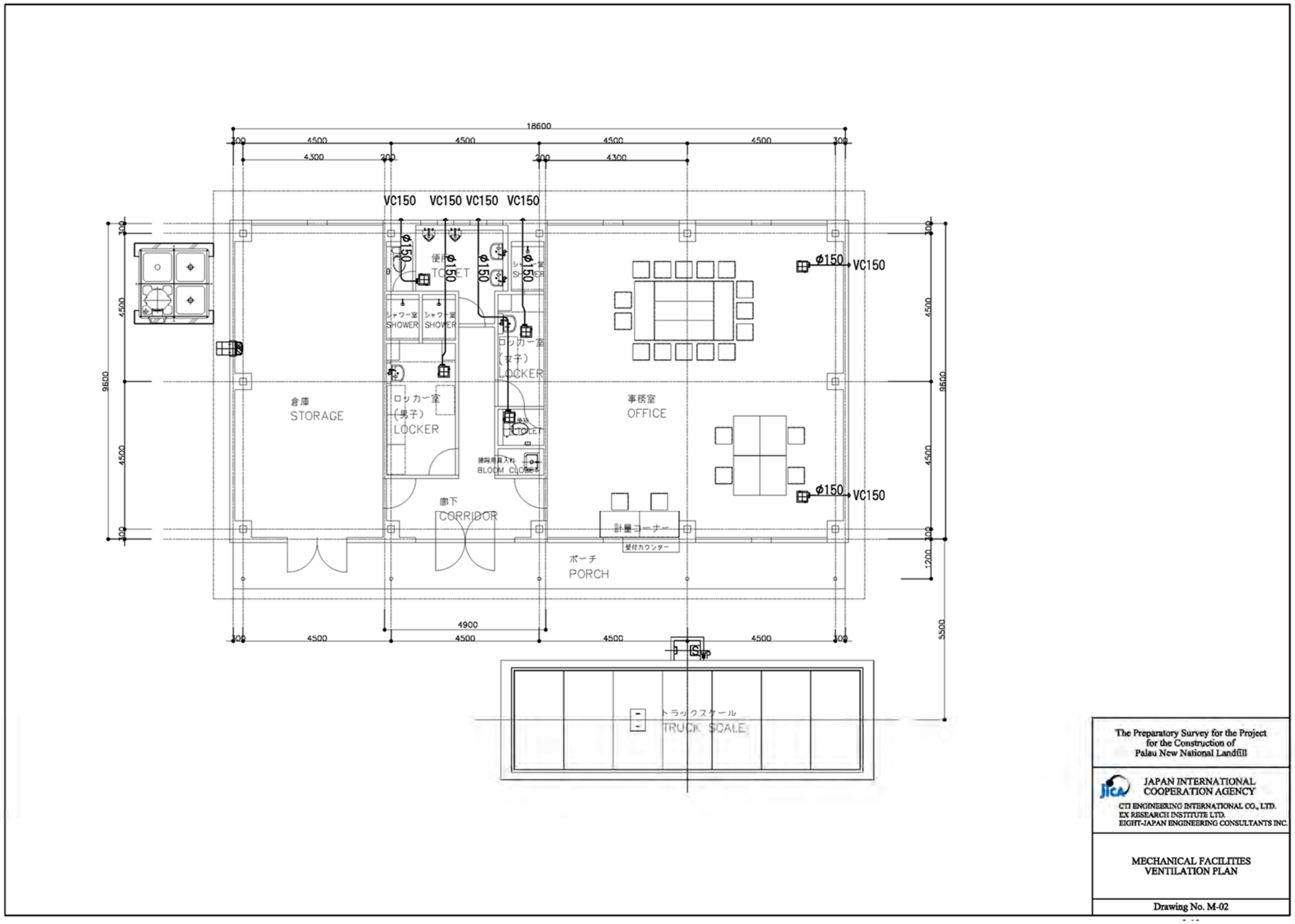


Figure 2.31 Mechanical Facilities in Administration Building Ventilation Plan

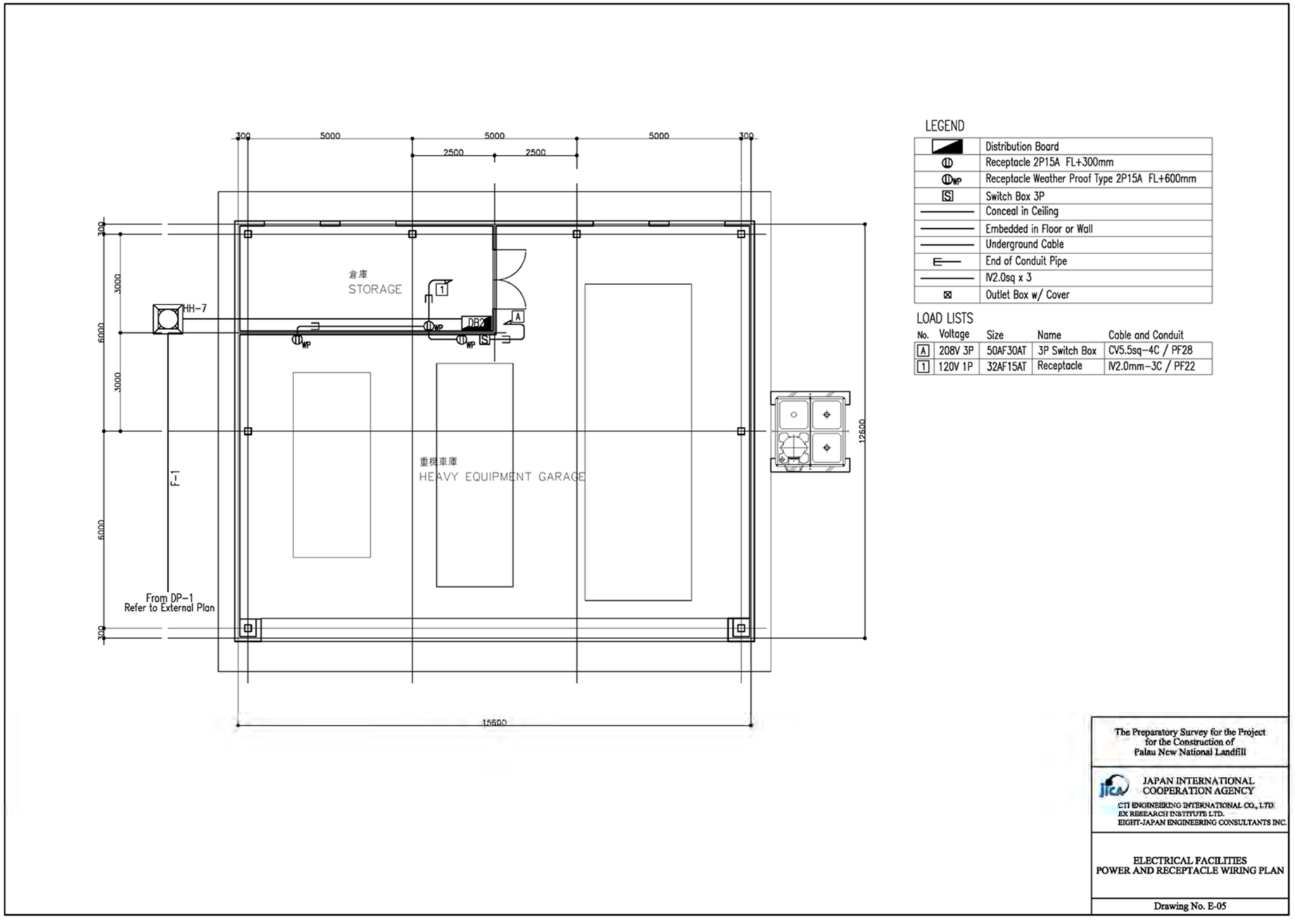


Figure 2.32 Mechanical Facilities in Heavy Equipment Garage Power and Receptacle Wiring Plan

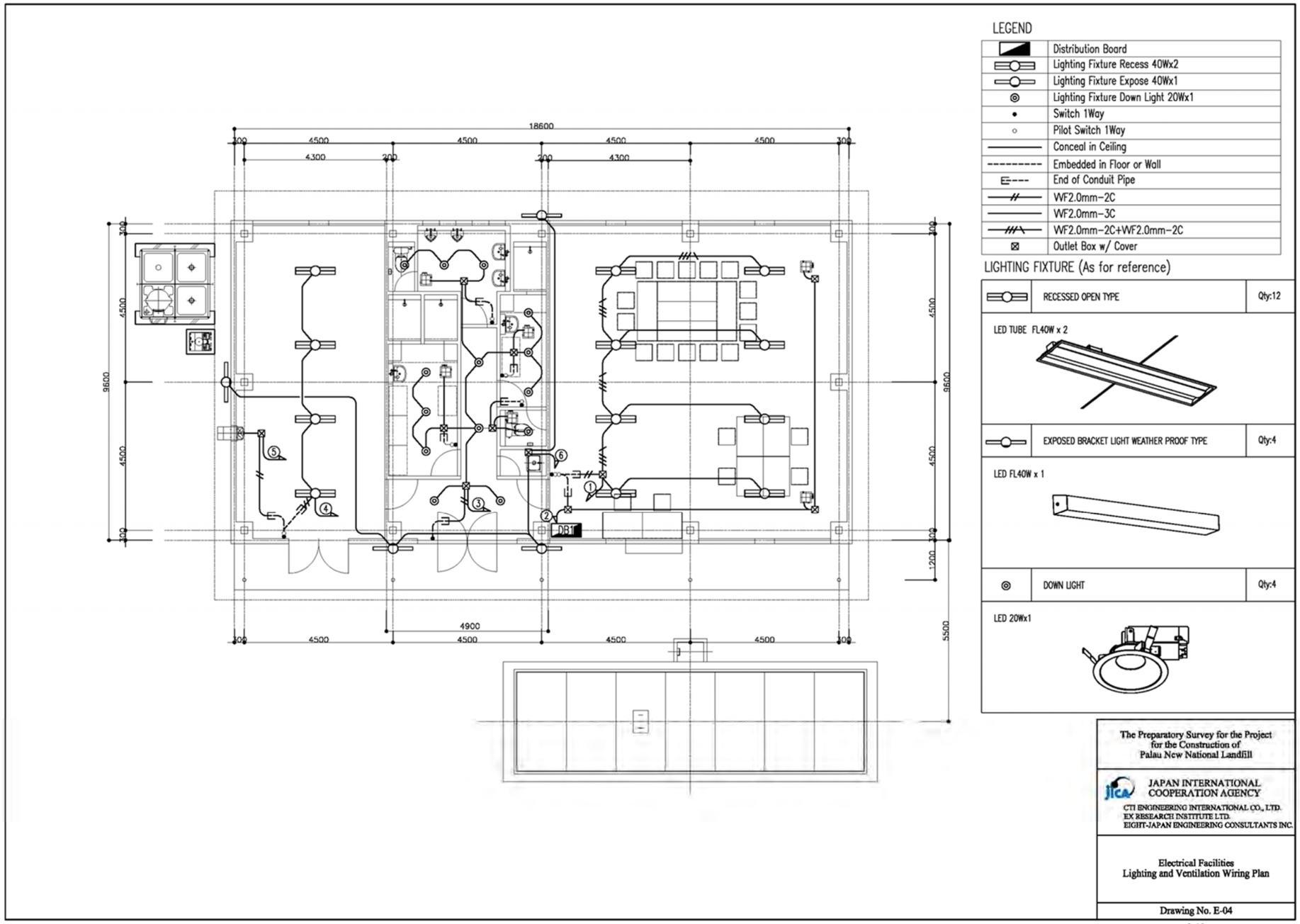


Figure 2.33 Electrical Facilities in Heavy Equipment Garage Lighting and Ventilation Wiring Plan

2.2.4 Implementation Plan

(1) Implementation Policy

(a) General Direction and Role of the Parties Concerned

The Project is to be implemented under the Japan's Grant Aid Scheme. Products and services are to be procured under the Japanese donation for the development project agreed by Exchange of Notes (hereinafter referred to as "the E/N") between the GOJ and the GOP. The role of the parties is described as follows:

- The GOJ decides to supply the donation to the GOP in accordance with the Japanese laws and regulations;
- JICA supplies the donation in accordance with the Japanese laws and regulations within an agreement of E/N on the basis of securement of justification of the Project and accountability of the donation;
- The GOP is responsible for implementation of the Project. As a client, the GOP shall provide necessary products and work force for project implementation by using the donation from JICA;
- The Consultant is a private firm or a consortium responsible for design, cost estimate, tender, procurement and construction supervision of the Project under the contract with the GOP; and
- The Contractor is a private firm or a consortium responsible for supply of necessary products and work force for the Project under the contract with the GOP.

(b) Implementation Framework in Palauan Side

The implementation agency of the Project is BPW and DSWM. For smooth implementation, BPW will contact and hold meetings with Japanese Consultant and Contractor, and select the person in charge who can understand the system and function of new landfill and equipment, and implement Palauan obligations.

(c) Consultant

In order to implement construction of facilities and procurement of equipment, the Consultant in Japan makes a contract with BPW to carry out Detail Design and Construction Supervision. Main tasks for the consultants are described below.

(i) Before Tendering Phase

The Consultant is to review the work in the Survey and the result of the Survey, and to guarantee the consistency of the work.

(ii) Tendering Phase

The responsibility of the Consultant in the tendering phase is as follows:

- To arrange the Tender Documents;
- To assist the Tender;
- To prepare the answer and amendment of questionnaire;
- To implement the technical evaluation and to prepare the evaluation report; and
- To implement the cost evaluation and to assist contract negotiation.

(iii) Implementation Phase

Japanese engineers shall be assigned for quality assurance during this phase. The Consultant is always allocated in the site to arrange between Palauan authorities and the Contractor, and to conduct construction supervision.

(d) Contractor

Japanese Contractor selected by open tender will be responsible for the construction of facilities and procurement of equipment. The Contractor should consider fully keeping contact and arrangement to conduct required repair and maintenance of the facilities and equipment after completion of the Project.

(2) Implementation Condition

(a) Construction Condition

Safety management and prevention of discharging muddy water downstream are to be considered seriously because of heavy precipitation in Palau.

(b) Procurement Condition

Important materials required for the Fukuoka Method are to be procured from Japan such as pipes and impervious sheet while general materials are to be procured in Palau such as reinforcing bar and concrete. The Contractor should consider smooth procurement of these materials.

(3) Scope of Works

(a) Scope of Implementation

Undertakings taken by the GOP and responsible organizations are summarized in **Table 2.17** and undertakings of the construction taken by both countries is shown in **Table 2.18**.

Table 2.17 Undertakings to be taken by the GOP

(1) Before the Tender		
No.	Items	In charge
1	To open a bank account	MOF
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	MPIIC
3	To approve EA/EIS (Conditions of approval should be fulfilled, if any) and secure the necessary budget for implementation.	EQPB/MPIIC
4	To conduct UXO survey at the site and share the result with JICA	MPIIC
5	To secure the Project site	MPIIC
6	To obtain the planning, zoning, building permit	MPIIC
7	To submit Project Monitoring Report (with the result of Detail Design)	MPIIC
(2) During the Project Implementation		
No.	Items	In charge
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	MPIIC
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A 1) Advising commission of A/P 2) Payment commission for A/P	MPIIC/MOF
3	To ensure prompt unloading and customs clearance at ports of disembarkation in recipient country and to assist in logistical arrangement with the Supplier(s) on internal transportation therein	MPIIC
4	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work	GOP
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted. Such customs duties, internal taxes and other fiscal levies mentioned above included commercial tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract.	MOF

(2) During the Project Implementation		
No.	Items	In charge
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	GOP
7	To submit Project Monitoring Report	MPIIC
8	To improve accessibility to the site	MPIIC
9	To provide facilities for distribution of electricity, drainage, tele-communication and other incidental facilities necessary for the implementation of the Project outside the site(s)	MPIIC
10	To take necessary measure for construction safety - traffic control - rope off	MPIIC
11	To implement EMP and EMoP	MPIIC
12	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	MPIIC
(3) After the Project		
No.	Items	In charge
1	To implement EMP and EMoP	MPIIC
2	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between BPW, MPIIC and JICA.	MPIIC
3	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) O&M structure 3) Routine check/Periodic inspection 4) Monitor the effectiveness of the Project based on the indicators outlined in the final report indexes.	MPIIC

Note: A/P: Authorization to Pay, B/A: Banking Arrangement

Table 2.18 Undertakings of the Construction to be taken by Each Country

Facilities		Japan		Palau	Remarks
		Architecture	Civil		
Major facilities	Embarkment		○		
	Impervious Sheet Construction		○		
	Leachate Collecting Pipe		○		
	Rainwater Collecting Pipe		○		
	Gas Pipe		○		
	Leachate Treatment Facility		○		
Management facilities	Truck Scheel	○			
	Monitoring Facility		○		
	Administration Building	○			
	Others		○		
Relevant facilities	Approach Road		○		
	Scattering Prevention Fence		○		
	Fence		○		
	Electricity Wiring			○	From the nearest telegraph pole to the Administration Building

Note: A circle in the above table indicates the country in charge of the construction work.

(b) Scope of Procurement

(i) Transport to the Site

Transport of materials and equipment to the site is to be conducted by Japanese side.

(ii) Installation of Equipment

Operational guidance of equipment for start-up is to be conducted by Japanese side.

(4) Construction and Procurement Supervision

Palauan side is to contract with the Consultant recommended by JICA and the Consultant is to implement detail design and construction supervision. Construction and procurement are to be implemented by the Contractor contracted with Palauan side. The Consultant and the Contractor are to send the supervisors for supervision.

Table 2.19 Consultant Personnel for Construction and Procurement Supervision

Position	Personnel	Quantity	In charge	Duration
Construction	Chief Consultant	1	Comprehensive Project Management	Spot
	Resident Engineer	1	Construction Management	Resident
	Supervisor for Civil Work	1	Supervision for Civil Work	Spot
	Supervisor for Architectural Work	1	Supervision for Architectural Work	Spot
	Supervisor for Electric and Mechanical Facilities	1	Supervision for Electric and Mechanical Work	Spot
Procurement	Engineer for Inspection	2	Inspection for Equipment	Spot

(5) Quality Control Plan

(a) Materials and Construction Work

Main tests for the quality control of materials and construction are as follows:

Table 2.20 Quality Control Plan of the Materials and Construction Work

Items	Test items	Method	Frequency
Concrete	Compression test	JIS A 1108	Twice per day
	Slump test	JIS A 1101	All vehicle basically
	Chloride content measurement	JIS A 5308	Once per week
	Air volume measurement	JIS A 1116 etc.	When the sampling is conducted for the strength test
	Cement quality measurement	JIS R 5210 etc.	Before construction and when the materials are changed
Embarkment	Compaction test of soil	JIS A 1210 etc.	Before construction and when the soil is changed
	Mechanical analysis of soil	JIS A 1204 etc.	Before construction and when the soil is changed
	Density test of soil	JIS A 1214 etc.	Once at the 3 spots for 3,000m^3

(b) Export Products

Factory inspection and pre-shipment inspection for securing the quality and packing condition of materials and equipment are to be conducted by the Consultant and the Contractor, and inspection before shipping is also to be carried out by the third-party organization.

(6) Procurement Plan

(a) Ready Mixed Concrete

Ready mixed concrete is to be procured from a plant located in 10km from the site.

(b) Aggregates and Roadbed Materials

Aggregates and roadbed materials are to be procured from quarries near the site.

(c) Another Main Materials

Some materials are to be procured from Japan, which are not able to be procured in Palau or are required strict deadline. Suppliers of main materials are as follows:

Table 2.21 Supplier List of Main Materials

Items	Specification	Supplier			Route
		Palau	Japan	Third country	
Materials					
Leachate Collecting Pope	Polyethylene pipe		○		
Gas Pipe	Polyethylene pipe		○		
Pervious Sheet	Polyethylene pipe		○		
Circulating Pump	For sewage and sludge		○		
Truck Scheel	40t, with control board		○		
Deformed steel bars	D12～D32	○			Koror
Cement	Portland	○			Koror
Boulder	150～200mm	○			Quarry
Roadbed materials	Aggregate	○			Quarry
Joint material	Bituminous, 20mm	○			Quarry
Admixture	Concrete	○			
Steel member for architecture			○		
Roofing material for architecture			○		
Silt Fence	#300 20m×5m		○		
Soil bag	Polypropylene, 48cm x 62cm		○		
Water supply hose	Polyvinyl Chloride, φ100mm、φ50mm		○		
Blue sheet	#2000, 3.6m×5.4m		○		
Materials for temporary work					
Fuel	Petrol/Diesel	○			Koror
Timber for framework		○			Koror
Plywood for framework		○			Koror
H-steel	H-300×300, etc.		○		

Note: A circle in the above table indicates the supplier who provides the main materials.

(d) Construction Machine

Lease dealers for construction machine are not available in Palau, so that construction machine is to be borrowed from construction companies in Palau with operators. Procurement of versatile equipment is not difficult such as excavator, dump truck, truck crane and so on. Since a middle-size bulldozer is not popular in Palau, it is to be procured from Japan. Suppliers of construction machine are enumerated as follows:

Table 2.22 Supplier List of Construction Machine

Machine	Specification	Lease/ Rent	Supplier			Route
			Palau	Japan	Third country	
Excavator	Bucket Capacity 1.2m^3	Lease	○			Koror
Excavator	Bucket Capacity 0.8m^3	Lease	○			Koror
Excavator	Bucket Capacity 0.45m^3	Lease	○			Koror
Excavator	Bucket Capacity 0.28m^3	Lease	○			Koror
Dump Truck	10t	Lease	○			Koror
Bulldozer	21t class	Lease		○		
Tire Roller	8～20t	Lease	○			Koror
Road Roller	10～12t	Lease	○			Koror
Motor Grader	W=3.1m	Lease	○			Koror
Wheel Loader	2.5m^3	Lease	○			Koror
Truck Crane	25～50t hanging	Lease	○			Koror
Breaker	1,300kg class	Lease	○			Koror
Trailer	20t	Lease	○			Koror
Vibration Roller	Boarding type, 3～4t	Lease	○			Koror
Vibration Roller	Hand guide type	Lease	○			Koror
Agitator - body Truck	5m^3	Rent	○			Koror
Concrete Pump Truck	90～110m^3/h	Rent	○			Koror
Water Truck	5.5m^3	Lease	○			Koror

Note: A circle in the above table indicates the supplier who provides the main materials.

(7) Operational Guidance Plan

(a) Adjustment and Trial Operation Guidance

The adjustment and trial operation of bulldozer, excavator, wheel loader, dump truck and compactor truck are to be carried out by the supplier/manufacturer of equipment newly introduced. Operational items are vehicle inspection, control board inspection and operational confirmation.

(b) Initial Operational Guidance

Initial operational guidance is not necessary for the same type equipment of existing ones in M-Dock Landfill such as bulldozers, excavators and dump trucks. However, for the wheel loader which is not introduced in M-Dock and compactor trucks which have different operational methods between manufactures, it is to be carried out by the supplier/manufacturer.

(c) Operational Guidance

Operational guidance is to be carried out for the wheel loader and the compactor truck as well as the initial operational guidance. In addition, since BPW has the plan to add staffs for equipment maintenance in future, guidance of the equipment maintenance for new staff should be conducted by the supplier/manufacturer.

(8) Soft Component (Technical Assistance) Plan

Soft component activities are not implemented in the Project.

(9) Implementation Schedule

Implementation schedule is as shown in **Figure 2.34**.

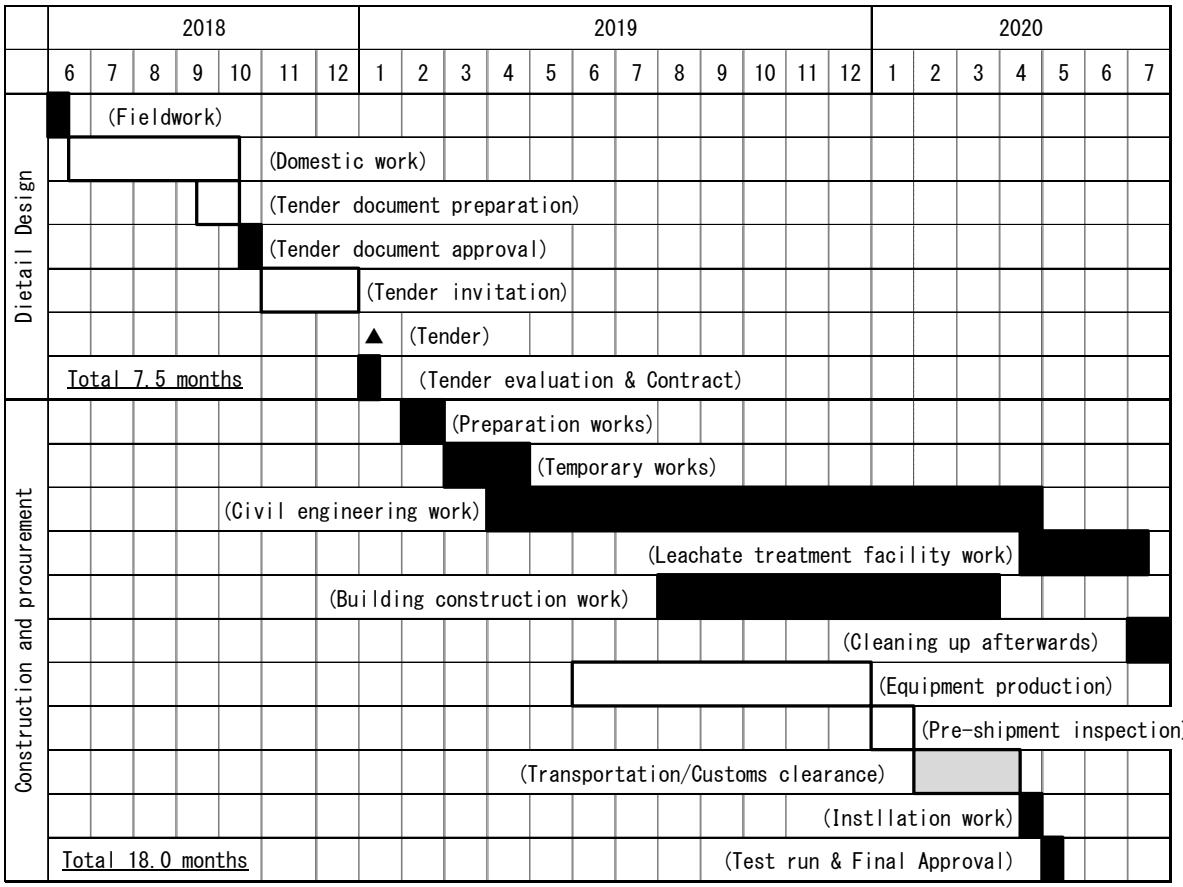


Figure 2.34 Implementation Schedule

2.3 Obligations of Recipient Country

2.3.1 General Undertakings to be taken by Palau

The undertakings required for the Palauan side for the smooth implementation of the Project are as follows:

(1) To provide all data and information necessary for the Project;

(2) To ensure prompt unloading and custom clearance at the port/terminal of disembarkation in Palau and internal transportation of the equipment procured under Japan's Grant Aid;

(3) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Palau with respect to the procurement of products and services under the Project;

(4) To arrange the acquisition of visa and other formalities that may be necessary for the entry of Japanese nationals into Palau and stay therein for the performance of the work;

(5) To maintain and use the equipment properly and effectively with a suitable number of staff assigned for the O&M and to bear all expenses other than those covered under the Grant Aid;

(6) To secure and clear the land of the Project site before the start of construction; and

(7) To bear the advising commission of the Authorization to Pay (A/P) and payment commission to the Japanese bank for banking services based upon the Banking Arrangement (B/A).

2.3.2 Specific Undertakings to be taken by Palau

The specific undertakings required for the Palauan side for the smooth implementation of the Project are as described below.

(1) Land Acquisition

Land acquisition is precondition for the Project.

(a) The Site

The acquisition of the site covering 8ha and located in Aimeliik State is required until the Project beginning. Ownership of the site is adjusted between the GOP and residents.

(b) Land for Office

The land for the office and storage of materials is needed. The Consultant and the Contractor are to work in the office.

(c) Soil Disposal Yard

Approximately 150,000m^3 residual soil is to be generated from the site and moved to the soil disposal yard prepared by Palauan side in 2km from the site. More than 10,000m^2 area is required when the 150,000m^3 residual soil is moved.

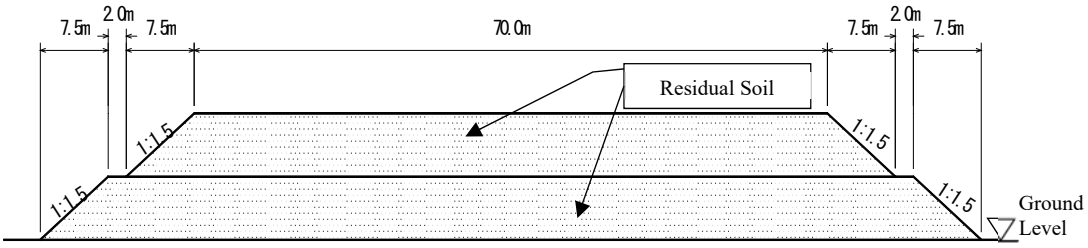


Figure 2.35 Conceptual Sectional Drawing of the Soil Disposal Yard

(2) Removal of Unexploded Ordinance (UXO)

Remains of guns and ammunitions were found at the site. The survey and removal of UXO are to be conducted by Palauan side for securing safety. The survey and removal of UXO are conducted by Palau National Safety Office under BPW with Norwegian People's Aid (NPA), which is Norwegian NPO. The survey is to be conducted within all area and excavated depth in the site. Since the war remains are recognized as a cultural asset, the removal of remains of gun and ammunitions is to be conducted by Palauan side until beginning of the Project.

Photo 2.1 Survey for UXO by Palauan Side

(3) Electricity Wiring at the Project Site

Wiring for electricity is to be carried out by Palauan side from the existing telegraph pole transmitting high-voltage wire (22kV) to the switchboard in the Administration Building. The wiring is implemented in the following manner:

- A transformer is to be set on the existing telegraph pole (22kV) and transforms electricity to 110V;
- Cables are to be laid under the ground for 80m long between the existing telegraph pole and the switchboard in the Administration Building; and
- A total of four (4) hand holes are to be built to lay the cables underground: one under the existing telegraph pole, two at transfer points and one under the Administration Building.

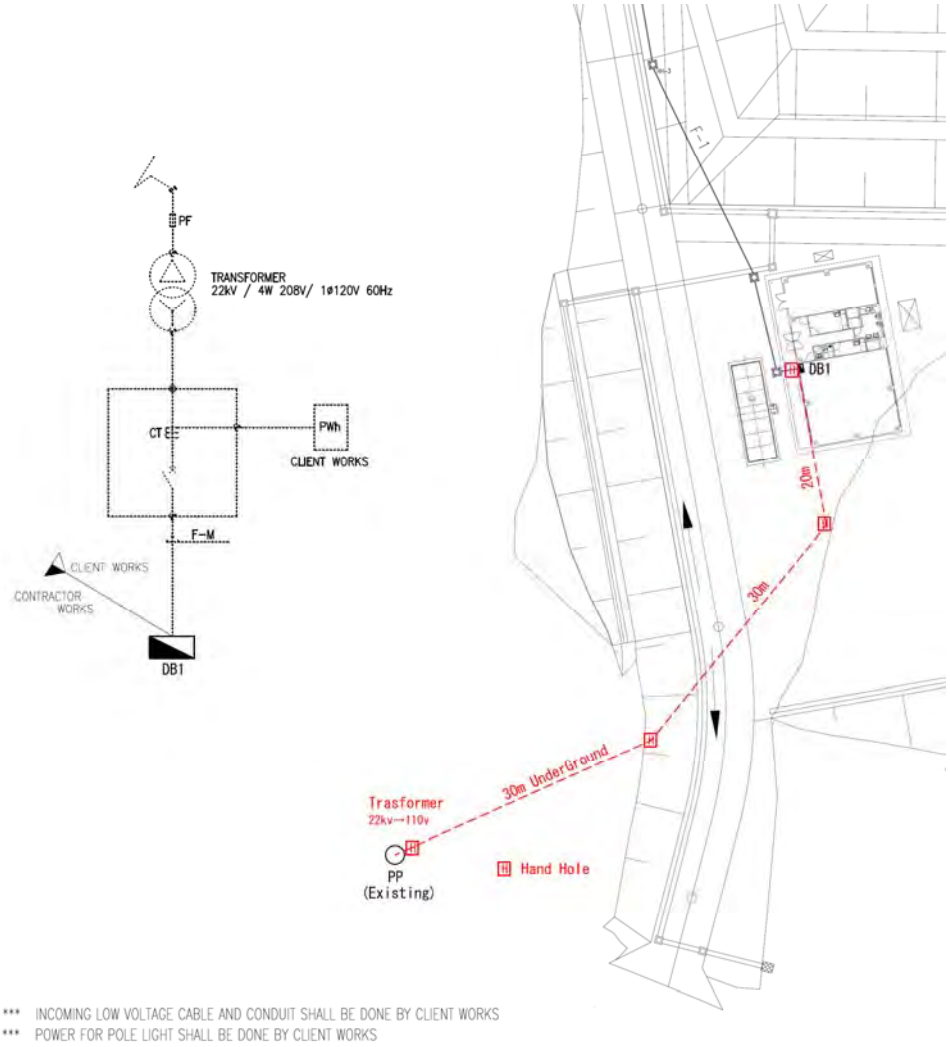


Figure 2.36 Planning Drawing of Electricity Wiring

(4) Submission of Project Monitoring Report

The Project Monitoring Report is to be submitted by Palauan side to JICA at the following time:

- Before the Tender: Submission with the result of Detail Design
- During the Project Implementation: Submission on a quarterly basis

- After Signing of Certification of Completion for the Work: Submission as a final within one month

(5) Implementation of Environmental Management Plan and Environmental Monitoring Plan

Environmental Management Plan (hereinafter referred to as "EMP") and Environmental Monitoring Plan (hereinafter referred to as "EMoP") are to be implemented by Palauan side and the result of environmental monitoring is to be submitted to JICA during the Project implementation and for three (3) years after completion of the Project.

(6) Operation of Leachate Treatment

As mentioned **Subsection 2.2.2(2)(d)**, leachate treatment facilities composed by the Gravel Contact Oxidation Treatment Channel, the Coral Sand Channel and the Vegetation-Based Water Purification Pond is to be constructed for the improvement of water quality. Installation and maintenance of aggregate, coral sand and vegetation shall be conducted for the leachate treatment operation by DSWM as mentioned **Subsection 2.4.1(2)(d)**.

2.4 Project Operation Plan

DSWM under the BPW, MPIIC will carry out O&M of the facilities and equipment procured under the Project after completion of the Project.

2.4.1 Operation and Maintenance Plan of New Landfill

(1) Organization of O&M of New Landfill

The organizational chart planned by BPW after construction of new landfill is illustrated in **Figure 2.37**. Two (2) personnel for the management of new landfill will be added to the existing personnel.

DSWM has been operating the M-Dock Landfill and already obtained basic skills for the O&M of landfill. DSWM will therefore ensure that enough personnel exist to operate and maintain the new landfill.

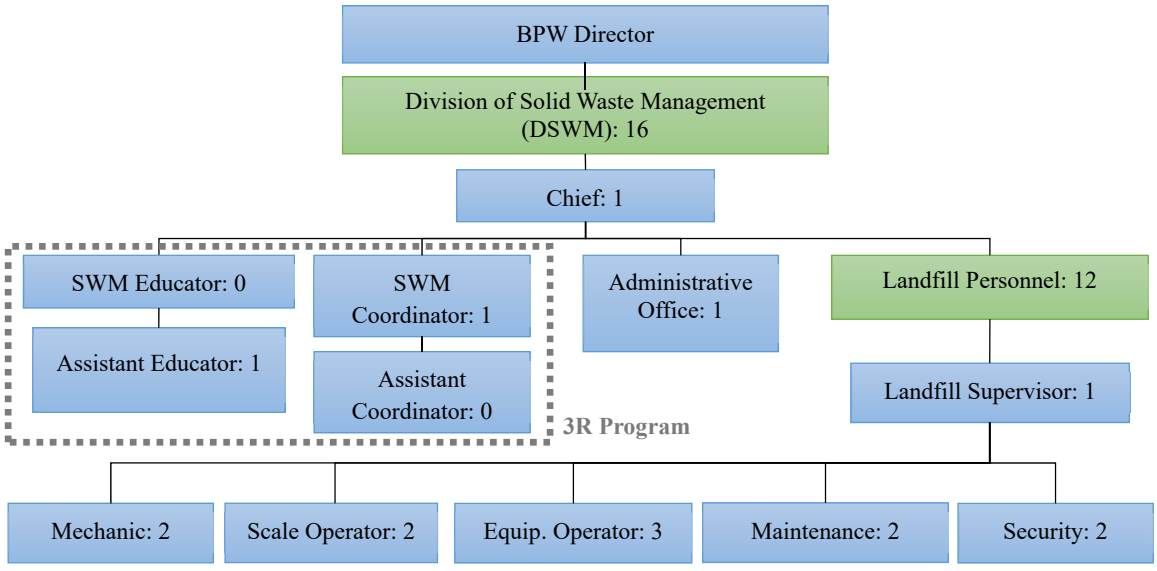


Figure 2.37 Assumed Organizational Chart of DSWM

(2) Method of Landfill O&M

Points to consider ensuring relevant and safe O&M of the landfill are as follows:

- Understanding of documents related to design and construction;
- Control of solid waste carried into the site;
- Management of landfilling; and
- O&M of facilities.

(a) Understanding of Knowledge and Documents related to Design and Construction of Landfill

Understanding of design policy and concepts is indispensable for smooth O&M of landfill. Especially, understanding of features and effects of semi-aerobic type structure and leachate treatment system is necessary. The leachate treatment system in this landfill comprises circulation system and a combination of three kinds of treatment methods, i.e. Gravel Contact Oxidation Treatment, Sand Filtration and Vegetation-Based Water Purification. Technical principles of these methods are so important that the persons in charge of O&M should understand them satisfactorily.

Since drawings may be changed in the construction phase, as built drawings prepared by the Contractor should be used for management of facilities.

(b) Control of Solid Waste Carried into the Site

To control solid waste carried into the site, it is important to measure the volume of solid waste carried into the new landfill and to remove the toxic waste affecting the leachate quality. In particular, it is quite useful to compare predicted amount of waste generation with actual amount to manage the landfill operation. This comparison brings valuable information about the capacity of remaining volume of the landfill and required volume of cover soil.

Additionally, since the BPW plans to introduce a toll collection system at the site, the control work will include charging the disposal fee. Moreover, it is essential to make a proper guidance and education so as not to allow prohibited waste into the new landfill. Toxic waste should not be disposed in the new landfill because the leachate treatment system planned in the Project does not cover the treatment of toxic waste.

(i) Inspection at the Time of Loading

When the waste is carried in, an interview with a driver, measurement of the volume and type of solid waste and visual inspection should be conducted to check whether the carried waste is mixed with prohibited waste or not and record the volume of waste at the weighing building. This inspection aims at managing all the waste to be carried into the landfill.

Interview with a Driver

An interview is to be carried out with the driver of waste disposal vehicle to identify the type of waste when the vehicle stops on the truck scale.

Measurement of the Volume and Type of Waste

The volume of waste is to be measured on the truck scale located next to the Administration Building and the disposal charge is to be collected at the same time. Unit price of the disposal charge depending on the types of waste is to be studied and determined by J-PRISM Phase 2. In addition to measuring the weight of the waste, the following data should be recorded at the weighing building:

- Delivering date;
- Vehicle numbers;
- Volume of delivering waste;

- Type of delivering waste; and
- Others.

Measurement of vehicle weight is not necessarily made every time and the weight will be automatically calculated by using a card reader if vehicle information including the gross weight of vehicle has been registered in advance. All the data recorded by the weighing system will be aggregated and compiled as a daily report, monthly report and annual report. The way of aggregation should be confirmed before installation.

Visual Inspection

Waste be visually inspected to examine whether or not the waste being delivered is the same type of waste reported by the driver at the truck scale. The visual inspection will enable personnel to confirm that the waste carried into the landfill does not contain toxic waste.

(ii) Visual Inspection at the Landfill

Visual inspection at the landfill is also to be carried out when the transportation truck is unloading the waste.

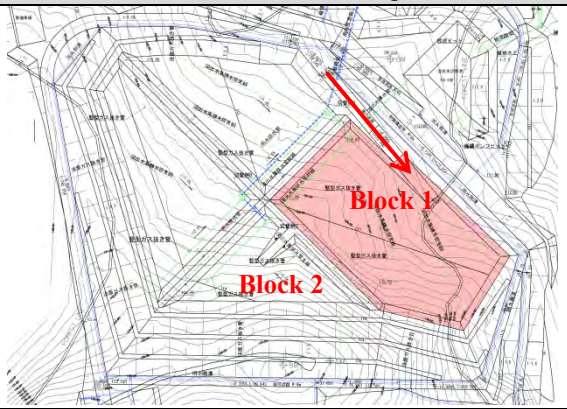
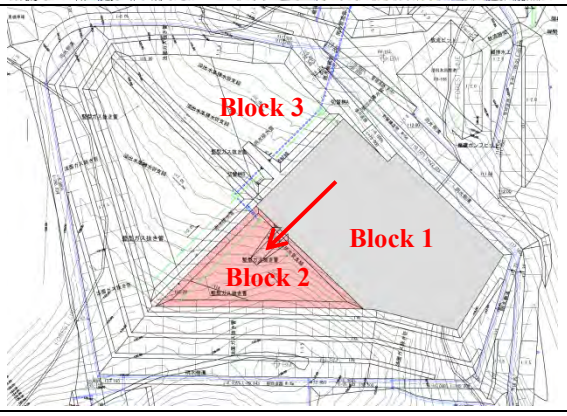
(iii) Refusal of Waste Reception

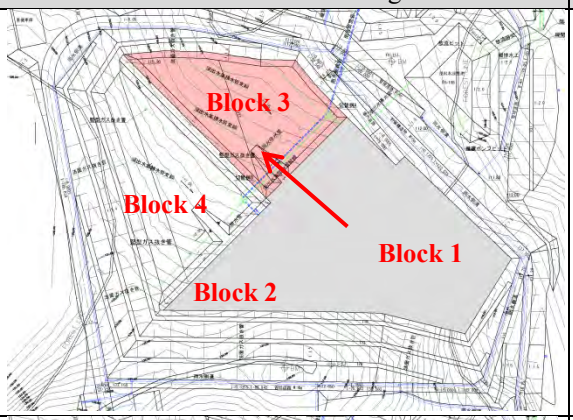
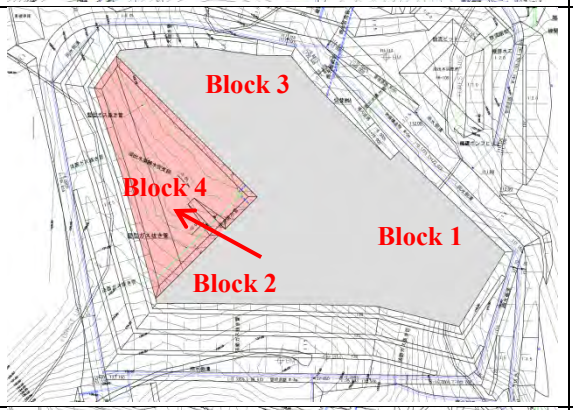
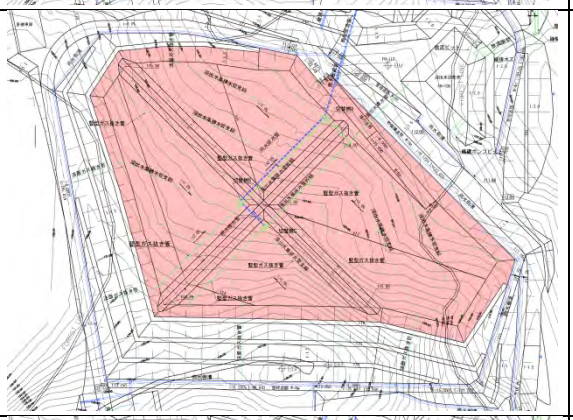
The transporting trucks should be required to take back the waste when the inspection confirms the truck is carrying prohibited waste.

(c) Management of Landfill Operation

The landfill operation including delivering and filling the waste for the management of landfilling are implemented stepwise as below. The landfill site is to be divided into four blocks and the landfilling method is described as follows:

Table 2.23 Stepwise Landfill Operation

Phase	Location of landfilling	Method
Phase 1		Block 1 attached inside road is landfilled at first. The waste is to be filled until 50cm lower than the top of the embarkment. The remaining 50cm should be covered with soil. A road to the Block 2 is to be installed after landfilling of Block 1.
Phase 2		Rain discharge pipes of the switching pit are to be closed before starting Block 2 landfilling and the leachate in Block 2 is to be switched to flow to the leachate collection pipe in Block 1. The waste of Block 2 is also to be filled until 50cm lower than the top of the embarkment and the remaining 50cm should be covered with soil. A road to the Block 3 from Block 1 is to be built after landfilling of Block 2.

Phase	Location of landfilling	Method
Phase 3		Rain discharge pipes of the switching pit are to be closed before starting Block 3 landfilling and the leachate in Block 3 is to be switched to flow to the leachate collection pipe in Block 1. The waste of Block 3 is also to be filled until 50cm lower than the top of the embarkment and this remaining 50cm be covered with soil. A road to the Block 4 from Block 2 is to be installed after landfilling of Block 3.
Phase 4		Rain discharge pipes of the switching pit are to be closed before starting Block 4 landfilling and the leachate in Block 4 is to be switched to flow to the leachate collection pipe in Block 3. The waste of Block 4 is also to be filled until 50cm lower than the top of the embarkment and the remaining 50cm be covered with soil. All Blocks are to be filled until top of the embarkment after landfilling of Block 4.
Phase 5		The waste is to be filled until a top of the downstream embarkment, which ground level is approximately 117m.
Phase 6		Counterweight embankment is to be constructed before landfilling after Phase 5. The height of counterweight embankment is 1.0m, which ground level is from 117m to 118m. Transportation trucks are to enter from the access road directly. The waste is to be filled until 50cm from the top of the embankment, this remaining 50 cm should be covered with soil.

Phase	Location of landfilling	Method
Phase 7		Counterweight embankment, which height is 2.5m, is to be constructed and the berm, which width is 2.0m, is to be constructed in front of the counterweight embankment. Transportation trucks are to enter from the access road directly. The waste is to be filled until 120.0m of the ground level and the top 50cm should be covered with soil.
Phase 8		Counterweight embankment, which height is 2.5m, is to be constructed contiguous to counterweight embankment of Phase 7. Transportation trucks are to enter from the access road directly. The waste is to be filled until 122.5m of the ground level and the cover soil is to be filled 50cm. The slope of landfill, which height is 5.0m, is constructed when Phase 8 has finished.
Phase 9	The work of Phase 7 and Phase 8 is to be repeated after Phase 9 and the slope of landfill, which is 5.0m height, is to be constructed and the berm which is 2.0m width is installed each 5.0m height. Counterweight embankment is to be constructed for 9 times.	

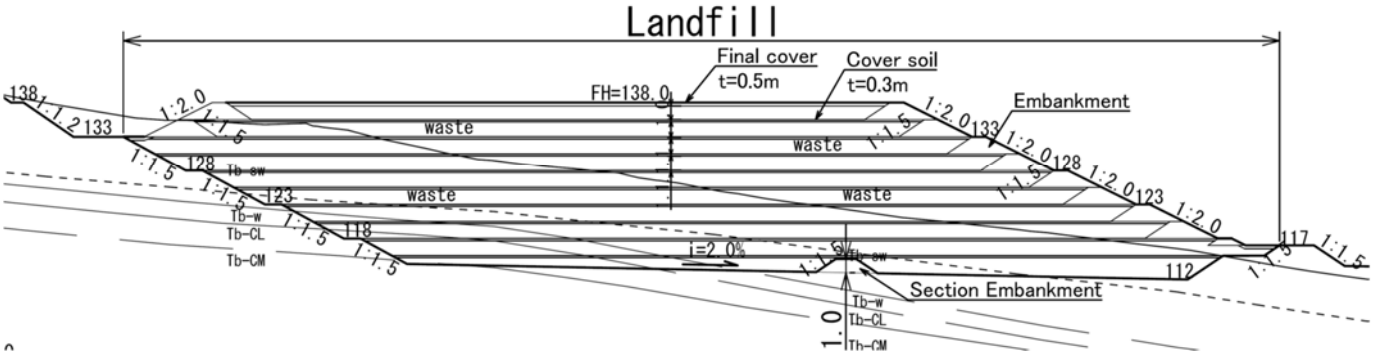


Figure 2.38 Longitudinal Section of Completed Landfilling

(d) Maintenance of Facilities

All facilities comprising the new landfill should be kept in good condition to function well for the security and safety of the landfill.

(i) Regular Inspection

Inspection items, inspection method, judgment standard and inspection frequency of facilities for the new landfill are enumerated as below. In terms of truck scale, the supplier of the equipment should make a start-up guidance and instructions, and explain the necessary actions for maintenance and operation of the equipment.

Table 2.24 Regular Inspection of the Circulating Pump and Discharging Pump

Inspection Items	Method	Evaluation Criteria	Frequency
Pump (Current value、Pressure, etc.)	Visual	Abnormal value	Everyday
Pump (Abnormal sound and vibration)	Acoustic	Abnormal sound	Everyday
Pump (Packing)	Visual	Proper quantity	Once per 3 months
Pump (Seal)	Visual	Water leakage	Once per 3 months
Operation Board (Indication Lamp)	Visual	Lighting	Once per week
Operation Board (Alarm)	Visual	Alarm	Everyday

Table 2.25 Regular Inspection of the Concrete Pit

Inspection Items	Method	Evaluation Criteria	Frequency
Damage and Crack of Concrete	Visual	Damage and Crack	Once per month
Exposure of Reinforcing bar	Visual	Exposure of Reinforcing bar	Once per month
Subsidence and Inclination of construction	Visual	Subsidence and Inclination	Once per month
Dirt on the concrete	Visual	Dirt	Once per month

Table 2.26 Regular Inspection of the Impervious Sheet on the Leachate Pond

Inspection Items	Method	Evaluation Criteria	Frequency
Wrinkle and Stretch of impervious sheet	Visual	Abnormal Condition	Once per week
Swelling and sink of impervious sheet	Visual	Abnormal Condition	Once per week
Separation of impervious sheet Junction	Visual	Separation	Once per week
Damage of impervious sheet	Visual	Damage	Once per week
Crack and removal of sheet fixing	Visual	Abnormal Condition	Once per week

Table 2.27 Regular Inspection of the Gravel Contact Oxidation Treatment Channel

Inspection Items	Method	Evaluation Criteria	Frequency
Crack of channel	Visual	Crack	Once per week
Overflow from cannel	Visual	Overflow	Once per week
Corrosion beside channel	Visual	Corrosion	Once per week
Clogging of aggregate	Visual	Clogging	Once per week
Discharge condition from channel	Visual	Property water volume	When leachate discharging

Table 2.28 Regular Inspection of the Coral Sand Channel

Inspection Items	Method	Evaluation Criteria	Frequency
Crack of channel	Visual	Crack	Once per week
Overflow from cannel	Visual	Overflow	Once per week
Corrosion beside channel	Visual	Corrosion	Once per week
Clogging of coral sand	Visual	Clogging	Once per week
Flowing water volume to the Vegetation-Based Water Purification Pond	Visual	Property water volume	When leachate discharging

Table 2.29 Regular Inspection of the Vegetation-Based Water Purification Pond

Inspection Items	Method	Evaluation Criteria	Frequency
Vegetation condition in the Pond	Visual	Growth of vegetation	Once per week
Water storage condition in the Pond	Visual	Water quality of the storage water	Once per week
Precipitation of sediment in the pond	Visual	Volume of precipitation	Once per week
Slope condition	Visual	Abnormal condition such as collapse	Once per week
Volume of discharging to the downstream	Visual	Property water volume	When leachate discharging

(ii) Extension of Gas Exhausted Pipes

Gas exhausted pipes should be extended in accordance with progress of the landfilling to avoid being covered by the waste. A total of nine (9) gas pipes are to be installed as below at the landfill site.

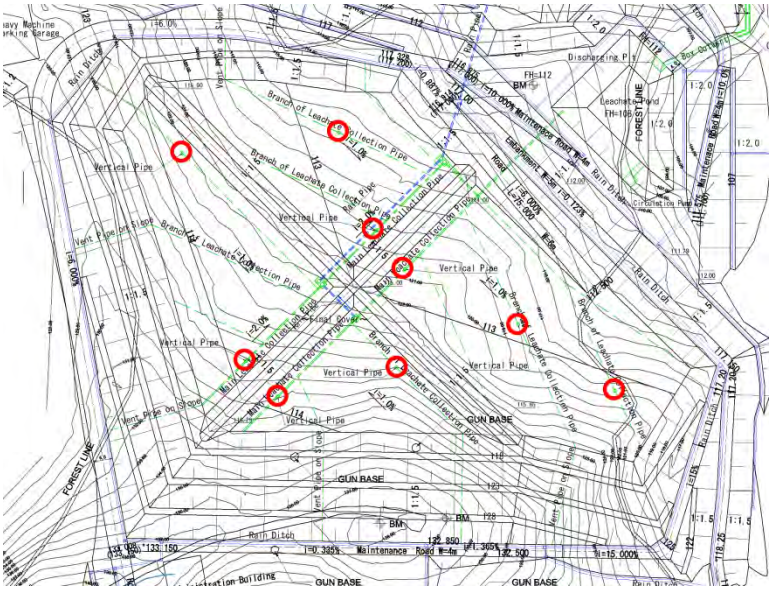


Figure 2.39 Location of Gas Exhausted Pipes

The gas exhausted pipes are installed in the drum and cobblestones are filled around the gas pipes, as illustrated in **Figure 2.40**. The additional drum is to be jointed and the gas pipe is to be extended and cobblestones are to be filled before the pipe is not to be filled by the waste. In addition, holes which width is 2 or 3cm should be drilled at eight (8) points per a circle of five (5) stages on the drum surface.

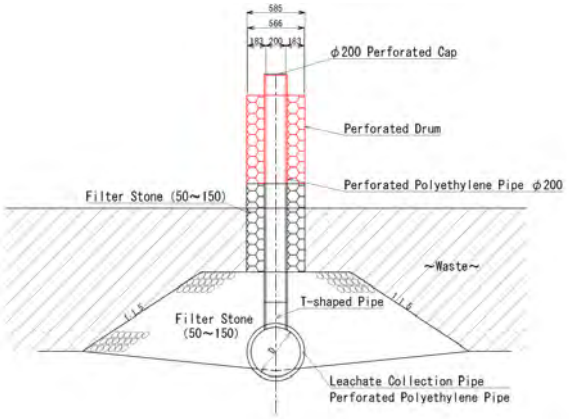


Figure 2.40 Typical Cross Section of the Gas Exhausted Pipe

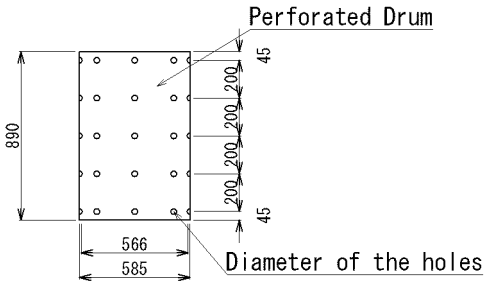


Figure 2.41 Typical Cross Section of the Drum

(e) Environmental Management

Regular monitoring should be implemented for the environmental management against solid waste, leachate and gas. The Environmental Monitoring Plan such as monitoring items, location, method and frequency is described in **Subsection 1.3.10**.

2.4.2 Operation and Maintenance Plan of Equipment

(1) Organization of O&M of Equipment

Operation of equipment is to be carried out by DSWM as well as that of the new landfill. Maintenance of equipment is also to be implemented by mechanics in DSWM who have much experience and are able to maintain all kinds of equipment in the site. Two (2) personnel from mechanic and maintenance staff are to be allocated for the O&M of equipment. In addition, two (2) safety staff are to be assigned for the operation of environmental measuring equipment, such as pH meter and gas analyzer.

(2) Method of Equipment O&M

(a) Equipment for the O&M of New Landfill

Procured equipment, i.e. Bulldozer, Excavator, Wheel Loader and Dump Truck are basically to be stored at the heavy machine garage after completion of their daily operation. In addition, general inspection and fixing should be carried out at the maintenance space in the garage.

(b) Equipment for the Collection and Transportation of Waste

Compactor trucks are to collect and transport the waste generated from government offices and public institutions in Babeldaob Island. The waste collection and transportation system in Koror State and Babeldaob Island will be studied and proposed by J-PRISM Phase 2.

(c) Equipment for the Environmental Measurement

pH meter and gas analyzer are to be stored by BPW and exchanging of consumables is to be conducted as needed by BPW.

2.5 Project Cost Estimate

2.5.1 Initial Cost Estimate

(1) Cost Borne by Japan's Grant Aid

The cost borne by the Japan's Grant Aid is not shown in this report due to confidentiality.

(2) Cost Borne by Recipient Country

The cost to be borne by the GOP is estimated to be about USD25,100 (2,820 thousand Japanese Yen). The breakdown is shown in **Table 2.30**.

Table 2.30 Cost Borne by Recipient Country

No.	Items	Cost (US Dollar)	Cost (Japanese Yen)
1	Advising Commission for Banking Arrangement (B/A) and Authorization to Pay (A/P), and Payment Commission	5,600	630,000
2	Lading Electric Wire	15,500	1,740,000
3	Connecting Electricity	4,000	450,000
Total		25,100	2,820,000

Exchange Rate: US$1.00 = 112.84 Japanese Yen (as of June 2017)

(3) Cost Estimation Conditions

1. Estimation Timing : June 2017
2. Foreign Exchange Rate : USD1.00 = JPY 112.84 USD: US Dollar JPY: Japanese Yen

   Foreign Exchange Rate applied is the average of Telegraphic Transfer Rate (TTS rate) for three months from March 2017 to May 2017.
3. Construction Period : The implementation schedule of the detailed design, construction and procurement is approximately 26 months.
4. Remarks : This cost is estimated by taking Japan's Grant Aid scheme into account.

2.5.2 Operation and Maintenance Cost

(1) O&M Cost of New Landfill

Compared with the O&M cost of the exiting M-Dock Landfill, some items, specifically, a) electricity charge of administration building, heavy machine garage and circulating pump, b) maintenance cost of circulating pump, and c) fuel cost for delivering cover soil from soil disposal yard to the new landfill should be added as the O&M cost of new landfill. The additional cost is estimated at USD36,100 per year and the cost summary is presented in **Table 2.31**.

Table 2.31 Additional O&M Cost of New Landfill

Items	Summary	Cost (USD)
Electricity charge of administration building, heavy machine garage and circulating pump	Maximum electricity consumption: 18kVA × 8h × 300day (25day × 12months) = 43,200kWh Public electricity charge: 0.295 US$/kWh × 43,200 kWh = 12,744 US$	13,000
Maintenance cost of circulating pump	Annual maintenance rate: 3% of Estimated price	6,000
Fuel cost for delivering cover soil from soil disposal yard to the new landfill	Fuel cost for loading by the wheel loader at the soil disposal yard and for delivering soil by the dump truck for 2km. 1) Fuel consumption rate Wheel loader (1.3m^3): 9.6L/h Dump truck (8t): 7.7L/h 2) Delivering frequency Amount of cover soil: 87,000m^3 (for 20 year) Amount of daily cover soil: 14.5m^3 (300day per year) Amount of loading on the dump truck: 4m^3/nos. Delivering frequency: 4 times/day 3) Operation time Delivering time: 20 minutes × 4round = 80 minutes Loading time: 10 minutes × 4times = 40 minutes Dumping time: 10 minutes × 4times = 40 minutes Total time: 2.7 hours 4) Fuel consumption Wheel loader: 9.6L/h×2.7h = 26 L/day Dump truck: 7.7L/h×2.7h = 21 L/day Total: 47 L 5) Fuel cost Diesel unit price: 1.22US$／L Daily cost: 47 L × 1.22US$/L =57 US$/day Annual cost: 57 US$ × 300day = 17,100 US$	17,100
Total		36,100

(2) O&M Cost of Equipment

The O&M cost of equipment for the new landfill is estimated at USD31,300 per year additionally as shown in **Table 2.32**.

Table 2.32 Operation and Maintenance Cost of Equipment

Items	Annual O&M cost per unit	Quantity of equipment	Annual O&M cost (USD)
Bulldozer: 21t	12,500	1	12,500
Excavator: 0.8m^3	5,900	1	5,900
Wheel Loader: 1.3m^3	3,000	1	3,000
Dump Truck: 8t	4,300	1	4,300
Compactor Truck: 2t	2,800	2	5,600
Total			31,300

Exchange Rate: US$1.00 = 112.84 Japanese Yen (as of June 2017)

(3) Total Cost and Budgetary Provision

The total O&M cost is USD67,400 which is added to the existing O&M cost of the M-Dock Landfill, and the breakdown is shown in **Table 2.33**.

Table 2.33 Total O&M Cost

Items	Summary	Cost (USD)
Electricity charge	administration building, heavy machine garage and circulating pump	13,000
Maintenance cost of circulating pump	Annual maintenance rate: 3% of Estimated price	6,000
Fuel cost	For delivering cover soil from soil disposal yard to the new landfill	17,100
O&M Cost of Equipment	Bulldozer, Excavator, Wheel loader, Dump truck, Compactor truck	31,300
Total		67,400

The budget and expenditure on the SWM sector in Palau is summarized in **Table 2.34** below and it is obvious that the expenditure fluctuated for three (3) years from 2014 to 2016. The budget, however, increased year by year and it had reached at USD500 thousand in 2016. There is a plan to increase the number of personnel and spread the SWM budget according to information from BPW. In addition, a method of collecting waste disposal charge will be considered by J-PRISM Phase 2.

Although the above additional O&M cost, i.e. USD67,400 is calculated at 13.4% of the total budget of 2016, i.e. USD502,842, it is judged that this additional amount will be handled by introducing the collection of disposal charge.

Table 2.34 Budget and Expenditure on the SWM in Palau

Items	2014	2015	2016
Budget	432,012	493,284	502,842
Total Expenditure (a + b + c)	538,968	676,743	229,633
a. Improvement of landfill	458,186	169,000	0
b. Salary, Wage, etc.	9,214	93,307	96,594
c. Equipment maintenance, Fuel cost, etc.	71,625	414,435	133,038

Source: DSWM, the fiscal year in Palau starts from October and end up to next September.

3. PROJECT EVALUATION

3.1 Preconditions

Precondition for project implementation and implementation status are as follows:

Table 3.1 Precondition for Project Implementation

.	Precondition	Implementation Status and Plan as of April 2018	In charge
1	To open bank account (B/A)	Before the Tender	MOF
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant and to bear the Advising commission of A/P	Before the Tender	MPIIC
3	To approve Environmental Assessment / Environmental Impact Statement (Conditions of approval should be fulfilled, if any) and secure the necessary budget for implementation	Approved on March 2018	EQPB／MPIIC
4	To conduct Unexploded Ordnance (UXOs) survey and removal at the site	Done on December 2017	MPIIC
5	To take necessary measure for construction safety		MPIIC／BPW
6	To secure the Project site with the legal land leasing agreement	To be agreed with a landowner on April 2018	MPIIC
7	To bear the Payment commission for A/P to a bank in Japan for the banking services based upon the B/A	When each contract is to be sighed	MPIIC
8	To ensure prompt unloading and customs clearance at ports of disembarkation in recipient country and to assist in logistical arrangement with the Supplier(s) on internal transportation therein	During the Project	MPIIC
9	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted	During the Project	MPIIC
10	Undertakings taken by the recipient country - To secure the space for residual soil from the construction site - To distribute electricity line to the site - To install filling material into the Leachate Treatment Facilities	 - Before the construction - Before the construction - During the construction	MPIIC

MPIIC: Ministry of Public Infrastructure, Industries and Commerce
EQPB: Environmental Quality Protection Board
MOF: Ministry of Finance

3.2 Necessary Inputs by Recipient Country

Necessary inputs by Recipient Country for the project achievement are as follows:

- To set workers for the O&M of the landfill;
- To implement the continuous environmental monitoring; and
- To confirm the new system of waste collecting and transporting and tool collection through the connection with J-PRISM Phase 2.

3.3 Important Assumptions

Important assumptions of the Project are as follows:

- Unexpecting environmental change and disaster such as large flood around the site do not occur;
- Relevant policies of Palauan government do not change dramatically; and
- O&M of the landfill and collection and transportation of the waste in Babeldaob Island are conducted by DSWM as a main authority.

3.4 Project Evaluation

Relevance and Effectiveness are to be prospected as following reasons.

3.4.1 Relevance

Through the development of the landfill and the procurement of relevant equipment, the Project contributes to the solid waste management and environmental sanitary improvement; thus, relevance of the Project is high. The synergistic effects are also expected through the cooperation with the present technical assistance, J-PRISM Phase 2. Details of the relevance are as follows:

(1) Development of Urban Environment and Improvement of Sanitary Conditions

Through the construction of the landfill and procurement of the equipment for Koror State and Babeldaob Island, the Project contributes to improving the solid waste management, to conserving the natural nature, which is the largest tourist resource in Palau and to maintaining the sanitary condition.

(2) Positioning and Necessity between the Project and the Waste Management Plan in Palau

In the NSWMP (2012~2017), there are three strategies related to solid waste management as follows:

- To promote the relationship with stakeholders through the activities such as policy planning, capacity development, information sharing and education and enlightenment for local residence;
- To promote the reduction of the waste; and
- To improve the existing solid waste management and disposal framework.

Development of the landfill, implementation of the sanitary landfilling and improvement of the collection and transportation of the waste contribute to the above strategy 3) in the NSWMP.

(3) Assistance Policy and Achievement related to Solid Waste Management of Japan and JICA

The Project is categorized into “Environment and Climate Change” as Priority Area in Japan's Development Assistance Policies for the Republic of Palau and “Environmental Protection” as Development Issue in Project Planning for Palau.

(4) Relationship and Role Sharing with Another Project and Another Donor

JICA projects related to solid waste management in Oceania including Palau have been conducted from 2004. Especially, projects for the landfill improvement and the capacity development based on the Fukuoka Method, semi-aerobic landfill structure, had been conducted in the J-PRISM Phase2. The Project therefore plans that the soft component after construction of the landfill is to be conducted by J-PRISM Phase2 and a sustainable solid waste management framework is to be built.

3.4.2 Effectiveness

Effectiveness is evaluated by both quantitative effect and qualitative effect.

(1) Quantitative Effect

Indicators and target of the quantitative effect are shown in **Table 3.2**.

Table 3.2 Outcome of the Project

Indicators	Base year (2020)	Target year (2023)
Amount of the daily delivering waste to the landfill	0	27.07 ton/day
Operation rate of the heavy machine	0	2hours/day

(a) Amount of the Daily Delivering Waste to the Landfill

As the only existing national landfill, M-Dock, the landfilling capacity is already exceeded, and the life span is extended by the bulk up of embankment. The M-Dock Landfill is expected to be full in few years, thus, quantitative effect is equal to the receiving capacity of the landfill. Amount of the delivering waste in the target year (2023) is more than 27 t per day.

(b) Operation Rate of the Heavy Machine

Operation rate of the heavy machine for the landfill O&M is one of the quantitative effects. Operation time in 2023 is to be two (2) hours/day if operation time in 2020, base year, is 0 hour/day. Operation rate of the heavy machine is to be each operation time of Bulldozer, Excavator and Wheel Loader and actual work time is to be measured by working record.

(2) Qualitative Effect

Adequate disposal of the waste which had been dumped openly in Babeldaob Island contributes to improve sanitary environment in Babeldaob Island and conserving environment in Palau.

APPENDICES

APPENDIX 1

Member List of the Survey Team

Member List of the Survey Team

(1) 1st Survey (22nd April ~ 1st June 2017)

No	Name	Assigned Position	Affiliation
1	Dr. Mimpei ITO	Team Leader	Director Environmental Management Division 1 Environmental Management Group Global Environment Dept., JICA
2	Ms. Mizuki HOSOKAI	Project Coordinator	Environmental Management Division 1 Environmental Management Group Global Environment Dept., JICA
3	Ms. Ayako YOSHIDA	Project Planner	Project Formulation Advisor JICA Micronesia Office
4	Mr. Masakazu MAEDA	Chief Consultant/ Solid Waste Management	CTI Engineering International Co., Ltd.
5	Mr. Takuya KOUKETSU	Facility Design/Leachate	Eight-Japan Engineering Consultants Inc.
6	Mr. Hirofumi MIYOSHI	Equipment Plan/Cost Estimate	CTI Engineering International Co., Ltd.
7	Mr. Shunpei ICHIKAWA	Construction Plan/Cost Estimate	CTI Engineering International Co., Ltd.
8	Mr. Akira HASEYAMA	Environmental and Social Considerations	EX Research Institute Ltd.

(2) 2nd Survey (25th June ~ 9th July 2017)

No	Name	Assigned Position	Affiliation
1	Mr. Masakazu MAEDA	Chief Consultant/ Solid Waste Management	CTI Engineering International Co., Ltd.
2	Mr. Takuya KOUKETSU	Facility Design/Leachate	Eight-Japan Engineering Consultants Inc.
3	Mr. Akira HASEYAMA	Environmental and Social Considerations	EX Research Institute Ltd.

(3) 3rd Survey (20th January ~ 30th January 2018)

No	Name	Assigned Position	Affiliation
1	Mr. Nobuaki MIYATA	Team Leader	Resident Representative, JICA Palau Office
2	Ms. Mizuki HOSOKAI	Project Coordinator	Environmental Management Division 1 Environmental Management Group Global Environment Dept., JICA
3	Mr. Masakazu MAEDA	Chief Consultant/ Solid Waste Management	CTI Engineering International Co., Ltd.
4	Mr. Takuya KOUKETSU	Facility Design/Leachate	Eight-Japan Engineering Consultants Inc.

APPENDIX 2

Survey Schedule

Survey Schedule

(1) 1st Survey (22nd April ~ 1st June 2017)

Date		Team Leader	Project Coordinator	Consultants
Apr. 22	Sat		Arrival @ Koror	
Apr. 23	Sun		Meeting Preparation	Arrival @ Koror
Apr. 24	Mon		Meeting with JICA Palau Office and Pre-meeting with BPW Visiting at the proposed site	
Apr. 25	Tue		Pre-meeting with BPW	
				Meeting with BPW and EQPB
Apr. 26	Wed	Arrival @ Koror		
		Signing on M/D Visiting at the Koror Recycle Center		
Apr. 27	Thu	Visiting at M-Dock		
Apr. 28	Fri	Data Collection		
Apr. 29	Sat	Returning		
Apr. 30	Sun		Returning	
May 3	Wed			Starting Geotechnical Survey
May 4	Thu			Starting Topographic Survey
May 6	Sat			Meeting with J-PRISM Phase2
May 8	Mon			Meeting with J-PRISM Phase2
May 9	Tue			Starting Survey for Gun bases
May 13	Sat			Dr. Matsufuji and Mr. Kawanabe Arriving
May 17	Wed			Presentation by Dr. Matsufuji and Mr. Kawanabe
May 19	Fri			Dr. Matsufuji and Mr. Kawanabe Returning Finishing Topographic Survey
May 25	Thu			Visiting the Embassy of Japan
May 30	Tue			Presentation of the result of the Survey
May 31	Wed			Finishing Geotechnical Survey
Jun. 1	Thu			Collecting water sample for Water Quality Survey Returning

(2) 2nd Survey (25th June ~ 9th July 2017)

Date		Consultants
Jun. 25	Sun	Arrival @ Koror
Jun. 26	Mon	Meeting with BPW
Jun. 27	Tue	Documents and data collecting
		Modifying design and plan of landfill
Jun. 28	Wed	Meeting with BPW
		Modifying design and plan of landfill and Documents and data collecting
Jun. 29	Thu	Documents and data collecting and visiting the site
Jun. 30	Fri	Meeting with BPW
Jul. 1	Sat	Holiday
Jul. 2	Sun	Holiday
Jul. 3	Mon	Meeting for the Technical Note and preparation of stakeholder meeting
Jul. 4	Tue	Signing of the Technical Note and holding stakeholder meeting
Jul. 5	Wed	Reporting
Jul. 6	Thu	Reporting
Jul. 7	Fri	Site survey and reporting to JICA Palau office
Jul. 8	Sat	Data arrangement and reporting
Jul. 9	Sun	Returning

(3) 3rd Survey (20th January ~ 30th January 2018)

Date		Team Leader	Project Coordinator	Consultants
Jan. 20	Sat			Arrival @ Koror
Jan. 21	Sun		Arrival @ Koror	
		Team meeting		
Jan. 22	Mon	Explanation of the Survey Meeting for M/D Confirming of EIA status		
Jan. 23	Tue	Signing of M/D		
Jan. 24	Wed		Retuning	Visiting the soil disposal site
Jan. 25	Thu			Visiting the site
Jan. 26	Fri			Confirming EIS progress
Jan. 27	Sat			Arrangement of documents
Jan. 28	Sun			Holiday
Jan. 29	Mon			Reporting to the JICA Palau Office
Jan. 30	Tue			Returning

APPENDIX 3

List of Parties Concerned in the Recipient Country

List of Parties Concerned in the Recipient Country

所属	名前	役職
Bureau of Public Works (BPW)	Brian Melairei	Director
Division of Solid Waste Management (DSWM), BPW	Calvin Ikesiil	Chief
	Jessica Emesiochel	SWM Coordinator
	Joseline Skebong	SWM Educator
	Puananni Pedro	Administrative
	Vernon Basilius	Landfill Supervisor
Solid Waste Management Office, Koror State Government	Fuji Katsuo	Consultant
Environmental Quality Protection Board (EQPB)	Mike Blesam	
	Carlos Wasisang	
JICA Palau Office	Nobuaki MIYATA	Resident Representative
	Olga Singeo	Program Officer
Embassy of Japan	Koji TOMITA	Counsellor
	Takao MOCHIDA	Economic Researcher
Norwegian People's Aid (NPA)	Luke Atkinson	Program Manager

APPENDIX 4

Minutes of Discussions

Minutes of Discussions

(1) 1st Survey (22nd April ~ 1st June 2017)

Minutes of Discussions
on the Preparatory Survey
for the Project for the Construction of Palau New National Landfill

In response to the request from the Government of Republic of Palau (hereinafter referred to as "Palau"), Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of the Project for the Construction of Palau New National Landfill (hereinafter referred to as "the Project") to Palau, headed by Dr. Ito Mimpei, Director of Environmental Management Team, Environmental Management Group, Global Environment Department, from 26th to 27th of April, 2017. The Team held a series of discussions with the officials of the Government of Palau and conducted a field survey. In the course of the discussions, both sides have confirmed the main items described in the attached sheets.

Koror, 26th, April, 2017

Dr.Ito Mimpei	Mr.Brian Melairei
Leader	Director
Preparatory Survey Team	Bureau of Public Works
Japan International Cooperation Agency	Ministry of Public Infrastructure, Industries and Commerce
Japan	Republic of Palau

ATTACHMENT

1. Objective of the Project
   The objective of the Project is to promote an appropriate solid waste management through the construction of new national landfill site, thereby contributing to achieve sustainable environment of Palau.

2. Title of the Preparatory Survey
   Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for the Construction of Palau New National Landfill".

3. Project site
   Both sides confirmed that the site of the Project is in Ongerarekieu, Aimeliik State, Republic of Palau, which is shown in Annex 1.

4. Responsible authority for the Project
   Both sides confirmed the authorities responsible for the Project are as follows:
   Division of Solid Waste Management, Bureau of Public Works (hereinafter referred to as "BPW"), Ministry of Public Infrastructure, Industries and Commerce (hereinafter referred to as "MPIIC")

4-1. BPW, MPIIC will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be managed by relevant authorities properly and on time. The organization charts are shown in Annex 2.

5. Items requested by the Government of Palau
   As a result of discussions, both sides confirmed that the items requested by the Government of Palau are as described in Annex 3.

5-1. JICA will assess the feasibility of the above requested items through the survey and will report the findings to the Government of Japan. The final scope of the Project will be decided by the Government of Japan.

6. Procedures and Basic Principles of Japanese Grant

6-1. The Palauan side agreed that the procedures and basic principles of Japanese Grant as described in Annex 4 shall be applied to the Project. As for the monitoring of the implementation of the Project, JICA requires the Palauan side to submit the Project Monitoring Report that the form is attached as Annex 5.

6-2. The Palauan side agreed to take the necessary measures, as described in Annex 6, for smooth implementation of the Project. The contents of the Annex 6 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report. The contents of Annex 6 will be updated as the Preparatory Survey progresses, and eventually, will be used as an attachment to the Grant Agreement.

7. Schedule of the Survey

7-1. The Team will proceed with further survey in Palau until 1st of June and will again come back to Palau in the end of June.

7-2. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Palau in order to explain its contents around the middle of November, 2017.

7-3. If the contents of the draft Preparatory Survey Report is accepted and the undertakings for the Project are fully agreed by the Palauan side, JICA will finalize the Preparatory Survey Report and send it to the Palauan side around February, 2018.

7-4. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. The Palauan side confirmed to give due environmental and social considerations during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8-2. The Project is categorized as "B" from the following considerations:
The project is not considered to be a large-scale solid waste management project, is not located in a sensitive area, and has none of the sensitive characteristics

under the JICA guidelines for environmental and social considerations (April, 2010), it is not likely to have a significant adverse impact on the environment.

8-3. The Palauan side confirmed to conduct the necessary procedures concerning the environmental assessment [including Environmental Assessment (EA)/ Environmental Impact Statement (EIS) and information disclosure, etc.] and make EA/EIS report of the Project. The EA/EIS approval shall be received from the responsible authorities and submitted to JICA by the end of December, 2017.

8-4. Both sides confirmed that there is no PAP (Project Affected People) residing in the Project site.

8-5. The Palauan side explained about the process and progress of EIS approval procedure as follows.

(1) Conduct EA and submit the result of EA to Environmental Quality Protection Board (EQPB).
(2) EQPB will determine whether the EIS is required or not.
(3) Based on EQPB's decision, EIS will be done.
(4) Necessary survey, evaluation and expectations will be taken by the trusted third party.
(5) Draft EIS will be prepared.
(6) Public consultation of draft EIS.
(7) Final draft EIS will be prepared.
(8) Approval of EIS.

8-6. The Palauan side requested the team to perform the baseline testing of the ground water in the project site on the following heavy metals. Baseline data will be needed for a project effectiveness monitoring after construction. BPW has a responsibility to conduct monitoring on those items once after they start the operation.

(1) Hydrogen Sulfide
(2) Iron
(3) Manganese
(4) Sulfate
(5) Arsenic
(6) Barium

(7) Cadmium
(8) Fluoride
(9) Lead
(10) Mercury
(11) Nitrate
(12) Nitrite
(13) Selenium

9. Other Relevant Issues

9-1. Necessary Approval of Construction of the Facilities

The Palauan side described necessary procedures for obtaining approval for the construction of facilities in the Project as follows:

(1) Capital Improvement Project (CIP) submits draft outline design to BPW, MPIIC for their review and recommendations.
(2) BPW submits detailed design to EQPB.

9-2. Securing Budget by the Government of Palau for the Project

The Palauan side shall secure necessary budget to cover the cost for taking necessary major undertakings to be covered by the Palauan side for the Project as per Annex 6.

9-3. Customs Duties and Tax exemption

The taxes including custom duty, and any other taxes and levies in Palau which are to arise from the Project activities will be exempted by the Palauan side. BPW will take any procedures necessary for the tax exemption with the Ministry of Finance on its responsibility.

9-4. Submission of Project Monitoring Report

Project Monitoring Report (PMR) will be prepared by the Palauan side for confirming the outline and progress of the Project. The Team described the purpose of the preparation of PMR, BPW agreed to submit PMR to JICA monthly during the Project implementation. The format of PMR is attached as Annex 5.

9-5 Unexploded ordnance survey

The Palauan side confirmed to conduct the unexploded ordnance (UXO) survey at the site and will share the result of the survey with JICA by December, 2017.

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 List of Requested Items
Annex 4 Japanese Grant
Annex 5 Project Monitoring Report (template)
Annex 6 Major Undertakings to be taken by the Government of Palau

Annex1

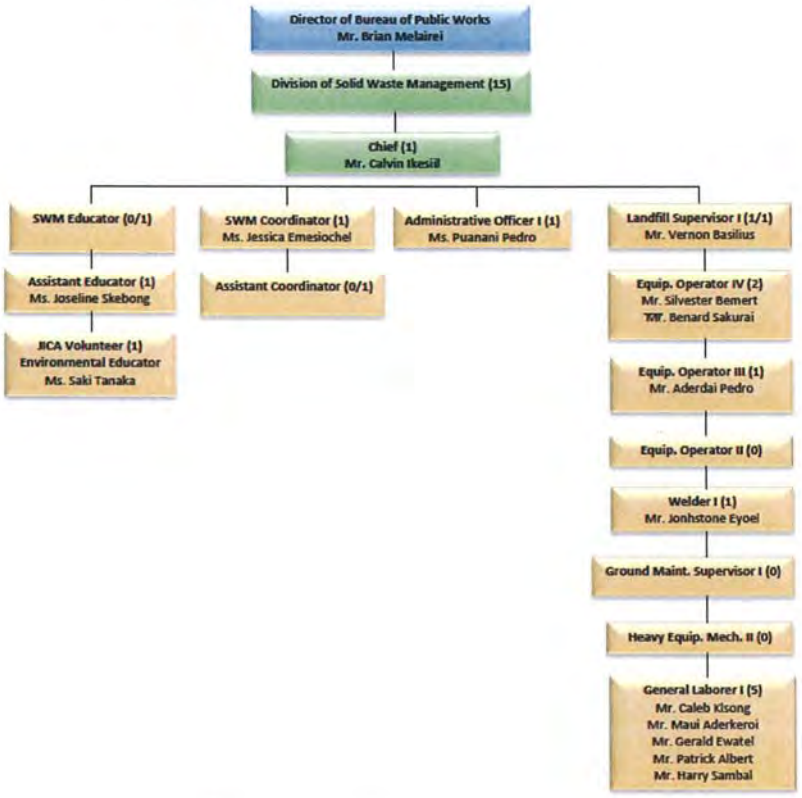
Principal Area of the ROP

Project Site Location

Detailed location map for the project site

Annex 2

SWM ORGANIZATIONAL CHART



Annex 3

List of Requested Items

No.	Requested Component	Description	Unit	Priority
1	Equipment for management and maintenance of landfill site	Bulldozer (D6)	1	A
2	ditto	Excavator(PC200)	1	A
3	ditto	Wheel loader	1	A
4	ditto	Dump Truck (10 ton)	1	A
5	ditto	Weigh Scale system(30-50 tons)	1	A
6	Equipment for waste collection	Compactor Truck	3	A
7	Laboratory Equipment	BOD meter	1	A
8	ditto	COD meter	1	A
9	ditto	pH meter	1	A
10	ditto	Turbidity meter	1	A
11	ditto	Gas Analyzer(Xp-3140)	1	A

Annex 4

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or 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. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation
- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal
-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes
-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")
-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")
-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement
-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation
-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the 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 necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant 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.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take 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 executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (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 feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

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 to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

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

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the

Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX
20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Executing Agency	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Line Ministry	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations
See Attachment 2.

2-4-2 Activities
See Attachment 3.

2-4-3 Report on RD
See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations
See Attachment 2.

2-4-2 Activities
See Attachment 3.

2-4-3 Report on RD
See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

-

-

-

Attachment 7

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

Annex 6

Major Undertakings to be taken by the Government of Palau

1. Specific obligations of the Government of Palau which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open bank account (B/A)	within 1 month after the signing of the G/A	MOF		
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract	MPIIC		
3	To approve EA/EIS(Conditions of approval should be fulfilled, if any) and secure the necessary budget for implementation	by the end of 2017	EQPB MPIIC		
4	To conduct UXO survey at the site and share the result with JICA	by the end of 2017	MPIIC		
5	To secure the Project site	before notice of the bidding document	MPIIC		
6	To obtain the planning, zoning, building permit	before notice of the bidding document	MPIIC		
7	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding documents	MPIIC		

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	MPIIC		
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	MPIIC		
	2) Payment commission for A/P	every payment	MOF		
3	To ensure prompt unloading and customs clearance at ports of disembarkation in recipient country and to assist in logistical arrangement with the Supplier(s) on internal transportation therein	during the Project	MPIIC		
4	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work	during the Project	GOP		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted Such customs duties, internal taxes and other fiscal levies mentioned above included commercial tax, income tax and corporate tax of Japanese nationals, resident tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract.	during the Project	MOF		
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	GOP		
7	To submit Project Monitoring Report	quarterly	MPIIC		
	To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	MPIIC		
8	To improve accessibility to the site	before the commencement of the project	MPIIC		
9	To provide facilities for distribution of electricity, drainage, tele-communication and other incidental facilities necessary for the implementation of the Project outside the site(s)		MPIIC		
	1) Electricity The distributing line to the site	before the commencement of the project	MPIIC		
	2) Canal Construction of canal beyond the site	3 months before completion of the construction	MPIIC		
10	To take necessary measure for construction safety - traffic control - rope off	during construction	MPIIC		
11	To implement EMP and EMoP	during the construction	MPIIC		
12	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	MPIIC		

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To implement EMP and EMoP	for a period based on EMP and EMoP	MPIIC		
2	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between BPW, MPIIC and JICA.	for three years after the Project	MPIIC		
3	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection 4) Monitor the effectiveness of the Project based on the indicators outlined in the final report indexes.	After completion of the construction	MPIIC		

(2) 3rd Survey (20th January ~ 30th January 2018)

Minutes of Discussions
on the Preparatory Survey
for the Construction of New National Landfill
(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Bureau of Public Works, Ministry of Public Infrastructure, Industries and Commerce, Republic of Palau and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 26th, April, 2017 and in response to the request from the Government of Republic of Palau(hereinafter referred to as "Palau") dated 3rd, August, 2015, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for **the Construction of New National Landfill** (hereinafter referred to as "the Project"), headed by Mr.Nobuaki Miyata, Resident Representative of JICA Palau Office from 21th to 24th January, 2018.

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Koror, 23rd January, 2018

Mr.Nobuaki Miyata
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Mr.Brian Melairei
Director
Bureau of Public Works
Ministry of Public Infrastructure, Industries and Commerce
Republic of Palau

ATTACHEMENT

1. Objective of the Project

   The objective of the Project is to promote an appropriate solid waste management through the construction of new national landfill site and the provision of needed equipments to maintain the landfill site and to carry out the waste collection, thereby contributing to improve sanitary situation and environmental protection of Palau.

2. Title of the Preparatory Survey

   Both sides confirmed to change the title of the Preparatory Survey as "the Preparatory Survey for the Project for the Construction of New National Landfill".

3. Project site

   Both sides confirmed that the site[s] of the Project is in Ongerarekieu, Aimeliik State, Republic of Palau, which is shown in Annex 1.

4. Responsible authority for the Project

   Both sides confirmed the authorities responsible for the Project are as follows:
   The Division of Solid Waste Management, Bureau of Public Works (hereinafter referred to as "BPW"), Ministry of Public Infrastructure, Industries and Commerce (hereinafter referred to as "MPIIC") will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care by relevant authorities properly and on time. The organization charts are shown in Annex 2.

5. Contents of the Draft Report

   After the explanation of the contents of the Draft Report by the Team, the Palau side agreed to its contents.

6. Cost estimate

Both sides confirmed that the cost estimate described in the Draft Report is provisional and will be examined further by the Government of Japan for its approval.

Both sides confirmed that the cost estimate including the contingency described in the Draft Report is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

7. Confidentiality of the cost estimate and technical specifications

Both sides confirmed that the cost estimate and technical specifications in the Draft Report should never be duplicated or disclosed to any third parties until all the contracts under the Project are concluded.

8. Timeline for the project implementation

The Team explained to the Palau side that the expected timeline for the project implementation is as attached in Annex 3.

9. Expected outcomes and indicators

Both sides agreed that key indicators for expected outcomes are as follows. The Palau side will be responsible for the achievement of agreed key indicators targeted in year 2023 and shall monitor the progress based on those indicators.

[Quantitative indicators]

Indicator	2020 (Baseline year)	2023
1 Total amount of incoming waste to the new national landfill site (t/day)	0	27.07t/day
2 Operating rate of heavy vehicles (hour/day)	0	2 hours/day

(Note) Total amount of incoming waste will be weighed by a truck scale that will be placed by this Project.

(Note) Operating rate of heavy vehicles will be calculated based on the daily operation record of a bulldozer, an excavator and a wheel loader .

[Qualitative indicators]

Municipal solid waste generated from ten states in Babeldaob island is expected to be disposed appropriately at the new national landfill site. This will contribute to improve the sanitary environment of each states and that leads to protect the environment of Palau.

10. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 4 . With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in (2)-3,4,5 of Annex 4, both sides confirmed that such customs duties, internal taxes and other fiscal levies include VAT, commercial tax, income tax and corporate tax, which shall be clarified in the bid documents by BPW, MPIIC during the implementation stage of the Project.

The Palau side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that the Annex 4 will be used as an attachment of G/A.

11. Monitoring during the implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 5. The timing of submission of the PMR is described in Annex 4.

12. Project completion

Both sides confirmed that the Project completes when all the facilities constructed and equipment procured by the grant are in operation. The completion of the Project will be reported to JICA promptly, but in any event not later than six months after completion of the Project.

13. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability). The result of the evaluation will be publicized. The Palau side is required to provide necessary support for the data collection.

14. Schedule of the Study

JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Palau side around May 2018.

15. Environmental and Social Considerations

15-1 General Issues

15-1-1 Environmental Guidelines and Environmental Category

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as B because the Project is not considered to be a large-scale solid waste management project, is not located in a sensitive area, and has none of the sensitive characteristics under the Guidelines, it is not likely to have a significant adverse impact on the environment.

15-1-2 Environmental Checklist

The environmental and social considerations including major impacts and mitigation measures for the Project are summarized in the Environmental Checklist attached as Annex 7. Both sides confirmed that in case of major modification of the content of the Environmental Checklist, the Palau side shall submit the modified version to JICA in a timely manner.

15-2 Environmental Issues

15-2-1 Environmental Impact Assessment (EIA)

Both sides confirmed the EIA report will be approved by Environmental Quality Protection Board in in January 2018.

15-2-2 Environmental Management Plan and Environmental Monitoring Plan

Both sides confirmed Environmental Management Plan (EMP) and Environmental

Monitoring Plan (EMoP) of the Project is as Annex 8, respectively. Both sides agreed that environmental mitigation measures and monitoring shall be conducted based on the EMP and EMoP, which may be updated during the Detailed Design stage. Both sides also confirmed that the modification of the content of Annex 8 shall be made based on the final result of the expected environmental and social impact, and/or the Detailed Design.

15-3 Social Issues

15-3-1 Land securing

Both sides confirmed the eight(8) hectares of land requires to be secured for the construction of new landfill and one(1) hectares to place residual soil from the construction site, however, currently there are no residents reside in the area and resettlement will not be occured for the implementation of the Project.

The Palau side shall secure the site for the construction of the new landfill based on the legal agreement by the end of March 2018. Both sides confirmed that the legal agreement means land use agreement between the landowners and the government with an appropriate amount of compensation. Also, the Palau side will make an Abbreviated Resettlement Action Plan (hereinafter referred to as "A-RAP") with the support of JICA.

Such land securing shall be implemented based on the A-RAP which will be prepared in line with the Guidelines and authorized by the Palau side by the end of March 2018.

15-4 Environmental and Social Monitoring

15-4-1 Environmental Monitoring

Both sides agreed that the Palau side will submit results of environmental monitoring to JICA by using the monitoring form attached as Annex 9. The timing of submission of the monitoring result is described in Annex 4. Both sides also confirmed that the modification of the content of Annex 9 shall be made based on the final result of the expected environmental and social impact, and/or the Detailed Design.

15-4-2 Social Monitoring

Both sides confirmed that the Palau side will implement social monitoring based on A-RAP. Both sides agreed that BPW, MPIIC will submit results of social monitoring to JICA by using the monitoring form attached as Annex 9. The timing of submission of the monitoring result is described in Annex 4. Both sides also confirmed that the modification of the content of Annex 9 shall be made based on the final result of the expected environmental and social impact, and/or the Detailed Design.

15-4-3 Information Disclosure of Monitoring Results

Both sides confirmed that the Palau side will disclose results of environmental and social monitoring to local stakeholders. The Palau side agreed JICA will disclose results of environmental and social monitoring submitted by the Palau side as the monitoring forms attached as Annex 9 on its website.

16. Other Relevant Issues

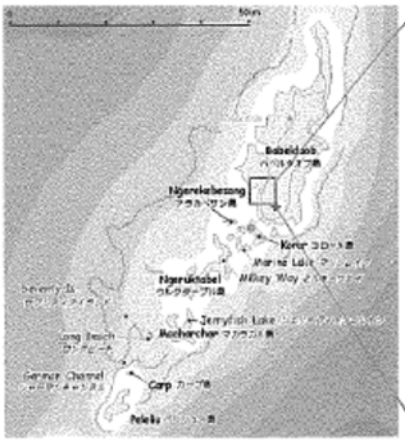
16-1. Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded, will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

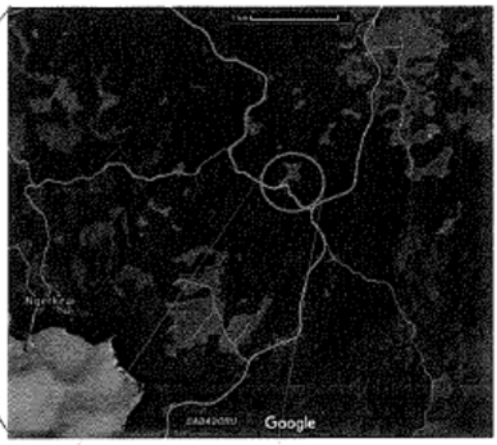
Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Project Implementation Schedule
Annex 4 Major Undertakings to be taken by the Government of Palau
Annex 5 Project Monitoring Report (template)
Annex 6 Issues to be Considered for Smooth Implementation of the Project
Annex 7 Environmental Check List
Annex 8 Environmental Management Plan/Environmental Monitoring Plan
Annex 9 Environmental and Social Monitoring Form

Annex1

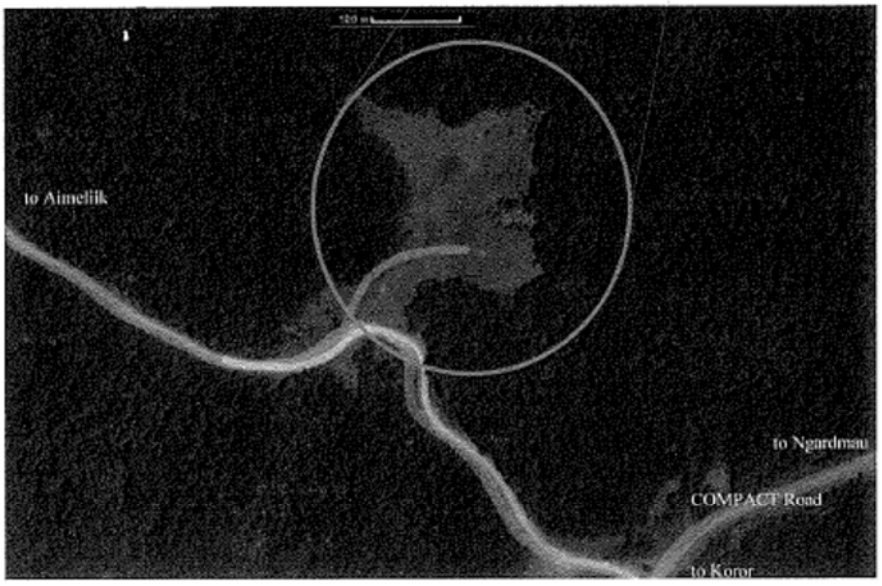
Principal Area of the ROP



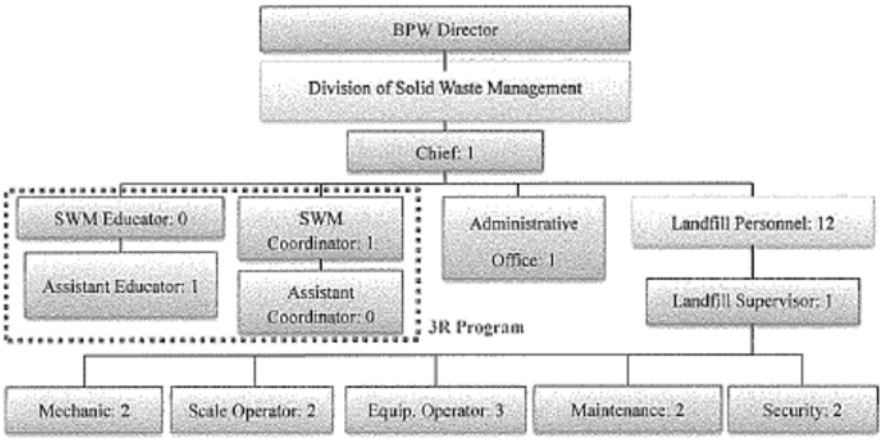
Project Site Location



Detailed location map for the project site



Annex 2



Project Organization Chart

Annex 3

Timeline for the project implementation

The project implementation will start from May, 2018 and the construction of the new national landfill site and procurement of equipment will be completed by July, 2020.

year / contents	2018	2019	2020	2021
① Detailed design	May◇ ■■■■	Jan		
② Construction		Feb ■■■■■■■■■■	▲ Jul	
③ Procurement		Jun ■■■■■■■■■■	May	
④ Defects inspection				■July

◇ Scheduled timing of EN/GA

▲ This mark indicates the completion of the new national landfill site.

Annex 4

Major Undertakings to be taken by the Government of Palau

1. Specific obligations of the Government of Palau which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open bank account (B/A)	within 1 month after the signing of the G/A	MOF	USD 5,600	
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant and to bear the Advising commission of A/P	within 1 month after the signing of the contract	MPIIC		
3	To bear the Payment commission for A/P to a bank in Japan for the banking services based upon the B/A	within 1 month after the signing of the contract	MOF		
4	To approve Environmental Assessment / Environmental Impact Statement (Conditions of approval should be fulfilled, if any) and secure the necessary budget for implementation	by the end of January 2018	EQPB MPIIC	USD 10	
5	To conduct Explosive Remnants of War(ERW)survey at the site and share the result with JICA	Clearance confirmed during the DOD mission	MPIIC	N/A	
6	To secure the Project site with the legal land leasing agreement	by the end of March 2018	MPIIC	To be determined based on the RAP	
7	To secure the space for residual soil from the construction site with an appropriate access road from the main road which heavy vehicles can pass and take necessary measures for environmental consideration of the area	before notice of the bidding document	MPIIC	USD 40,000	
8	To obtain the planning, zoning, building permit	before notice of the bidding document	MPIIC	N/A	
9	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding documents	MPIIC	N/A	
10	To implement RAP	for a period on the compensation program	MPIIC	To be stated in the RAP	
11	To implement social monitoring, and to submit monitoring report to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	To be continued until termination of the Project implementation	MPIIC	N/A	

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	MPIIC	Included (1) No. 1, 2 and 3	
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A			-ditto-	
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	MPIIC	-ditto-	
	2) Payment commission for A/P	every payment	MOF	-ditto-	
3	To ensure prompt unloading and customs clearance at ports of disembarkation in recipient country and to assist in logistical arrangement with the Supplier(s) on internal transportation therein	during the Project	MPIIC	N/A	
4	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work	during the Project	GOP	N/A	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted Such customs duties, internal taxes and other fiscal levies mentioned above included commercial tax, income tax and corporate tax of Japanese nationals, resident tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract.	during the Project	MOF	N/A	
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	GOP	To be determined as the necessity arises	
7	To submit Project Monitoring Report	quarterly	MPIIC	N/A	
	To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	MPIIC	N/A	
9	To provide facilities for distribution of electricity, drainage, tele-communication and other incidental facilities necessary for the implementation of the Project outside the site(s)				
	1) Electricity The distributing line to the site	before the commencement of the project	MPIIC	USD 19,500	
10	To take necessary measure for construction safety - traffic control - rope off - Clearance of ERW(If any ERW found out during construction)	during construction	MPIIC Contractor	Included the Construction Cost, except Clearance of ERW	

NO	Items	Deadline	In charge	Estimated Cost	Ref.
11	To implement EMP and EMoP	during the construction	BPW Contractor	N/A	
12	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	BPW	N/A	
13	To prepare coral sand for low-cost water purification system	during the construction	MPIIC	USD 300	

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To implement EMP and EMoP	for a period based on EMP and EMoP	MPIIC	N/A	
2	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between BPW, MPIIC and JICA.	for three years after the Project	MPIIC	N/A	
3	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection 4) Monitor the effectiveness of the Project based on the indicators outlined in the final report indexes.	After completion of the construction	MPIIC	USD 36,100 per year	

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX
20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Executing Agency	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Line Ministry	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

	Contingency Plan (if applicable):

Actual Situation and Countermeasures
(PMR)

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

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Attachment 7

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

Annex 6

Issues to be Considered for Smooth Implementation of the Project

・Both the Palau side and the Team considered that the land issue is the most critical issue for the implementation of the Project. This matter needs to be solved no later than the end of March 2018 to get an approval of the Government of Japan.

The Palau side is required to share the legal document of land leasing agreement between the government and the landowners with a mutually agreed amount of compensation by the above mentioned deadline.

Also, the Palau side needs to authorize the Abbreviated Resettlement Action Plan by the end of March 2018 with the support of JICA.

Annex 7

Environmental check list

The environmental check list for projects regarding wastes was filled as below based on the JICA guidelines for environmental and social considerations.

Category	Environmental Item	Main Check Items	Yes: Y No: N N/A: Not applicable	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a)Y (b)N (c)N (d)Y	The EIA report was prepared by using Taiwanese Fund. The EIA report was updated in accordance with the designed assisted by Japan and submitted to EQPB to wait approval.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a)Y (b)Y	The 1st community meeting was held in November, 2016. The 2nd community meeting was held in July, 2017. Japanese Consultant Team delivered the presentation to explain the project. Consensus between BPW and the Community has been made.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)Y	Several options, National Landfill or State landfills, had been discussed and the option to construct one National Landfill was chosen.
2 Pollution Control	(1) Air Quality	(a) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust, and dioxins emitted from various sources, such as incinerators, and vehicles used for waste collection and transportation comply with the country's emission standards and ambient air quality standards?	(a)Y	(a) In accordance with calculation result, contamination of ambient air will not exceed the Environmental Standards at the settlement area.
	(2) Water Quality	(a) Do effluents from various facilities comply with the country's effluent standards and ambient water quality standards? (b) Does the water quality of leachates from the waste disposal sites comply with the country's effluent standards and ambient water	(a)Y (b)Y (c)Y	(a) Wastewater treatment facilities would be in place so that environmental standards at the downstream rivers would be met. (b) In accordance with calculation result.

Annex 7

Category	Environmental Item	Main Check Items	Yes: Y No: N N/A: Not applicable	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		quality standards? (c) Are adequate measures taken to prevent contamination of surface water and groundwater by these effluents and leachates?		contamination of eater quality will not exceed the Environmental Standards at the downstream rivers. (c)Semi-aerobic Landfill and leachate Treatment Facility will be installed.
	(3) Wastes	(a) Are wastes, such as treatment residues, cinder, and fly ash generated from crushing and segregation processes, and diverted wastes from composting process properly treated and disposed of in accordance with the country's regulations? (b) Are hazardous and dangerous wastes properly segregated from other wastes, stabilized, treated, and disposed of in accordance with the country's standards?	(a)Y (b)Y	(a) Waste generation is not expected from the project. (b) Hazardous wastes is not included to the project scope.
	(4) Soil Contamination	(a) Are adequate measures taken to prevent contamination of soil and groundwater by leachates from the waste disposal sites?	(a)Y	(a) The Permeability coefficient of the site is smaller than 10^{-7}m/s and also soil stabilization will be taken at cracks of base layer or embankments to secure continuous impermeable layer, therefore Soil Contamination will not be occurred.
	(5) Noise and Vibration	(a) Do noise and vibrations generated by the facility operations (especially incinerators, waste segregation and crushing facilities), and vehicle traffic for waste collection and transportation comply with the country's standards?	(a)Y	(a) As the results of calculation, Noise Level and Vibration Level are expected to be smaller than the Environmental Standards in Japan.
	(6) Odor	(a) Are adequate odor control measures taken?	(a)Y	(a) Generation of offensive odor will be prevented because the semi-aerobic landfill, Leachate pipes and gas venting pipes will be introduced at the site and suitable operation such as periodical cover soil and extension of gas venting pipes will be taken during the operation phase.

Annex 7

Category	Environmental Item	Main Check Items	Yes: Y No: N N/A: Not applicable	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a) The site is out of the conservation areas. In accordance with the above mentioned, the project will not affect to any conservation areas.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g. coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the project will adversely affect aquatic organisms? If impacts are anticipated, are adequate measures taken to reduce the impacts on aquatic organisms? (e) Is there a possibility that the project will adversely affect vegetation and wildlife? If impacts are anticipated, are adequate measures taken to reduce the impacts on vegetation and wildlife?	(a)N (b)N (c)N (d)Y (e)Y	(a)(b)(c)(d)(e) In accordance with the EIA study in 2017, any rare species of wild animals/trees/plants which should be protected were not identified in the proposed site. Identified wild life (Animals/Plants/Grasses) were not listed in the Red List issued by IUCN.
	(3) Management of Abandoned Sites	(a) Are environmental protection and restoration plans (such as landfill gas and leachate collection and treatment systems, prevention of illegal dumping, and reforestation) after facility closure considered? (b) Is a sustainable management framework for the abandoned sites established? (c) Are adequate financial provisions secured to manage the abandoned sites?	(a)Y (b) Y (c) Y	(a)(b)(c) Environmental Monitoring will be continued during Operation Phase and Post Landfill Phase.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people	(a)N (b)N (c)N (d)N (e)N (f)N (g)N (h)N (i)N	(a)(b)(c)(d)(e)(f)(g)(h)(i)(j) There will be no resettlement as the project site is within the disposal site where there are no residents.

Annex 7

Category	Environmental Item	Main Check Items	Yes: Y No: N N/A: Not applicable	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(j)N	
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Are considerations given to the existing recovery systems, including waste pickers? (c) Is there a possibility that waste transportation will adversely affect the regional traffic? (d) Is there a possibility that effluents from the project and leachates form the waste disposal sites will adversely affect fisheries and other water uses by local inhabitants (especially drinking water)? (e) Is there a possibility that pathologic insects or other disease vectors will breed as a result of the project?	(a)N (b)N (c)N (d)N (e)N	(a) (b) (c) (e) The project will not be affect to the living and livelihood, because there is not settlement arround (2km) the site. (d)There is not Water Resourse (Pump Stations) at the downstream area of the site.

Annex 7

Category	Environmental Item	Main Check Items	Yes: Y No: N N/A: Not applicable	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)Y	(a) The historical gun-bases from World War II is identified in the site and the necessary measures will be taken by the Palau side to clear the site before the Construction.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)Y	(a) The change of landscape at the site will be occurred. there is a trekking rote for hiking to the fall, the site will not be observed from the route considering the distance between the site and the fall.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a)N/A (b)N/A	(a)(b) There are no ethnic minorities or indigenous peoples in or near the project site.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a)Y (b)Y (c)Y (d)Y	(a) Considerations will be given so that labor-related laws and ordinances would be complied with. (b)(c) Measures to prevent accidents such as training of workers would be taken (d) Training would be conducted for security guards as necessary

Annex 7

Category	Environmental Item	Main Check Items	Yes: Y No: N N/A: Not applicable	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a)Y (b)Y (c)N	(a) A temporary reservoir will be constructed during the construction phase; therefore, a clear upper portion of effluent will be discharged by installing a temporary sedimentation pond The contamination level of effluent will be managed to 200mg-SS/L at the end-point of the sedimentation pond and 25mg-SS/L at the mixing point to the river.. (b) There are no primeval forests, tropical rain forests, or ecologically valuable habitats (e.g. coral reefs, mangroves, or tidal flats) in or near the project site. No endangered species have been found in or near the project site. (c) As the result of calculation, air pollution and noise and vibration will not exceed the environmental standards, but mitigation measures would be taken such as control of working hours.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a)Y (b)Y (c)Y (d)N	(a)(b) Monitoring would be planned and implemented in accordance with EQPB regulations. (c) Monitoring would be included in the business plan in order to ensure its implementation. (d) These issues will be discussed with the relevant authorities before initiation of the Project.

Annex 7

Category	Environmental Item	Main Check Items	Yes: Y No: N N/A: Not applicable	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation).	(a)N/A	(a) The site area is 8ha. No large-scale deforestation would be conducted.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)N/A	(a) The site area is 8ha.The Project is not likely to cause transboundary or global issues.

Annex 8

Environmental Management Plan

Environmental management will be appropriately fulfilled by applying the same system based on a BPW monitoring plan during the construction and after the facilities start their operation.

No.	Item		Mitigation Measures	Implementing Organization	Responsible Organization	Cost
During Construction Phase						
1	Pollution Prevention	Air Quality	• Construction vehicles will be operated efficiently by adjusting construction planning and schedule to minimize the number of vehicles and the operation duration.	Contractor for construction work	BPW	Included in the Construction Cost
2		Water Quality	• A temporary reservoir and a fence for stockyard of residual soil will be constructed during the construction phase; therefore, muddy water will be trapped by the pond and the fence.			
3	Pollution Prevention	Wastes	• Wastes generated by the construction work (including waste by construction workers and supervising staff) will be disposed properly in M-Dock Landfill. • The green waste will be generated during construction phase and utilized as the compost materials. • Cover soil will be transported to a stockpile site which is prepared by the Palauan National Government, and disposed properly by using cover soil for other landfill sites and embankments for public works projects.	Contractor for construction work	BPW	Included in the Construction Cost
4	Social Environment	Heritage	• War Historical Site will be handled in conformity with Palauan Law by Palauan Government.			BPW
5		Working Conditions	• Work safety measures will be carried out.			Included in the Construction Cost
6	Others	Accidents	• Safe slope for cut and embankment work will be determined. • Construction duration will be secured appropriately. • Construction work during rain will be carefully conducted.			

Annex 8

During Operation Phase						
1	Pollution Prevention	Air Quality	• Dust generation will be prevented by implementation of cover soil. • Air quality will be monitored by using a gas analyzer. • Methane generation volume will be minimized by adopting a semi-aerobic type landfill (Fukuoka Method). (Some 23% reduction of methane generation will be made compared with non-aerobic landfill for 20 years.)	Operator and DSWM	BPW	Included in the Operation Cost
2		Water Quality	• Organic pollution in leachate will be minimized by adopting a semi-aerobic type landfill. • Leachate will be circulated from a leachate pond to the landfill site to reduce the volume and improve the quality. • Leachate treatment facilities will be constructed at the site to minimize the impacts on the water quality in the downstream of the site. • Rain water in the site except for leachate will be retained in a pond and then discharged into the downstream.			
3		Soil Contamination	• Cracks of the foundation rock and embankments will be improved by replacing cement soil to secure the impermeability of the site.			
4		Odor	• Odor generation will be minimized by adopting a semi-aerobic landfill, such as implementation of regular cover soil, and installation of leachate collection pipes and gas exhausted pipes to accelerate decomposition of waste. • Proper landfill management like regular cover soil and addition of gas exhausted pipes will result in prevention of offensive odor.	Operator and DSWM	BPW	Included in the Operation Cost
5	Social Environment	Management of Abandoned Site	• Proper management of gas generation and leachate will be made to minimize impacts on the environment.			
6		Working Conditions	• Work safety measures will be carried out. (see **Work Safety Measures to be Taken** in detail.)			
7	Others	Accidents	• Proper landfill management like regular cover soil and waste compaction, and securement of embankment with safe slope will result in prevention of collapse of waste. • Work safety measures will be carried out. (see **Work Safety Measures to be Taken** in detail.)			

Annex 8

Work Safety Measures to be Taken

Period	Facility	Possible Accidents at Work	Work Safety Measures to be Taken
During Construction Phase	General	Falling from scaffolding	• Enough width and slope of walkways and stairs should be designed to enable to walk them on easily. • Signs to show walkways and stairs, and handrails will be installed to prevent from falling.
		Contact with trucks and heavy machine	• The traffic line should be designed so as not to contact between the workers and trucks and heavy machine.
		Falling/flying of work pieces	• The workers should wear helmets in the site.
During Operation Phase	Landfill Site	Inhaling of dust and poisonous gas	• The water should be sprinkled to avoid scattering the dust in the site. The gas analyzer should be used to detect the poisonous gas.
		Heat stroke	• Duration of outdoor work should be shortened as much as possible by taking moderate rest and drinking water.
		Slips, falls	• Enough width and slope of walkways and stairs should be designed to enable to walk them on easily. • Signs to show walkways and stairs, and handrails will be installed to prevent from falling.
		Contact with trucks or heavy machine	• Places that rotate, move, or stick out should be covered or colored for watching out. • Signs should be placed to show that the places that rotate or move are in operation. • The height of the floor should be appropriate and secured to keep enough space between the machine and hand rails.
		Noise and vibration	• Anti-vibration devices should be installed to prevent noise/vibration that would be hazardous to the workers.
		Explosion and fire	• Flammable material should keep fire away in the site. • Fire extinguishers or sand for extinguisher should be installed in the site.
		Electrification	• Signs should be put on the places with high voltage. • Electric system should be designed to prevent electric leakage and electrification. • Water pipes should be put below the electric lines if the water pipes cross the electric lines.

Annex 8

Environmental Monitoring Plan

For items that may be negatively impacted, monitoring would be conducted as shown in below.

Item	Monitoring Item		Location	Method	Frequency	Responsible Organization
During Construction Phase						
Air Quality	Dust		Around construction site	Visual Inspection	Once a day	Construction contractor.
Water Quality	SS (Sus-pended Solids)	(Criteria) 200mg/L	At discharge point to outside the site boundary	Portable SS meter	Once a day	Construction contractor
		25mg/L	Sampling spots at the river (SW-B and RW-A)			
Waste	Amount of Construction Waste (Including Green Waste)		M-Dock	Contractor Report	Once a month	Construction contractor
	Amount of Stock & Pile Soil		Stock & Pile Yard			
Livelihood	Number of employees and their salaries Level of livelihood		N/A	Actual status, Hearing Survey	Once a month	BPW
Cultural	Necessary measures will be taken by the Palau side		The Site	Report from BPW or construction contractor	Before Construction	BPW
Working Condition	Falling down from scaffolding - Design walkways and stairs so that they can be easily walked on (they should have enough space and not too steep) - Put up signs to show walkways and stairs and put handrails Contact with trucks and heavy machineries - Design the traffic line so that there would be no or little contact between the workers and trucks and heavy machineries Falling/flying of work pieces - Require workers to wear helmets		The Site	Report from construction contractor	Once a month	Construction contractor
Accident	Confirmation of the Construction Plan, drafts and calculation documents Confirmation of the working site Slant, terms of construction, measures during rain fall		The Site	Report from construction contractor	As appropriate	Construction contractor

Annex 8

During Operation Phase						
Air Quality	Dust		Around the site	Visual Inspection	Once a day	BPW
	CH_4 and H_2S		Gas Venting Pipe(s)	Gas Detector	Once a month	
Water Quality	Transparency	4.5cm	At discharge point to outside the site boundary	Transparency meter	Once a day at Rainy day	BPW
	Temperature	(Criteria) -	Sampling spot at the river (SW-B and RW-A) Twice a month pH meter	Thermometer	Twice a year (Until Stabilization of landfill)	
	Colour	-		Visual Inspection		
	pH	6.5-8.5		pH mete		
	COD	3.0mg/L		COD test kit		
	Transparency	25cm		Transparency meter		
	pH	It should be monitored to detect accidental water quality change.	Leachate Reservoir Pond	pH meter	Once a week	
	EC			EC meter		
	pH		Monitoring Well No.1, No.2	pH meter	Once a month	
	EC			EC meter		
	pH		Reservoir Pond No.1・No.2	pH meter	Once a month	
	EC			EC meter		
Soil Contamination	Soil Contamination shall be monitored by monitoring of the Well No.1 and No.2.		Monitoring Well No.1, No.2	pH meter and EC meter	Once a month	BPW
Odor	Number of complains about odor from residents		N/A	Report of Complain	As appropriate	BPW
Management of Abandoned Sites	Monitoring of air and water quality shall be continued until completion of stabilization of the landfill layer.		-	-	-	BPW
Working Conditions	Falling down from scaffolding - Design walkways and stairs so that they can be easily walked on (they should have enough space and not too steep) - Put up signs to show walkways and stairs and put handrails Contact with trucks and heavy machineries - Design the traffic line so that there would be no or little contact between the workers and trucks and heavy machineries Falling/flying of work pieces - Require workers to wear helmets		The Site	Report from BPW	Once a month	BPW
Accident	Number of reported accidents		The Site	Report from BPW	Once a month	BPW

Legend: N/A: Not adopted

Note * When the project is made more specific, monitoring items will be determined after further identification of waste composition

** When required treatment methods for hazardous wastes are determined, monitoring methods will be considered.

Annex 9

Monitoring Form

1. Construction Phase
Implementing Organization: Contractor for construction work
Responsible Organization:BPW,MPIIC

Note:Below (2) Social Environment's contents in "Livelihood" will be monitored by BPW, MPIIC.

(1) Pollution Control

—Air

Parameters	Measured Value (Average)	Measured Value (max)	Standard	Remarks		
				Sampling Points	Span	Method
Dust			Significant Dust is not observed	Around the site	Once a day	Visual Inspection

—Water Quality

Parameters	Measured Value (Average)	Measured Value (max)	Standard	Remarks		
				Sampling Points	Span	Method
SS (Suspended Solids)			200mg/L a	At discharge point to outside the site boundary	Once a day	Portable SS meter
SS (Suspended Solids)			25mg/L a	Sampling spots at the river	Once a day	Portable SS meter

a Voluntary standard value. 25mg/L is In accordance with Japanese Environmental Standard (A).

—Waste

Monitored Item	Result(During reported term Once a Month)
Amount of the construction waste at M-Dock	
Amount of the Stock & Pile Soil at the Stock & Pile Yard	

(2) Social Environment

—Livelihood

Monitored Item	Result(During reported term Once a Month)
Number of employees and their salaries Level of livelihood	
Compensation for land owners	
Number of reports complain	

—Cultural

Monitored Item	Result(During reported term Once a Month)
World War II gun base; Necessary measures will be determined by the Palau side	

－Working Condition

Monitored Item	During reported term Once a Month
Falling down from scaffolding - Design walkways and stairs so that they can be easily walked on (they should have enough space and not too steep) - Put up signs to show walkways and stairs and put handrails	
Contact with trucks and heavy machineries - Design the traffic line so that there would be no or little contact between the workers and trucks and heavy machineries	
Falling/flying of work pieces - Require workers to wear helmets	

－Accident

Monitored Item	During reported term Once a Month
Confirmation of the Construction Plan, drafts and calculation documents Confirmation of the working site Slant, terms of construction, measures during rain fall	

2. Operation Phase
Implementing Organization: Operator and DSWM
Responsible Organization:BPW,MPIIC
(1) Pollution Control
－Air

Parameters	Measured Value (Average)	Measured Value (max)	Standard	Remarks		
				Sampling Points Method)	Span,	Method
Dust			Significant Dust is not observed	Around the site	Once a day	Visual Inspection
Methane			1.5% b	Gas Venting Pipe(s)	Once a day	Gas Detector
H_2S			1ppm b	Gas Venting Pipe(s)	Once a day	Gas Detector

b Occupational Safety Standards in Japan

－Water Quality

Parameters	Measured Value (Average)	Measured Value (max)	Standard	Remarks		
				Sampling Points	Span	Method
Transparency			4.5cm (SS 200mg/L) c	At discharge point to outside	Once a day at Rainy	Transparency meter

				the site boundary	day	
Temperature			No standard because it is a parameter of natural condition.	Sampling spot at the river (SW-B and RW-A)	Twice a month	pH meter
Color			No standard because it is a parameter of natural condition.	Sampling spot at the river (SW-B and RW-A)	Twice a month	pH meter
pH			6.5-8.5 d	Sampling spot at the river (SW-B and RW-A)	Twice a month	pH meter
COD			3mg/L e	Sampling spot at the river (SW-B and RW-A)	Twice a month	Testing Kit
Transparency			25cm (SS25mg/L) f	Sampling spot at the river (SW-B and RW-A)	Twice a month	Transparency meter
pH			6.5-8.5 d	Leachate Reservoir Pond	Once a week	pH meter
Electric Conductivity			It should be monitored to detect accidental water quality change.	Leachate Reservoir Pond	Once a week	Electric Conductivity meter
pH			6.5-8.5 d	Monitoring Well No.1 · No.2, Rain water Reservoir Pond No.1 · No.2	Once a month	pH meter
Electric Conductivity			It should be monitored to	Monitoring Well	Once a	Electric Conductivity

			detect accidental water quality change.	No.1 ・ No.2, Rain water Reservoir Pond No.1 ・ No.2	month	meter

c: Voluntary standard value
d EQPB regulation Class-1
e Japanese Environmental Standard(A)
f Voluntary standard value

－Soil Contamination
Soil Contamination shall be monitored by monitoring of the Well No.1 and No.2.

－Odor

Monitored Item	During reported term Once a Month
Number of reported complain	

(2) Social Environment
－Management of Abandoned Sites

Monitored Item	During reported term Once a Month
Monitoring of air and water quality shall be continued until completion of stabilization of the landfill layer.	

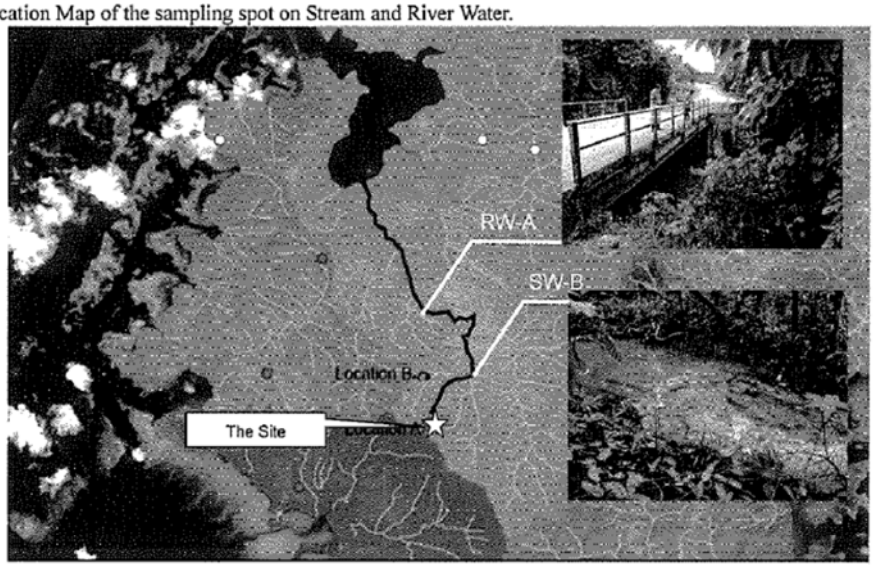
－Working Condition

Monitored Item	During reported term Once a Month
Falling down from scaffolding - Design walkways and stairs so that they can be easily walked on (they should have enough space and not too steep) - Put up signs to show walkways and stairs and put handrails	
Contact with trucks and heavy machineries - Design the traffic line so that there would be no or little contact between the workers and trucks and heavy machineries	
Falling/flying of work pieces - Require workers to wear helmets	

－Accident

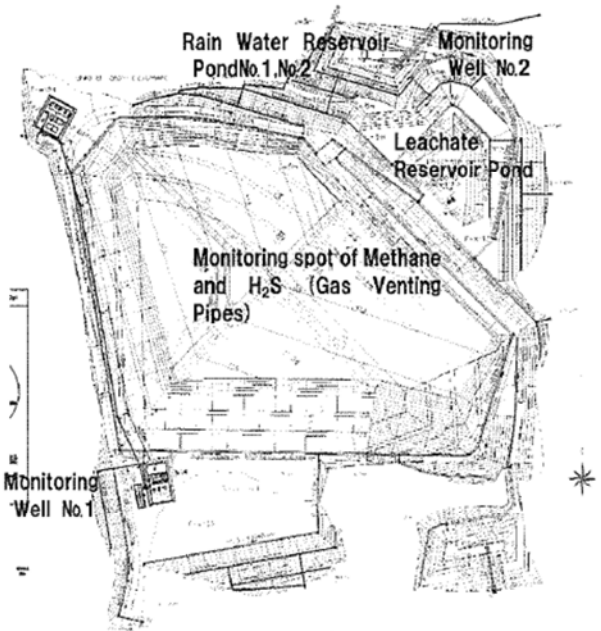
Monitored Item	During reported term Once a Month
Number of reported accidents	

Location Map of the sampling spot on Stream and River Water.



Source : BPW

Location Map in the landfill site



【別添１：残土置き場に関する資料】

BUREAU OF PUBLIC WORKS
P.O. Box 100
Koror, Republic of Palau 96940
Tel: (680) 488-2480 / 488-2860 Fax: (680) 488-2536
E-mail: bpw@palaunet.com

January 29, 2018

Mr. Hatsuichi Ngirchomlei
Chief Sechal Ra Imul
Koror
Republic Of Palau 96940

Alii Sechal ra Imul,

Thank you for support of our National Landfill relocation endeavors. The new landfill project that we have partnered with each other to develop, will generate approximately 235,000 cubic yards of soil that needs to be properly disposed.

To save cost on transportation of soil materials, we have identified a grass land area within the Trei property that can accommodate these materials with minimal impact to the forest environment. This grass land is shown on the attached satellite photo. The site sits on Lots No. 17MO2-006 and 17MO2-007

The area slopes from the road into the forest about 400 feet towards the east. We believe that after the soil disposal the value of this piece of property is elevated in that it will be a large flat land that can accommodate new development for the Trei Clan.

With this I come to you seeking your approval in this regards. If this request merits your kind understanding and approval, please indicate it as the highest representative of the Trei Clan at the space provided for you.

Thank you very much for your never ending support!!

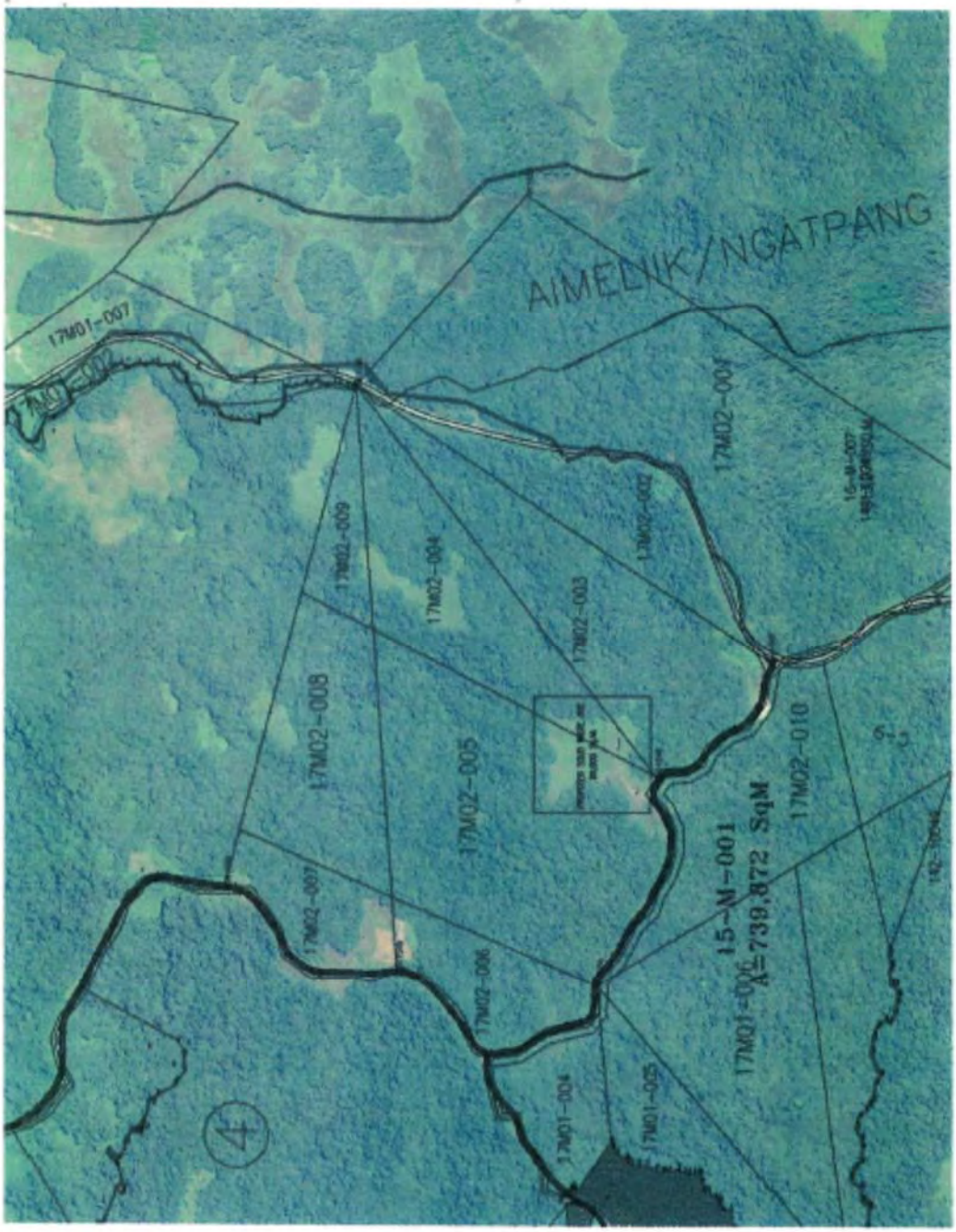
Sincerely,

Brian Melairei
Director
Bureau of Public Works.

APPROVED:

Sechal ra Imul
Hatsuichi Ngirchomlei

Date 1/29/18


AIMELIK/NGATPANG
17M01-007
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17M02-003
17M02-008
17M02-005
17M02-010
15-N-001
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X=738,872 SqM

APPENDIX 5

Technical Note

Technical Note

TECHNICAL NOTE

FOR

THE PROJECT FOR THE CONSTRUCTION OF PALAU NEW NATIONAL LANDFILL

Based on the Minutes of Discussion on the Preparatory Survey for the Project for the Construction of Palau New National Landfill (hereinafter referred to as "the Project") signed between the Palauan side and the Japan International Cooperation Agency (hereinafter referred to as "JICA") Preparatory Survey Team on April 26, 2017, the second field survey was completed in close cooperation between the JICA Preparatory Survey Team (hereinafter referred to as "the Team") and counter personnel of the Bureau of Public Works (hereinafter referred to as "BPW") .

In the course of the survey, technical issues have been discussed for the Project to be implemented under the Japan's Grant Aid, and BPW and the Team confirmed the main items described in the attached sheets.

Koror, July 4, 2017

Mr. Masakazu Maeda
Chief Consultant
JICA Preparatory Survey Team
CTI Engineering International Co., Ltd.

Mr. Brian Melairei
Director
Bureau of Public Works
Ministry of Public Infrastructure,
Industries and Commerce

Witness:

Mr. Nobuaki Miyata
Resident Representative
JICA Palau Office

ATTACHMENT

1. Design Service Life of the New Landfill

Due to land acquisition difficulties for additional landfill sites in the future, BPW requested the Team that the design service life of the new landfill should be not less than twenty (20) years. The Team agreed that the new landfill will be designed considering this request although the final design criteria including the service life of the new landfill will be determined by JICA and the Government of Japan. BPW and the Team (hereinafter referred to as "the both sides") confirmed that the request by the Palauan side will be considered in the study in Japan.

2. Future Projection of Solid Waste Amount

The Team explained BPW that the future projection of solid waste amount was made based on a result of waste amount survey at M-Dock conducted by J-PRISM Phase 2 as well as previous surveys in Babeldaob by J-PRISM Phase 1. The revised waste amount projection is presented in **Annex-1**. The both sides agreed that the design service life of the new landfill will be estimated by using this projection.

3. Disposal of Residual Soil Produced by Construction Work

BPW agreed that the residual soil produced by construction of the new landfill will be able to be disposed outside of the landfill site. The both sides confirmed that the disposal site of the soil will be directed by BPW and the Project will cover transportation cost from the construction site to the disposal site. The disposal site directed by BPW is shown in attached **Annex-2**.

4. Main Features of the New Landfill

The both sides agreed that main features of the new landfill will be summarized as shown in attached **Annex-3**. However, these features will be finally decided by JICA and the Government of Japan after the study in Japan.

5. Implementation of EA/EIS

The both sides confirmed that BPW will make necessary support for smooth implementation of EA/EIS to get an approval by the Environmental Quality and Protection Board. The Project should be approved by end of November 2017.

6. Implementation of UXO Survey

The both sides confirmed that BPW will carry out necessary surveys for unexploded ordinance remaining in

the new landfill site by end of November 2017.

LIST OF ANNEXES

Annex-1: Future Projection of Solid Waste Amount

Annex-2: Disposal Site of Residual Soil Produced by Construction Work

Annex-3: Main Features of the New Landfill

Annex-1: Future Projection of Solid Waste Amount

Table 1 Summary of Future Projection of Solid Waste Amount

Year	Household Waste (1) (t/day)	Commercial Waste (2) (t/day)	Daily Waste Generation (3) = (1) + (2) (t/day)	Annual Waste Generation (3) × 365 (t/year)	Accumulated Waste Generation (t)
2020	7.67	17.3	24.97	9,114	9,114
2021	7.67	17.9	25.57	9,333	18,447
2022	7.67	18.5	26.17	9,552	27,999
2023	7.67	18.9	26.57	9,698	37,697
2024	7.67	19.4	27.07	9,881	47,578
2025	7.67	19.8	27.47	10,027	57,605
2026	7.67	20.3	27.97	10,209	67,814
2027	7.67	20.7	28.37	10,355	78,169
2028	7.67	21.0	28.67	10,465	88,634
2029	7.67	21.3	28.97	10,574	99,208
2030	7.67	21.6	29.27	10,684	109,892
2031	7.67	21.9	29.57	10,793	120,685
2032	7.67	22.2	29.87	10,903	131,588
2033	7.67	22.5	30.17	11,012	142,600
2034	7.67	22.8	30.47	11,122	153,722
2035	7.67	23.1	30.77	11,231	164,953
2036	7.67	23.2	30.87	11,268	176,221
2037	7.67	23.5	31.17	11,377	187,598
2038	7.67	23.7	31.37	11,450	199,048
2039	7.67	24.0	31.67	11,560	210,608
2040	7.67	24.1	31.77	11,596	222,204
2041	7.67	24.3	31.97	11,669	233,873
2042	7.67	24.6	32.27	11,779	245,652
2043	7.67	24.7	32.37	11,815	257,467
2044	7.67	24.9	32.57	11,888	269,355

Annex-2: Disposal Site of Residual Soil Produced by Construction Work

BPW will secure the disposal site of residual soil and the site shall be located within two kilometers from the new landfill site as shown in a red circle in the following map below.

Annex-3: Main Features of the New Landfill

1. Types of Solid Waste Disposed in the New Landfill

The types of solid waste disposed in the new landfill should be household waste and commercial waste generated in Koror State and ten (10) states in Babeldaob Island. These wastes basically will be flammable ones without any intermediate treatment.

2. Required Volume of the New Landfill

The required volume of the new landfill should be determined in consideration of design service life of the landfill, i.e., at least twenty (20) years.

3. Conversion Rate of Waste Volume

The conversion rate of waste volume should be applied for a rate of typical flammable waste, i.e., 1.3 cubic meters (m^3) per ton.

4. Main Facilities of the New Landfill

4.1 Retaining Structure

A retaining structure should be constructed at the downstream of the new landfill site. The structure will be a gravity type of soil embankment.

4.2 Leachate Control Work

A leachate control work should be carried out through installation of leachate collection pipes at the ground level of the new landfill site. Seepage control sheets such as HDPE sheets are not required because of impervious soil conditions of the site.

4.3 Leachate Treatment Facilities

Leachate treatment facilities should be installed at the downstream of the new landfill site. The facilities will be composed of gravel beds, filter using coral and coconut husk, aquatic plants using *cyperus alternifolius*, and biotope based on recirculation of leachate.

4.4 Stormwater Detention Pond

A stormwater detention pond should be built in the new landfill site to regulate the excessive rainwater and avoid overflowing untreated leachate to the downstream of the site.

4.5 Other Facilities Necessary for Operation and Maintenance of the Site

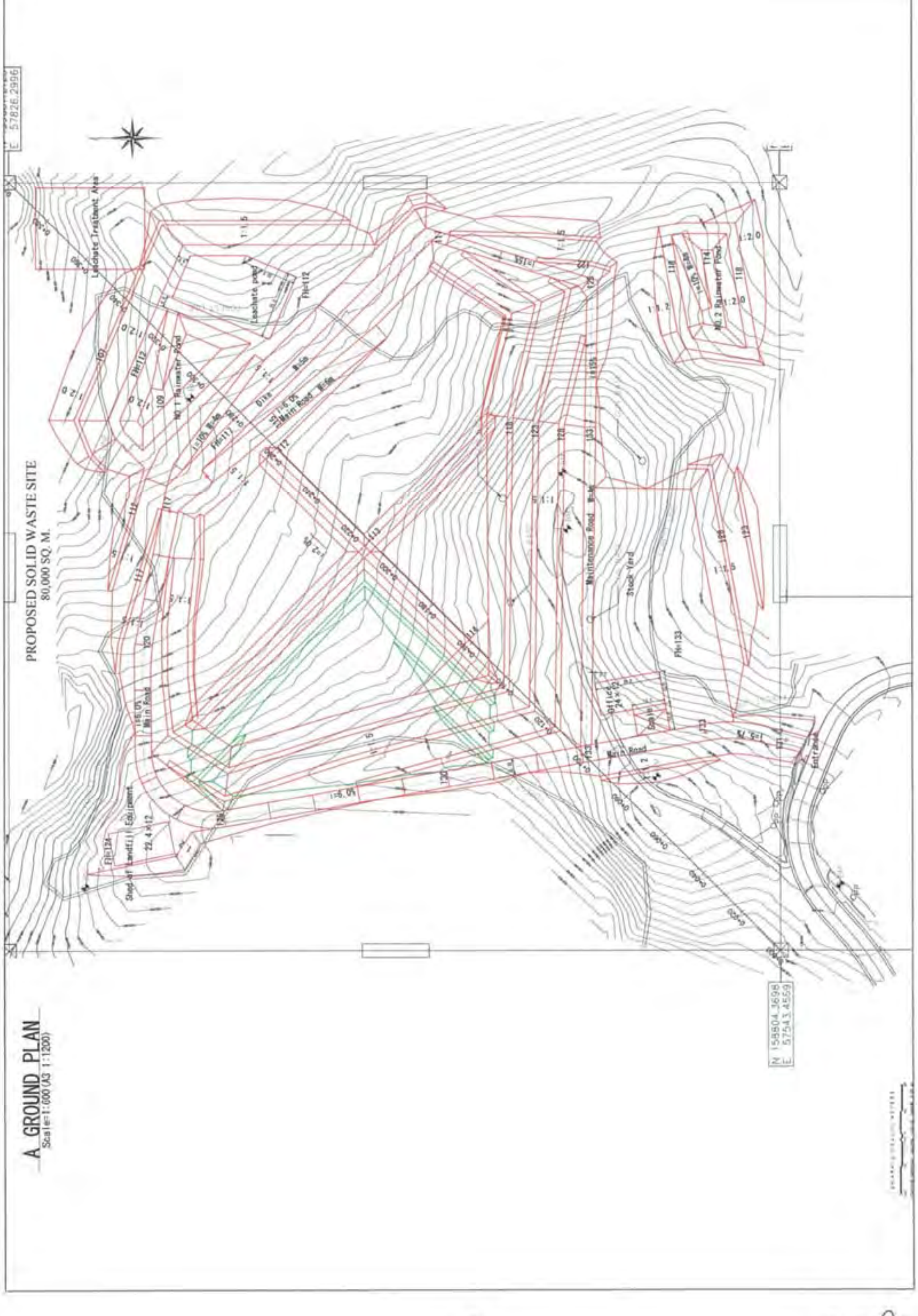
The following facilities necessary for operation and maintenance of the new landfill site should be built inside the site.

a. Truck Scale

   A truck scale with measuring, storing and compiling data system should be installed in the new landfill site.

b. Administration Office

   An office for operation and maintenance of the new landfill with a toilet, shower and storage space should be built in the site.


A GROUND PLAN
Scale1:600 (A3 1:1200)
PROPOSED SOLID WASTE SITE
80,000 SQ. M.
Leachate Treatment Area
Leachate pond
NO.1 Rainwater Pond
NO.2 Rainwater Pond
Main Road
Maintenance Road
Stock Yard
Office
Entrance
N 158804.3698
E 57543.4559
E 57826.2996

- 7 -