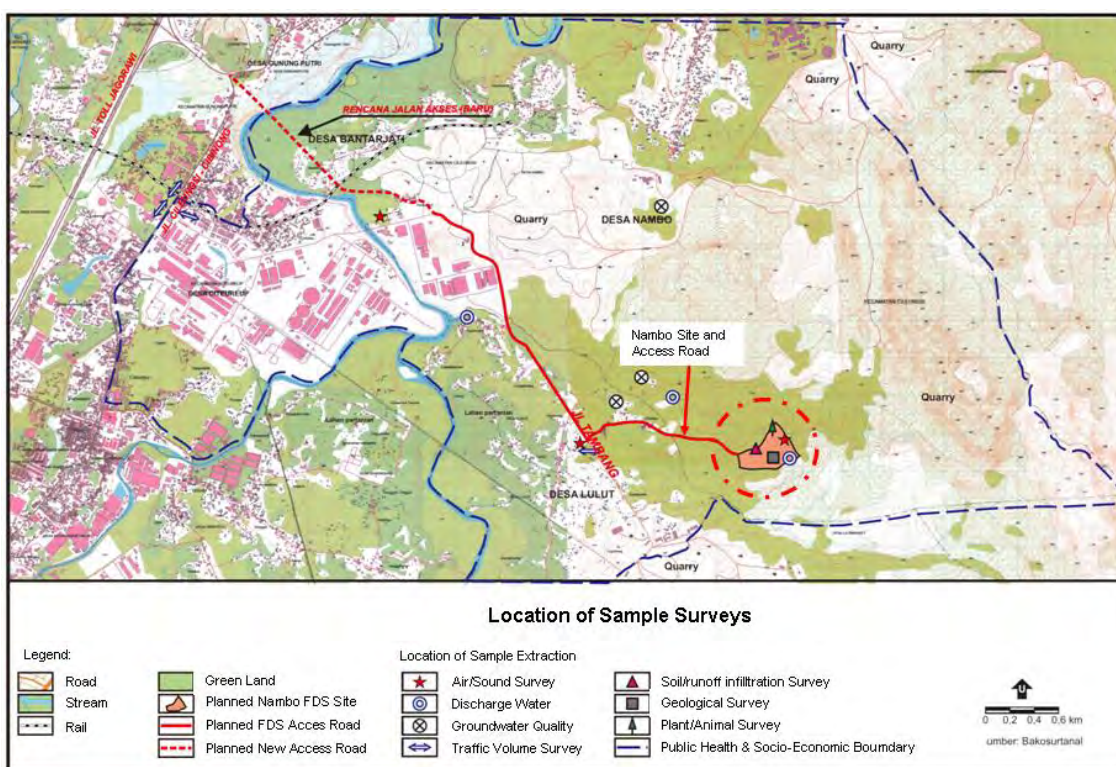


6. Nambo Project Plan

6.1 Design Conditions

6.1.1 Site Condition

The majority of the Nambo Project site has a relatively gentle undulating landscape with an average slope of approximately 3%–15% with only several areas reaching a slope of 30%. On the contrary, the Southeastern area of site has a steep slope of more than 15% with some areas reaching 40%. The altitude of the site is 170–250 meters above sea level, with the highest point being in the southeastern area of the site, gradually descending towards the northwest. The majority of the project site is composed of marl and clay consisting of calcareous sandstone phenocrysts. Furthermore, the Southeastern area of 20%–24% slope is composed of limestone, marl, and quartz sandstones.



Source: Nambo Pre-Feasibility Study Report, PT. MAZA

Figure 6-1 Project Site Surrounding

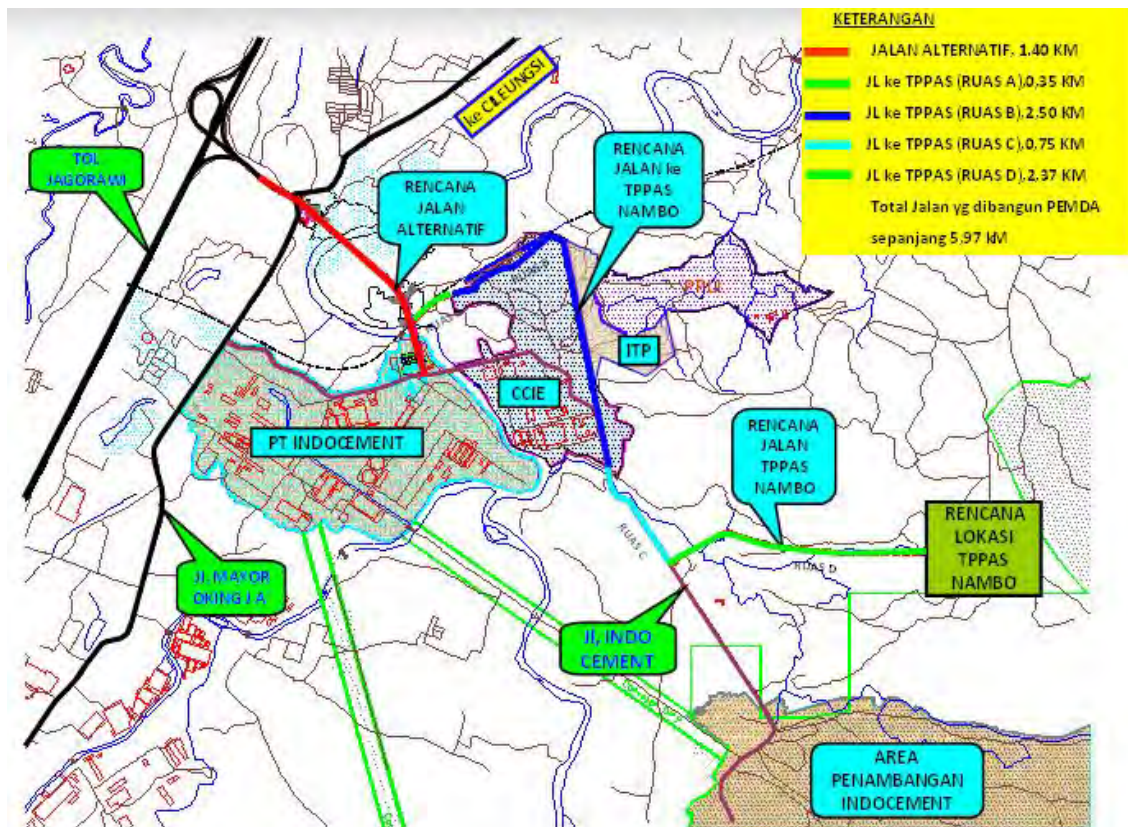
As shown in Figure 6-1, there is no inhabitants in the whole original 100 hectares of the site as the site was under the ownership of the national forestry company, “PT Perhutani: Forestry State-Owned Company), hence there is no issue of resettlement. There are five villages around the project site vicinity; however there are no residences within a one kilometer radius. Four explanatory stakeholder meetings have been conducted for the local residents and in general, there have been no opposition towards the project. Local residents in the area use well water (15 meter shallow wells) for domestic use.

6.1.2 Surrounding Infrastructure

As shown in Figure 6-2, the access road from the existing main road to the Nambo project site is owned by the cement factory, “PT Indocement.” With regards to the operation of the Nambo

Waste Treatment and Disposal Site, the Memorandum of Understanding (MOU) has been reached between the Cement Factory and the West Java Provincial Government, which indicated the utilization of access road developed by PT. Indocement. So far PT. Indocement has requested the provision of high calorie wastes (such as recyclable plastics, non-recyclable plastics and papers) to the Cement Factory for fuel use in exchange for the use of the access road.

This feasibility study reviews the terms stated in the MOU explained above. For other part of access road, the West Java Provincial Government will finance the construction costs of the new access road.



Notes:

Red: Land is owned by Pt. Indocement and the road construction will be conducted by Pt. Indocement

Green: Land should be acquired by the government and the construction of the road should be conducted and paid by the government

Dark Blue: Land is owned by Pt. Cibingon Center Industrial but they have agreed to provide the right of way for the construction of the road. Pt. Indocement has agreed to level the land for this portion, and the government will construct the road

Light Blue: Land and existing mining road is owned by Pt. Indocement, but Pt. Indocement has agreed to provide right of way to Nambo FDS

Source: Pt. Indocement

Figure 6-2 Access Road to Nambo Project Site

6.1.3 Amount of Waste

Amount of received waste is assumed to be 1,000 tons/day as same as the Pre-FS. It is expected that it is possible to receive 1,000 tons/day even if recycling of waste may be promoted, since waste generation is increasing as described in chapter 4.1. In case that amount of received waste

exceeds 1000 tons/day, it is taken into account that waste is transferred to other landfill or incineration plant under planning.

6.1.4 Waste Material Balance

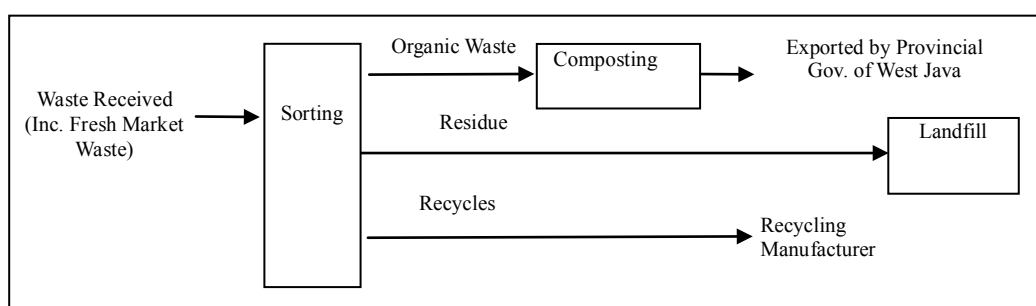
Waste characteristics have been assumed based on the sampling and analysis data by ITB at Cipayang and Galuga disposal site described in Chapter 4.2.

6.1.5 Annual Operational Days and Operational Hours

Waste will be received 360 days per year, which is the same as the Pre-FS. Operation hours will be established individually per facility.

6.2 Technology Selection

The intermediate treatment comprises respective disposal processes of sorting, recycle, and compost.



Source: JICA Survey Team

Figure 6-3 Outline Flow of Intermediate Treatment

The received waste is classified to the organic waste, the plastic, the recyclable one and the residue (non-burnable garbage etc.) as well as Pre-FS.

The composting is the most suitable as the organic waste management method in this project as a result of making comparative study from the viewpoint of the environmental impact, the economy, the sustainability, and safety about two or more methods (The evaluation for comparison of the organic waste management method is in Table 6-1). The plastic is utilized as fuel according to the meeting result with Indonesian side. The recyclable wastes will be the recycling use. The residue is transferred to the landfill.

The biogas plant that had been examined by the interim report has been decided not to be introduced because the load on the cost side is large.

Table 6-1 Evaluation of Organic Waste Management Method

| | Environmental Impact | Economic | Sustainability | Safety | Total Evaluation |
|-------------|--|--|---|--|---|
| Composting | A | A | A | A | A |
| | The smallest impact. | Most economical efficiency with simple facilities and operation | High sustainability if the exporting of the compost is secured *1 | Safety established by a lot of experiences in Indonesia and other regions. | Suitable method as organic waste management of this business. |
| Biogas | A | B | A | A | B |
| | The negative environmental impact can be suppressed small by consideration in equipment, e.g. installation of the exhaust gas processing system etc. | Economically disadvantage, because of the comparatively high equipment and operating cost, | No matter to be mentioned about the sustainability *2 | Safety established by some experiences. | Economically disadvantage compared with composting |
| RDF | A | B | B | B | B |
| | The negative environmental impact can be suppressed small by consideration in equipment, e.g. installation of the exhaust gas processing system etc. | Economically disadvantage, because of the comparatively high equipment and operating cost, e.g. drying equipment for high moisture organic garbage | No long-term operation experience of making organic garbage RDF in Japan, because of the safety problem | Safety unestablished yet to make organic RDF | Economically, sustainability and safety disadvantage *3 |
| Incinerator | A | B | A | A | B |
| | The negative environmental impact can be suppressed small by consideration in equipment, e.g. installation of the exhaust gas processing system etc. | Because of the comparatively high equipment and operating cost, disadvantage in the point of the economy | No problem of the sustainability with steps against the protest campaign *4 | Safety established by a lot of experiences in Japan and other regions. | Economically disadvantageous compared with composting |

*1: Provincial Government of West Java is describing that they will make contract that all the compost product should be exported by Provincial Gov. of West Java.

*2: Actually, some biogas plants (organic refuse) are in operation in Japan. However, the enough training of operation might be necessary in Indonesia.

*3: In case of making RDF of plastic, which has comparatively lower moisture than organic, and with the certain receiving organization, it is suitable.

*4: If the incinerator is planned to build in West Java, enough steps against negative campaign are necessary.

Additional note to Table 5-1: Introduction of the “Anaerobic Digestion Process”

Introduction of the “Anaerobic Digestion Process” already adopted in Bali was this time suggested by Indonesian side. Indonesian side insists that the introduction of this technology make it possible to reduce the final waste volume to the landfill and extend the life of landfill. By this technology which was proposed by the Pre-FS also, the waste is temporarily stored in the anaerobic cells where pressure and temperature is controlled. In these cells, methane gas generates during short term and it is utilized for power generation. According to the Pre-FS, in case that waste amount is 400 ton/d, 16 units of anaerobic cells (capacity of each cell is 12 days) are installed, and methane gas production is completed in 180 days. After 180 days, the waste is transferred to the compost maturation zone.

We evaluated this “Anaerobic Digestion Process” and concluded that it is difficult to adopt it for the following reasons.

- 1) As for the “Anaerobic Digestion Process”, we do not possess technology nor experience in Japan. Therefore, we cannot adopt this process with scientific proof.
- 2) We investigated the operating results in foreign countries concerning the “Anaerobic Digestion Process”. However, we could not find the reliable data.
- 3) It is estimated that small amount of gas will generate during a short term of around 180 days.
- 4) According to the Pre-FS, compost maturation zone also necessary. It is disadvantageous to adopt such technology in the site where area is limited.

Therefore, we excluded this technology in Table 5-1.

The proposed Intermediate Treatment Process fully satisfies the following requirements as per Article 30 of Regional regulation of the province of West Java (November 12, 2010).

- To classify
- Composting/Utilization of Compost for Fertilizer
- Recycling and / or Production

Supplementary Explanation Regarding the Composting:

Based on meeting result with West Java Provincial Government, composting periods is set 20 days and West Java Provincial Government guarantees the taking-over of the ownership of compost products. In this regards, West Java Provincial Government acknowledges;

- All of the 20day-compost is taken away everyday to the Government with a burden on the Government.
- Due to such period of compost process (20 days), there are possibilities that the compost products do not satisfy a required quality specified in the standard of composting in Indonesia. The compost might be still premature or on the way to decompose.
- There are possibilities that hazardous waste including medical wastes contains compost products

To fulfill the consensus with the government and the relevant standard, a windrow turner and a screen are to be used in the composting to get the compost quality efficiently better.

6.2.1 Leachate Treatment

To proposed leachate treatment facility shall be designed under the following functions of solutions for issues in the Pre-Feasibility Study.

- i) Appropriate quantity of capacity of the regulation pond and quantity of leachate would be determined based on the analyzed past 10 years meteorological data because that the untreated leachate shall not be discharged to the public water area even in the rainfall season.
- ii) The function of the leachate in the regulation pond is sent back to the vent sticking out the landfill and contaminant would be purified by microbe inhabiting in the inside of the landfill. Therefore, load of the leachate treatment facility could be reduced and the risk-reduction for environmental influence could be expected.
- iii) The function is to fill up the floating carriers keeping microbe in the biological response tank and keep stability for the treatment.

6.3 Basic Design

6.3.1 Outline

(1) Process Flow and Material Balance of Whole Facility

Received waste is to be classified and treated considering actual sorting operation as shown in Table 6-2 below. Flow-sheet/material balance is as shown in Figure 6-4. “iv) waste other than above” and residue separated in the composting unit is buried into the landfill. They are compacted to half-one volume using landfill compactor in order to expand project life of the landfill. In this figure, life of landfill also indicated. It will be revised in the final report based on updated waste characteristics data.

Table 6-2 Classification and Disposal of Received Waste

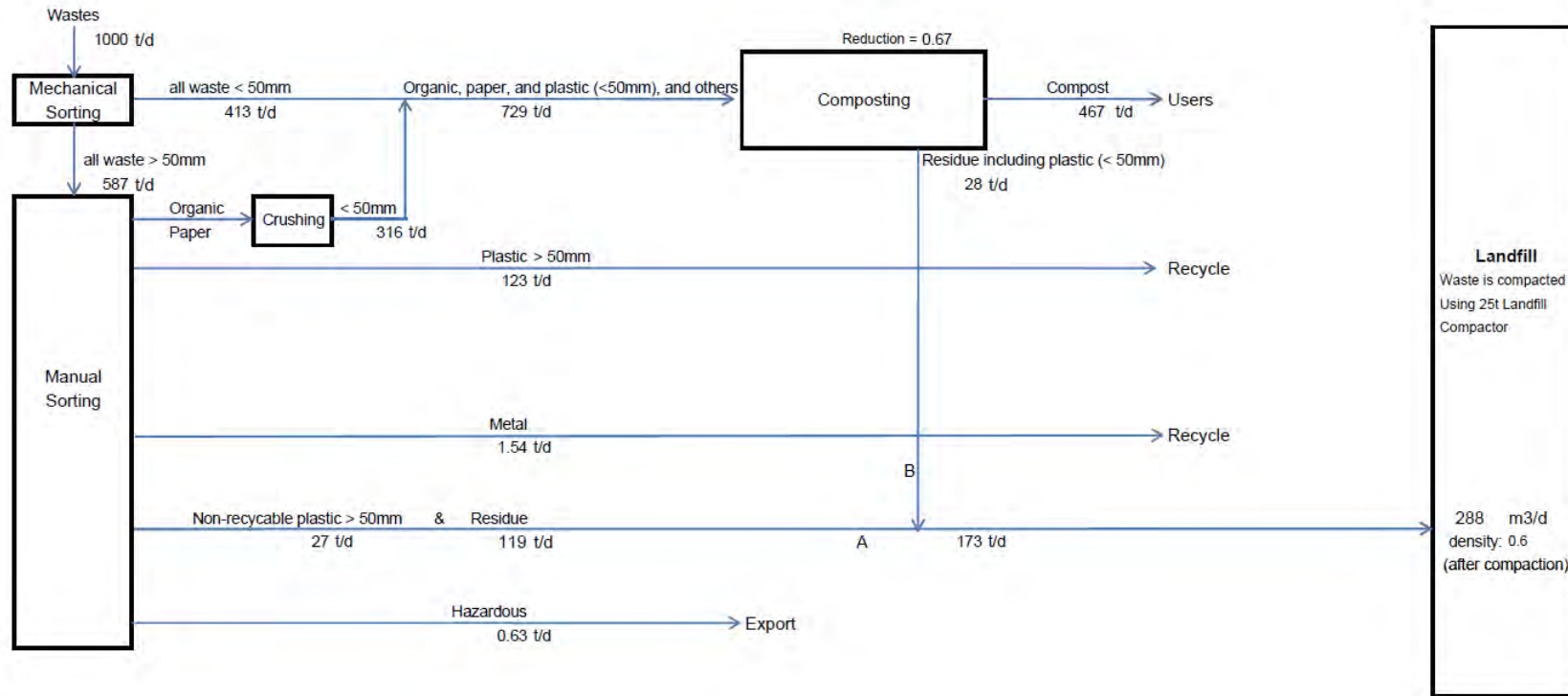
| Classification | | Sort of Waste | Treatment |
|----------------|---|---|---|
| i) | Organic Waste (sourced from those other than the above) | <ul style="list-style-type: none"> - Organic + Leaves/Garden - Plastic under 50mm - Paper - Residues (supposed to be organic) | Composting => Exported by Provincial Gov. of West Java |
| ii) | Recyclable Metal and so on | - Metal | Recycling |
| iii) | Recyclable Plastics | - Recyclable plastic | Recycling (Note-1) |
| iv) | Waste other than above | <ul style="list-style-type: none"> - Non recyclable plastic - Minerals - Disposal Nappies - Composites - Textile - Rubber - Others | Landfill (Compacted using landfill compactor) |
| v) | Hazardous Waste | - Hazardous wastes (medical, electrical, electronic, harmful) | Temporary storage Then exported and processed in an external organization. (Note-2) |

Note-1: Recycling of plastic

Recyclable plastic will be sold to recycling manufacture after classified. The recycling manufacture classifies them again by quality and by color at its factory. Then, after such process as machine crush, washing, and pelletizing, it carries into the plastics processing plant of the inside and outside of Jawa, and makes it a reuse article.

Note-2: Outsourcing of hazardous waste treating

Treatment of hazardous waste will be outsourced to the PPLi. The business activities of the PLLi are 1) stabilizing treatment of hazardous waste, 2) land-filling, 3) Liquid waste treatment, and 4) site clean-up. The hazardous wastes carried into PLLI will be treated by stabilization process, which involves chemical pre-treatment followed by a mixing process involving Portland cement, absorbed clay, water and other reagents in varying proportions to create stable substances.



Life of landfill

| | | |
|---------------|------|-----------|
| Whole volume | m3 | 2,708,155 |
| Wastes volume | m3 | 1,730,872 |
| Life | year | 16.7 |

Annual operation = 360days

Waste to Landfill (ton/day)

| | A | B |
|-------------------|------------|-----------|
| Plastics | 26.5 | 17.5 |
| Rubbers, leathers | 4.9 | 0.5 |
| Textiles | 36.9 | 1.5 |
| Glass | 7.8 | 4.6 |
| Nappies | 66.3 | - |
| Metals | - | 0.8 |
| Hazardous | - | 0.1 |
| Others | 2.8 | 2.7 |
| Total | 145 | 28 |

Figure 6-4 Flow-Sheet/Material Balance

(2) Whole Facilities Site Plan

The outline of the plan is shown below and the overall layout plan is shown in Figures 6-5, 6-6 and 6-7.

- 1) In the earthwork plan in the project area, the ground level in the connecting portion of northern access road for boundary part is EL 185 m and connecting to facility is EL 189 m.
- 2) The flow swamp from south to north in central area of site. The regulating reservoir is planned to construct from the viewpoint of disaster prevention despite the fact that there is no clear local legal restriction in terms of the construction of the regulating reservoir in the large-scale development and the local Pre-FS plan are also not included in such a restriction.
- 3) 10 m-width Perimeter road will be constructed around the facilities. At the swamp cross section in central area of site, the construction of waterway facility will be conducted by backfilling the area as a drainage structure
- 4) The facility at the centre portion, entrance is a flat area with planned EL: EL 189 m. which has the three zones from west to east side, 1. Common facility, Management facility and Car park zone (90 m * 120 m). 2. Compost Zone (200 m * 100 m) and 3. Sorting Zone (180 m * 100 m).
- 5) Landfill area located at east side of seepage water treatment plan and regulating reservoir.
- 6) The earth work volume is "Cut; 1,510,000m³, Fill; 540,000 m³, the balance; 970,000m³ (inclusive of earthwork at landfill). The balance soil will be used as molding.
- 7) Although the balance soil can be used as molding, there is no space for the temporary stock yard for it at the current area. Therefore, it is requested to keep the new yard beside the disposal site for the purpose of temporary stock yard for molding soil.

(3) Circulation Plan

Circulation plan is indicated in Figure 6-7.

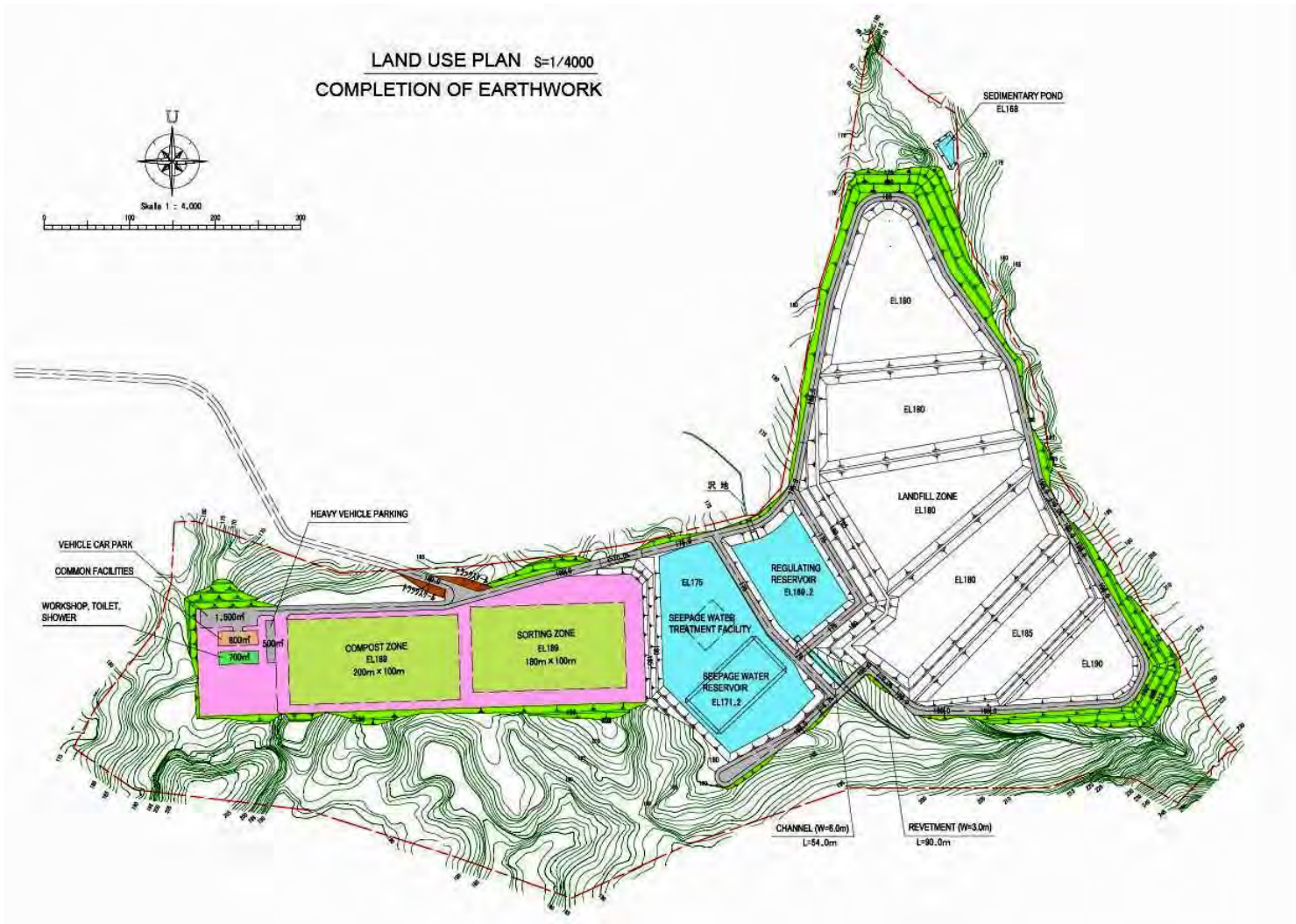


Figure 6-5 Overall Layout Plan (Plan View)

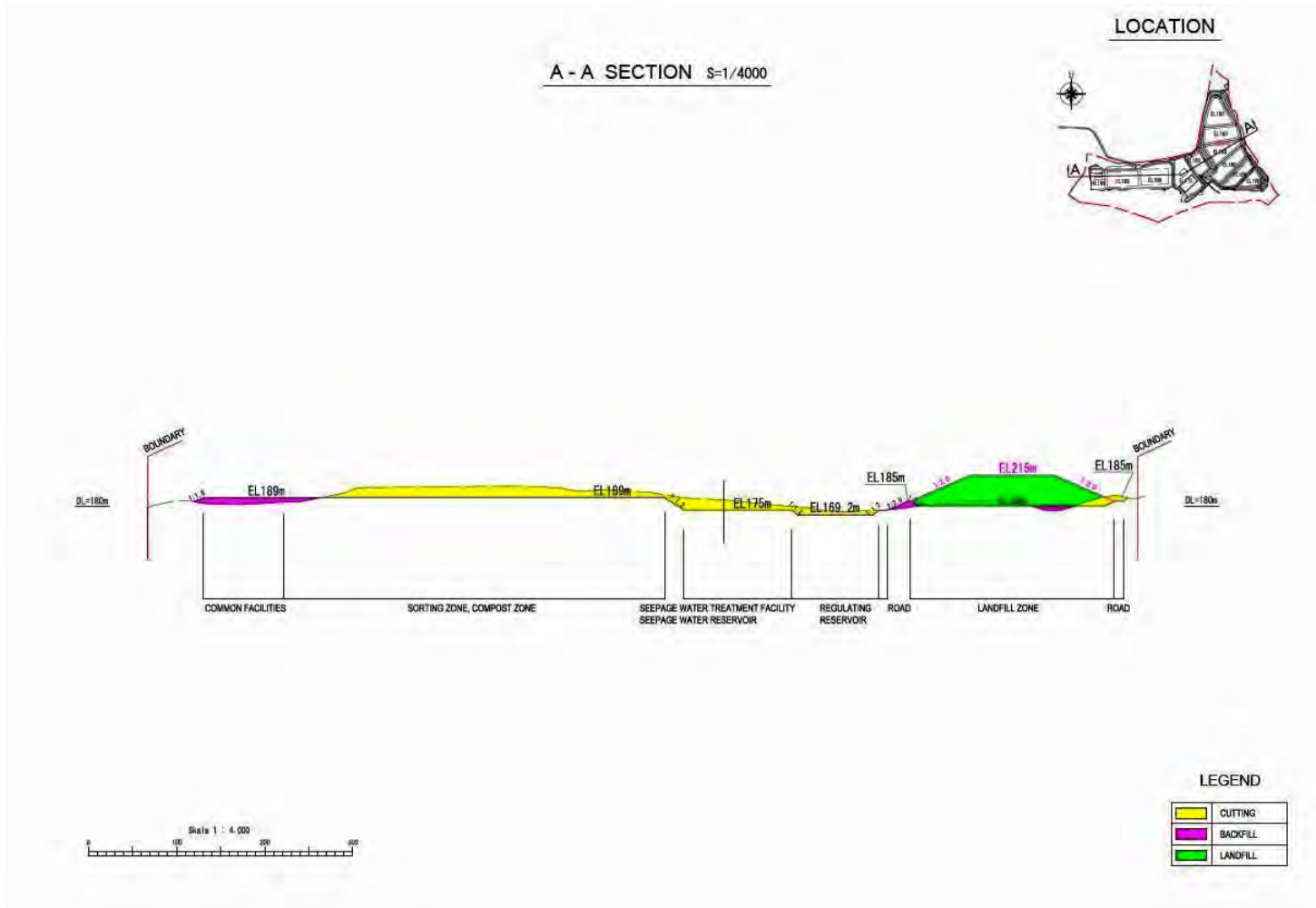


Figure 6-6 Overall Layout Plan (Section View)

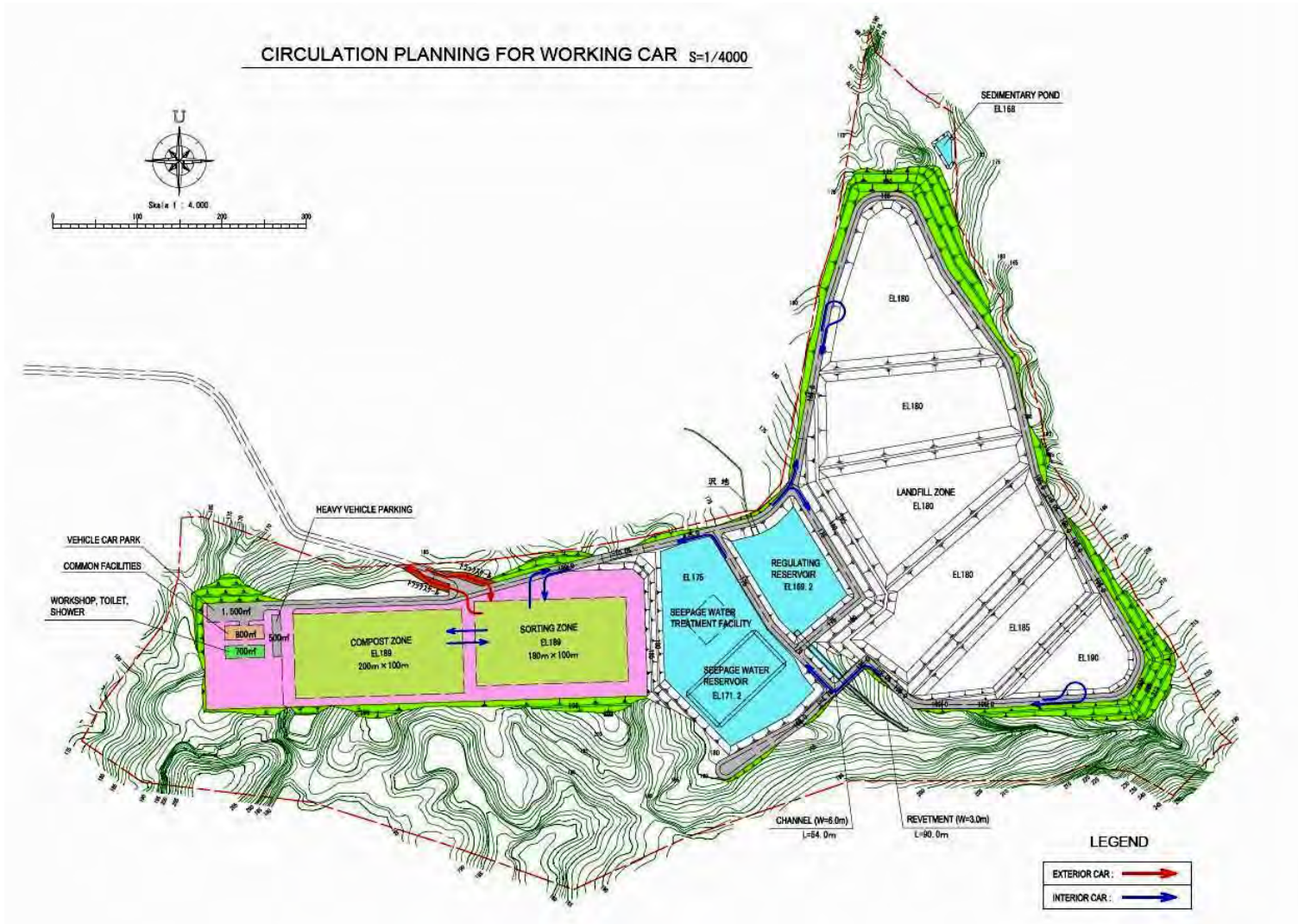


Figure 6-7 Circulation Plan

6.3.2 Sorting

(1) Process Flow

Process flow and material balance of sorting system is shown in Figure 6-8.

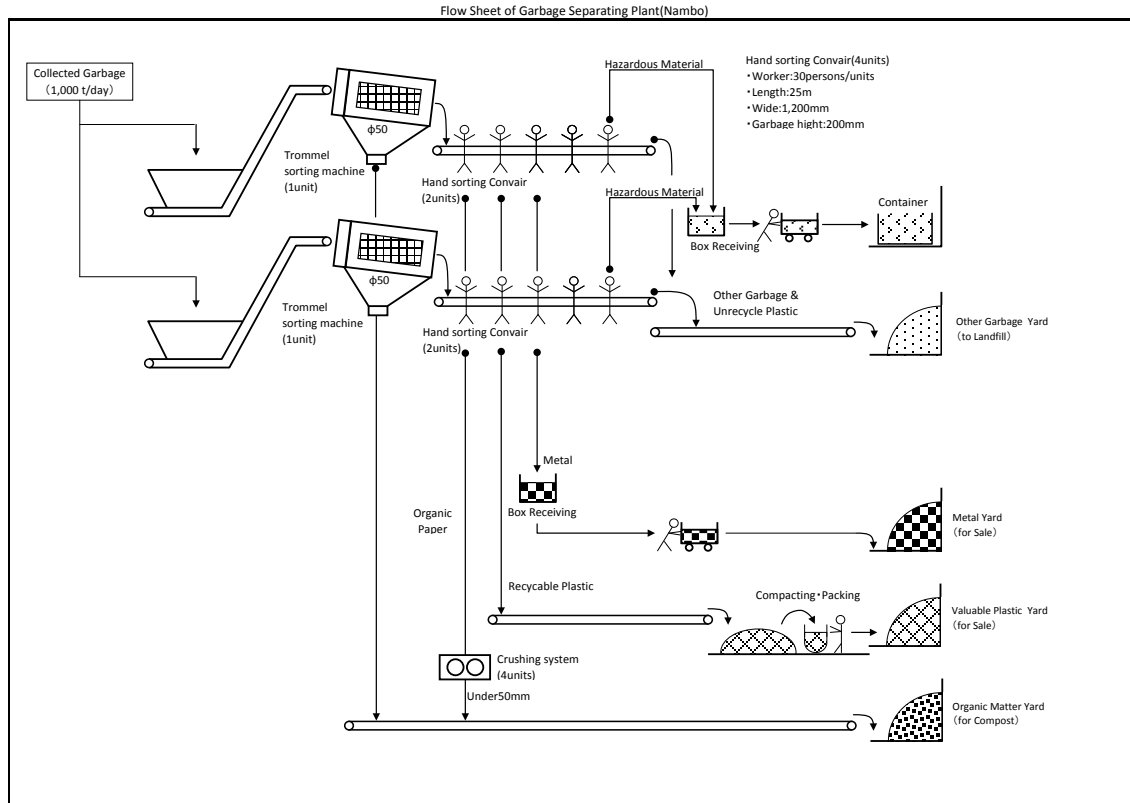


Figure 6-8 Process flow and material balance for Nambo

i) Receive and feeding system

The garbage delivered by garbage trucks is pooled in receiving yard and then dumped to receiving hopper by heavy equipment. The dumped waste is fed to separating service.

ii) Separating system

The waste from 'Receiving and feeding system' is classified by the machine by particle size. The smaller one is mainly organic. The small size waste is fed to conveyance system, and the over size waste is fed to manual sorting system.

In the manual sorting system, the waste is separated to 5 kinds of waste.

| | |
|---|---|
| Recyclable plastic | →for sell |
| Non- Recyclable plastic | →To Landfill |
| Others(Impossible to separate) | |
| Organic (kitchen waste, papers, leaves) | →Under 50 mm by Shredder, feed to composting system |
| Metal | →for sell |
| Hazardous, medical, etc | →To outside |

a. Conveyance system

The separated waste should be fed to storage system.

b. Storage system

The fed waste should be stored in storage area.

c. Dust collection system

To keep the working environment clean, the dust around workers and equipments should be collected and exhausted to atmosphere through the dust collector and the blower.

d. Common service

Dust collector needs compression air to backwash filter, so the compressor should be equipped.

Further more, the plant water feed and discharge pump should be equipped.

(2) Component Equipments, Processing Capacity

Main constructing facilities are shown as below (Capacity of these facilities will be mentioned in final report). Besides, operating time and annual operating days are shown in Table 6-3.

Table 6-3 Operating Time and Annual Operating Days

| System, service | Operation time | Annual Operating Days |
|----------------------------|---------------------------|-----------------------|
| Receive and feeding system | 7 days/week, 16 hours/day | 360 days |
| Separating system | 7 days/week, 12 hours/day | 360 days |
| Feeding system | 7 days/week, 12 hours/day | 360 days |
| Storage system | 7 days/week, 12 hours/day | 360 days |
| Dust collection system | 7 days/week, 12 hours/day | 360 days |
| Common service | 7 days/week, 12 hours/day | 360 days |

1) Receive and feeding system

Receiving yard Structure : Reinforced concrete construction

Receiving hopper Type : Direct dumping

Units : 2

Feeding conveyor Type : Apron conveyor

Units : 2

2) Separating system

Screening by size Type : Trommel (ϕ 50mm)

Units : 2

Manual sorting conveyor

Type : Belt conveyor

Units : 4

Shredder for compost Type : Single shaft Shredder

Disposal capacity : 8.8 t/hr/unit

Units : 3

3) Feeding system

Feeding conveyor Type : Belt conveyor

Units : 20

4) Storage system

Storage yard Structure : Reinforced concrete construction

- 5) Dust collection system
 Dust collector Type : Bag filter with Automatic backwash
 Disposal capacity : 1,000 m³/min
 Units : 1
 Blower Type : Turbo fan
 Disposal capacity : 1,000 m³/min × 4.0 kPa
 Units : 1
- 6) Common service
 Compressor Type : Lubricant supply
 Disposal capacity : 3.6 m³/min × 0.83 Mpa
 Units : 1
- Deodorize-insect proof equipment
 Type : pressure spraying type
 Disposal capacity : 18.0 l/min × 1,471 kPa
 Units : 1
- 7) Others
 Heavy-equipment Type : wheel loader
 capacity : 5.6 m³/bucket
 Units : 4

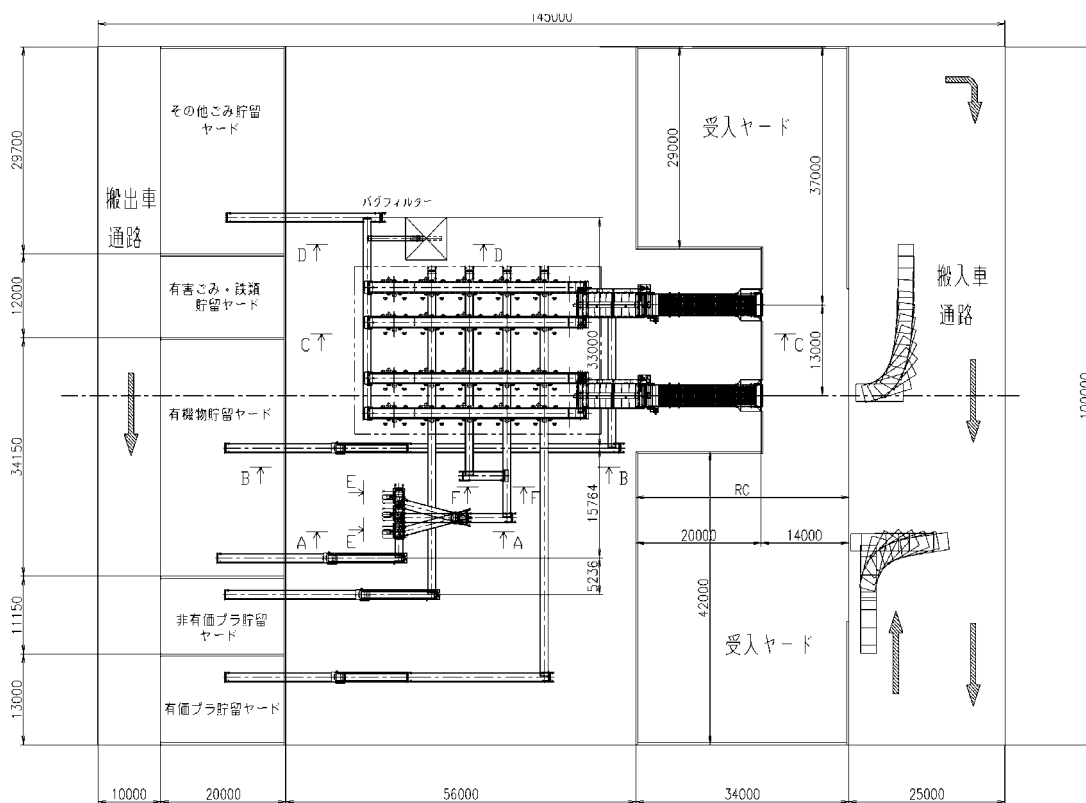


Figure 6-9 Nambo Sorting Facility Layout

6.3.3 Compost

(1) Process

- 1) The organic waste sorted as described in section 6.3.2 is transported by dump trucks to a windrow hall and piled up trapezoid in cross section by wheel loaders.
- 2) The windrow stands in the building for 20 days for the natural process of decomposition of the organic matter and is turned from time to time by a windrow turner.
- 3) The compost after 20 days decomposition is screened and taken out by dump trucks employed by WJPG.

(2) Building and Equipments

- 1) Windrow Hall: a floor space of 20,000 m²
- 2) Wheel loaders: 7 units
- 3) Dump trucks: 10 units
- 4) Windrow turner: 1 units
- 5) Screen: 1 units

(3) Compost Hall Drawings

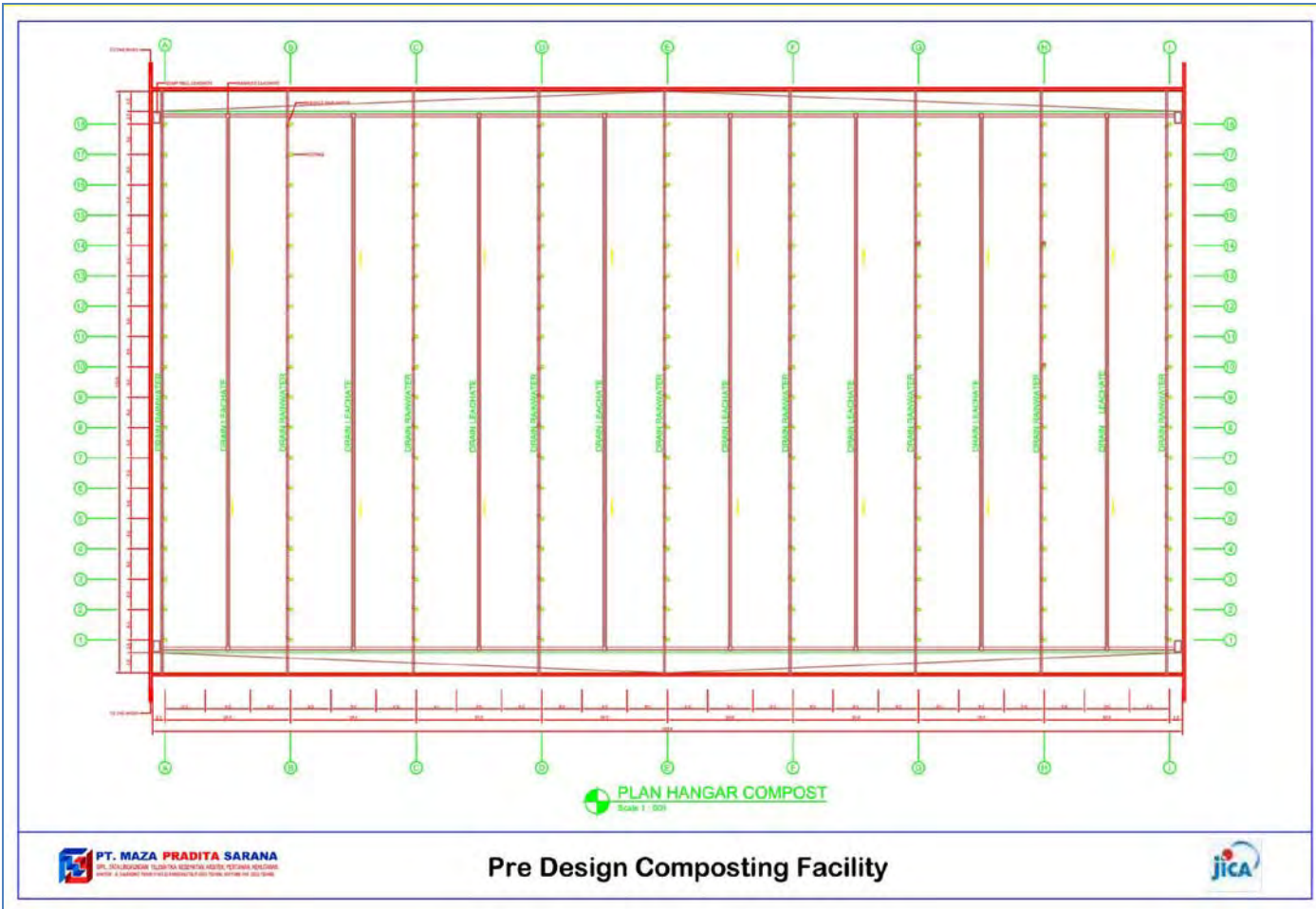


Figure 6-10 Compost Building Plan

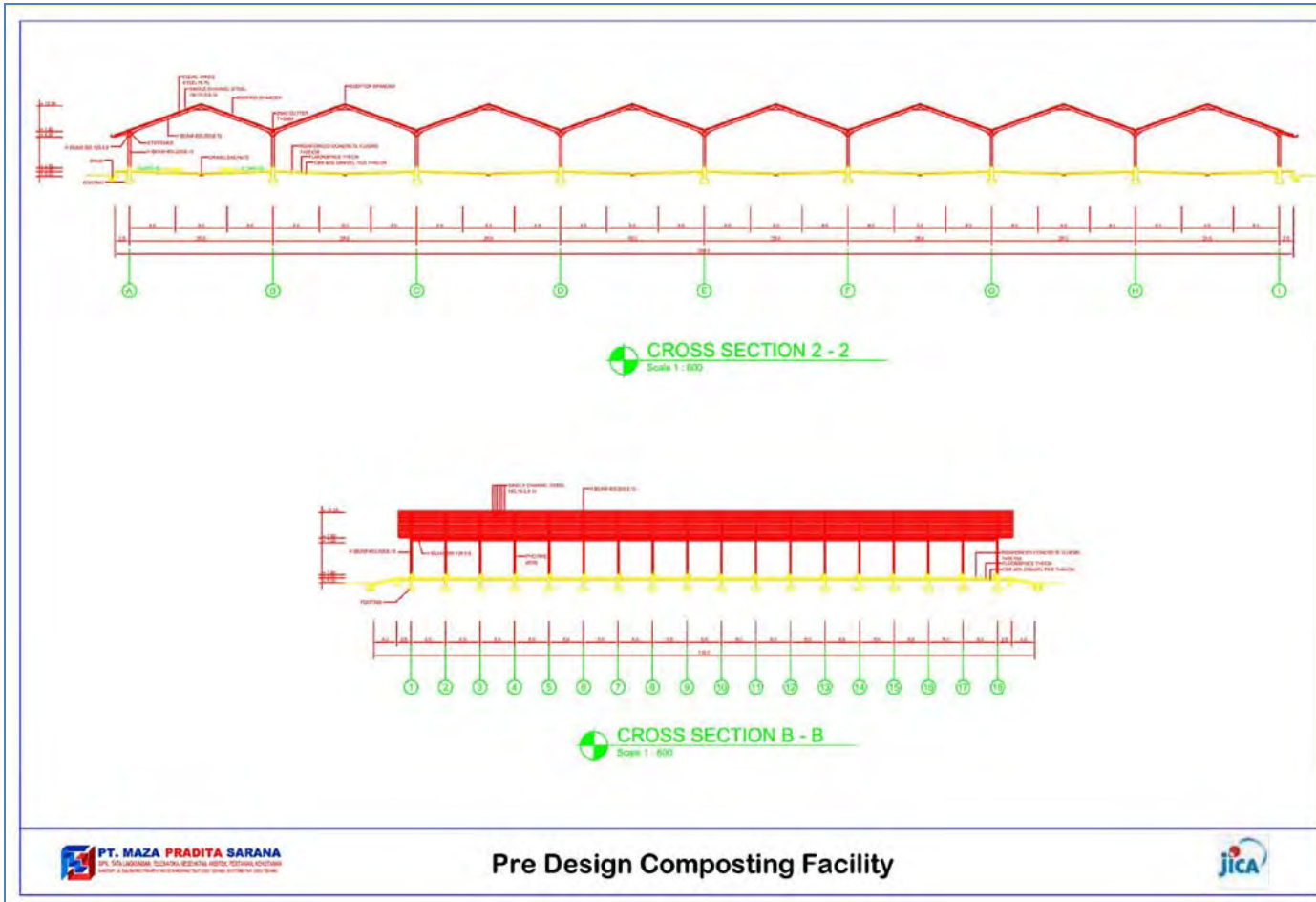


Figure 6-11 Compost Building Cross Sections

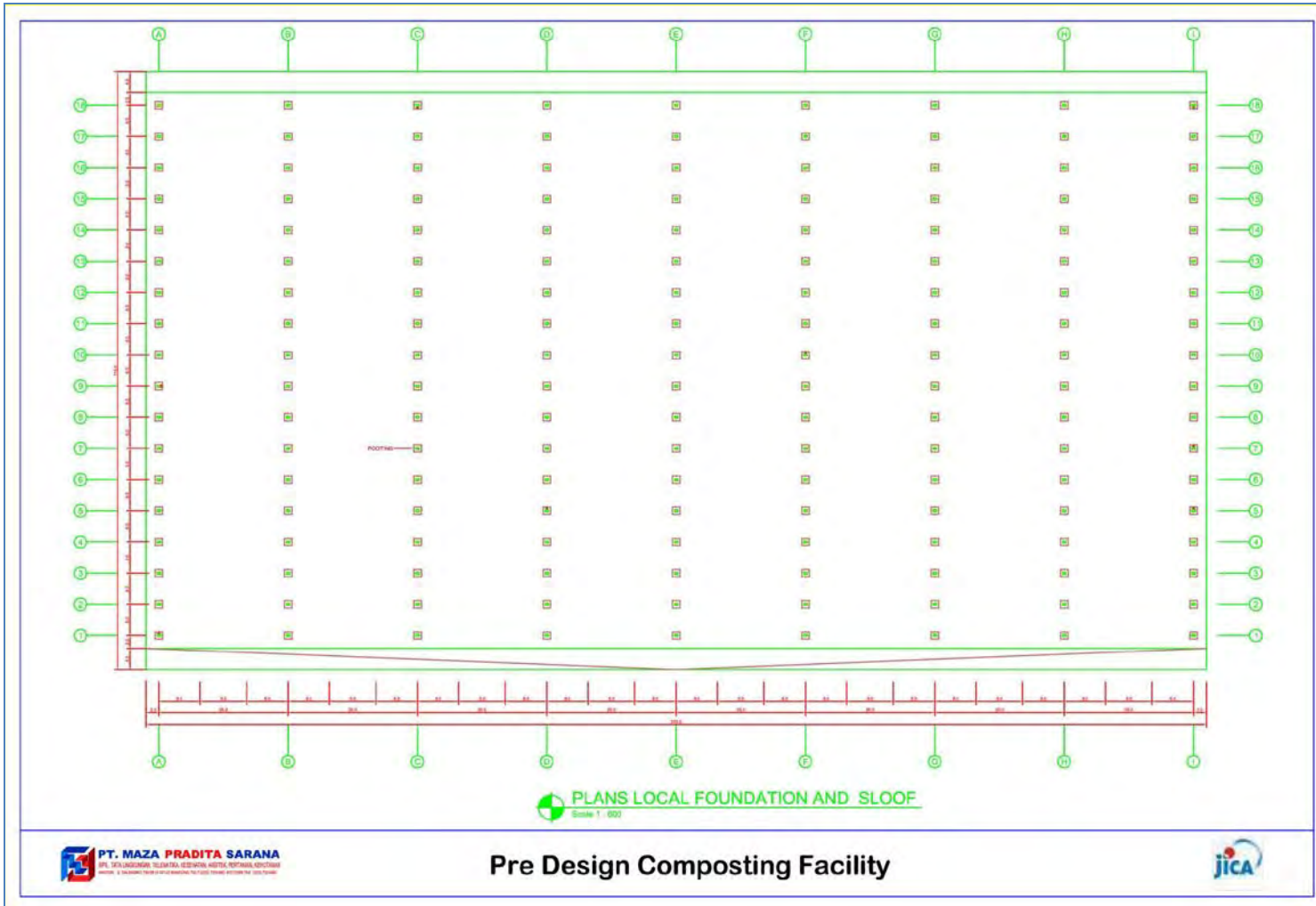


Figure 6-12 Compost Building Foundations

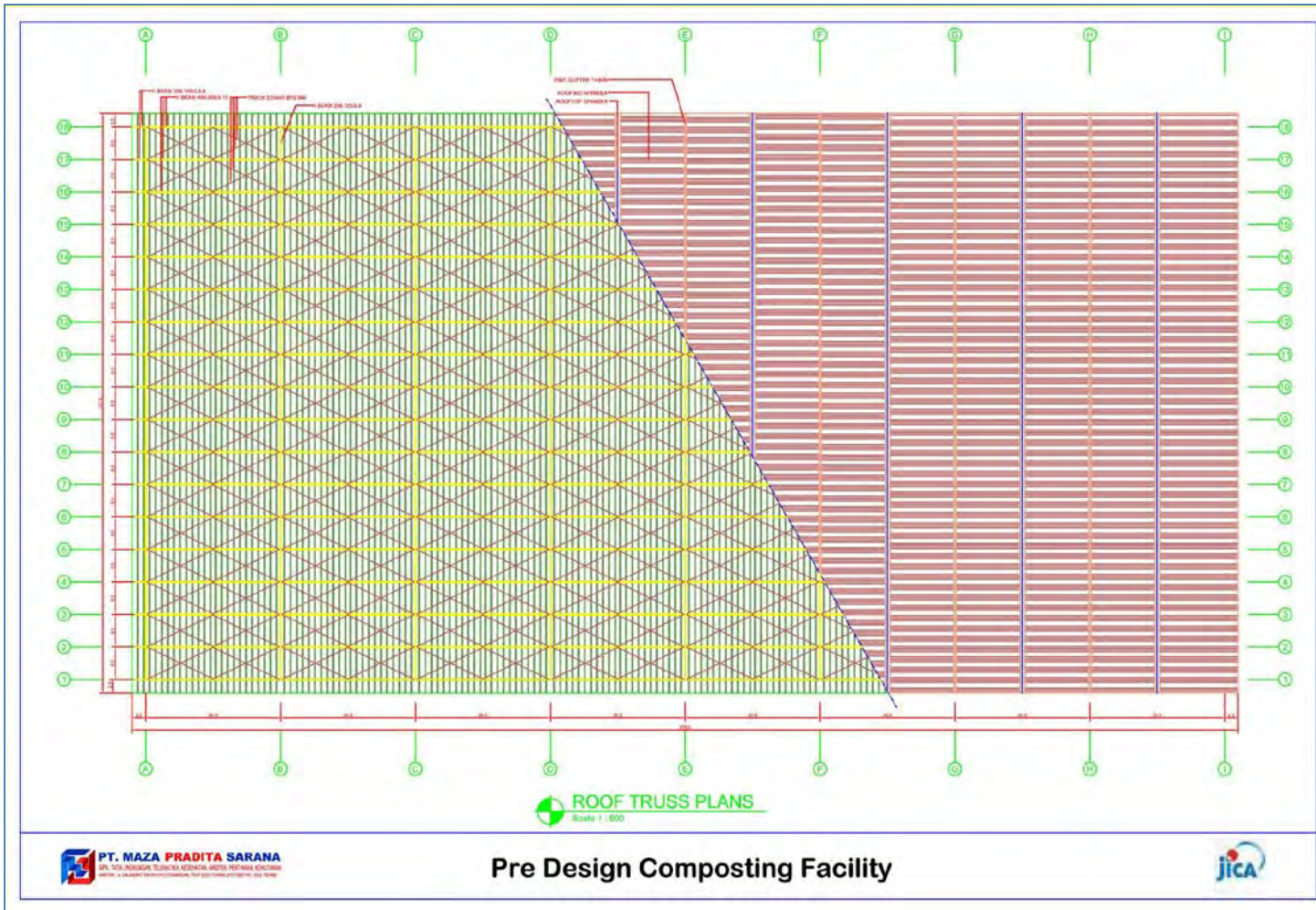


Figure 6-13 Compost Building Roof Plan

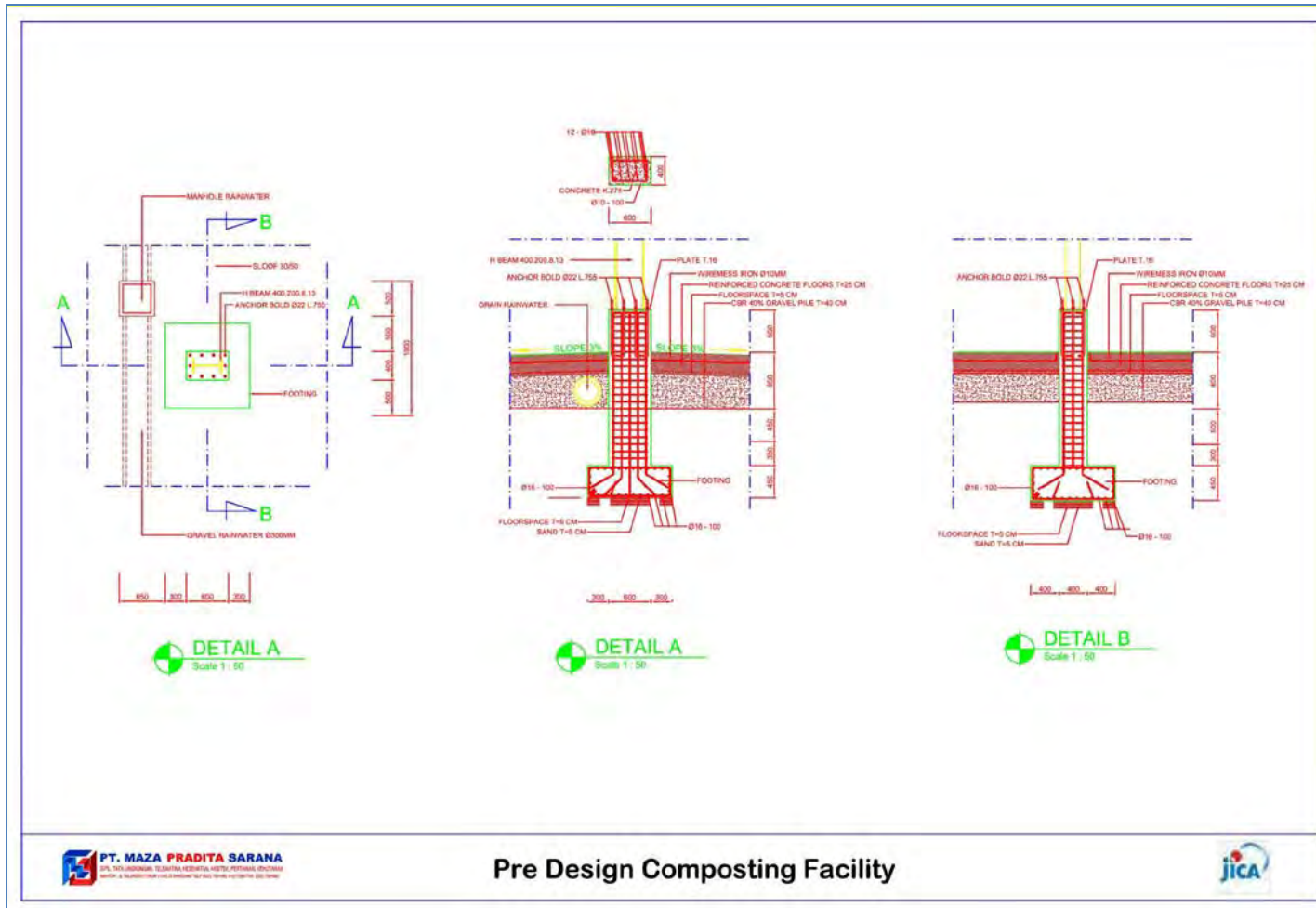


Figure 6-14 Compost Building Foundation Details

Scientific Basis for Fremantation Period for Compost

The relation between the necessary days for composting and effect of activator can be referred to a study in Indonesia, which reports experiment of compost producing using activator in Sukuna Village in Sleman Regency with statistical validation. Usually, it takes a few months for whole composting process without activator, and generally it was known the activator enables to shorten the time up to 2 weeks, however, the exact effect by the density of activator were unknown. Here, application of activator were changed from 15ml/L to 75ml/L, and adopted it to 9 composting samples. The result shows that the average necessary composting days were 11.22 days for 75ml/L, and 18.11 days for 15ml/L. Consequently, the it can be expected that the necessary time for composting process with activators would be less than 20 days even the density of activator comes less. Note that the activator cost will be covered by the WJPG.

Source: SP Ganefati, 2008, Dosis efektif inoculant cair untuk mempercepat waktu pengomposan sampah organik

6.3.4 Sanitary Landfill

The main purpose of the Final Landfill Disposal Site is to prevent filled wastes from spilling out or collapse, keeping safe stock of the filled disposal and to prevent the Leachate from flowing out of the site through function of bottom seepage control sheets.

(1) Type of the Final Landfill Disposal Site

- The type of the Final Landfill Site is roughly divided into two type, Open type and Closed System Type. In this case, we selected Open type considering of required huge volume of waist material during over ten years (estimated roughly more than 1,000,000 m³) and difficulty to dig such huge space into hard limestone.

(2) Land Development

- Land development plan is developed considering present the groundwater level and balance of cutting and filling volumes of the soil.
- At the date of renouncement of the Final Landfill Disposal Site, collected groundwater through the Groundwater Collecting and Drainage System should be available to be discharged into existing channels as a natural flow.
- To simplify both operation of the Final Landfill Disposal Site and control of volume & quality of the Leachate from the Groundwater Collecting and Drainage System, filling site is divided into smaller lots. Dividing of the Lot should be based on consideration for water flow directions of groundwater together with collected water, location of the Groundwater Collecting and Drainage System and discharging location of the treated water
- Section dikes of earth bank type shall be provided at the border of each Lot and the sealing shall be provided on the surface of the dike.

- 1) Stability of the Filling Bank:
Confirm the stability of the slope with circular failure analysis
- 2) Slope gradient of cut and fill:
Cut area 1:1.2–1:1.8, Fill area 1:1.8–1:2.0
- 3) Each Lot area of the Final Landfill Disposal Site:
Lot: 10.4 ha

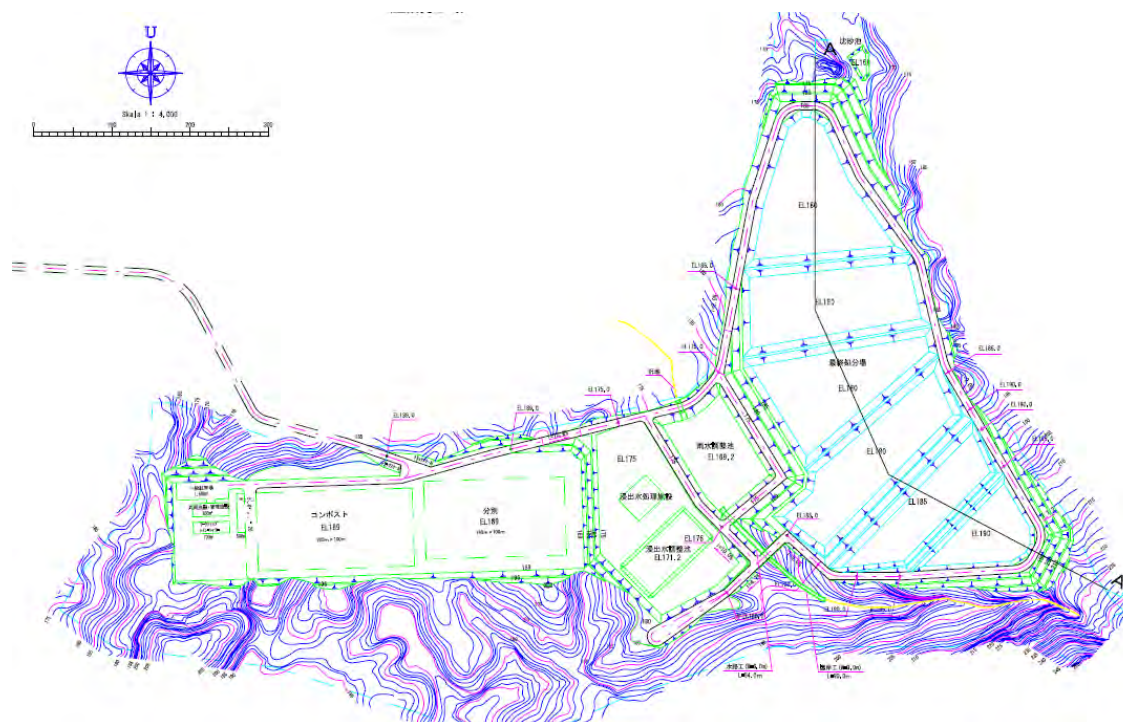


Figure 6-15 Section Plan for Final Landfill Disposal Site

(3) Sealing Works

Sealing Works will prevent the public basin and groundwater from contamination by the holding water of the filled waste and rainwater (Leachate) on the filling site. This is a preventive measure against negative impact on the neighboring environment.

- Type of the Sealing Structure:
Dual Seepage Control Sheets structure will be applied for Sealing Works.

Details of the Sealing Works structures are as follows;

Table 6-4 Sealing Works

| | Bottom area | Slope area |
|--------------|---|--|
| Surface ↑ | Protective soil Layer t=50 cm | Protective soil Layer t = 50 cm |
| | Protective Sheet, density > 500 g/m ² (Short-fiber nonwoven fabric) | (during operation) |
| | Seepage Control Sheet t=1.5 mm | Protective Sheet, density > 400 g/m ² (Long-fiber nonwoven fabric) |
| | Protective Sheet, density > 500 g/m ² | Seepage Control Sheet t=1.5 mm |
| | Seepage Control Sheet t = 1.5 mm | Protective Sheet, density >500 g/m ² (Short-fiber nonwoven fabric) |
| | Protective Sheet, density >500 g/m ² | Seepage Control Sheet t = 1.5 mm |
| | Protective soil layer (Excavated soil) | Protective Sheet, density > 500 g/m ² |
| ↓ | t = 50 cm | Protection gunite-shooting (Cut portion only) |
| Bottom | | t = 10 cm |

(4) Groundwater Collecting and Drainage System works

The Groundwater Collecting and Drainage System is provided for attaining the safe and smooth construction work through preventing the damage of Sealing structure due to swelling by uplift of ground water pressure and improving the traffic ability of the heavy earthwork and hauling equipments during operation.

- Location of the groundwater collecting and drainage pipes and the Leachate collecting and drainage pipes is decided to keep thorough horizontal distance between each pipe on the plan.
- Each distance between trunk underground collecting pipes and branch pipes should be not more than 40 m and 20 m respectively.
- All the piping structures should have thorough durability.
- Dimensions and types of pipes should be determined based on structural and hydraulic calculations so as to be able to collect water from each Lot of the Final Landfill Disposal Site as a system.

Trunk lines:

High-density polyethylene Dual structural porous pipe $\phi 200$

Branch lines:

High-density polyethylene Dual structural porous pipe $\phi 150$

- The collected water from each Lot of the Final Landfill Disposal Site shall be directed into the Protection Regulating Reservoir.

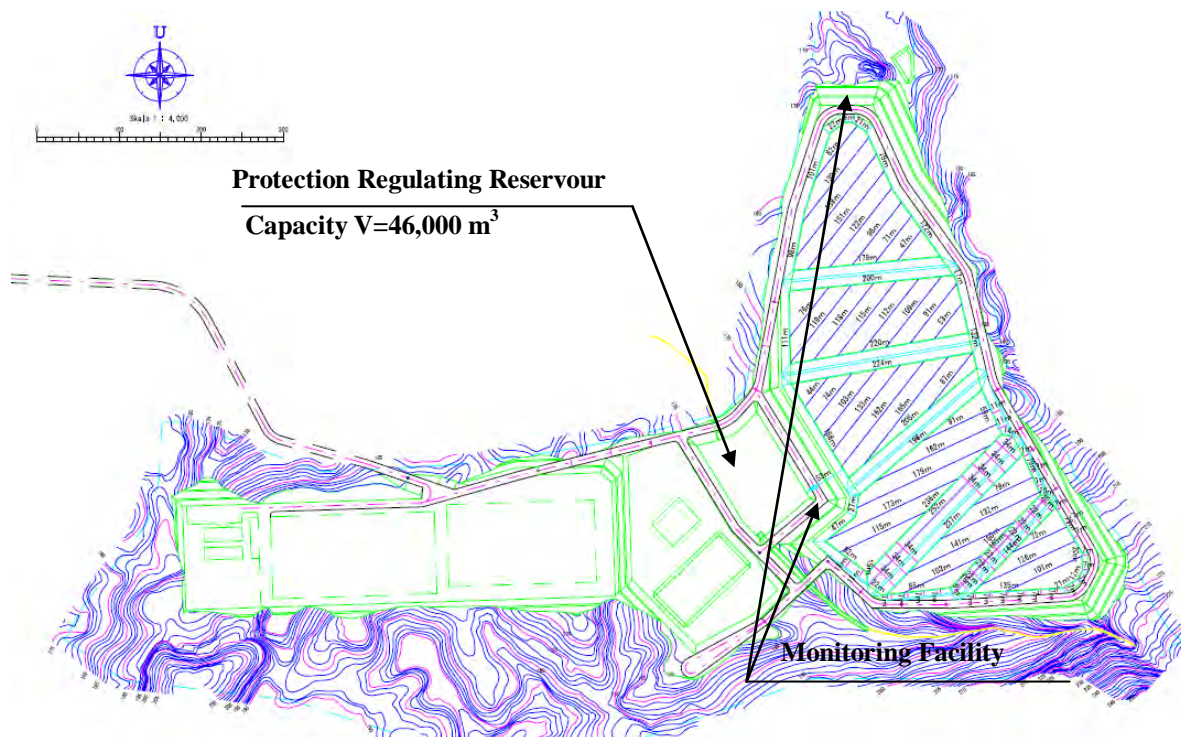


Figure 6-16 Plan for Groundwater Collecting and Drainage System

(5) Rainwater Collecting and Drainage System works

Basic purpose of this system is collecting and draining all the rainwater inside the Site basin promptly. Rainwater should be separated from the leakage of the waste to reduce the amount of the Leachate for the sake of reducing the work loads of both Leachate treatment system and Sealing Works

- Rainwater from the adjacent basin, roads and slopes within the Site, is collected through U-shape ditch which is provided at appropriate location, finally is directed to the Protection Regulatory Reservoir through Rainwater collection sumps.

Trunk ditch: U-600~ U-1,200

Branch ditch: U-3300~ U-500

- Rainwater in the no-landfill area is collected through the collecting pipes in each Lot and is directed into the Protection Regulatory Reservoir

Rainwater collection and drainage piping for the non-landfill area:

High-density polyethylene Dual structural porous pipe $\phi 300\sim\phi 600$

- Sectional dimension of the drainage is confirmed through the hydraulic analysis.
- Capacity of the Protection Regulatory Reservoir will be calculated based on the “Technical Standard of Protection Regulatory Reservoir and others (Draft)” (Japan River Association).

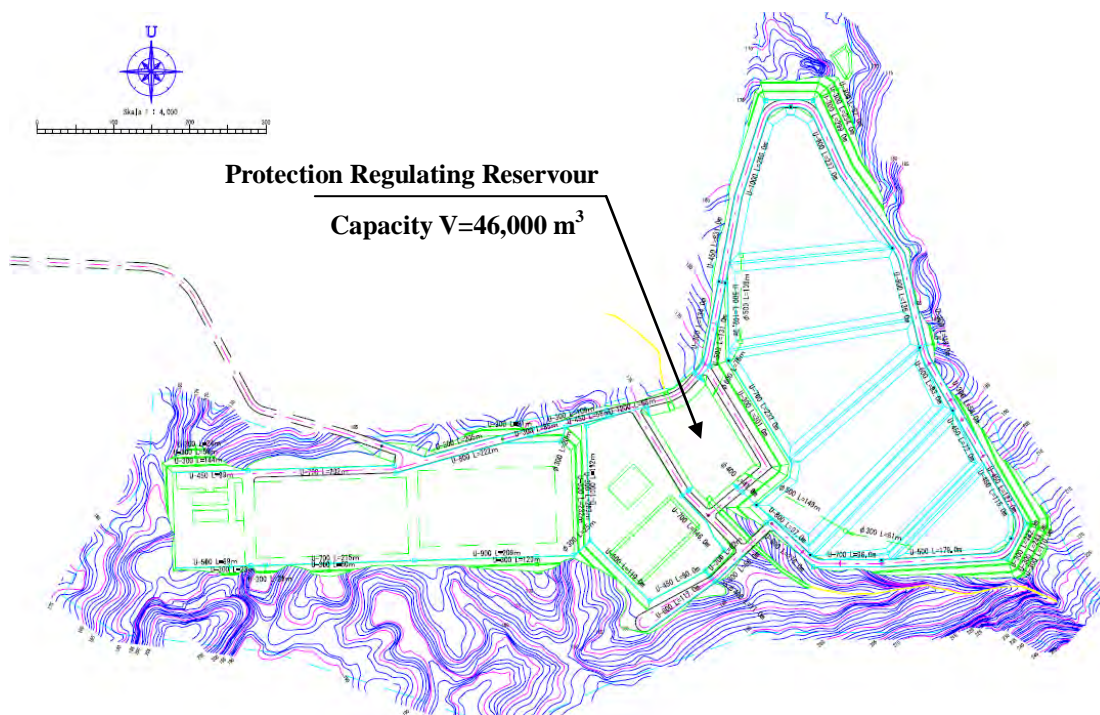


Figure 6-17 Plan for the Rainwater Drainage Facilities

(6) Leachate Collection and Drainage System works

Releasing all the Leachate to outside of the Landfill Site as rapidly as possible through the Leachate Collection and Drainage System makes the deposited waste itself keep in semi-aerobic condition, facilitate decomposition of the filled waste and prevents the Leachate from further deterioration. Another aim of providing the Leachate Collection and Drainage System is to

reduce potential structural loads, which is caused by the Leachate water pressure on the seepage sheets and storage structure.

- Precipitation data used for the design of the Leachate Collection and Drainage System is based on those of the Nambo area in 2004.
- Branch line pipes of the Leachate Collection and Drainage System should be apart not more than 15m each and dimensions and type of pipe and its covering material are decided under consideration of such as prevention from clogging by sedimentation and scales and quantity of the air inflow. Considering the efficiency of the collection and drainage, the shape of the basement of the Leachate Collection and Drainage System should be concavity shape and pipe structure should have thorough durability and strength.

Trunk lines:

High-density polyethylene Dual structural porous pipe $\phi 700$

Branch lines:

High-density polyethylene Dual structural porous pipe $\phi 200$

- Protective Soil Layer over the collection and drainage pipes should be well compacted and covered with non-woven fabrics to prevent any sucking of Leachate.
- Leachate Collection Sumps should be located on each Lot of the Disposal Site to separately collect and drain leachate of each Lot properly. Collected Leachate in the Sumps is pumped up into Regulating Reservoir. Each wall penetration portion of pipe shall be executed with specific cares so as no leakage occurs at this portion.
- Hydraulic test should be applied to the system to check and confirm no leakage.

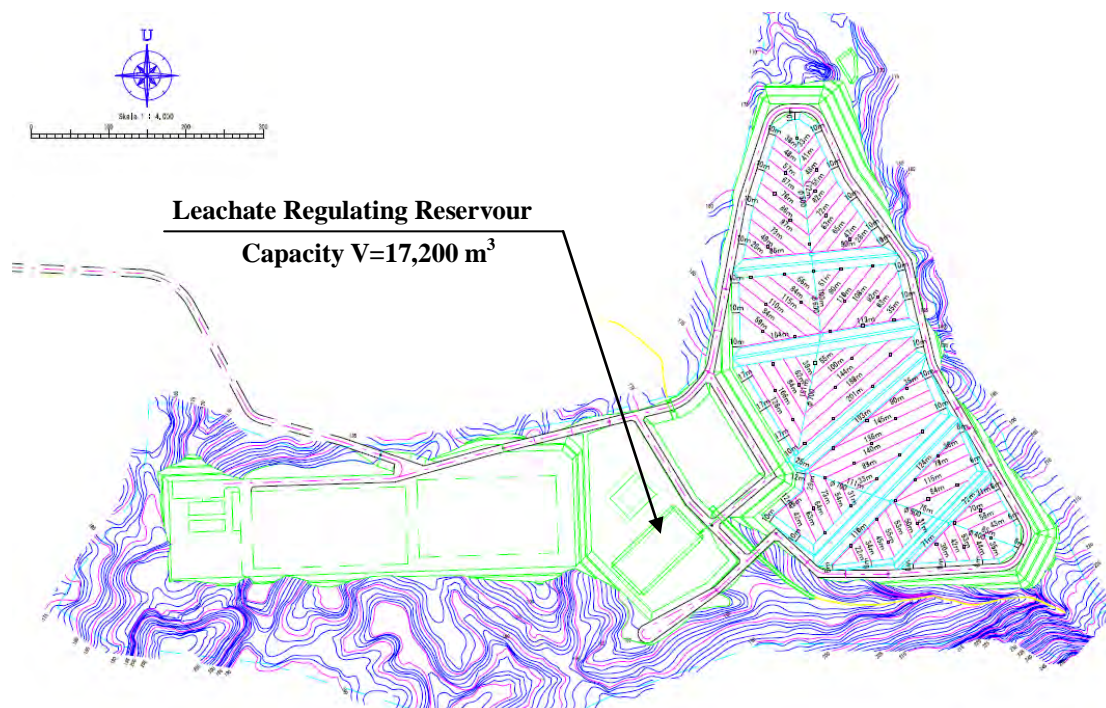


Figure 6-18 Plan for Leachate Collection and Drainage System

(7) Gas Discharge Treatment System Works

Gas Discharge Treatment System will be installed in the site to rapidly discharge gas derived from the filled waste. This system together with the Leachate Collection and Drainage System works not only for gas discharging but also air supply to the filling site to expand the Semi-aerobic area.

- As the Gas discharge system also works as the Leachate drainage pipe, the system should have thorough capacity for collection and drainage purpose.
- Major material's dimension and specification are as follows;

Vertical Gas Discharge pipes:

High-density polyethylene Dual structural porous pipe $\phi 600$

Gas Discharge pipes on slope area:

High-density polyethylene Dual structural porous pipe $\phi 200$

Gabion: $1.2 \text{ m} \times 0.5 \text{ m} \times 0.5 \text{ m}$

(8) Groundwater Monitoring Facility

Two Groundwater Monitoring Facilities are provided to routinely measure the required environmental monitoring items of the groundwater for the period from the commencement of waste filling to renouncement of the Site. Locations of these Groundwater Monitoring Facilities are shown in the Groundwater Collection and Drainage System Plan. 1 point will be located at Collection pit for Groundwater Collecting and Drainage System; another point will be located at a mountain stream of northeast side of area considering topography so that we can analyze the change of quality of underground water.

Monitoring items and monitoring frequency will be determined according the situation of the Site referring Ordinance No. 33 of Ministry of the Environment, Japan.

- Above ground structures of the Groundwater Monitoring Facilities should be provided to keep off unauthorized persons and to protect the facility from any adverse weather conditions.

Groundwater Monitoring Well: 2 Lots, PVC pipe $\phi=100\text{mm}$

(9) Shatter Proofing Work and Gate

Shatter Proofing Work will be provided on the Site to prevent the waste from scattering due to wind or birds outside of the Site

6.3.5 Leachate Treatment

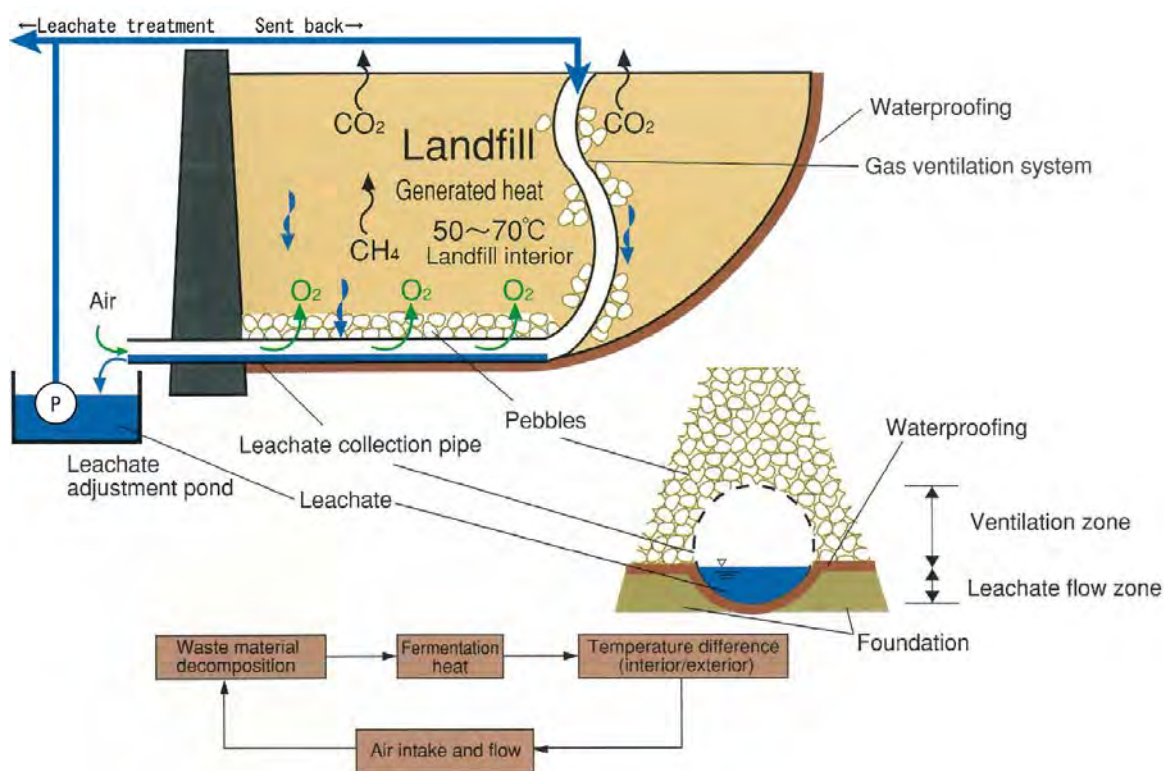
(1) Basic Policy for the Plan

The proposed leachate treatment facility shall be designed under the following functions as solutions for issues in the Pre-Feasibility Study.

1. The function is to discharge the treated water to the large river secured enough amount of water around one year. The treated water, maximum 250 L per minute, is to be discharged to the assumed large river from the effluent tank in the leachate treatment facility through the plumbing, 150 mm in diameter by gravity flow. The length of plumbing is approximately 2.5 km, and the method of construction for the plumbing would be the under-grounding piping on a roadside, the grounding piping, and the piping under the bridge. The West Java State Government agreed that the planning, the construction, and the cost allocation should be executed by the state government. The concept of the Closed

System, moreover, should be taken to limit the influence of the treated water; therefore, the following measures shall be adapted. Those measures would secure approximately 70% of the expected system. While the amount of leachate is 360 m³ per date in case of covering a sheet, the amount of it is 1,160 m³ per date in case of non-covering; therefore, 69% of reduction would be realized. The purified water of the equipment employed in the leachate treatment facility; furthermore, the treated recycled water would be used; therefore, the discharging water 60 m³ per date could be reduced comparing to use tap water. Those measures would secure approximately 70% of the expected system.

- The reduction measure for quantity of leachate would be planed by the surface exclusion of rainwater coving a sheet on a finished landfill-block.
 - In addition, the reduction measure for the outflow discharge of the treated water would be planned by re-using the treated water.
2. Appropriate quantity of capacity of the regulation pond and daily quantity of leachate would be determined based on the analyzed meteorological data: 1994 to 2008 and the planning which the un-treated leachate shall not be discharged to the public water area even in the rainfall season
 3. The function is that leachate in the regulation pond is sent back to the vent sticking out the landfill (vertical gas venting facility) and contaminant would be purified by microbe inhabiting in the inside of the landfill. Therefore, load of the leachate treatment facility could be reduced and the risk-reduction for environmental influence could be expected.



Source: Environmental Bureau, Fukuoka City (part modified)

Figure 6-19 Mechanism of Semi-aerobic Landfill: Fukuoka Method

4. The function is to fill up the floating carriers keeping microbe in the biological response tank and keep stability and high-efficiency for the treatment.

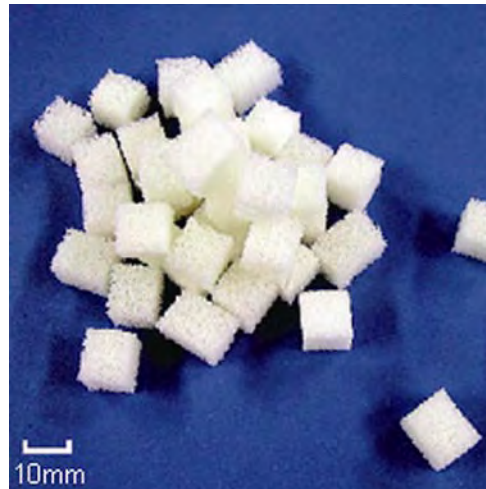


Figure 6-20 Imaged Floating Carries

(2) Block Flow

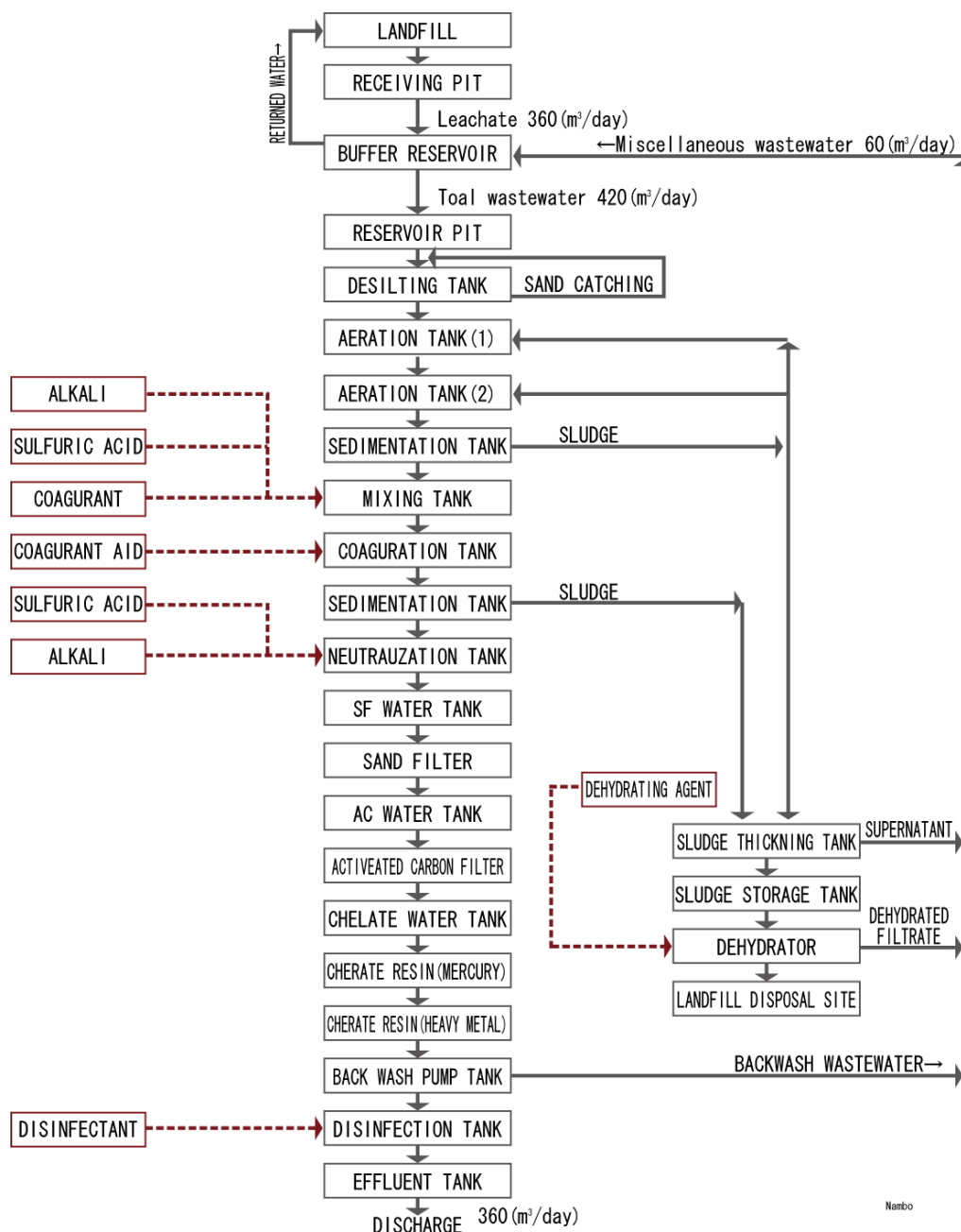


Figure 6-21 Block Flow for Leachate Treatment Facilities

(3) Instrument and Treatment Capacity

i) Processing Waste Water

Leachate of Domestic Waste Landfill & Miscellaneous Wastewater

Miscellaneous Wastewater mainly means discharged water form the backwashing process protecting plugging of the sand filter etc.

ii) *Processing Quantity of Leachate & Wastewater*

| | |
|---|-----------------------------|
| Quantity of Leachate (daily average) | 360 m ³ /day |
| <u>Quantity of Miscellaneous Wastewater (daily average)</u> | <u>60 m³/day</u> |
| Quantity of Total Wastewater | 420 m ³ /day |

In 420 m³ per day treated total wastewater, 60 m³ per day would be re-used in the backwashing process etc; therefore, quantity of the discharged water to the public water area would be 360 m³ per day

Table 6-5 Processing Quantity of Leachate & Wastewater

| | m ³ per day | m ³ per hour | m ³ per minute |
|--------------------------------------|------------------------|-------------------------|---------------------------|
| Quantity of Leachate | 360 | 15.0 | 0.25 |
| Quantity of Miscellaneous Wastewater | 60 | 2.5 | 0.04 |
| Quantity of Total Wastewater | 420 | 17.5 | 0.29 |

iii) *Quality of Water Flow*

Table 6-6 Quality of Water Flow

| Item | Leachate | Total Wastewater |
|------------------------|----------|------------------|
| BOD mg/L | 1,000 | 900 |
| COD _{Cr} mg/L | 2,000 | 1,800 |
| S S mg/L | 300 | 260 |

- Organic matters in the leachate result from land filled used-nappies and impurities etc. BOD would be assumed between the case that combustible waste is land filled on the semi-aerobic landfill and the case that incombustible waste or incineration ash is mainly land filled. Nambo's BOD ratio will be higher than Legok Nangka because of containing used-nappies in waste material compare with Legok Nangka,
- Leachate in the regulation pond would be sent back to the vent sticking out the landfill (vertical gas venting facility) and be contacted with microbe inhabiting in the inside of the landfill; therefore, quantity of contaminant in the leachate would be decreased.
- In order not to fill in with incinerated ash, it is not assumed that calcium & chloride ion would become a high-density of an obstacle for the water treatment
- In the begging of landfill operation, the following critical condition would be assumed. In those cases, with applying an expansion of catchment area for leachate, the concentration of leachate would be reduced.
 1. BOD & COD would exceed the concentration of leachate.
 2. TDS, Total Dissolved Solids, would be high-level.

iv) *Quality of Treated Water*

| | |
|-----|----------------|
| p H | 6.0~9.0 |
| BOD | below 50 mg/L |
| COD | below 100 mg/L |
| S S | below 100 mg/L |

- There are no appropriate disposal-standards for a leachate treatment facility; therefore, the standard "Industrial Plant I" shall be applied. The three items, NH₃, NO₂ & NO₃, however, would be excluded since the discharging river is not a river under the closed water area.

v) *Treatment Flow*

- Polluted Water Treatment
 - Inflow Regulation + Biological Treatment + Coagulating Sedimentation Tank + Advanced Treatment (Sand Filter Treatment + Activated Carbon Treatment + Chelate Treatment) + Disinfection & Re-Use
 - In order not to fill in with incinerated ash containing many calcium & chloride, the treatment for calcium & chloride ion would not be practiced.
 - The floating carriers are filled up in the biological treatment tank, the biological treatment, and stability and high-efficiency for the treatment would be designed.
 - After the biological treatment, the combined process treatment; the coagulating sedimentation, the sand filter, the activated carbon treatment, and the chelate treatment are designed for treating the refractory COD, the color, and the heavy metal.
- Sludge Treatment
 - Landfill disposal after concentration & dehydration

vi) *Calculation for Quantity of Leachate*

- Selection of Meteorological Data
 - The meteorological data: 2004, the maximum monthly precipitation would be employed in the meteorological data from 1994 to 2008 for calculating the quantity of leachate.
 - Annual Precipitation 4,678 mm
- Leachate Coefficient
 - Leachate Coefficient (landfill operation) 0.82
 - Calculated by the method of Blaney Criddle
 - Leachate Coefficient (finished landfill) 0.10
 - Leachate Coefficient could be reduced from 0.42 to 0.10 by covering a sheet on the surface and excluding most of rainfall water; moreover, quantity of leachate could be restrained.
- Determination of Conversion Area
 - Maximum Conversion area would be determined by calculating the conversion area on each landfill order based on the leachate coefficient and the landfill area. The maximum conversion area is 21,300 m², and the landfill area is: Finished Landfill Area: 115,400 m² & Operated Landfill Area: 11,900 m².
- Calculation between the Quantity of Leachate and the Maximum Capacity Regulation
 - Table 6-7 is acquired the relationship between the quantity of leachate which should be treated in one day and the maximum capacity regulation for protecting overflow based on the daily precipitation of 2004 & the maximum conversion area. The relationship between the quantity of leachate and the maximum capacity regulation is that the more the quantity of daily treated leachate-capacity increases, the more the quantity of non-treated & saved leachate decreases; as a result, the maximum capacity regulation would be reduced. In experiences based on profitability with construction, workability & profitability with maintenance, and area-condition etc, both appropriate ratio is 360 m³ per day, the quantity of leachate on Table 6-7 since the figure, the maximum capacity regulation divided by the quantity of leachate, is mainly adapted approximately 50 days as a standard.
 - The required capacity of regulation pond in the case mentioned above, therefore, should be over 17,201 m³.

**Table 6-7 Relationship between the Quantity of Leachate
and the Maximum Capacity Regulation**

| Quantity of Leachate (m ³ per day) | Maximum Capacity Regulation (m ³) | Maximum Capacity Regulation /Quantity of Leachate (day) |
|---|--|--|
| 280 | 23,183 | 82.8 |
| 300 | 20,363 | 67.9 |
| 320 | 18,761 | 58.6 |
| 340 | 17,981 | 52.9 |
| 360 | 17,201 | 47.8 |
| 380 | 16,421 | 43.2 |
| 400 | 15,641 | 39.1 |
| 420 | 15,250 | 36.3 |
| 440 | 14,930 | 33.9 |
| 460 | 14,610 | 31.8 |

(4) Plot



Figure 6-22 Ground Floor Plan

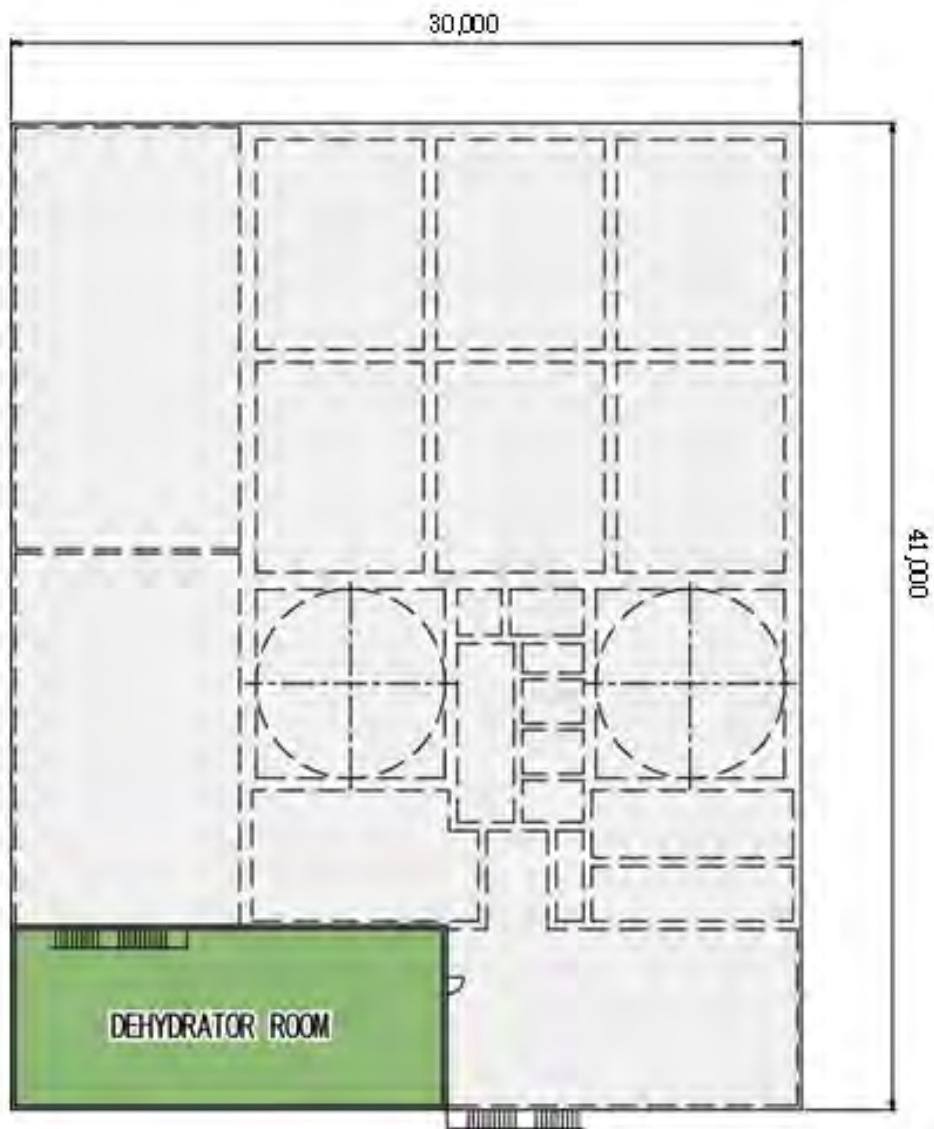


Figure 6-23 Second Floor Plan

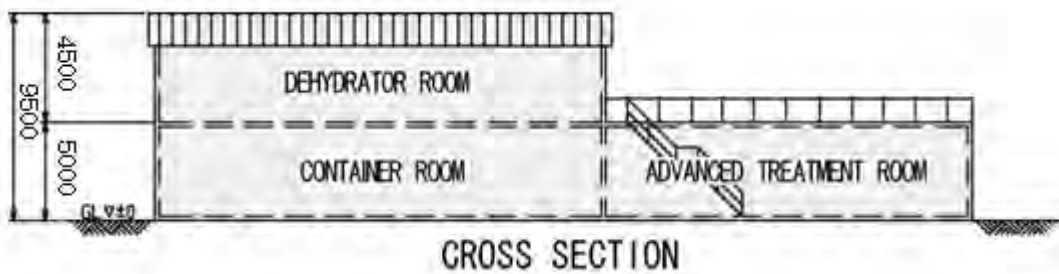


Figure 6-24 Cross Section

6.4 Project Implementation Plan

6.4.1 Sorting

(1) Construction

This facility should be constructed economically and safety based on design concept. Therefore, we need to plan with regarding site condition and the progress of the construction. In addition, we need keep applicable laws and regulations in construction.

(2) Construction management plan

Work Process Plan

Prior to start of the construction, make a work process plan and arrange it to a progress schedule. The work process plan makes a week or a monthly progress schedule for every works, and it is important to assume the detailed examination with the network process.

General Construction Plan

Prior to start of the construction, we need to make the general construction plan. The construction plan needs to gather up about a procedure and a method of construction as follows. (It's need to revise by contents of the construction appropriately.)

| | |
|---|--|
| 1. Construction summary | 8. Construction management plan |
| 2. Plan progress schedule | 9. The emergency system and correspondence |
| 3. The site organization system | 10. Traffic management |
| 4. Safety management | 11. Environmental measures |
| 5. Designated machine | 12. Maintenance of the site work environment |
| 6. Main material | 13. Industrial waste disposal method |
| 7. Construction method (Include a main machine, a temporary plan, a construction site) | |

In addition, the construction plan should be enough considered each time schedule of engineering works, building works, machinery production, installation construction, electricity construction, other construction. And we should plan with considering of the condition of construction, and the plan should be safety and economical.

Construction contents in sorting facility

- Machinery apparatus installation
- The piping, duct work
- Electric instrumentation work

Each equipments should be manufactured by based on the design document in a factory and transported to site and installed. The method of movement and installation in indoor should be selected such as the hang crane or the roller pull. It should be considered carefully, should not damage each equipments in transfer and installation.

In addition, temporary works, site assembling, welding and painting should be worked out according to the design document. The equipments must be run without trouble.

Construction schedule (plan)

The sorting process is shown in the figure below with color.

WORK SCHEDULE FOR THE SORTING FACILITY BUILDING CONSTRUCTION
NAMBO SOLID WASTE MANGEMENT PLANT, WEST JAVA , INDONESIA

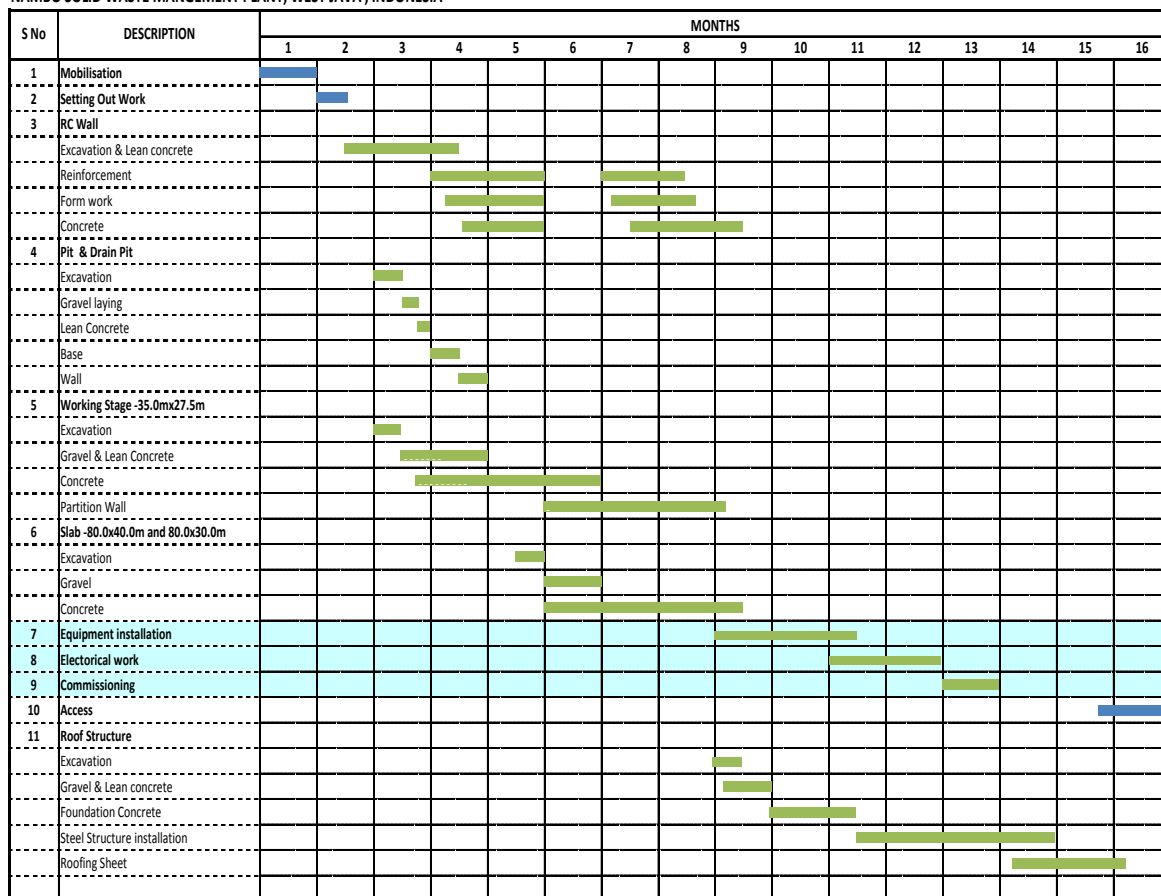


Figure 6-25 Construction schedule (plan) for sorting facility

[Sorting Building]

(1) Introduction

This method statement describes the procedures for Sorting Building Construction Works. The Sorting building consists of a receiving facility, sorting facility, transport facility, storage yard, dust collection facility and common facility. Some facilities will be covered by roof structure. The major items and construction schedule as shown below.

(2) Major Items

The major item civil works for the construction of Sorting Facility building includes the following items:

- Foundation for ingress access road, receiving yard and storage yard
- Retaining wall for the receiving yard and storage yard.
- Working platform.
- Transfer pit and drainage pit.
- Equipment installation.
- Electrical work.
- Access road.
- Steel roof structure.

(3) Program

| S No | DESCRIPTION | MONTHS | | | | | | | | | | | | | | | |
|---------------|---------------------------------|--------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 1 | Mobilisation | █ | | | | | | | | | | | | | | | |
| 2 | Setting Out Work | | █ | | | | | | | | | | | | | | |
| 3 | RC Wall | | | | | | | | | | | | | | | | |
| | Excavation & Lean concrete | | | █ | █ | █ | █ | | | | | | | | | | |
| | Reinforcement | | | | █ | █ | █ | █ | | | | | | | | | |
| | Form work | | | | █ | █ | █ | █ | | | | | | | | | |
| 4 | Pit & Drain Pit | | | | | | | | | | | | | | | | |
| | Excavation | | | █ | █ | | | | | | | | | | | | |
| | Gravel laying | | | █ | █ | | | | | | | | | | | | |
| | Lean Concrete | | | █ | █ | | | | | | | | | | | | |
| 5 | Working Stage -35.0m x 27.5m | | | | | | | | | | | | | | | | |
| | Excavation | | | █ | █ | | | | | | | | | | | | |
| | Gravel & Lean Concrete | | | █ | █ | █ | █ | █ | █ | | | | | | | | |
| | Concrete | | | █ | █ | █ | █ | █ | █ | | | | | | | | |
| 6 | Slab -80.0x40.0m and 80.0x30.0m | | | | | | | | | | | | | | | | |
| | Excavation | | | | | █ | █ | | | | | | | | | | |
| | Gravel | | | | | █ | █ | █ | █ | | | | | | | | |
| | Concrete | | | | | █ | █ | █ | █ | █ | | | | | | | |
| 7 | Equipment installation | | | | | | | | | █ | █ | █ | █ | █ | | | |
| 8 | Electrical work | | | | | | | | | | █ | █ | █ | █ | █ | | |
| 9 | Commissioning | | | | | | | | | | | | | | | | |
| 10 | Access | | | | | | | | | | | | | | | | |
| 11 | Roof Structure | | | | | | | | | | | | | | | | |
| | Excavation | | | | | | | | | █ | █ | | | | | | |
| | Gravel & Lean concrete | | | | | | | | | █ | █ | █ | █ | █ | █ | █ | █ |
| | Foundation Concrete | | | | | | | | | █ | █ | █ | █ | █ | █ | █ | █ |
| | Steel Structure installation | | | | | | | | | | █ | █ | █ | █ | █ | █ | █ |
| Roofing Sheet | | | | | | | | | | | | | | | | | |

Figure 6-26 Schedule Plan Sorting Building

(4) Layout Plan and Sections

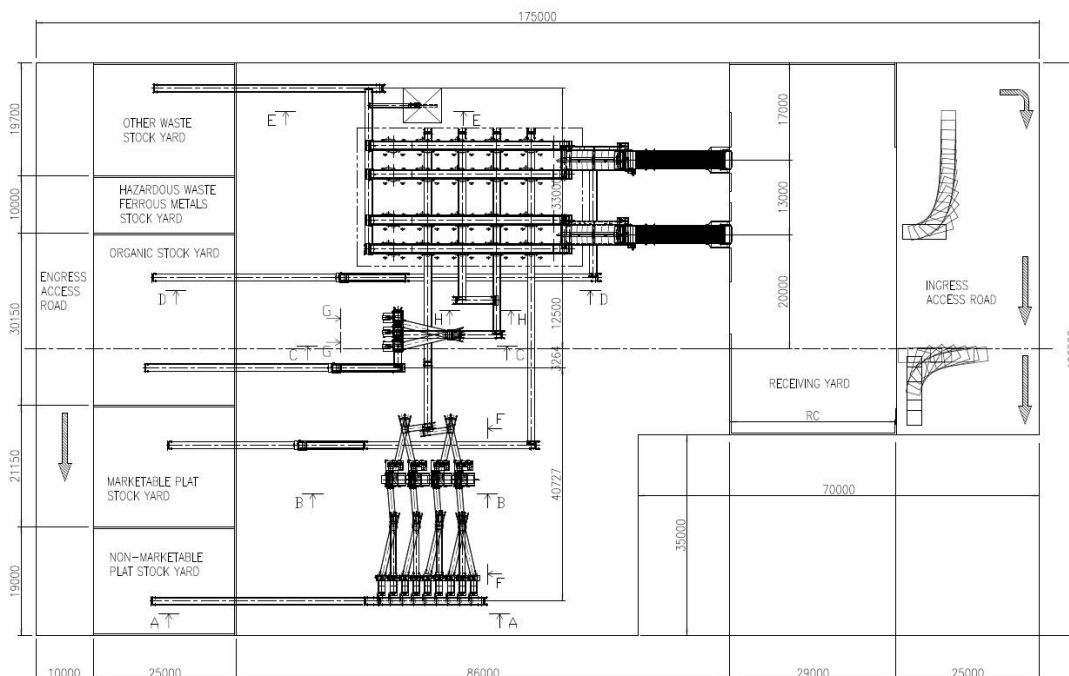


Figure 6-27 Plan

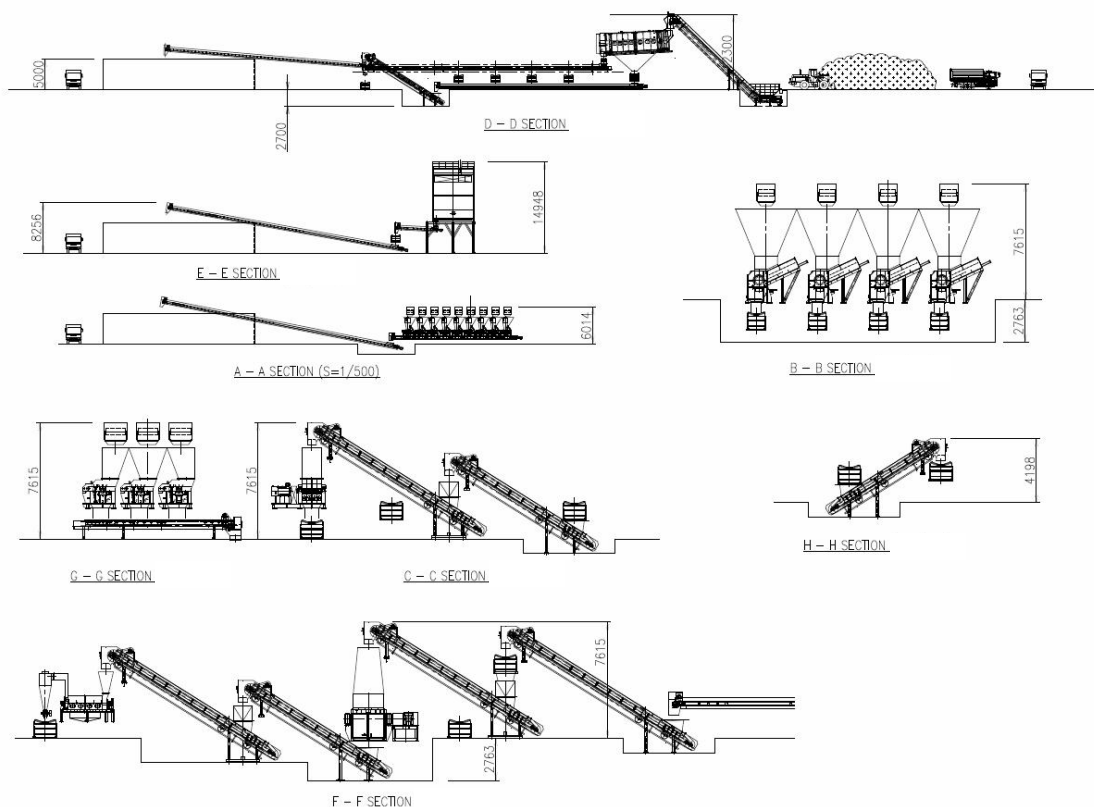


Figure 6-28 Section

[Other Facilities Related to Sorting]

(1) Construction Period

This facility should be constructed economically and safety based on design concept. Therefore, we need to plan with regarding site condition and the progress of the construction. In addition, we need keep applicable laws and regulations in construction.

(2) Construction Period

Work Process Plan

Prior to start of the construction, make a work process plan and arrange it to a progress schedule. The work process plan makes a week or a monthly progress schedule for every works, and it is important to assume the detailed examination with the network process.

General Construction Plan

Prior to start of the construction, we need to make the general construction plan. The construction plan needs to gather up about a procedure and a method of construction as follows. (It's need to revise by contents of the construction appropriately.)

| | |
|---|--|
| 1. Construction summary | 8. Construction management plan |
| 2. Plan progress schedule | 9. The emergency system and correspondence |
| 3. The site organization system | 10. Traffic management |
| 4. Safety management | 11. Environmental measures |
| 5. Designated machine | 12. Maintenance of the site work environment |
| 6. Main material | 13. Industrial waste disposal method |
| 7. Construction method (Include a main machine, a temporary plan, a construction site) | |

In addition, the construction plan should be enough considered each time schedule of engineering works, building works, machinery production, installation construction, electricity construction, other construction. And we should plan with considering of the condition of construction, and the plan should be safety and economical.

Construction Contents in Sorting Facility

- Machinery apparatus installation
- The piping, duct work
- Electric instrumentation work

Equipments should be manufactured by based on the design document in a factory and transported to site and installed. The method of movement and installation in indoor should be selected such as the hang crane or the roller pull. It should be considered carefully, should not damage equipments in transfer and installation.

In addition, temporary works, site assembling, welding and painting should be worked out according to the design document. The equipments must be run without trouble.

Construction Schedule (plan)

The sorting process is shown below with color.

WORK SCHEDULE FOR THE SORTING FACILITY BUILDING CONSTRUCTION

NAMBO SOLID WASTE MANGEMENT PLANT, WEST JAVA , INDONESIA

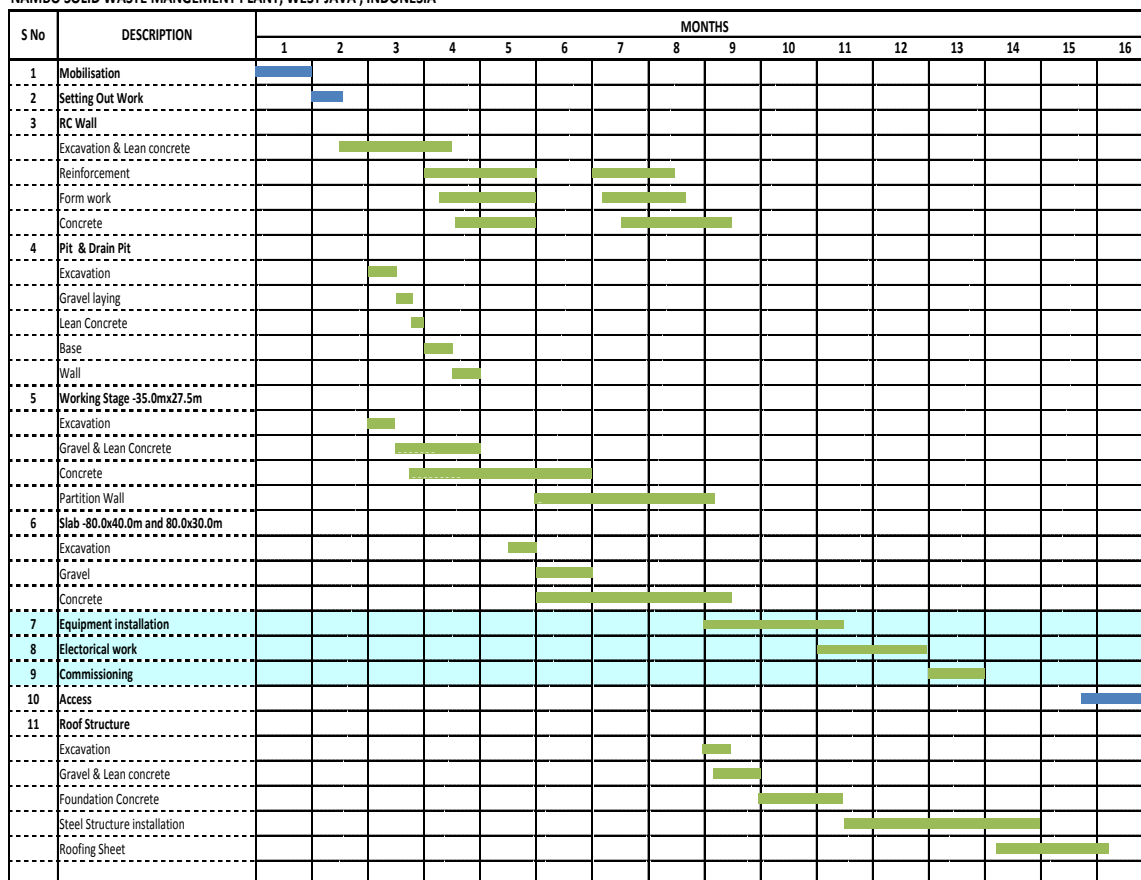


Figure 6-29 Schedule Plan Sorting Facilities

6.4.2 Compost

(1) Construction Events

- 1) Drainage
- 2) Base Foundation
- 3) Base Slab
- 4) Building

(2) Construction Period

The construction of the compost hall begins with drainage after completion of earth work of the site and proceeds to base foundation, base slab, and building. The construction period from the drainage to the building is one and half year.

6.4.3 Sanitary Landfill

(1) Outline

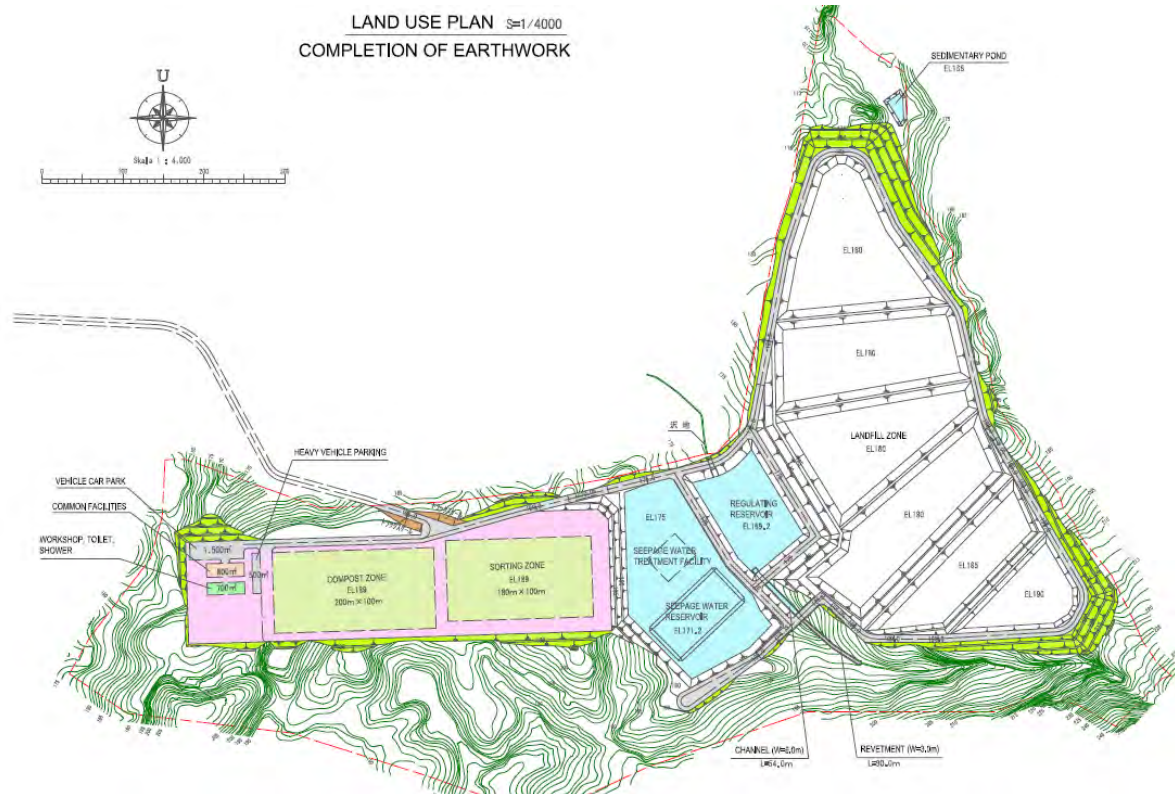


Figure 6-30 Plan of Site Formation

1-1 Outline of the Works

Table 6-8 Outline of Facilities

| | |
|--|---|
| Area for Development | 40 ha |
| Area for FDS | 10.4ha |
| Capacity for Disposal | 1,730,000 m ³ (Total Capacity 2,700,000 m ³) |
| Daily Reception Volume and usable years | Daily Reception Volume=288 m ³ /day, Usable Volume=16.7 years |
| Structural Detail | |
| Land Development | Cutting and filling volumes: (Cutting Volume 1,510,000m ³ , Filling Volume 540,000 m ³ (Balance volumes will be stocked temporary at adjoining land for future covering soil. |
| Slope Gradient | Slope Gradient for Cutting: 1:1.8~1.2, Slope Gradient for Filling: 1:2.0, Slope which will be not touched with disposal materials, will be protected by sodding. |
| Sealing Structure | Bottom (Seepage Control Sheet (HDPE Sheet, t=1.5 mm) 2 Layers + Protective Sheet (Short-fiber nonwoven fabric, t=10 mm) 3 Layers. Dual Seepage Control Sheet structure and Protective soil Layer t=50 cm. Slope (Seepage Control Sheet (HDPE Sheet, t=1.5 mm) 2 Layers + Protective Sheet (Short-fiber nonwoven fabric, t=10 mm) 2 Layers + Protective Sheet (Long-fiber nonwoven fabric, t=4.5 mm) 1 Layers. Dual Seepage Control Sheet structure. The surface of cutting slope will be smooth using gunite-shooting. The surface of Dual Seepage Control Sheet structure will be covered by 50cm protective soil Layer before spreading disposal materials. |
| Rainwater Drainage Facilities | For the sake of protecting downstream from bad influence, rainwater from the adjacent basin, roads and slopes within the Site, is collected through U-shape ditch which is provided at appropriate location, finally is directed to the Protection Regulatory Reservoir through Rain water collection sumps. Trunk ditch: U-600~1,200, 5,477m, Branch ditches: U-500~300, 2,843 m, Drainage pipe for Slope: φ 400~150, 233m, Drainage pipe for the Area which is not yet covered by disposed materials: φ 600~300, 414 m, Connecting pit etc... Protection Regulating Reservoir: Total Volume 71,300 m ³ , Accretion Sand Volume 6,300 m ³ , Possible Regulation Volume 46,400 m ³ |
| Groundwater Collecting and Drainage Facilities | For the sake of attaining the safe and smooth construction work through preventing the damage of Sealing Structure due to swelling by uplift of ground water pressure, locate the groundwater collecting drainage pipes. Corrected groundwater is guided to Protection Regulating Reservoir. Trunk lines: High-density polyethylene Dual structural porous pipe, φ 200-3,566 m. Branch lines: High-density polyethylene Dual structural porous pipe, φ 200-3,566 m. φ 150=3,892 m, porous mat 591 m, Pipe 53 m Groundwater Monitoring Facilities : 2 Groundwater Monitoring Facilities are provided to routinely measure the required environmental monitoring items of the groundwater. |
| Leachate Collection and Drainage Facilities | For the sake of releasing all the Leachate to outside of the Landfill Site as rapidly as possible to Leachate Regulating Reservoir, locate the Leachate Collection and Drainage Facilities. Trunk lines: High-density polyethylene Dual structural porous pipe, φ 700~400-730 m. Branch lines: High-density polyethylene Dual structural porous pipe, φ 200-6,396 m. Leachate Regulating Reservoir: Regulating Volume 17,201 m ³ , Bottom and Slope will be covered by Concrete plate/Slab (t=15 cm)+Seepage Control Sheet (HDPE Sheet, t=1.5 mm) 1 Layers + Protective Sheet (Short-fiber nonwoven fabric, t=10 mm) 2 Layers. |
| Gas Discharge Treatment Facilities | For the sake of discharging gas rapidly delivered from the filled waste. This facilities works not only for gas discharging but also air supply to the filling site to expand the Semi-aerobic area. Vertical Gas Discharge pipes: 64 locations, Gas Discharge pipes on slope area: φ 200-311 m |
| Other Facilities | Shatter Proofing Facilities, Gate etc.. |

1-2 Bill of Materials

Table 6-9 Bill of Works/Materials

| ITEM | | Specification | Quantity | Unit |
|--------------------------------------|--|---|-----------|------|
| Earth Work | | | | |
| | Excavation | Cutting area including grubbing, cleaning and disposal Weathered rock (20%) | 1,506,600 | m3 |
| | Loading & transportation | Loading soil, transportation 0.5~1.0km, temporary stocking | 538,000 | m3 |
| | Embankment | Embankment area including grubbing, cleaning and disposal Transportation from temporary stock yard in the Site, Spreading and compacting | 538,000 | m3 |
| | Loading, Transportation & Temporary stocking | Balance soil will be stocked temporary at adjoining land. | 968,600 | m3 |
| | Cutting Slope trimming | Trimming by Machine | 37,800 | m2 |
| | Embankment Slope Trimming | Trimming by Machine | 56,900 | m2 |
| | Planting for Slope | Cutting/Filling slope without Seepage Control Sheet. Leaf mould t=15 cm + Seeding | 44,500 | m2 |
| Sealing Structure | | | | |
| | Fixing sealing sheet | fixing points for edge of Sealing Sheet Upside-down trapezoid(0.35-0.7,H0.5) | 2,708 | m |
| | Seepage Control Sheet (Bottom) | Dual Seepage Control Sheet Structure | 94,817 | m2 |
| | Seepage Control Sheet (Slope) | Dual Seepage Control Sheet Structure | 45,380 | m2 |
| | Protective Soil Layer (Bottom) | Use original ground soil, t=50cm | 94,817 | m2 |
| | Protection Layer for Sheet (Slope) | Cutting slope . Mortar t=10 cm | 45,380 | m2 |
| | Protective Soil Layer (Top) | Use original ground soil, t=50cm | 87,863 | m2 |
| | Concrete slab for Leachate Reservoir Pond | Bottom and slope of Leachate Reservoir Pond(t=15 cm) | 6,954 | m2 |
| Rain Water Drainage System | | | | |
| | Correcting pit | Concrete Structure | 1 | Lot |
| | U-Ditch (outskirt) | Trunk ditch: U-600~1,200, Branch ditches: U-500~300. Drainage pipe for Slope: ϕ 400~150 | 8,553 | m |
| | Pipe for the Area which is not yet covered by disposed materials | ϕ 600~300 | 414 | m |
| | Canal for downstream | Culvert, Revetment (if necessary) | 174 | m |
| | Embankment for Protection Regulating Reservoir | Including soil work | 0 | m3 |
| Groundwater correcting System | | | | |
| | Groundwater correcting pipe/pit | Groundwater correcting pipe (Trunk line: ϕ 200-3,566 m, Branch line: ϕ 150-3,892 m) | 8,102 | m |
| | Groundwater Monitoring Facility | Groundwater Monitoring Well and Shed | 1 | 式 |
| Leachate Drainage System | | | | |
| | Correcting pit | Concrete Structure | 1 | Lot |
| | Leachate correcting Pipe (Trunk) | Trunk Line ϕ 400~700 PE Pipe | 730 | m |
| | Leachate correcting Pipe (branch) | Branch Line ϕ 200 (High-density polyethylene Dual structural Porous Pipe) | 6,396 | m |
| | Ventilation Pipe (Slope) | polyethylene Porous Pipe, ϕ 200(20 m interval: High-density polyethylene Dual structural Porous Pipe) | 311 | m |
| | Ventilation Pipe (Vertical) | Polyvinyl chloride Pipe, ϕ 300(40 m interval) | 62 | nos. |
| Temporary Work | | | | |
| | Temporary Facilities | | 1 | Lot |
| | Temporary Access Road | | 1 | Lot |
| | Temporary Drainage System | | 1 | Lot |

1-3 Soil Investigation

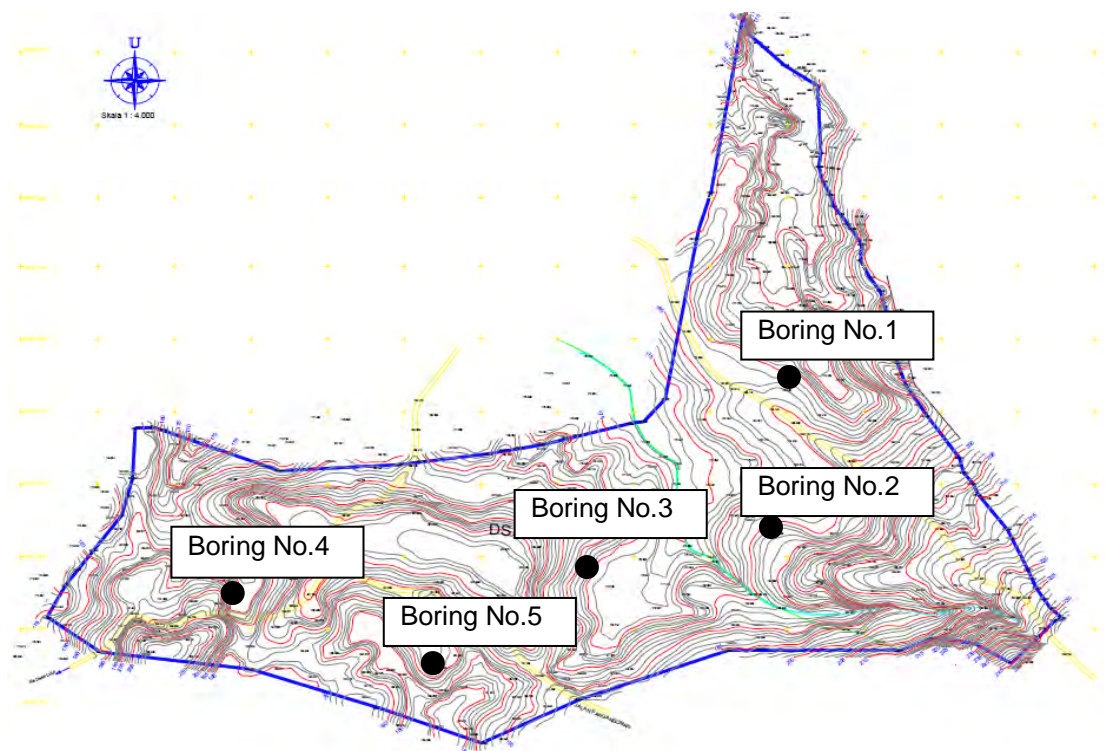


Figure 6-31 Location of Boring Test

Table 6-10 Result of Field Permeability Test

| Depth (m) | BH-1 | BH-2 | BH-3 | BH-4 | BH-5 | BH-6 | BH-7 |
|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 0.50 - 5.50 | CH 7.083E-05 | FH 1.141E-04 | FH 1.339E-05 | CH 2.880E-04 | FH 2.715E-05 | CH 9.897E-05 | FH 7.066E-05 |
| 5.50 - 10.50 | FH 5.108E-05 | FH 4.470E-06 | FH 1.752E-06 | CH 1.194E-04 | CH 4.939E-06 | FH 3.598E-05 | FH 6.152E-05 |
| 10.50 - 15.50 | FH 2.496E-05 | - | FH 3.806E-06 | CH 1.509E-04 | FH 7.515E-06 | FH 4.453E-05 | FH 3.138E-05 |
| 15.50 - 20.50 | FH 8.789E-06 | CH 5.763E-06 | FH 1.579E-06 | CH 1.628E-04 | FH 9.856E-06 | FH 1.586E-05 | FH 2.032E-05 |
| 20.50 - 25.50 | FH 5.073E-06 | CH 9.917E-06 | FH 3.849E-06 | CH 9.392E-05 | FH 4.423E-06 | FH 2.685E-05 | FH 1.309E-05 |
| 25.50 - 30.00 | FH 4.678E-06 | CH 6.032E-06 | FH 1.897E-06 | CH 8.756E-05 | FH 4.117E-06 | FH 1.185E-05 | FH 1.123E-05 |

Table 6-11 Resume of Laboratory Test Result

| No | BORE HOLE | DEPTH (meter) | TYPE SOIL | CLASSIFICATION | Index Properties | | | | | | | | | | | | | Engineering Properties | | | | | | | | | |
|----|-----------|---------------|-----------|----------------|---|----------------|----------------|------------|----------|------------------|----------------|------------------|------|------|---------------|-----------|-----------|------------------------|-----------|-----------|------------|-----------|-----------|--------------------|-----------|---------|---|
| | | | | | Determination of dry density & moisture content | | | | | SPECIFIC GRAVITY | | ATTERBERG LIMITS | | | FLUID CONTENT | | | TRIAXIAL TEST | | | UNCONFINED | | | CONSOLIDATION TEST | | | |
| | | | | | w | w _p | w _L | Void Ratio | Porosity | G | G _s | WL | WP | PL | SHRINKAGE | SHRINKAGE | SHRINKAGE | SHRINKAGE | SHRINKAGE | SHRINKAGE | SHRINKAGE | SHRINKAGE | SHRINKAGE | SHRINKAGE | SHRINKAGE | | |
| | | | | | (%) | (%) | (%) | | (%) | | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | |
| 1 | BH-1 | 2.00 - 2.50 | UDS | CH | 42.7 | 1.70 | 1.19 | 1.19 | 0.54 | 93.3 | 2.61 | 69.2 | 33.1 | 36.1 | 0.0 | 11.8 | 40.2 | 48.0 | 88.2 | 6.06 | 0.99 | 0.93 | 0.77 | 1.21 | 0.35 | 3.0E-03 | |
| 2 | | 7.00 - 7.50 | DS | CH | 19.2 | - | - | - | - | - | 2.63 | NP | NP | NP | 0.0 | 19.2 | 35.7 | 45.0 | 80.7 | - | - | - | - | - | - | - | |
| 3 | | 11.50 - 12.00 | DS | CH | 9.2 | - | - | - | - | - | - | NP | NP | NP | - | - | - | - | - | - | - | - | - | - | - | - | |
| 4 | BH-2 | 1.00 - 1.50 | UDS | CH | 39.6 | 1.67 | 1.20 | 1.17 | 0.54 | 88.0 | 2.60 | 84.9 | 37.2 | 32.7 | 0.0 | 15.4 | 40.0 | 44.7 | 84.7 | 13.08 | 0.52 | 0.83 | 0.69 | 1.20 | 0.41 | 3.7E-03 | |
| 5 | | 7.00 - 7.50 | DS | CH | 18.4 | - | - | - | - | - | - | NP | NP | NP | - | - | - | - | - | - | - | - | - | - | - | - | |
| 6 | | 11.50 - 12.00 | DS | CH | 12.2 | - | - | - | - | - | - | NP | NP | NP | - | - | - | - | - | - | - | - | - | - | - | - | |
| 7 | BH-3 | 2.50 - 3.00 | UDS | SP | 44.9 | 1.64 | 1.14 | 1.10 | 0.57 | 90.5 | 2.62 | 73.3 | 34.1 | NP | 0.0 | 12.5 | 41.0 | 46.5 | 87.5 | 0.49 | 12.34 | 0.75 | 0.63 | 1.19 | 0.44 | 3.2E-03 | |
| 8 | | 7.00 - 7.50 | DS | CH | 35.2 | - | - | - | - | - | 2.61 | 83.8 | 31.4 | 32.4 | 0.0 | 10.0 | 41.3 | 48.7 | 90.6 | - | - | - | - | - | - | - | - |
| 9 | | 11.50 - 12.00 | DS | SP | 22.2 | - | - | - | - | - | - | NP | NP | NP | - | - | - | - | - | - | - | - | - | - | - | - | |
| 10 | BH-4 | 2.00 - 2.50 | UDS | CH | 45.3 | 1.61 | 1.10 | 1.17 | 0.58 | 88.1 | 2.61 | 89.0 | 31.1 | 37.8 | 0.0 | 13.4 | 39.3 | 45.4 | 84.7 | 7.62 | 0.76 | 1.23 | 1.13 | 1.08 | 0.48 | 2.6E-03 | |
| 11 | | 7.00 - 7.50 | DS | SP | 33.1 | - | - | - | - | - | 2.63 | 76.0 | 32.2 | NP | 8.0 | 9.7 | 41.7 | 40.6 | 82.1 | - | - | - | - | - | - | - | - |
| 12 | | 11.50 - 12.00 | DS | CH | 28.1 | - | - | - | - | - | 2.62 | 72.0 | 34.1 | 37.9 | 0.0 | 11.9 | 41.2 | 46.9 | 88.1 | - | - | - | - | - | - | - | - |
| 13 | BH-5 | 2.50 - 3.00 | UDS | SP | 44.1 | 1.63 | 1.13 | 1.11 | 0.57 | 88.1 | 2.62 | 92.8 | 30.2 | NP | 0.0 | 14.7 | 39.3 | 46.0 | 85.2 | 6.83 | 0.65 | 1.04 | 0.92 | 1.13 | 0.46 | 3.0E-03 | |
| 14 | | 7.00 - 7.50 | DS | CH | 8.6 | - | - | - | - | - | - | NP | NP | NP | - | - | - | - | - | - | - | - | - | - | - | - | |
| 15 | | 11.50 - 12.00 | DS | SP | 7.4 | - | - | - | - | - | - | NP | NP | NP | - | - | - | - | - | - | - | - | - | - | - | - | |
| 16 | BH-6 | 2.00 - 2.50 | UDS | CH | 49.1 | 1.56 | 1.05 | 1.08 | 0.60 | 86.1 | 2.60 | 91.9 | 30.1 | 33.8 | 0.0 | 8.7 | 39.9 | 41.4 | 91.6 | 6.28 | 0.36 | 0.58 | 0.46 | 1.26 | 0.43 | 3.6E-03 | |
| 17 | | 7.00 - 7.50 | DS | CH | 29.1 | - | - | - | - | - | 2.62 | 84.7 | 32.3 | 32.2 | 0.0 | 9.1 | 40.7 | 50.2 | 90.9 | - | - | - | - | - | - | - | - |
| 18 | | 11.50 - 12.00 | DS | CH | 21.7 | - | - | - | - | - | 2.63 | 76.7 | 32.7 | 44.0 | 0.0 | 13.0 | 38.5 | 48.6 | 87.0 | - | - | - | - | - | - | - | - |
| 19 | BH-7 | 2.00 - 2.50 | UDS | CH | 52.2 | 1.57 | 1.03 | 1.14 | 0.61 | 88.7 | 2.61 | 92.4 | 30.2 | 61.2 | 0.0 | 15.9 | 37.1 | 47.0 | 84.1 | 8.34 | 0.22 | 0.38 | 0.32 | 1.20 | 0.48 | 3.6E-03 | |
| 20 | | 7.00 - 7.50 | DS | CH | 13.1 | - | - | - | - | - | - | NP | NP | NP | - | - | - | - | - | - | - | - | - | - | - | - | |
| 21 | | 11.50 - 12.00 | DS | CH | 8.3 | - | - | - | - | - | - | NP | NP | NP | - | - | - | - | - | - | - | - | - | - | - | - | |

Boring Log

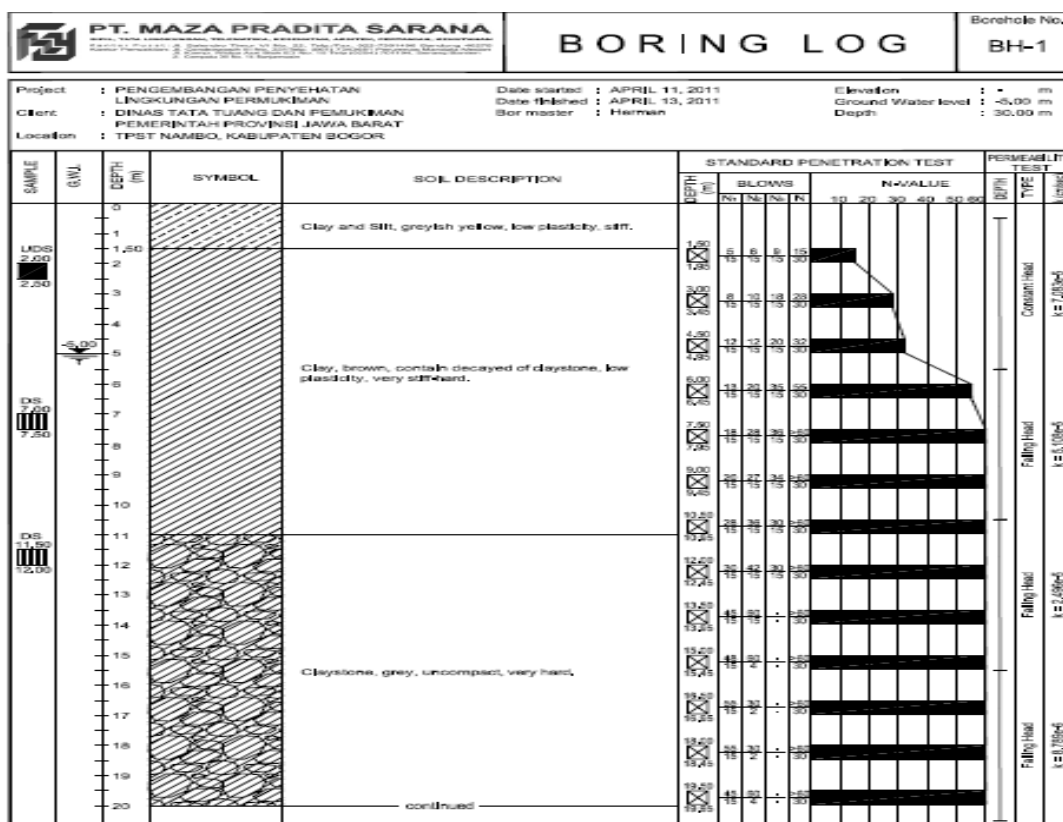


Figure 6-32 BH-1

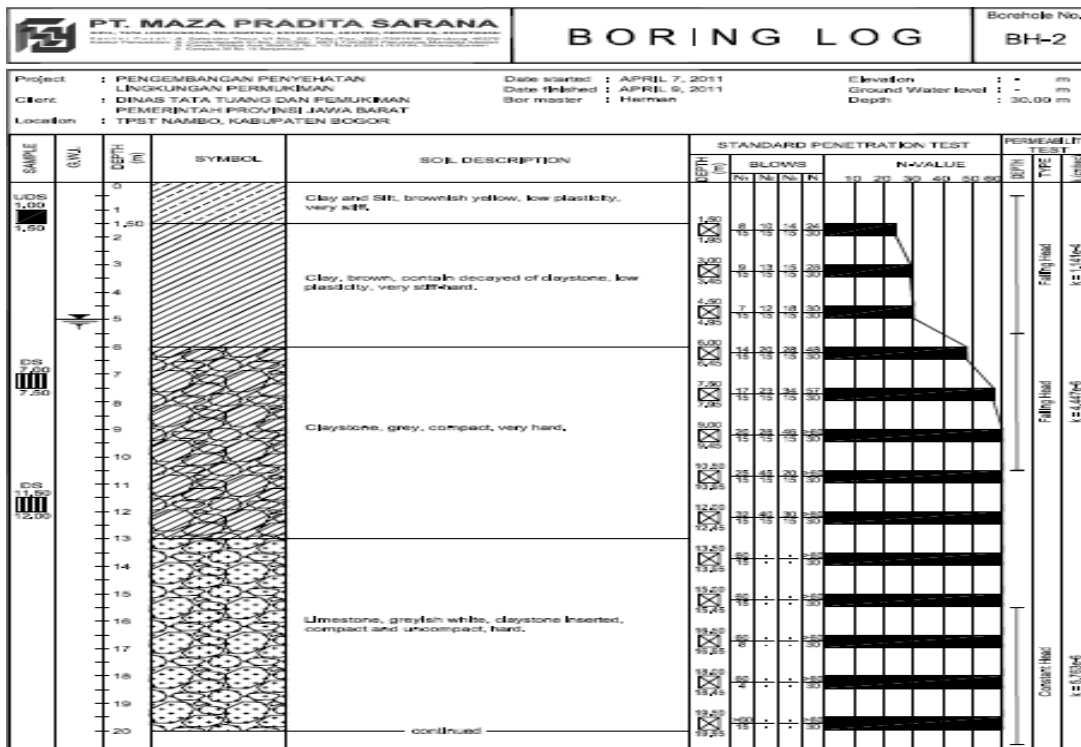


Figure 6-33 BH-2

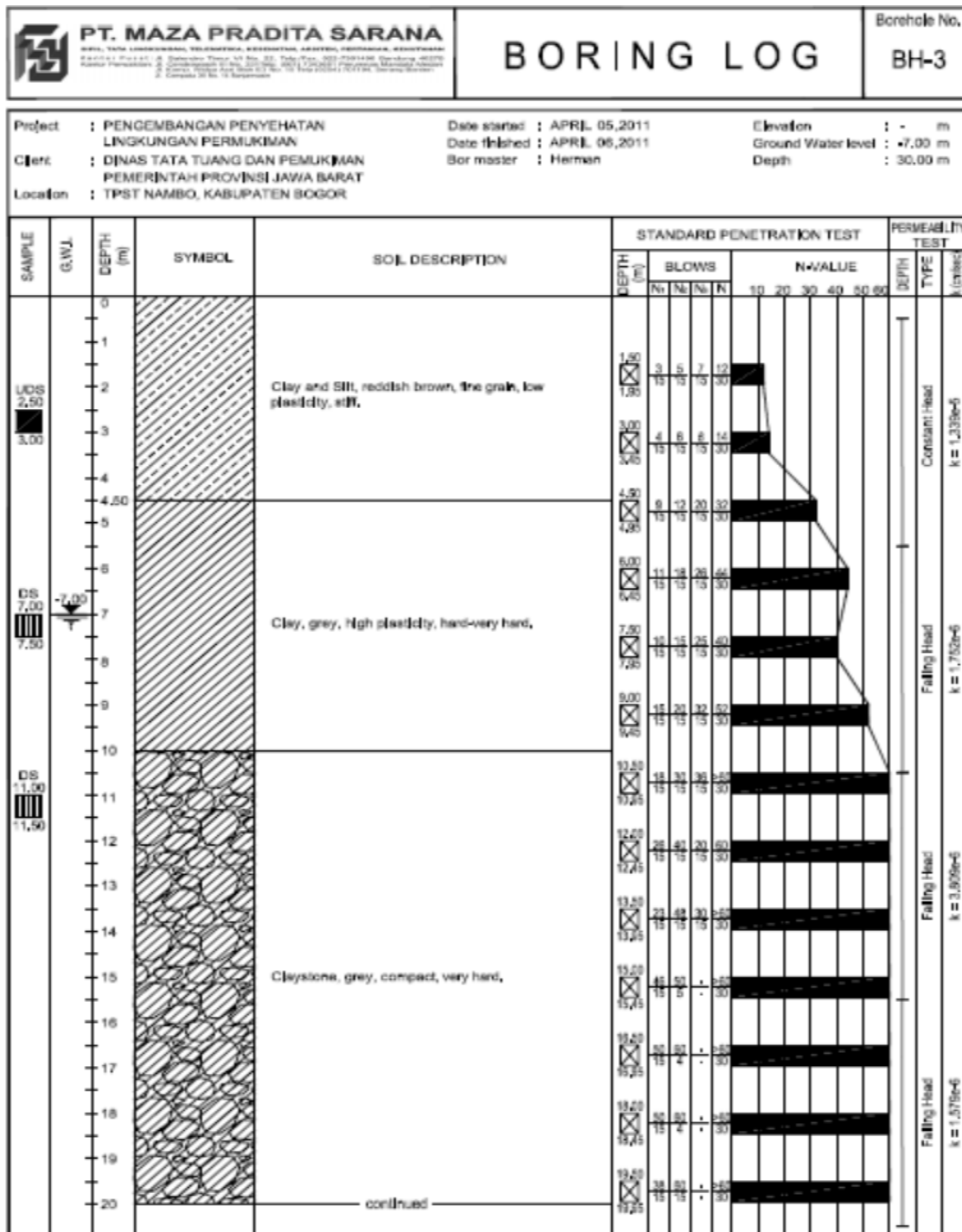


Figure 6-34 BH-3

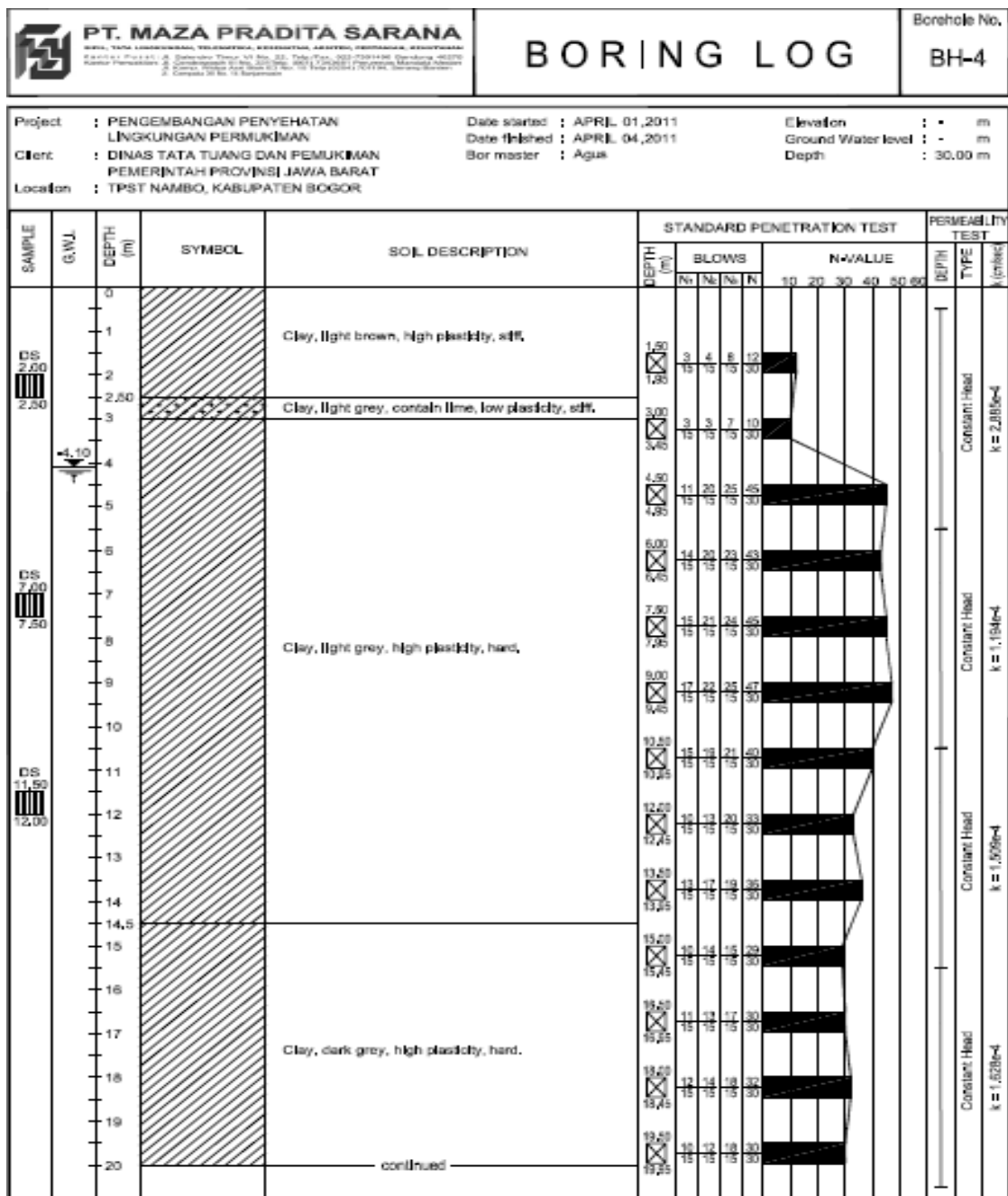


Figure 6-35 BH-4

(3) Safety Management

- 3-1 Priority shall be set to safety during execution of the works. A safety management plan and a safety management organization shall be established for the consent of the Engineer prior to commencement of the works. A safety officer and members of the safety committee will carry out site safety inspection periodically, i.e. daily as a tool box meeting, weekly and monthly for the sake of confirming the safe execution of the works and respond appropriately once a nonconforming matter is observed.
- 3-2 Thorough countermeasures shall be provided to avoid accidents regarding plants, equipment, temporary facilities and traffic accidents during execution of the works. Safety training will be provided to workers to increase safety awareness of them so as to prevent accidents derived from unawareness.
- 3-3 Particular safety concerns in regard with construction of the treatment facility are as follows:
1. Falling accidents at open holes, edge of structures or slope areas.
 2. Accidents related to heavy equipment such as collision, being caught, mobile crane's turning over, dropping down of lifted material, etc.
 3. Collapse or turning over of ground or excavated slope.
 4. Accidents involving a third party due to heavy equipment operating outside the site premises.
 5. Health difficulties among aged or latent deficient people.
- Health and safety management plan will be prepared to be approved by the Engineer prior to commencement of the works to prevent occurrence of the above matters.
- 3-4 Identification of concerning falling accident areas such as open holes, edge of structures, slope areas, etc. and providing safety measures such as handrails, indication of open holes, safety ropes and safety belt usage will be provided and maintained together with appropriate instructions as countermeasures against the issue described above in 3.3.1.
- 3-5 Confirmation of supervision hierarchy, installation of keeping off device & collision prevention facility, confirmation of standards in keeping off of safety protection key, and strict banning of equipment operators' absence from the operating box while the engine is on, etc. will be instructed and carried out against the issue described above in 3.3.2.
- 3-6 Pre-job inspection toward excavating slope, strict banning of people entering into excavating area, establishment of instruction hierarchy and emergency case organization, etc. will be instructed and implemented against the issue described above in 3.3.3.
- 3-7 Planning and implementation of absolutely safe driving outside the site premises, thorough training for drivers, providing traffic controllers, etc. will be instructed and carried out against the issue described above in 3.3.4.
- 3.8 Instruction and confirmation of suitable assignment of aged or latent deficient people, thorough countermeasures against heat stroke, etc. will be instructed and carried out against the issue described above in 3.3.5.

(4) Quality Control

- 4-1 A quality control management plan will be established conforming to the requirements of the Specification prior to commencement of the works for the Engineer's approval

4-2 Based on the approved quality control management plan, requests for approvals of material, design, etc. will be submitted to the Engineer within the time specified in the Specification. Each work will start following the approval.

4-3 Passing of tests and inspection specified in the Specification under attendance of the Engineer shall be required during execution stage. Those concrete and other works that are covered or visually hindered from outside when completed shall be carried out under attendance of the Engineer.

4-4 Strict quality control is particularly required for execution of the water sealing work which is the most important function of the treatment facility.

(5) Schedule Control

5-1 Overall integrated progress management will be carried out based on the network progress program sheet.

5-2 Weekly and monthly programs will be established. Thorough coordination will be made among various sub-contractors, material suppliers, etc. using these programs so as to confirm maintainability and appropriateness of the progress. Moreover, coordination with the Engineer will be made in regard with the overall work progress so as the works will be completed without delay.

(6) Summary of Construction Method

6-1 Site Development

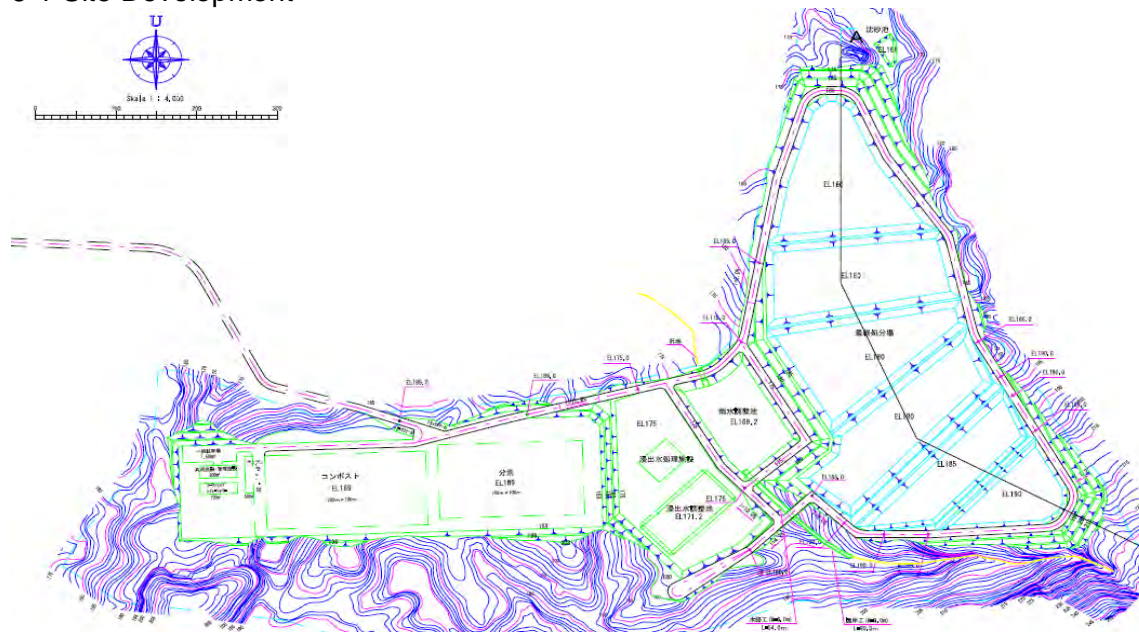


Figure 6-38 Site Formation Plan

| | |
|-------------------------|---|
| 1. Survey | <ol style="list-style-type: none"> 1. Confirmation of the site premises boundary and felling area 2. Acquisition of the Engineer's approval |
| 2. Felling and Grubbing | <ol style="list-style-type: none"> 1. Following the confirmation of site premises boundary, felling area will be indicated using tape, etc. The felling work will be carried out after confirmation by the Engineer. 2. Felling and grubbing will be thoroughly and neatly executed so no remaining roots, etc. shall obstacle the sealing works. 3. The initial felling will be carefully executed at the area within approx. 2m line from the boundary so as to avoid sequential falling down of trees due to strong wind or collapse of the slope, etc. 4. Trees, leaves, roots, grasses and other rubbish will be suitably treated based on the instruction of the Engineer. |
| 3. Temporary Work | <ol style="list-style-type: none"> 1. Temporary Drainage <ol style="list-style-type: none"> (1) Temporary drainage will be provided so as not to hinder the upstream water flow for the period between start of the felling work and completion of the main trunk drainage. (2) The temporary drainage will be made of pipes and channels using corrugate pipes, etc. to be installed suitably for site conditions maintaining thorough flowing capacity. Changing over of drainage will be made based on earthwork progress. (3) Safety device such as screen will be provided on the inflow mouth so as to prevent any person, especially local children, from dropping into the mouth. (4) Temporary sedimentation ponds will be provided so as to prevent turbid water from flowing into downstream rivers during rains. Sediment in the ponds will be periodically dredged using small backhoe, etc. 2. Temporary Roads <ol style="list-style-type: none"> (1) The surplus excavated material will be used for sub-base of the temporary roads as much as possible. (2) Design of the temporary roads will be carried out maintaining safety grade of slope to prevent traffic accidents during the works. Crushed stone will be spread over the surface of the roads to maintain vehicles' trafficability and prevent slipping accidents during rain. (3) Temporary roads will be diverted occasionally based on the progress of the earthwork. Drainage pipe will be installed for ravine area if needed to prevent water ponding at upper stream side. 3. Other Temporary Facilities <ol style="list-style-type: none"> (1) As for other temporary facilities such as temporary office, substations, water supplying facilities, etc., their structural design and construction method will be established based on careful site investigation and the Engineer's approvals. (2) As for temporary safety facilities such as sedimentation ponds, timber made channel, pedestrian walkways, etc., their structure shall be firm from safety viewpoint, derived through consultation with the Engineer. Necessary reinforcement works will be provided and thorough maintenance will be provided. (3) Thorough consideration will be paid and necessary facilities will be provided especially for the safety of local residents. Meetings with local residents will be held under the Engineer's consent to explain the works and latent dangers and to let them understand those dangers. |
| 4. Earthwork | <ol style="list-style-type: none"> 1. Cutting Work <ol style="list-style-type: none"> (1) Total cutting volume of Nambo area treatment facility construction work is approx. 1,510,000 m³ of which 540,000 m³ will be used as filling material for the site development works and the rest of the material, i.e. 970,000 m³ will be temporarily stocked at adjacent development area, 600,000 m², to be used later as material of covering, small banking, etc. (2) Cutting work will be carried out based on the design drawings, using |
| Cutting Work | |
| Filling Work | |

| | |
|-----------------------------------|--|
| | <p>suitable equipment such as backhoe, bulldozer, dump truck, etc. Prior approvals by the Engineer are required for all cutting works in regard with inspection, etc.</p> <p>(3) Specific care shall be paid for slope cutting to meet designated grade, while avoiding loosening of ground due to excess excavation.</p> <p>(4) Slope and bottom of the treatment area shall be executed carefully avoiding any unevenness and getting rid of any boulders, stones, etc. for the sake of maneuverability of the sealing work.</p> |
| | <p>2. Filling Work</p> <p>(1) Thorough site investigation will be carried out prior to the filling work. Suitable underdrain will be installed at brook or spring areas to drain water outside the filling zone, through temporary sedimentation pond if necessary, prior to the filling work.</p> <p>(2) Trial filling will be carried out prior to the filling work for the sake of deciding the equipment to be used, thickness of layer, number of compaction run, etc. through consultation with the Engineer based on test results derived from this trial filling.</p> <p>(3) Filling work will be carried out based on the design drawings using suitable equipment such as backhoe, bulldozer, dump truck, compaction equipment, etc. Prior approvals by the Engineer are required for all filling works in regard with inspection, etc.</p> <p>(4) Spreading and compaction of material will be executed conforming to the Specification and test results of the trial filling under the supervision of the Engineer. Necessary rectification measures will be taken through consultation with the Engineer in case of encountering soft ground at the filling area, to avoid future deteriorating settlement.</p> <p>(5) No area shall be left without compaction at the end of each day. The surface shall be well compacted to prevent water intrusion, which causes muddy condition. Certain grade shall always be kept at the surface of the layer to drain the rain water.</p> |
| <p>5. Surface Protection Work</p> | <p>1. All slope surfaces that directly touch the waste shall be covered with sealing sheet. Seeding will be provided for other slopes after compaction and surface treatment. Suitable material and method of seeding for the area will be selected through consultation with the Engineer.</p> <p>2. Surface flatness will be maintained through mortar spreading, etc. for the cutting slope, where mechanical finishing is not possible.</p> <p>3. As for filling slope, slope surface will be thoroughly compacted by using slope bucket, etc. and then, surface protection measures will be done.</p> |

6-2 Sealing Works

6-2-1 Standard and Specification of the Sealing Work

1) Sealing Sheet

Sealing sheet material will be selected from high elastic type products conforming to the standard specified by the "Japan Sealing Work Association". (See Figure 6-39: Each standard value for Durability of Sheet is based on 15 years use.)

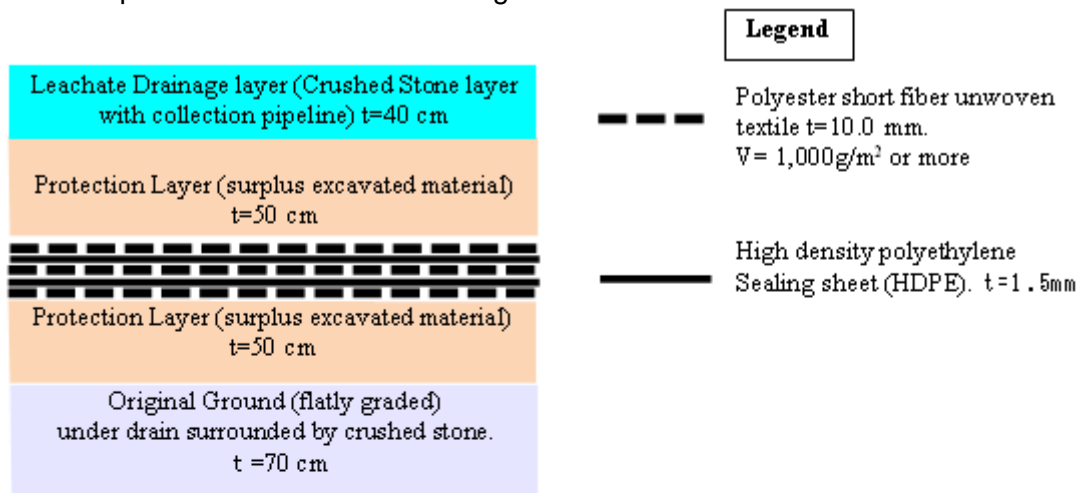
2) Protection Mat

Protection mat material will be selected from unwoven textile products, either short or long fiber one, conforming to the standard specified by the "Japan Sealing Work Association". Refer to attached data No.2. (See Figure 6-40)

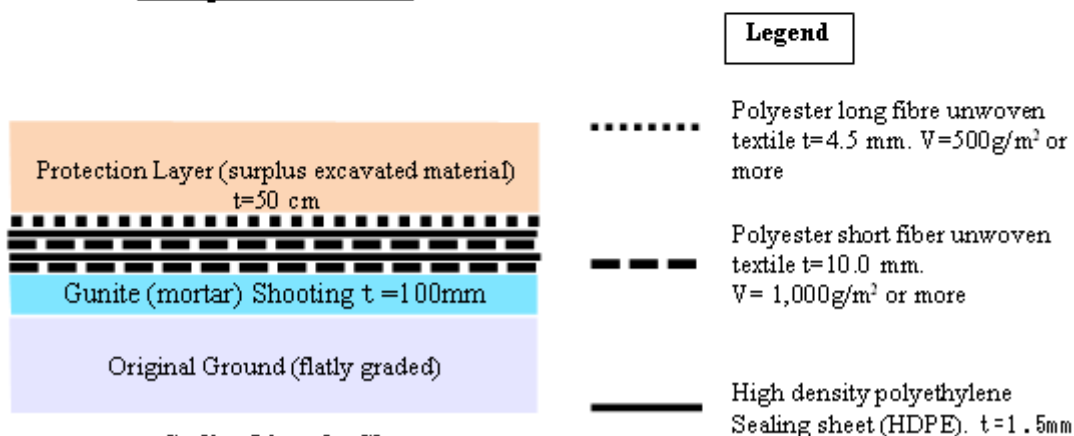
3) Protection Soil layer

Surplus excavated material will be fundamentally used as covering soil, but any cobbles shall be removed so as not to damage the sealing sheet. Final thickness of the covering soil is set to be greater than 50 cm.

6-2-2 Composition of the Landfill Sealing Liner



Sealing Liner for Bottom



Sealing Liner for Slope

Sealing Sheet
The Standard specified by "the Japan Sealing Work Association"

| ITEM | | Synthetic Rubber and resin Material | | | | Asphalt Material | | | |
|---|--|---|-----------------------------------|----------------------|-----------------|---|------------|-------------|----|
| | | Non-reinforced Type | | | Reinforced Type | Sheet Type | Spray Type | | |
| | | Low-elasticity Type | Average elasticity Type | High elasticity Type | | Penetrated or Layered | Single | Woven Sheet | |
| Basic Characteristic (Performance Value) | Outward Appearance | 1. Not be curved extremely. 2. Not be undulated extraordinarily. 3. Not be sticky extraordinarily. 4. No tearing, no cutting, no hole. 5. No dent and not thin extraordinary. 6. No exfoliation between layers 7. No damage | | | | 1. Not be sticky extraordinarily. 2. No tearing, no cutting, no hole. | | | |
| | Thickness (mm) | 1.5 over Average thickness is 0~+15% from nominal thickness. (However, measurement value is within +10%~+15%) | | | | 3.0 over | | | |
| | Coefficient of Permeability | | 1x10 ⁽⁻⁹⁾ cm/sec under | | | | | | |
| | Tensile Performance | Tensile Strength (N/cm over) | 120 | 140 | 350 | 240 | 100 | 10 | 80 |
| | | Elongation Ratio (% over) | 280 | 400 | 560 | 15 | 30 | 10 | 80 |
| | Tearing Performance (N over) | | 40 | 70 | 140 | 50 | 30 | 10 | 70 |
| Strength Performance of Joint Shearing Strength (N/cm over) | | 60 | 80 | 160 | 140 | 50 | ... | | |
| Durability Characteristic | Resistance Performance against Weather/Ultraviolet Rays (% over) | Tensile Strength Ratio | 80 | | | 80 | | | |
| | | Percent of Elongation Ratio | 70 | | | 50 | | | |
| | Resistance Performance against Weather/Ultraviolet Rays (% over) | Tensile Strength Ratio | 80 | | | 80 | | | |
| | | Percent of Elongation Ratio | 70 | | | 70 | | | |
| Against Stress Cracking | | ... | No crack | ... | ... | | | | |
| Chemical-Resistant | Acid-Resistant Performance (% over) | Tensile Strength Ratio | 80 | | | 80 | | | |
| | | Percent of Elongation Ratio | 80 | | | 70 | | | |
| | Alkaline-Resistant Performance (% over) | Tensile Strength Ratio | 80 | | | 80 | | | |
| | | Percent of Elongation Ratio | 80 | | | 70 | | | |
| Safety Performance (Elute Density) | | Under standard Value | | | | | | | |

* Durability Standard Value = Basic Performance Standard Value x ○○%

* 1N=1.01972x10⁽⁻¹⁾ kgf

Figure 6-39 Sealing Sheet
(The Standard specified by "the Japan Sealing Work Association")

Protection Mat
The Standard specified by "the Japan Sealing Work Association"

| ITEM | Unit | Examination Method | Non Woven Sheet | | | Geo-Composite | |
|--|------------------------|--------------------|--|---|---------------------|---------------|----------|
| | | | Long-fiber | Short Fiber | Non-wool Felt 1) | | |
| Material | | | Synthetic Fiber and Synthetic Resin | | | | |
| Mass for Unit area (A guide volume) | g/m ² | | 400 over | 500 over | 1,000 over | | |
| Strength | Tensile Strength | N/5 cm | JIS L 1908 | 925 over | 140 over | 100 over | 500 over |
| | Penetration Resistance | N | ASTM D 4833 | 500 over | | | |
| Shading Performance | % | JIS L 1055 | 95 over | | | | |
| Durability Characteristic | Against Weather 2) | N | JIS L 1415 | WS-type Quickening Exposure Method 500 over by Penetration Resistance Test after Exposure Method | | | |
| | Against Shading 2) | % | JIS L 1055 | 95 Over | | | |
| Safety | Elute Density | | Notice No. 13 of Ministry of Environment Ordinance No. 35 of the Prime Minister's Office | Should be under Sewerage Standard value based on the Water Pollution Prevention Law By Elution Test | | | |

1) Over JIS L 3204-3-4

2) Durability Characteristic will be applied for Against Shading Protection Material only.

Figure 6-40 Protection Mat
(The Standard specified by "the Japan Sealing Work Association")

6-2-3 Work Execution Flow

| | |
|---|---|
| 1. Surface Protection Work | 1. Treated surface shall be flat without any matter such as stone, stump, etc. that might damage the sheet. |
| | 2. Both bottom and slope surfaces must be treated without any uneven area and thoroughly compacted. |
| | 3. Previous countermeasures shall be provided so as no slope collapse or denudation occurs due to such as boiling ground water. |
| 2. Spreading of Lower Covering Soil Layer | 1. Surplus excavated soil without stone, etc. will be hauled from the temporary stock pile and be spread by bulldozer, etc. and be compacted by roller of 8 ton to 20 ton class. |
| 3. Execution of Protection Mat (Lower, Intermediate and Top Layers) | 1. Prior to execution, request for approval of the material shall be submitted to the Engineer. |
| | 2. The required amount of protection mat will be delivered to the site based on the patching schedule, and placed by laborer and truck crane, etc. |
| | 3. Length of joint overlapping shall be conforming to the Specification and manufacturer's engineering standards. The joint will be made by manual type welding connector. |
| | 4. The protection mat above the sealing sheet shall be placed following thorough cleaning of the sealing sheet. |
| 4. Execution of Sealing Sheet (Lower, and Upper Layers) | 1. Prior to execution, request for approval of the material shall be submitted to the Engineer. |
| | 2. The required amount of sealing sheet will be delivered to the site based on the patching plan, and placed by labors and truck crane, etc. |
| | 3. Patching plan of the sealing sheet will be prepared with reasonable patterns so as to minimize site joint welding. Length of joint overlapping shall be conforming to the Specification and manufacturer's engineering standards. Number of overlapped layers shall be limited to three. |
| | 4. Extension of the sealing sheet for the upper side of slope will be carried out from the upper side toward down side manually using rope, etc. Specific care shall be paid during this time so as not to damage the sheet by friction or shock. Sheet edge shall be kept clean. Any oil or mud attached to the sheet will be cleared off using waste clothes, etc. |
| | 5. Spread sealing sheet will be temporarily fixed by using sand backs, etc. Spreading work will be suspended under strong wind. |
| | 6. Joint welding work shall be executed by engineers with thorough experience. Basics of joint welding are as follows: a. Joint work shall be fundamentally carried out by automatic heat welding tool. The welding length shall be conforming to the Specification and manufacturer's engineering standards. b. Daily trial welding will be carried out so as to decide joint conditions such as welding temperature, roller speed, roller weight, etc. c. Patching plan of the sealing sheet will be prepared with reasonable patterns so as to minimize site joint welding. Padding welding will be provided for those area with three layers overlapping so as to reinforce the water tightness. |
| | 7. Inspection for the joint portion shall be carried out to check overlapping width, welding width, water tightness, joint strength, etc. Overlapping width and welding width shall be checked for the whole length. Manual shearing and tensile strength tests shall be provided for all joint edges. |
| | 8. Inspection of site joint portion's water tightness shall be carried out within a week after joint work at the site. Visual observation and penetration test with inspection bar will be executed for the whole joint length at first, then followed by either negative air pressure or positive air pressure test using case. These inspection must be done after thorough curing of joint portion. |
| | 9. Those sheet blocks that passed the inspection will be covered by upper protection mat after confirming that no gravel or foreign material is on the |

| | |
|---|--|
| | sheet surface. |
| | 10. As for treatment of those areas where sheet and other matter such as concrete structure, underdrain for seepage water, etc. meet together, the execution method will be prepared beforehand conforming to the Specification, and consultation with the Engineer. |
| 5. Spreading of Upper Protection Soil Layer | 1. Covering soil, temporarily stocked at adjacent area, will be hauled to the site and manually placed on the sheet by using wheel barrow, etc. Manual spreading will be executed followed by compaction using tire-roller of 8 ton to 20 ton class. Assistant worker will be deployed with the tire-roller to check that the tire-roller does not damage the sheet during compaction. |
| | 2. Careful manual compaction using small vibration roller will be provided within 2 meter of the bottom area from the intersection of bottom and slope. |

6-3 Drainage Facilities

6-3-1 Underground Water Drainage

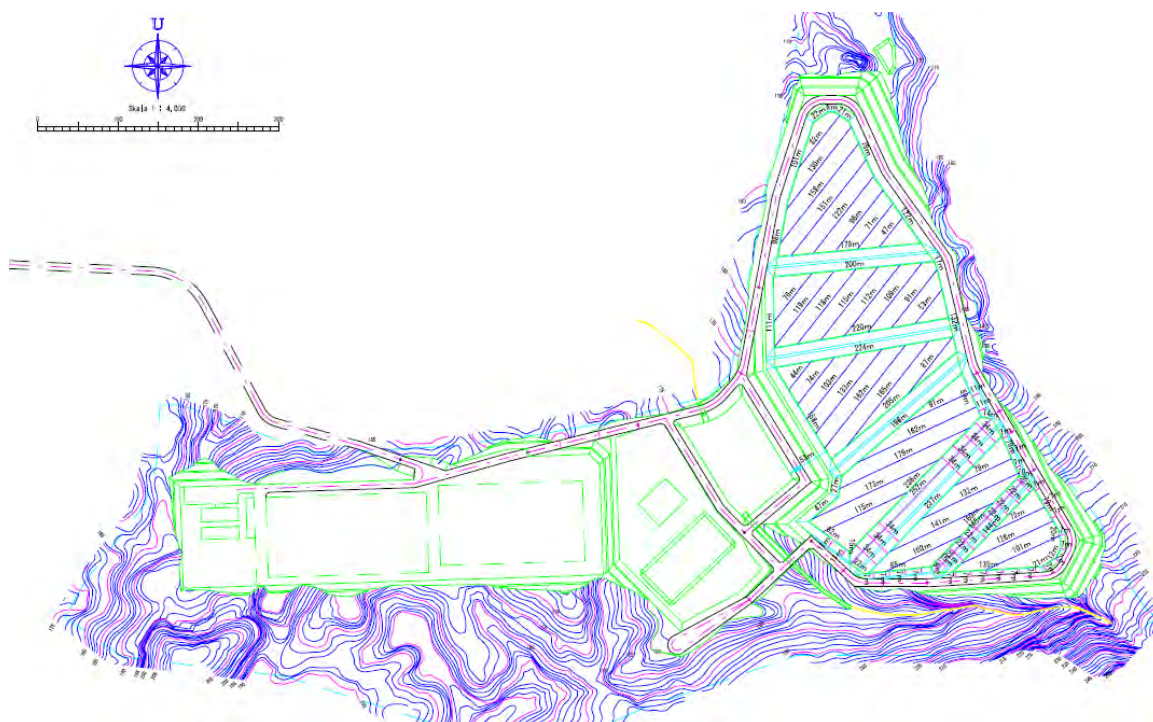


Figure 6-41 Plan of Underground Drainage Facility

6-3-1-1 Work Execution Flow

| | |
|--|--|
| 1. Material Approval and Layout Confirmation of Drainage Pipes | 1. Request for approval of the material will be submitted to the Engineer prior to the execution. |
| | 2. Double setting high density polyethylene perforated pipes with sufficient durability and strength will be used as pipe materials. Size and thickness will be decided based on hydraulic and structural calculation. |
| | 3. Location of drainage trunk lines will be decided based on thorough consideration for ground conditions including spring water which has become apparent after site development. These locations will be approved by the Engineer through consultation. |
| 2. Excavation | 1. Excavation will be carried out based on the design drawings. Specific care will be provided so as not to loosen the ground by excess digging. |
| 3. Installation of Drainage Pipes and Filter Material | 1. As for joint portion, each inserting length shall be checked so a firm joint will be made. |
| | 2. Mono size crushed stone, grade 4, will be placed around the drainage pipe as filter material. No foreign material such as soil, debris, etc. shall be mixed with the filter material. Placing and compaction of the filter material will be carried out equally at both sides of the pipe so as not to cause impact or partial pressure to the pipes. |
| | 3. Concrete plate will be placed above the compacted filter material so as to prevent foreign material such as soil or debris going into gaps of the filter material as they may cause sticking of perforated pipes. |
| | 4. Caps will be provided to the edge of pipes to prevent soil going into the pipe. |

6-3-2 Drainage of Rain Water

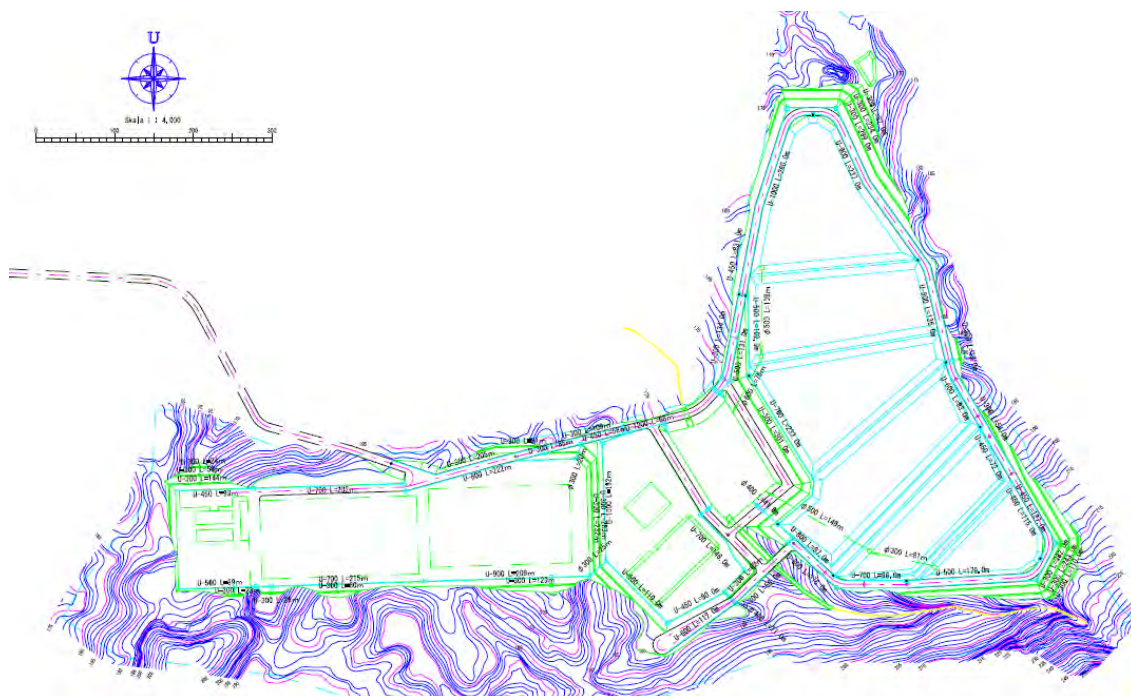


Figure 6-42 Plan for Rainwater Drainage Facility

6-3-2-1 Work Execution Flow

| | |
|--|--|
| 1. Material Approval and Layout Confirmation of Drainage Pipes, Sump pits and Concrete Channel | 1. Request for approval of the material will be submitted to the Engineer prior to the execution. |
| | 2. Double setting high density polyethylene pipes with sufficient durability and strength will be used as pipe materials. Size and thickness will be decided based on hydraulic and structural calculation. |
| | 3. Concrete and re-bars to be used for structures shall be conforming to the Specification in regard with quality and strength. They shall be approved by the Engineer prior to usage. |
| 2. Excavation | 1. Excavation will be carried out based on the design drawings. Specific care will be provided so as not to loosen the ground by excess digging. |
| | 2. When encountering changes in the ground condition, the incident will be reported to the Engineer for his consent and instruction. |
| | 3. Bench cutting will be provided for natural ground filling zone and thorough compaction will be given. Specific care is needed for boundaries of cutting and filling. |
| 3. Installation of Drainage Pipes & Sump Pits and Concrete Channel Work | 1. Concrete products without any deficiency such as cracks will be installed. Their strength and dimensions must conform to the Specification. Specified tests such as bending test, etc. shall be implemented. The quality control data shall be approved by the Engineer prior to the usage. |
| | 2. Cast in place concrete shall conform to the Specification. The Engineer's inspection and approval must be obtained before casting. |
| 4. Rain Water Reservoir Works | 1. Excavation will be carried out based on the design drawings. Specific care will be provided so as not to loosen the ground by excess digging. |
| | 2. When encountering changes in the ground condition, the incident will be reported to the Engineer for his consent and instruction. |
| 5. Backfilling | 1. Specific care shall be paid so as no damage occurs to the structures during backfilling. As for concrete channel portion, filling material will be placed equally in both sides of the channel so no unbalanced pressure occurs and the filled material will be thoroughly compacted. |
| | 2. The structure shall be inspected by the Engineer prior to covering. |

6-3-3 Leachate Drainage Facility

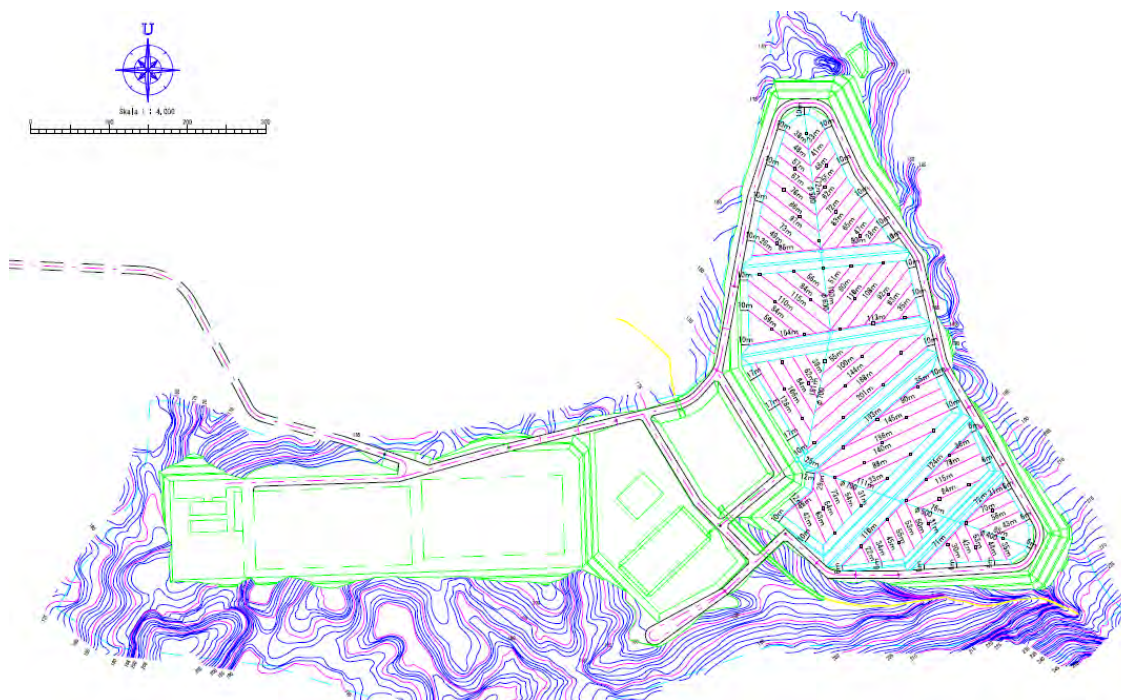


Figure 6-43 Plan of Leachate Drainage Facility

6-3-3-1 Work execution Flow

| | |
|--|---|
| 1. Material Approval and Layout Confirmation of Drainage Pipes and Sump Pits | 1. Request for approval of the material will be submitted to the Engineer prior to the execution. |
| | 2. Double setting high density polyethylene perforated pipes with sufficient durability and strength will be used as pipe materials. Size and thickness will be decided based on hydraulic and structural calculation. |
| | 3. Concrete and re-bars to be used for structures shall be conforming to the Specification in regard with quality and strength. They shall be approved by the Engineer prior to usage. |
| 2. Base Work | 1. Thorough compaction will be provided for the protection soil underneath the drainage pipes. |
| | 2. Unwoven textile will be placed on the top of the protection soil below the pipes to prevent the ground from damaging due to leaked water. Joint of unwoven textile will be carried out by welding. |
| 3. Installation of Drainage Pipes and Filter Material | 1. As for joint portion, each inserting length shall be checked so a firm joint will be made. Specific care is required for joint of drainage pipes and sump pits. |
| | 2. Mono-size crushed stone will be carefully placed under the drainage pipe. No foreign material such as soil, debris, etc. shall be mixed with this base material. |
| | 3. Monosize cobblestones without any soil or debris will be placed on top and sides of the drainage pipes. Placing shall be carried out so as not to cause any impact or partial pressure to the pipes, i.e. carefully and equally in both sides. |
| | 4. Heavy equipment will be banned to run over the drainage pipes. In case of an unavoidable operation, appropriate countermeasures shall be provided and the Engineer's approval shall be obtained. |
| | 5. Caps will be provided at the mouth of pipes to prevent the soil going inside |

| | |
|---------------------------------------|--|
| | the pipes. |
| 4. Sump Pits and Sump Reservoir Works | 1. Drainage pipes' penetrating portion of the sump pits shall be executed carefully so as no leakage will occur. |
| | 2. The concrete-made sump pits shall be watertight structures. The water tightness shall be mainly depending upon the concrete itself and waterproofing material will be used as auxiliary. 48 hours ponding test will be executed so as to confirm water tightness. No backfilling shall be provided until water tightness is confirmed. |
| | 3. Sump reservoir will be constructed by placing concrete plate with 15 cm thick on excavated and compacted slopes and 15 cm thick concrete will be cast at the bottom. A layer of lower protection mat, a layer of water sealing sheet and a layer of upper protection mat made of long fiber unwoven textile will be placed underneath the concrete. |
| 5. Backfilling | 1. Specific care shall be paid so as no damage occurs to the structures during backfilling. |
| | 2. The structure shall be inspected by the Engineer prior to covering. |

6-4 Facility Against Gas Outbreak

6-4-1 Work Execution Flow

| | |
|--|--|
| 1. Material Approval and Layout Confirmation of Gas Collection Pipes | 1. Request for approval of the material will be submitted to the Engineer prior to the execution. |
| | 2. Drainage pipe will be also used as gas collecting pipe. Double setting high density polyethylene pipes with sufficient durability and strength will be used as slope gas collecting pipe materials. |
| 2. Base Work | 1. Base will be sufficiently compacted to avoid uneven settlement. |
| 3. Installation of Gas Collecting Pipes and Filter Material | 1. Vertical pipe will be extended by jointing pipe along with the progress of the waste filling. Therefore, necessary protection will be provided to the joint portion to avoid damage. |
| | 2. Gas collecting pipe on slope shall be firmly fixed so as not to move or detach at joint during the waste filling work. |
| | 3. Necessary device shall be provided so as no closure of pipe occurs due to soil coming in. |

6.4.4 Leachate Treatment Facility

(1) Outline of Construction

1. Position Map

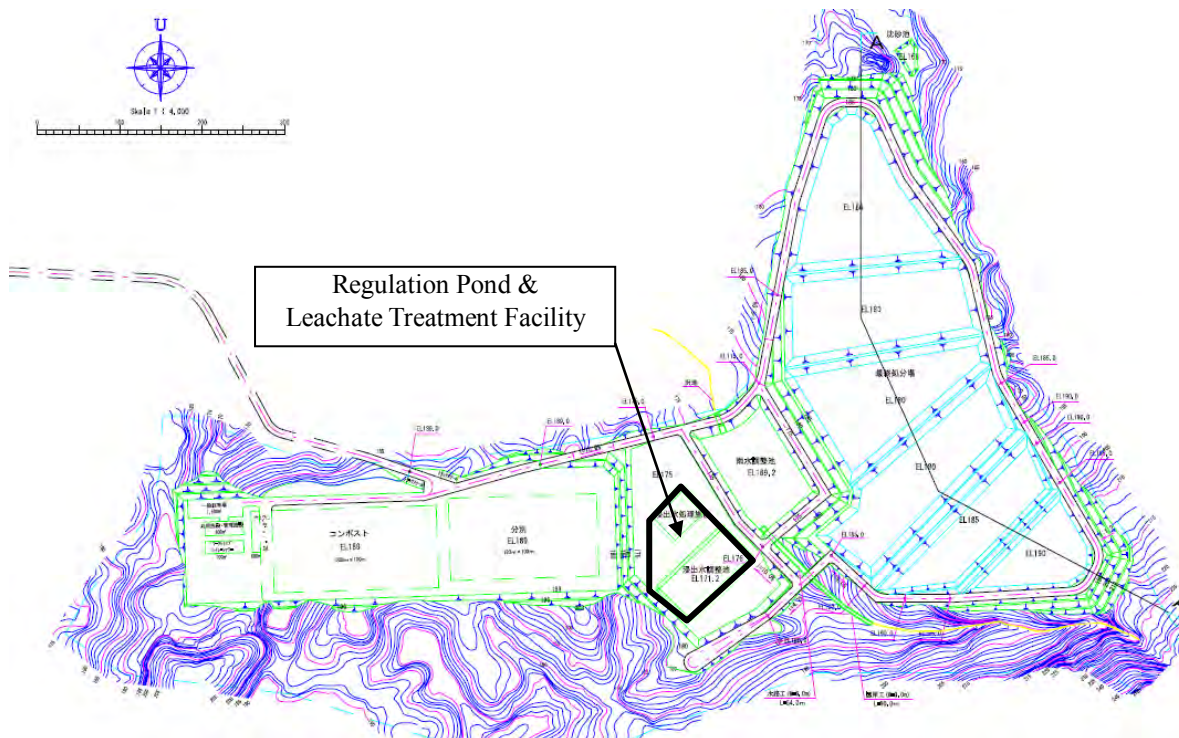


Figure 6-44 Planned Layout of Facility

2. Outline of Facility

The following construction & facility would be established.

Table 6-12 Facility Outline

| Name | Outline |
|-----------------------------|--|
| Regulation Pond | Leachate Regulation Pond: Regulating Volume 17,201 m ³ , Bottom and Slope will be covered by Concrete plate/Slab (t = 15 cm) + Seepage Control Sheet (HDPE Sheet, t = 1.5 mm) 1 Layers + Protective Sheet (Short-fiber nonwoven fiber, t = 10 mm) 2 Layers. |
| Leachate Treatment Facility | RC Building : 2 stories on the ground 27 m × 35.5 m <ul style="list-style-type: none"> • Treatment Tank • Machinery • Electrical & Instrumental Facility • Administration Office & Other Incidental Facilities |

(2) Construction Schedule

Outline of total schedule for establishing the facility is as follow.

| | 1 st year | 2 nd year | 3 rd year | Note |
|----------------------|----------------------|--------------------------------------|----------------------|------|
| Civil Work | ● → | | → | |
| Planning & Designing | ● → | | | |
| Regulation Pond | | Civil Structure ● → | Connection ● → | |
| Leachate Treatment | | Tank & Administration Office ● → | | |
| | | Machinery ● → | | |
| | | Electricity & Instrumentation ● → | | |
| | | Others ● → | | |

Figure 6-45 Construction Schedule

The points to be considered and major features about the total schedule are to;

- Apply the facility-establishment schedule of the total project regarding a temporary infrastructure for the construction.
- Start each execution of the leachate treatment from a possible part with establishment a temporary road and progression of the civil engineering-development on the total site.
- Consider an opinion of enterprise engaging a maintenance operation in deciding the detail facilities during the execution.
- Adjust the total scheme with considering to utilize a free depot of materials for civil engineering of the site office etc & a temporary office space about constructing the regulation pond.
- Plan and construct both the structure of treatment facility and the tank-construction inseparably as a unit
- Consider the operation-maintenance regarding machinery installation & instrumentation, examine and adopt a commodity procured easily in Indonesia
- Consider a traffic line or space for maintenance in installation of machinery.
- Consider an opinion of enterprise engaging a maintenance operation about the administration office & other Incidental Facilities
- Consider a preventive maintenance or long operation life of LCC & machinery, procure and keep enough spare parts in the facility-establishment process.

(3) System of Execution and Organization

System of Execution & Organization is the following figure.

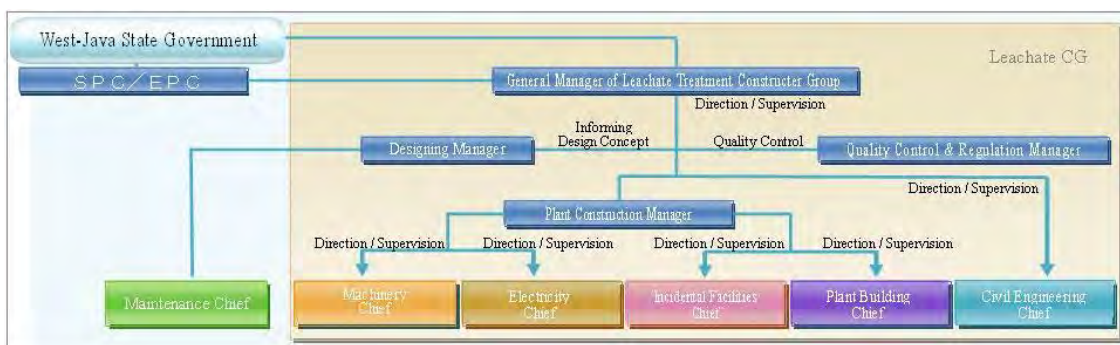


Figure 6-46 System of Execution and Organization

Consideration & features about the system of execution are to

- Have close communication including a report, a contact, and a consultation among each stakeholder such as the West-Java State Government, business entities, SPC, and EPC etc, and progress the uninterrupted facility-establishment.
- Establish the chain of command and improve a systematic response capability with a clarification of a responsibility, a role and a charged range.

(4) Safety Control

Safety is the priority matter in the construction. Planning for action should be well recognized before the construction, risk prediction & safety protection should be well considered, and well organized safety measure should be performed. In addition, Patrols & checks, protections for accident would be executed with large opportunities of “awareness”, then, it would be consistent to yield no-safety conditions.

Main items for the safety control are as follow.

Table 6-13 Items Safety Control

| | Name | Detail |
|---------|---|---|
| Daily | Safety Morning Meeting | Announcement of Safety Instructions & Notification Matters |
| | KY-KT Meeting | Re-confirmation of Risk Prediction (KY), Risk Measure (KT), Safety Inspection, and Operation Procedure |
| | Machinery Inspection before Use | Safety Inspection before Use |
| | Command & Supervision in Operation | Detection of No-Safety Condition & No-Safety Action and Improvement Measure |
| | Safety Process Meeting | Announcement & Settlement for Operation of the Next Day and Safety Instructions |
| | 5S | Arrangement (Seiri), Good Order (Seiton), Cleaning (Seisou), Clean Condition (Seiketsu), Good Manner (Shitsuke) |
| | Safety Confirmation in the End of Operation | Re-confirmation of Scatter & Flames etc |
| Weekly | Weekly Meeting | Result of Safety Patrol and Progress of Operation Schedule |
| | Weekly Self-Inspection | Inspection of Machinery, Electricity and Temporary Installation |
| | Weekly Clean-up | 3S of Office & Workshop etc: Arrangement (Seiri), Good Order (Seiton), Cleaning (Seisou) |
| Monthly | Safety & Health Committee | Reflection of Monthly Safety & Health Objective |
| | Accident Prevention Council | Reflection of Monthly Safety or Expansion of Case Study: Incident |
| | Monthly Meeting | Result of Safety Patrol and Progress of Operation Schedule |
| | Safety Workshop Meeting | Education for Safety & Health and Announcement of Notification Matters |

(5) Quality Management

Main items for the safety control are as follow.

- Obtain agreement about materials (for civil engineering) or a construction technique from a ordering before the execution based on the detailed design.
- Carry out inspections such as an acceptance inspection and number inspection etc under an attendance of ordering on carrying in the site regarding materials (for civil engineering).
- Inspect and confirm the condition before the next process under an attendance of ordering as a rule in each process of execution, and carry out a complete inspection on a completion of execution.
- Carry out inspections such as a filling-water test or a pressure test etc for testing a leakage of a tank & a plumbing or not, and incorporate those tests beforehand in case of taking certain time for testing.
- Carry out individual and whole inspections such as a performance test, a quality test, an each operation test: a rated value and a full value, and an emergency stop operation test etc for showing specified ability and function of the total system or not until a trial operation previous to a complete handing over.
- Carry out a multiple monitoring among a contractor, an administrator or administration division of each business entity, a supervisor, SPC, and PM enterprise as well as a monitoring of ordering.



Figure 6-47 Multiple Monitoring

(6) Control Process

Consideration & features about the process control are to:

- Hold a related council for related business entities and stakeholders, if necessary, and progress the uninterrupted construction work with sharing information or controversial issues of the civil engineering process condition etc.
- Realize a responsibility and a role for each stakeholder with creating a mile-stone, clarify a important arrival point in the process, and recognizing the target in the process of each construction-stakeholder, progress improvement of awareness, and reach the more smooth progress management than before.
- Make an integrated progress schedule with examining drawings and specifications and securing an appropriate construction term, and keep it with early preparation of a working drawing and detailed discussions; in addition, progress the uninterrupted constructive promotion and prevent a rework by making a construction planning & an operation procedure previously with agreement of ordering, and well-informing persons & technicians in charge of operations.

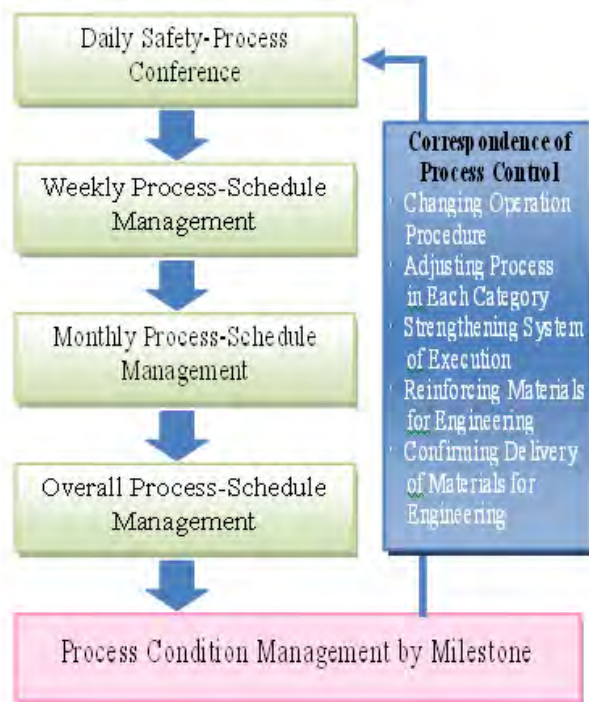


Figure 6-48 Flow of Control Process

(7) Emergency Response System

Supposed emergencies such as accidents, natural disasters, and incidents would be investigated, and formalized its response corresponding to each case and significance. In the emergency, as a rule, under a command of leader, information and the chain of command are integrated and prompt and appropriate response would be carried out with closed communications with ordering and stakeholders.

Supposed Contacts

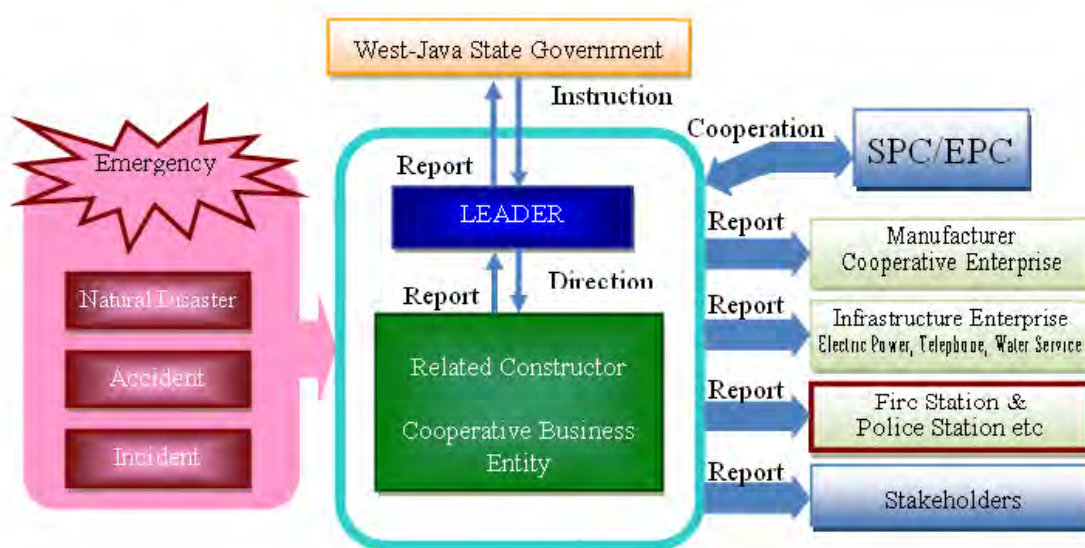


Figure 6-49 Emergency Response System

- Ordering, SPC/EPC, Disaster Prevention Department of Regional Administration, Police Station, Fire Station, Related Constructor, Corporative Business Entity, Partners, Infrastructure Business Entity, Other Stakeholder

Supposed Main Factors of Emergency:

- Natural Disasters
 - Heavy Rain, Gust, Tornado, Storm, Thunder, Earthquake, Landslide etc
- Accidents
 - Traffic Accidents, Conflagration, Mechanical Abnormality, Electric Shock, Leakage, Others
- Incidents
 - Injury, Theft, Violation, Riot, Terrorism, Intimidation, Others

(8) Outline of Construction Technique

- Regulation Pond
 - Based on the design, digging & unevenness adjustment etc by the civil engineering work would be carried out. In addition, the outer wall and batholith of pond would be constructed with a reinforced - concrete construction to protect leakage of leachate.
- Leachate Treatment Facility
 - Facility Building including the tank would be constructed with 2 stories above ground & a reinforced - concrete construction.
 - The tank of lechate treatment facility would be constructed with a liquid - applied membrane waterproofing, and a filling-water test should be carried out after finishing the construction.
 - Machinery would be procured easily in Indonesia with considering the maintenance. All machineries should be accepted with specifications & drawings before manufacturing, and its quality test with a manufacture responsibility should be carried out after the accomplishment of construction. Inspections, moreover, should be carried out on its emplacement and confirmation & inspections, operation tests, for showing specified ability and function or not should be carried out on its trial run.
 - Plumbing would be procured easily in Indonesia with its prior approval about employed materials or construction techniques. Number inspections & acceptances should be carried out on its emplacement; moreover, pressure tests or filling-water test should be carried out to confirm leakage from the plumbing after the accomplishment of construction.
 - Electrical & Instrumental Facilities would be procured easily in Indonesia with its prior approval about employed materials or construction techniques. Number inspections & acceptances should be carried out on its emplacement; moreover, inspections should be carried out to confirm its quality & operation after the accomplishment of construction.

6.4.5 Common Area Construction – External Work (Road, Drainage and Vehicular Parking)

(1) Introduction

This Method Statement describes the work procedures in road works, drainage works and vehicular parking works. The major items and construction schedule as shown below.

(2) Major Items

- 1) U-shape drainage work.
- 2) Man-hole work.
- 3) Asphalt work
 - Subgrade work
 - Lower Sub-base course
 - Upper Sub-base course
 - Prime and Tact Coat work.
 - Asphalt pavement work
 - Installation of road furniture and guardrail work
 - Road makings work

(3) Program

| S No | DESCRIPTION | MONTHS | | | | | | | | | | | |
|----------|-----------------------------------|--------|---|---|---|---|---|---|---|---|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| A | COMMON AREA 1 | | | | | | | | | | | | |
| 1 | Mobilisation | ■ | | | | | | | | | | | |
| 2 | Setting out Work | ■ | | | | | | | | | | | |
| 3 | U Drain | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 4 | Manhole | | | | | | | | | | | | |
| | Precast Yard Preparation | | ■ | ■ | | | | | | | | | |
| | Pre cast of Manhole | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Installation of Manhole | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 5 | Asphalt Road | | | | | | | | | | | | |
| | Preparation Work | | | | | | | | ■ | ■ | ■ | ■ | ■ |
| | 10.0m Width Road | | | | | | | | | ■ | ■ | ■ | ■ |
| B | COMMON AREA 2 | | | | | | | | | | | | |
| | Gravel Pavement –Base Preparation | | | | | | | | ■ | ■ | ■ | ■ | ■ |
| | Gravel Pavement Laying | | | | | | | | | ■ | ■ | ■ | ■ |
| | Asphalt Road | | | | | | | | | | ■ | ■ | ■ |

Figure 6-50 Schedule Plan for Common Area

6.5 Operation and Management

6.5.1 Operational Structure

- Table 6-14 shows an O&M System. 457 workers including the director manage operating and administration
- In the operating sector a manager and workers are assigned every plants, and in the administration sector a manager is assigned and workers are assigned every assignment segments.

Table 6-14 Operational Management of Plants System

| Position | | | | | | | Subtotal |
|-----------------------------------|---|---------|----------|--------------------|--------------------------|------------|----------|
| Director | <div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto; background-color: #cccccc;">Director</div> | | | | | | 1 |
| | | | | | | | |
| | Sorting | Compost | Landfill | Leachete treatment | Acceptance & measurement | Accounting | |
| Manager | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| Operationg administration manager | 4 | - | - | - | - | - | 4 |
| Plant equipment operator | 16 | - | - | - | - | - | 16 |
| Heavy equipment operator | 30 | 40 | 4 | - | - | - | 74 |
| QC engineer | - | - | - | - | - | - | 0 |
| Maintenance worker | 2 | 2 | 1 | 2 | - | - | 7 |
| Worker | - | 4 | 3 | - | 9 | 3 | 19 |
| Worker (Hand sorting) | 340 | 10 | - | - | - | - | 350 |
| Total | | | | | | | 476 |

Source: TPST Bantargebang

6.5.2 Sorting

(1) Operation

- 1) The waste should be received in 16 hrs (8:00–24:00).
- 2) The waste delivered in non-operating time should be pooled in receiving yard.
- 3) Time schedule of operation:
 - 08:00–24:00 operation
 - 20:00–24:00 maintenance
- 4) The workers shift: The others
 - 08:00–17:00 day shift working
 - 16:00–24:00 late shift working

The worker number and work time considered for shift work are shown below.

Table 6-15 Work item and work time and numbers

| Work item | WORKING HOURS (hrs/Day) | Day shift working 8:00–17:00 Figure | Late shift working 16:00–24:00 Figure | Total |
|---|-------------------------|-------------------------------------|---------------------------------------|-------|
| Surveyor for receiving pit(worker) | 16 | 4 | 4 | 8 |
| Operators for Heavy Equipments at receiving | 16 | 3 | 3 | 6 |
| Operators for plant equipment | 16 | 5 | 5 | 10 |
| Manual Labors for sorting (worker) | 16 | 144 | 144 | 288 |
| Bag Packing for plastic material(worker) | 16 | 24 | 24 | 48 |
| Operators for Heavy Equipments at storage | 8 | 3 | 3 | 6 |
| Maintenance worker | 8 | 2 | | 2 |
| Operating Administration manager | 12 | 3 | 2 | 5 |
| Site manager | 8 | 1 | | 1 |
| | Total | 189 | 185 | 374 |

(2) Maintenance

To avoid the fatal troubles, the appropriate daily maintenance and periodical maintenance (inspection) must be required. For above affairs, all personnel have to understand every method of the operation and maintenance, completely.

Table 6-16 Daily Operation & Maintenance (Examples)

| DAILY MAINTENANCE | REQUIREMENT |
|---|--|
| <ul style="list-style-type: none"> • To grasp equipment operation and adjustment for fluid volume, aeration, to medicine addition amount • To confirm for the situation of operation with equipments (current amount, vibration, eccentric sound, etc) • To confirm and make a record of indicated amount by measure equipment • Replenish consumed medicine and filling by equipments • To check the leak from tank, pipe and other equipments • The condition with tear for equipments, damage of belt, oil leak, and necessary repair for above • To issue the daily bulletin | <ul style="list-style-type: none"> • To understand the superannuation through daily maintenance, and make a plan to replacement. • To replace grease and oil (Lubrication) • Calibration, cleaning and replace tired parts for the instrument • Overhaul for utility equipments (if necessary, order to specialize company) • Replace tired parts and maintenance for electrical control circuit of instruments for measurement equipment of the power sauce devices (if necessary, order to specialize company) • To make a record for the result of periodical maintenance |

(3) Recommendable System/Organization for Operation and Maintenance (Example)

Suitable system/organization for proper operation and maintenance should be established according to the condition of detail design and conditions of construction. For reference, we show recommendable system/organization as below.

Table 6-17 Recommendable System/Organization for Operation and Maintenance (Example)

| Title | Job Descriptions | Demanded Skills |
|---|--|---|
| Surveyor for receiving pit (worker) | <ul style="list-style-type: none"> To survey for the acceptance To eliminate foreign material | - |
| Operators for Heavy Equipments at receiving | <ul style="list-style-type: none"> To transfer with heavy equipments from receiving pit to receiving hopper | <ul style="list-style-type: none"> License of Heavy Equipment |
| Operators for plant equipment | <ul style="list-style-type: none"> Daily Maintenance & Periodical Maintenance Adjustment for operation regarding to the order by the manager | <ul style="list-style-type: none"> General knowledge about operation and maintenance for the plant and relating equipments General knowledge about measurement and analysis |
| Manual Labors for sorting (worker) | <ul style="list-style-type: none"> Manual Sorting at Conveyer Line Maintenance after daily operation | - |
| Bag Packing for plastic material(worker) | <ul style="list-style-type: none"> Sorting and Packing by eliminated plastic material into bags for both recycling and elimination | - |
| Operators for Heavy Equipments at storage | <ul style="list-style-type: none"> Transferring and Loading to carriers (trucks) from stock-yard with a forklift | <ul style="list-style-type: none"> License of forklift and Crane |
| Maintenance worker | <ul style="list-style-type: none"> Maintenance of equipments and instruments | <ul style="list-style-type: none"> General knowledge about equipments and instruments Knowledge available for simplified maintenance |
| Operating Administration manager | <ul style="list-style-type: none"> Central Command (General Survey) Unified Operation (Operation& Maintenance) Adjustment for the operation with reference to Operation Index, and appropriate command to every personnel Trouble Shorting | <ul style="list-style-type: none"> Over-all knowledge for the operation and control of the plant |
| Site manager | <ul style="list-style-type: none"> Possibility for over-all | <ul style="list-style-type: none"> Same skill of the Central Commander Business Skill Crisis management capability |

6.5.3 Compost

(1) Operation

- 1) The organic waste sorted is loaded on dump trucks by a wheel loader, transported to a windrow hall and unloaded at spot as instructed.
- 2) The waste is piled up trapezoid in cross section as windrow by a wheel loader.
- 3) The windrows are turned from time to time by a windrow turner.
- 4) The windrow stands for 20 days for the natural process of decomposition of the organic matter. Then the waste is screened, loaded by a wheel loader on dump trucks employed by WJPG, and taken out.

In the operation 7 wheel loaders, 10 dump trucks, 1 windrow turner, and 1 screen are used 12 hours a day.

(2) Management

The operation is done by

- 1) 1 Manager,
- 2) 40 Equipment Operators in 2 shifts,
- 3) 2 QC Engineers in 2 shifts,
- 4) 4 Mechanics in 2 shifts, and
- 5) 10 Common Workers in 2 shifts.

6.5.4 Sanitary Landfill

(1) Landfill System

- The basic landfill system is “cell system”. Cell system is a waste disposal system that the day’s waste is loaded to the dipping bed by bulldozer and other heavy machines and then they are masked by cover soils (0.15m) superior and side surface day after day (daily cover).

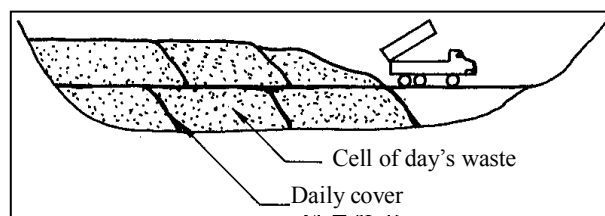


Figure 6-51 Cell System

- Each cell is separated by daily cover. Thus it is very effective for the prevention of backfire, spreading fire, reek of rot drift hazard and controlling harmful insects
- Each waste layer (thickness: 2.15m including daily cover 0.15m) is separated by intermediate cover soil layer (thickness: 0.35m).

(2) Landfill Works

- Landfill works is conducted through the following steps:
 - 1) Waste is unloaded from the waste collecting truck.
 - 2) Waste is mixed and its surface is leveled off. Then waste is flatted.
 - 3) The daily cover is given.
- Workers are staffed in the repository. When waste-collecting truck is arrived, they lead it, place the acceptance check of the waste at the waste inspection station whether unsuitable thing is not included.
- Landfill procedure go through the following steps:
 - 1) Lead the waste collecting truck.
 - 2) Place the acceptance check of the waste at the waste inspection station
 - 3) Mix the waste, level off its surface and compactify it.
 - 4) Carry the cover soil from lay-down and mask it.
- Workers take measures for the structure object and the impermeable liner.
- Vertical gas collection pipes etc. are set up to maintain the semiaerobic landfill structure with vertical gas collection pipes and leachate collection lines.

(3) Cover Soils Works

- Figure 6-44 shows slope of landfill. Waste is covered with the small dam, intermediate cover soil and the final cover soil. Waste is masked by cover soil the same day.
- The landfill slope of the dam is constructed in the progress of landfill. In addition, seepage control work is undertaken on the inside of the dam at the same time and then a sheet fixing and a drain ditch are also undertaken.
- The effects of soil covers, countermeasure on environment conservation, are prevention of dispersal and washout of waste, exuding strong odors and vermination

Intermediate cover: Thickness is 50 cm in each 2.0 m of waste layer.

Daily cover: Thickness is 0.15 m.

Final cover: Thickness is 0.65 m (include cover soil $t = 0.5$ m and humus and grassing $t = 0.15$ m) for the revegetation, creation of the forest, based on the land utilization plan after completion of landfill.

Cover material: Excess soil (cut-embankment balance) from onsite.

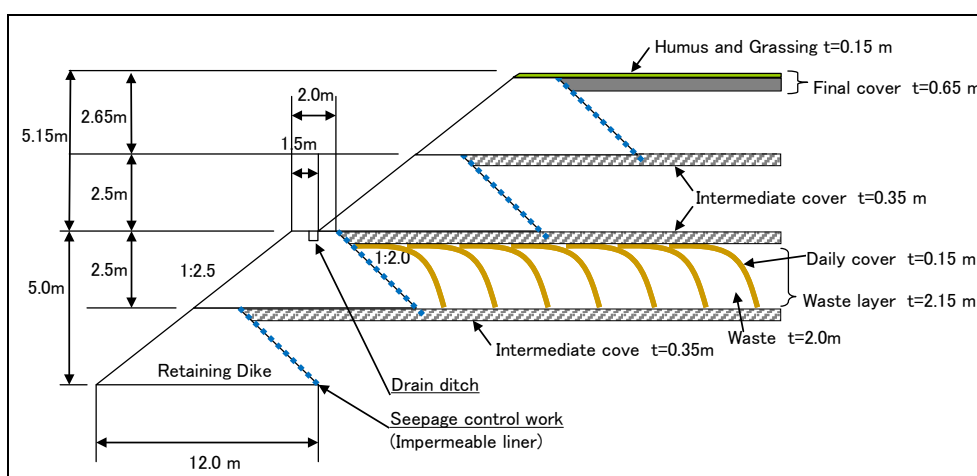


Figure 6-52 Slope of Landfill

(4) Landfill Strategy

- Waste is land-filled from the downstream side in consideration of dropping into naturally draining of rainwater, etc. for safety and efficiency. In addition, the dam is constructed in the progress of landfill and waste is land-filled on a step-by-step basis
- The doneness, the land sinking and the rest landfill capacity of the landfill site are kept tabs on for management to operate properly.

(5) Landfill Equipments

- Table 6-18 shows the functions and number of landfill equipments in consideration of the landfill system, waste production and land-filled solid waste, etc.
- The scheme is premised on the case: 10 t trucks of 25/day and waste transaction volume of 245 m³/day.

Table 6-18 Landfill Equipments

| Landfill equipments | Number/day | Remarks |
|-------------------------------|------------|---|
| Backhoe (0.7 m ³) | 2 | Covering soil Checking |
| Bulldozer (21 t) | 1 | Surface compaction Flattening out |
| Landfill compactor (25 t) | 1 | Surface compaction |
| Dump truck (10 t) | 3 | Transportation of waste from intermediate treatments landfill site |

(6) Personnel Distribution

- The scheme is premised on the case: 10 t trucks of 25/day and waste transaction volume of 245 m³/day.
- Hours of work are premised 8:00–17:00 with a group.
- Simulate to be procured from local people in Indonesia.
- In addition, working out of regular monitoring by O&M companies about once every six months is proposed to be implemented.

Table 6-19 Staff of O&M of Landfill System (Field Site)

| Position | Principal works |
|---|---|
| Manager (1) | <ul style="list-style-type: none"> • Total management of landfill • Liaison coordination and intercommunication with other plants. |
| Heavy equipment operator (3) | <ul style="list-style-type: none"> • Landfill and cover soil works. |
| Plant and heavy equipments controller (1) | <ul style="list-style-type: none"> • Maintenance of plants and heavy equipments. • Checking and maintenance of access aisles. • Regular checking of the dam and the slope. |
| Landfill worker (3) | <ul style="list-style-type: none"> • Leading waste collecting truck, checking waste and leading of unloading. • Management of collected waste |

(7) Design for Human Resource Development

Human resources development designs are worked out with the aim of an introduction of skill related to operation of plants and establishing of skill, and carried out with executives and middle-level executives with the aim of training of leadership role.

- 1) Skill development by training and dispatch of experts (especially seepage control work and handling skill of liner sheet).
- 2) Trainings of business management of landfill are worked out with executives and middle-level executives.

(8) Safety and Health Design

- Safety and health designs are drawn up annually with the aim of safety of worker and working environment and familiarized to worker.
- Safety and health designs is consist mainly of as follows:
 - 1) Set outlines.
Forwarding of efforts to be safety is shown to workers with the aim of prevention of accidents and disasters.

- 2) Set objectives
Objectives based on outlines, assessments of safety and health designs in the past and assumed risks are set with concrete numerical values.
 - 3) Select important issues
Specific means for achieving the goal are; enhancement safety management system, introductions of risk assessment, providing safety and health trainings, improvements of machines and equipments.
- Degree of goal achievement made a valuation at the end of the year is reflected programs for the coming year.

(9) Safety Training for Workers

Safety trainings are regularly provided with the aim of betterments of safety awareness of workers.

- Day after day at morning meeting : Confirm works and identify assumed risks.
- Twice/year: Lecture class for heavy equipments and dump trucks drivers.
- Once/year: Compulsory safety trainings.

(10) Programs of Utilization of a Vacant Lot

Use of a vacant lot of the post-landfill works includes forest and grass field reduction, parks, a factory complex and residential estate. Forest and glass field reductions are brought forward in case of this project in mind determinate configuration of landfill and ambient surroundings. Depending on the case, determine the site of a vacant lot to reflect the views of stakeholders. Mainly control points of a vacant lot of landfill are brought forward as follows:

- 1) Volume-loss management of leachate: Expeditious draining away of rain water to outside of landfill and securing of aerobic condition in landfill.
- 2) Landfill gas generation management: Release gas from ground level by gas collection pipes. Manage end of gas collection pipes in fear of close in to disinterested parties.
- 3) Landfill settlement management: Manage landfill settlement to prevent deep differential settlement insofar as leaving rainwater drainage designs untouched.
- 4) Circumjacent groundwater management: Manage circumjacent groundwater at fixed intervals and check presence or absence of leaking of leachate to circumjacent groundwater.
- 5) Degradation of land-filled solid waste and stabilization aspect management : Determine (1) compositions, (2) ignition loss, (3) moisture, (4) water quality of puddles in waste layer, (5) gas aspect, (6) temperature, (7) others with regularity in order to determine degradation of land-filled solid waste and stabilization aspect.

(11) Costs of O&M of Landfill Site

Table 6-20 shows costs of O&M of Landfill.

Table 6-20 Costs of O&M of Landfill

| Expense item | | Cost | Remarks column |
|-----------------------------|---|----------------|---|
| Labor cost | | 51,480 USD/yr | <p>Calculated based on wage of TPST BANTARGEBAANG.</p> <p>(1) Manager: 1 person × 1,650 USD/month × 12 month</p> <p>(2) Heavy Equipment Operator: 4 person × 330 USD/month × 12 month</p> <p>(3) Maintenance Worker: 1 person × 330 USD/month × 12 month</p> <p>(4) Worker: 3 person × 330 USD/month × 12 month</p> |
| Utility | Electricity | 0 USD/yr | <ul style="list-style-type: none"> N/A |
| | Fuel (Heavy equipment) | 275,440 USD/yr | <ul style="list-style-type: none"> Heavy equipment's fuel is diesel oil. Piece rate of diesel oil is 11,000 Rp/L Amount of fuel use (Equipments 1–3 is 8 hours/day, 300 days/year in production. Equipment 4 is for the transfer in plants. Thus they work 8 hours/day, 300 days/year in production |
| | Water | 0 USD/yr | <ul style="list-style-type: none"> During the dry season, watering may have to keep back dispersal of waste in O&M of landfill. Using well water since there are no clean water plants (initial cost of 100m well (earthwork and pump) is JPY 200,000). |
| | Medical agent | 0 USD/yr | <ul style="list-style-type: none"> N/A |
| Maintenance and repair cost | | 346,702 USD/yr | <ul style="list-style-type: none"> The degradation of the liner sheet and the fracture by heavy equipment miss operation. The breach of groundwater collecting lines, leachate collection lines, rain water collection lines by subsidence, and the clogging and so on. The falling of slopes by raining Flood to out-of-bounds and damage of sediment discharge. Mowing cost in slopes. |
| Others | Cover soil purchase | 0 USD/yr | <ul style="list-style-type: none"> Use excess soil (cut-embankment balance) from insite. |
| | Leveling of a dam | 294,935 USD/yr | <ul style="list-style-type: none"> Buying cost and transport cost of soil. Construction cost of the dam. Laying cost of impermeable liners (Liners laid slope inside the dam). Laying cost of vertical gas collection pipes (Lay vertical gas collection pipes (φ600 mm) in one place/2,000 m²) Others (Such as sheet protection layer) |
| | Accumulated fund of maintenance (Closing reserve) | 0 USD/yr | <ul style="list-style-type: none"> N/A |

(12) Monitoring Design

- Landfill monitoring are provided based on “Government Regulations about Management of Water Quality and Control over Water Pollution” in the Republic of Indonesia due to important factors to evaluate landfill stabilization (The details of A are described in 7.2.1.).
- Monitoring items and frequencies of groundwater and final effluent is as follows.

Table 6-21 Items of Monitoring of Groundwater

| Items | Monitoring frequency | | | | |
|----------------------------|---------------------------|-------------------------|-------------|------------------------|-------------|
| | Preinitiation of landfill | Initiation ~ Completion | | Completion ~ Abolition | |
| | One or more times | Once a month | Once a year | Once a month | Once a year |
| Physics | | | | | |
| Temperature | ○ | ○ | ○ | ○ | ○ |
| TDS | ○ | | ○ | | ○ |
| TSS | ○ | | ○ | | ○ |
| Inorganic Chemistry | | | | | |
| pH | ○ | ○ | ○ | ○ | ○ |
| BOD | ○ | | ○ | | ○ |
| COD | ○ | | ○ | | ○ |
| DO | ○ | | ○ | | ○ |
| PO4 ³⁻ as P | ○ | | ○ | | ○ |
| NO3 as N | ○ | | ○ | | ○ |
| NH3-N | ○ | | ○ | | ○ |
| As | ○ | | ○ | | ○ |
| Co | ○ | | ○ | | ○ |
| Ba | ○ | | ○ | | ○ |
| B | ○ | | ○ | | ○ |
| Se | ○ | | ○ | | ○ |
| Cd | ○ | | ○ | | ○ |
| Cr(VI) | ○ | | ○ | | ○ |
| Cu | ○ | | ○ | | ○ |
| Fe | ○ | | ○ | | ○ |
| Pb | ○ | | ○ | | ○ |
| Mn | ○ | | ○ | | ○ |
| Hg | ○ | | ○ | | ○ |
| Zn | ○ | | ○ | | ○ |
| Chloride | ○ | | ○ | | ○ |
| Cyanide | ○ | | ○ | | ○ |
| Fluoride | ○ | | ○ | | ○ |
| NO2-N as N | ○ | | ○ | | ○ |
| NO3-N | ○ | | ○ | | ○ |
| Chlorine free | ○ | | ○ | | ○ |
| H2S | ○ | | ○ | | ○ |

Table 6-22 Items of Monitoring of Final Effluent

| Items | Monitoring frequency | | | | |
|----------------------------|---------------------------|-------------------------|-------------|------------------------|-------------|
| | Preinitiation of landfill | Initiation ~ Completion | | Completion ~ Abolition | |
| | One or more times | Once a month | Once a year | Once a month | Once a year |
| Physics | | | | | |
| Temperature | ○ | ○ | ○ | ○ | ○ |
| TDS | ○ | | ○ | | ○ |
| TSS | ○ | | ○ | | ○ |
| Inorganic Chemistry | | | | | |
| pH | ○ | ○ | ○ | ○ | ○ |
| Fe | ○ | | ○ | | ○ |
| Mn | ○ | | ○ | | ○ |
| Ba | ○ | | ○ | | ○ |
| Cu | ○ | | ○ | | ○ |
| Zn | ○ | | ○ | | ○ |
| Cr (VI) | ○ | | ○ | | ○ |
| Cr | ○ | | ○ | | ○ |
| Cd | ○ | | ○ | | ○ |
| Hg | ○ | | ○ | | ○ |
| Pb | ○ | | ○ | | ○ |
| Sn | ○ | | ○ | | ○ |
| As | ○ | | ○ | | ○ |
| Se | ○ | | ○ | | ○ |
| Ni | ○ | | ○ | | ○ |
| Co | ○ | | ○ | | ○ |
| CN | ○ | | ○ | | ○ |
| H ₂ S | ○ | | ○ | | ○ |
| F | ○ | | ○ | | ○ |
| Cl ₂ | ○ | | ○ | | ○ |
| NH ₃ -N | ○ | | ○ | | ○ |
| NO ₃ -N | ○ | | ○ | | ○ |
| NO ₂ -N | ○ | | ○ | | ○ |
| BOD | ○ | | ○ | | ○ |
| COD | ○ | | ○ | | ○ |
| MBAS | ○ | | ○ | | ○ |
| Phenol | ○ | | ○ | | ○ |
| Vegetable Oil | ○ | | ○ | | ○ |
| Mineral Oil | ○ | | ○ | | ○ |

- Workers monitor condition of stabilization of waste to check landfill gas quality and quantity and ground temperature.
- Examination is worked out in 4 places, which supposed to large gas yield, and conduct a review of monitoring positions and position's numbers as results of yielded gas.

Table 6-23 Items Monitoring of Landfill Gas and Underground Temperature

| | |
|---------------------------|---|
| Checking spot | Landfill gas treatment plant (vertical gas collection pipe) |
| Number of Checking points | 4 points |
| Number of times | Twice/year (summertime, wintertime) |
| Items of checking | Landfill gas quantity: Measurement of gas flow rate Landfill gas composition: methane(CH ₄), carbon monoxide(CO), carbon dioxide(CO ₂), hydrogen sulfide(H ₂ S), ammonia(NH ₄), oxygen(O ₂) and azote (N ₂) Underground temperature in landfill: Measurement of temperature each 1 m deep. |

- Bad odor is monitored in FDS boundary.

Table 6-24 Items of Monitoring of Odor

| | |
|-------------------|--|
| Checking spot | Ground boundary of east and west side |
| Number of times | Twice/year (summertime, wintertime) |
| Items of checking | Odor index (Desired value 12) (corresponding to odor intensity 3.0) |

6.5.5 Leachate Facility

(1) Outline of Daily Operation

Staffing and Working hours

Table 6-25 Leachate Facility Staffing and Working Hours

| Type of Occupation | Working Hours | Duties | # of staff |
|---------------------------|---|--|------------|
| Operation Control Manager | 9:00-17:00 (full time, 6 days a week,) | • Total Operation Control | 1 |
| Maintenance Engineer | 9:00-17:00 (full time, 6 days a week,) | • Facility Operation • Dairy Check-Up | 2 |

Duties

Table 6-26 Leachate Facility Duties

| Type of Work | Duties |
|--|---|
| Total Operation Control | Management of Leachate Treatment Facilities (Planning, Operation Leading, Water Quality Control, Emergency Control , Budget Control, Purchasing Control, Safety Management & Sanitation Control, General Affairs) |
| Facility Operation & Daily Inspections | Operation Control, Facilities Check-Up, Light Maintenance, Chemicals Supply, Water Quality Check-UP, Leachate Circulation Work |

(2) Maintenance

Table 6-27 Leachate Facility Maintenance

| Personnel System | Duties | Frequency & Term |
|--|---|-------------------------|
| 2 (who are responsible for duties including check-up work for other facilities) | Periodical check-up for pumps, blower, hydro extractor and mixer | Once a year |
| | Exchange of activated carbon used for activated carbon absorption tower | Once or twice a month |
| | Exchange of filtration sand used for sand filtration tower | Once in every two years |
| | Periodical analysis for raw water and discharged water | Once a month |

(3) Planning for Monitoring

- Table 6-22 refers monitoring once per month and once per year
- Daily monitoring required the water-purify control would adopt measuring instruments such as the pH meter, the dissolved oxygen analyzer, and the ORP meter; moreover, Simplified Water Inspection Products, using color former such as the “pack-test” etc, would be practiced if necessary.

6.5.6 Common Area

(1) Work Contents

- Workers accept collected waste, check waste by watching, measure waste production and manage data.
- Workers manage cash flows and supports government.

(2) Personnel Distribution

Table 6-28 Staff of O&M

| Position | Principal works |
|--|---|
| Director (1 person) | <ul style="list-style-type: none"> • Management of the entire project. |
| Manager (1 person) | <ul style="list-style-type: none"> • Total management of acceptance and measurement • Liaison coordination and intercommunication with other plants. |
| Back-coated worker (3 persons/shift × 3 shifts) | <ul style="list-style-type: none"> • Management of acceptance of waste by visual check. • Management of expense sheet • Batching by weight and data management |
| black-coated worker (3 persons) | <ul style="list-style-type: none"> • Finance and accounting (management of cash flows) • Accommodation and works, general affairs, labor management. • Clerk • Supporting government such as reports. |

(3) O&M Cost of Common Area

Table 6-29 O&M Cost of Common Area

| Expense item | | Cost | Remarks column |
|-----------------------------|------------------------|-----------------|--|
| Labor cost | | 87,100USD/year | Calculated based on wage of TPST BANTARGEBAANG. (1) Director: 1person × 2610 USD/month × 12 month (2) Manager: 1 person × 1,650 USD/month × 12 month (3) Worker: 12 person × 250 USD/month × 12 month |
| Utility | Electricity | 960USD/year | <ul style="list-style-type: none"> Base cost (connection fees): about 20,000 Rp/kVA · month Specific cost: about 200 Rp/kwh |
| | Fuel (heavy equipment) | 0USD/year | |
| | Water | 357,804USD/year | <ul style="list-style-type: none"> Buy the Aqua as a drinking water. Research market rate of buying cost. |
| | Chemicals | 0USD/year | <ul style="list-style-type: none"> N/A |
| Maintenance and repair cost | | 0USD/year | |

6.6 Cost Summary

6.6.1 Facility and Equipment Costs

The Facility Initial Construction Costs and Equipment Costs are summarized as follows.

Table 6-30 Facility Construction and Equipment Costs

| Item | Cost | Currency | Public/Private |
|---------------------------------|-----------------------------|-------------------|----------------|
| Intermediate Treatment Facility | Sorting | 17,270,091 | USD |
| | Compost | 7,634,673 | USD |
| Final Disposal Site | Landfill | 42,226,714 | USD |
| | Leachate Treatment | 8,774,000 | USD |
| | Common Area | 6,151,623 | USD |
| Final Disposal Site Machinery | Landfill Heavy Equipment | 1,516,484 | USD |
| | Common Area Heavy Equipment | 60,975 | USD |
| | | | |
| Capital Costs | Total | 83,634,560 | USD |

6.6.2 Operation and Management Costs

The annual operation and maintenance costs are shown below.

Table 6-31 Annual Operation and Maintenance Costs

| Item | Cost | Currency | Public/Private |
|---------------------------------|------------------------|------------------|----------------|
| Intermediate Treatment Facility | Sorting | 1,610,225 | USD/yr |
| | Compost | 872,188 | USD/yr |
| Final Disposal Site | Landfill O&M | 1,019,041 | USD/yr |
| | Leachate Treatment O&M | 719,820 | USD/yr |
| | Common Area O&M | 93,480 | USD/yr |
| Insurance | 216,370 | USD/yr | SPC |
| O&M Annual Costs | Total | 4,531,124 | USD/yr |

The below items for the Financial Analysis are discussed in Chapter 12.

1. Assumption for Inflation Rate
2. Assumption for Depreciation
3. Assumption for Interest Rate
4. Assumption for Foreign and Local Currency Costs
5. Considerations for Interest Fluctuation Risk
6. Considerations for Foreign Exchange Risk
7. Assumptions for Calculating Insurance Costs (Refer to Chapter 10)
8. Calculation of Project IRR, Equity IRR, DSCR
9. Calculation of FIRR

Table 6-32 O&M Costs

| Administration sector | Transaction waste volume | Working hours | Personnel distribution | | | | | | | | Heavy equipments | Utility | Repair cost | Others |
|--|--------------------------|---|------------------------|----------------------|----------------------------------|--------------------------|--------------------------|---------------------|---------------------|----------------------|---------------------|---|---|---|
| | | | Director | Manager | Operating Administration manager | Plant equipment operator | Heavy equipment operator | QC engineer | Maintenance worker | Worker | | | | |
| ● Generalization (Communal area) | | • 8h/day • 250day/year | 1 (31,320 USD/yr) | | | | | | | | | | | |
| ● Finance and accounting (Communal area) | | • 8h/day • 250day/year | | 1 (19,800 USD/yr) | | | | | | | 3 (3,000 USD/yr) | | | |
| ● Acceptance and measurement (Communal) | 1,000t/day | • 24h/day • 8h/shift × 3shift • 360day/year | | | | | | | | | 9 (3,000 USD/yr) | • Backhoe (compact size) × 1 | • Electricity: 960 USD/yr • Water: 5,400 USD/yr | |
| ● Sorting | 1,000t/day | • 24h/day • 8h/shift × 3shift • 360day/year | | 1 (26,400 USD/yr) | 4 (19,800 USD/yr) ¥ | 16 (3,960 USD/yr) | 30 (3,960 USD/yr) | | 2 (3,960 USD/yr) | | | | • Electricity: 43,787 USD/yr • Water: - • Fuel: 203,000 USD/yr • Chemicals: 30,066 | 49,451 USD/yr • Repair cost of access road: 14,000 USD/yr • Crushing machine : 158,242 USD/yr |
| ● Compost | 729t/day | • 12h/day • 360day/year | | 1 (26,400 USD/yr) | | | | 2 (2,640 USD/yr) | 4 (2,640 USD/yr) | 10 (1,320 USD/yr) | | • Wheel loader × 7 • Dump truck × 10 • Turner × 1 • Screen × 1 | • Electricity: - • Water: - • Fuel: 413,143 USD/yr • Chemicals: - | 298,005 USD/yr |
| ● Landfill | 245m ³ /day | • 8h/day • 360day/year | | 1 (19,800 USD/yr) | | | | | 1 (3,960 USD/yr) | 3 (3,960 USD/yr) | | • Backhoe (0.7m ³) × 2 • Bulldozer (21t) × 1 • Landfill compactor (25t) × 1 • Dump truck (10t) × 3 | • Electricity: - • Water: - • Fuel: 275,440 USD/yr • Chemicals: - | 295,404 USD/yr • Leveling of a dam etc.: 294,331 USD/yr • Cover soil purchase: - |
| ● Leachete treatment | | • 7h/day • 6day/week (313day/year) | | 1 (19,800 USD/yr) | | | | | 2 (3,960 USD/yr) | | | • Heavy equipments (scoop up a dehydrated cake (85%, 3.2t/day) from concrete floor, load it onto a truck, landfill) | • Electricity: 23,300 USD/yr • Water: - • Fuel: - • Chemicals: 560,000 USD/yr | 80,000 USD/yr • Water monitoring cost (once/month) (raw water and final effluent): 28,800 USD/yr |

6.7 CMD Application Possibility Study

6.7.1 Application Possibility of CDM

Organic waste in received waste is to be composted in this project. While methane gas (GHG) generates in case that organic waste is filled in the landfill, it can be prevented in case that organic waste is composted. Therefore, this project can be considered as the CDM project.

Approved methodology, which can be applied to the project treating municipal waste including organic waste, is AM0025 “Avoided emissions from organic waste through alternative waste treatment processes” Version 12. For this project, the following conditions described in the methodology are applied.

- The project activity involves one or a combination of the following waste treatment options for the fresh waste that in a given year would have otherwise been disposed of in a landfill:
 - (a) A composting process in aerobic conditions;
- In case of composting, the produced compost is either used as soil conditioner or disposed of in landfills;
- The proportions and characteristics of different types of organic waste processed in the project activity can be determined, in order to apply a multiphase landfill gas generation model to estimate the quantity of landfill gas that would have been generated in the absence of the project activity;
- Waste handling in the baseline scenario shows a continuation of current practice of disposing the waste in a landfill despite environmental regulation that mandates the treatment of the waste, if any, using any of the project activity treatment options mentioned above;
- The compliance rate of the environmental regulations during (part of) the crediting period is below 50%; if monitored compliance with the MSW rules exceeds 50%, the project activity shall receive no further credit, since the assumption that the policy is not enforced is no longer tenable;

6.7.2 Study of GHG Reduction

(1) Baseline Emissions

Baseline emissions $BE_{CH_4, SWDS, y}$ is methane emissions from landfill in the absence of the project activity in year y (tCO₂e), which is calculated by the following equation according to “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site.”

$$BE_{CH_4, SWDS, y} = \varphi \cdot (1 - f) \cdot GWP_{CH_4} \cdot (1 - OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^y \sum_j W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1 - e^{-k_j})$$

Parameters are set as shown in Table 6-33. Calculation result is as shown in Table 6-35.

Table 6-33 Parameters

| | | | |
|--------------|--|------------|--|
| ϕ | Model correction factor to account for model uncertainties | 0.9 | |
| f | Fraction of methane captured at the SWDS and flared, combusted or used in another manner | 0 | Methane gas recovery is not yet obliged. |
| GWP_{CH_4} | Global warming potential of methane | 21 | - |
| OX | Oxidation factor | 0.1 | IPCC2006 Guideline |
| F | Fraction of methane in the SWDS gas (volume fraction) | 0.5 | IPCC2006 Guideline |
| DOCf | Fraction of degradable organic carbon that can decompose | 0.5 | IPCC2006 Guideline |
| MCF | Methane correction factor | 0.8 | Assumed that unmanaged solid waste disposal site |
| $W_{j,x}$ | Amount of organic waste type j prevented from disposal in the SWDS in the year x (tons) | Table 6-34 | - |
| DOC_j | Fraction of degradable organic carbons (by weight) in the waste type j | | IPCC2006 Guideline |
| kj | Decay rate for the waste type j | | IPCC2006 Guideline (MAT > 20 degC, MAP > 1,000 mm) |

Table 6-34 Amount of organic waste, DOC_j , and K_j

| Waste type j | $W_{j,x}$ (ton/day) | DOC_j (% wet waste) | K_j |
|--|------------------------|--------------------------|-------|
| Kitchen Refuse (= Food, food waste, beverages and tobacco (other than sludge)) | 252 | 15 | 0.40 |
| Leaves/Garden (= Garden, yard and park waste) | 264 | 20 | 0.17 |
| Papers (= Pulp, paper and cardboard (other than sludge)) | 98 | 40 | 0.07 |
| Residues (= Food, food waste, beverages and tobacco (other than sludge)) | 87 | 15 | 0.40 |
| Total | 701 | - | - |

(2) Project Emissions

Project emissions in year y (PE_y) is defined as follows.

$$PE_y = PE_{elec,y} + PE_{fuel,on-site,y} + PE_{c,y} + PE_{w,y}$$

$PE_{elec,y}$ = Project emissions from electricity consumption in year y (tCO_2e)

$PE_{fuel,on-site,y}$ = Project emissions from fossil fuel consumption in year y (tCO_2e)

$PE_{c,y}$ = Project emissions from composting in year y (tCO_2e)

$PE_{w,y}$ = Project emissions from wastewater treatment in year y (tCO_2e)

Where,

$$PE_{elec,y} = EG_{PJ,FF,y} * CEF_{elec}$$

$EG_{PJ,FF,y}$ = Is the amount of electricity generated in an on-site fossil fuel fired power plant or consumed from the grid as a result of the project activity, measured using an electricity meter < 4.513MWh/day x 365 days/y>

CEF_{elec} = Is the carbon emissions factor for electricity generation in the project activity < 0.891 tCO_2/MWh >

$$PE_{fuel,on-site,y} = F_{cons,y} * NCV_{fuel} * EF_{fuel}$$

$F_{cons,y}$ = Is the fuel consumption on site in year y (l or kg) < Diesel 589,000L/y, 0.84 kg/L >

NCV_{fuel} = Is the net caloric value of the fuel (MJ/l or MJ/kg) < 43.0 TJ/Gg (IPCC2006 Guideline) >

EF_{fuel} = Is the CO_2 emissions factor of the fuel (tCO_2/MJ) < 74,100 $kgCO_2/TJ$ (IPCC2006 Guideline) >

$$PE_{c,y} = PE_{c,N_2O,y} + PE_{c,CH_4,y}$$

$PE_{c,N_2O,y}$ = Is the N_2O emissions during the composting process in year y (tCO₂e)

$PE_{c,CH_4,y}$ = Is the emissions during the composting process due to methane production through anaerobic conditions in year y (tCO₂e)

$$PE_{c,N_2O,y} = M_{compost,y} * EF_{c,N_2O} * GWP_{N_2O}$$

$M_{compost,y}$ = Amount of organic waste (tones/y) <701 t/day x 365 days/y >

EF_{c,N_2O} = Emission factor of N_2O from composting (t N_2O /t compost)
<0.043=default value>

GWP_{c,N_2O} = Global warming potential for N_2O (tCO₂/N₂O) <310>

$$PE_{c,CH_4,y} = MB_{compost,y} * S_{a,y} < 0 >$$

Assuming that it is zero due to enough agitation during composting process.

$$PE_{w,y} = \text{emissions from wastewater treatment in year y (tCO}_2\text{e)} <0>$$

Assuming that it is zero since wastewater is not treated but recycled to composting process.

Consequently, project emissions are calculated as follows:

$$PE_y = 1,468 + 1,577 + 3411 = 6,456 \text{ tCO}_2\text{/year}$$

(3) Leakage

In case of this project, leakage prescribed in the methodology (GHG emissions which generate outside of project boundary) is caused from fossil energy consumption by transportation for composting. However, the distance is very short, since composting facilities will be installed near the landfill area. Therefore, leakage is almost zero.

(4) GHG Reductions

GHG reductions are calculated by the following equation:

$$\text{GHG reductions} = \text{Baseline emissions} - \text{Project emissions} - \text{Leakage}$$

Calculation result is shown in Table 6-35.

6.7.3 CDM Income

Based on GHG reduction, CDM income was calculated as shown in Table 6-35.

Table 6-35 Calculation Result of GHG Reductions and CDM Income

| | | | | | | | | | | |
|-----------------------------|------|------|------|-----|------|------|------|------|------|------|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Baseline emissions (E3 t/y) | 45.8 | 80.0 | 106 | 126 | 142 | 154 | 165 | 174 | 181 | 187 |
| Project emissions (E3 t/y) | -6.5 | | | | | | | | | |
| GHG reductions (E3 t/y) | 39.4 | 73.6 | 99.6 | 120 | 136 | 148 | 159 | 167 | 174 | 180 |
| CDM income (E3 EUR/y) | 197 | 368 | 498 | 600 | 680 | 740 | 795 | 835 | 870 | 900 |
| Year | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Baseline emissions (E3 t/y) | 192 | 196 | 200 | 204 | 207 | 209 | 212 | 214 | 216 | 218 |
| Project emissions (E3 t/y) | -6.5 | | | | | | | | | |
| GHG reductions (E3 t/y) | 185 | 190 | 194 | 197 | 200 | 203 | 205 | 207 | 209 | 211 |
| CDM income (E3 EUR/y) | 925 | 950 | 970 | 985 | 1000 | 1015 | 1025 | 1035 | 1045 | 1055 |

The CER unit price is set low as 5EUR/tCO₂, since the post-Kyoto Protocol framework after 2013 is future opaque. In the past, it has been more than 10 EUR or 15 EUR. Depending on the future situation, the CDM income may double, 3 times, or 4 times.

6.7.4 Procedure for CDM Authorization

Necessary procedure for the implementation of CDM project is as follows:

- A) Development of CDM project planning
- B) Preparation of Project Design Document
- C) Approval acquisition of the Parties concerned
- D) Validation (by DOE)
- E) Registration of the project (by CDM Executive Board)
- F) Monitoring
- G) Inspection and the certification of CER(Certified Emission Reduction) (by DOE)
- H) Publication of CER (by CDM Executive Board)
- I) Distribution of CER

Monitoring F) includes the following items. Data collection is necessary during the project's period.

- Kinds and amount of organic waste to be composted.
- Amount of compost production.
- Methane generation at the composting facilities (by sampling)
- Consumption of electricity and fossil fuel at the intermediate treatment facilities.

6.7.5 Evaluation and Items to be Noted

Taking into account the situation of current municipal waste management in Indonesia, CDM application to this Project may be feasible. Please note that, in order to carry out CDM project actually, several items have to be considered since the start of project design phase as shown hereunder.

Kind and amount of organic waste

In order to apply methodology AM0025, kind and amount of organic waste have to be monitored. Monitoring system, such as routine sampling and analysis of waste, has to be established during the project design phase.

Anaerobic fermentation in the composting process

Methodology AM0025 requires monitoring of methane gas generation at the composting facilities by weekly Oxygen measurement. If anaerobic condition is detected at the composting process, it is taken into consideration to the calculation of GHG reductions.

Trend of laws and regulations in Indonesia

According to the current laws and regulation regarding municipal waste management in Indonesia, neither composting nor methane gas utilization from landfill is obliged. In case that composting is obliged and observed at more than 50% of sites in the future in Indonesia, CDM will not be applied to this project. Therefore, it is necessary to check the updating of laws and regulations.

Additionality

The economical benchmark for assessing "additionality" of the current CDM project in Indonesia is IRR (internal rate of return) around 10% - 15%. If IRR of this Project is within this range, "additionality" may be economically demonstrated with no problem. In addition, it may

be also technically demonstrated, since there is currently no experience of large-scale composting facilities in Indonesia.

Expense for CDM project

Additional expenses are necessary for CDM project. They are mainly for PDD development, validation, project registration, CER inspection/certification, CER publication, and etc.

Credit period

There are two types of credit period. One is one term type which is finished in ten years. Another one is three term type, where one term is seven years and update examination is necessary for every seven years. If we choose three term type, we have to receive update examination based on the regulation and operating situation at the time of the update examination. Three sittings type is assumed for this study.

Use of ODA fund

It is generally forbidden to use ODA fund for CDM project. However, this rule will not be applied to the project since ODA fund is not used for the intermediate treating facilities. In fact, eleven CDM projects using ODA were registered by the United Nations. Four cases are using Japanese ODA with the certificate by Japanese government showing that it is additional ODA fund for CDM project.

6.8 Sale of Plastic (Recyclable Wastes)

6.8.1 Existing Situation

Despite the efforts of the authority to promote 3R, wastes generated from the target regions are delivered to the final disposal site mostly without sorting. For Nambo, it is estimated that approximately 123 tons/day of recyclable plastics are generated through sorting in the intermediate treatment facility.

In West Java Province, recycle plastics are sold as valuables at a certain price at the private markets (Refer to Chapter 3.1.1 for details). While the generated quantity of plastic wastes are large at 120 tons/day the existing market has demand for this quantity, and it is proposed that this project will incorporate the sale of plastics from the standpoint of waste recycling and as a revenue source. Plastics sold will be considered revenue to the SPC.

* Example of Plastic Recycle Process (John Peter's Plant in Bandung City).



Figure 6-53 Plastic Recycle Process

6.8.2 Possibility of Sale and Price

The possibility of the sale of recyclable plastics was discussed with KIMRUN, Pt. MAZA, John Peter's Plant (Largest Intermediate Waste Trading Company in Bandung) and ITB. The results are as follows.

- The market price of the waste plastics trade depends on the type of plastic but ranges at approximately Rp 350–3,000/kg. To be conservative, an average trading price of Rp 800/kg is assumed to be possible.

Table 6-36 Market Price of Recyclable Plastic Wastes

| Items | prices |
|----------------------|------------|
| Clean Plastics Bag | Rp. 600/kg |
| Dirty Plastics Bag | Rp. 350/kg |
| Water Mineral Bottle | Rp.1750/kg |
| Cup of water mineral | Rp.2000/kg |
| PE | Rp.2000/kg |
| PP | Rp.1750/kg |
| HD | Rp.1250/kg |
| Dirty- Mix Plastic | Rp. 450/kg |

- Considering the opinions of ITB and the local consultants, it is assumed that approximately 30%–50% of the wasted delivered to the final disposal site and sorted are possible for sale. To be conservative, 40% assumed to be possible for sale.
- To be on the safe side of the potential for sale and pricing, approximately 4,600 USD/day of income source is anticipated.

$$123\text{ton/day} \times 40\% \times \text{Rp } 800/\text{kg} = \text{Rp } 39,360,000/\text{day} \text{ (approximately USD4,600/day)}$$

Incidentally, the income from service fees (tipping fee) are USD 19,000/day in the case that the tipping fee is at USD 19/ton.

6.8.3 Revenue Collection and Attribution of Plastic Wastes Sold

In the discussions with KIMLUN so far, whether the income from the sale of recyclable plastics be received the SPC or the West Java Provincial Government has not strictly enforced. In the case that it is considered to be an income source for the West Java Provincial Government, it will be considered as a resource for the service fee (tipping fee). In contrast, if it is considered to be an income source for the SPC, it will be utilized to adequately lower the service fees (tipping fees).

Therefore, the sale of recyclable plastics and income from the sales will be attributed to the SPC. Furthermore, in the case that the sale does not get on track at the point of project implementation phase, the introduction of machinery (crushing and cleaning) in order to increase the sale price of plastics may be considered for financial feasibility.

Example of a plastic recycling factory is shown below.



Figure 6-54 Plastic Recycle Factory

Project name: PPP Waste management Project in West Java
Site: NAMBO
Sheet: Cash Flow

1. Cash flow

| Line Item | 0 | C 1 | C 2 | C 3 | O 1 | O 2 | O 3 | O 4 | O 5 | O 6 | O 7 | O 8 | O 9 | O 10 | O 11 | O 12 | O 13 | O 14 | O 15 | O 16 | |
|--|--------------------|---|------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--|
| Year | Total | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | |
| Inflation | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |
| Operational | | | | | | | | | | | | | | | | | | | | | |
| Tipping Fee Income | 107,451,381 | | | | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | 6,715,711 | |
| Plastic Sale Income | 23,040,000 | | | | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | 1,440,000 | |
| Operating Income | 130,491,381 | | | | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | 8,155,711 | |
| OPEX Annual Costs | | | | | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | 1,610,225 | |
| Sorting O&M | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| RDF O&M | | | | | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | 872,188 | |
| Compost O&M | | | | | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | 1,019,041 | |
| Landfill O&M | | | | | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | 719,820 | |
| Leachate O&M | | | | | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | 93,480 | |
| Common Area O&M | | | | | 216,370 | 216,370 | 216,370 | 216,370 | 223,580 | 216,370 | 225,090 | 216,370 | 216,370 | 223,580 | 216,370 | 216,370 | 216,370 | 216,370 | 216,370 | 216,370 | |
| Insurance | 4,151,730 | 666,670 | | | | | | | | | | | | | | | | | | | |
| Operating Expenditure | -73,187,793 | -666,670 | 0 | 0 | -4,531,124 | -4,531,124 | -4,531,124 | -4,531,124 | -4,539,334 | -4,531,124 | -4,539,844 | -4,531,124 | -4,531,124 | -4,538,334 | -4,531,124 | -4,531,124 | -4,531,124 | -4,531,124 | -4,531,124 | -4,531,124 | |
| Net Operating Cash Flow | 57,303,587 | -666,670 | 0 | 0 | 3,624,587 | 3,624,587 | 3,624,587 | 3,624,587 | 3,617,377 | 3,624,587 | 3,615,867 | 3,624,587 | 3,624,587 | 3,617,377 | 3,624,587 | 3,624,587 | 3,624,587 | 3,624,587 | 3,624,587 | 3,624,587 | |
| Investment | | | | | | | | | | | | | | | | | | | | | |
| Capital Expenditure | 17,270,091 | 5,756,697 | 5,756,697 | 5,756,697 | | | | | | | | | | | | | | | | | |
| Sorting Facility Construction | | | | | | | | | | | | | | | | | | | | | |
| RDF Construction | | | | | | | | | | | | | | | | | | | | | |
| Compost Facility Construction | 7,634,673 | 2,544,891 | 2,544,891 | 2,544,891 | | | | | | | | | | | | | | | | | |
| Landfill Equipment | | | | 1,516,484 | | | | | | | | | | | | | | | | | |
| Leachate Treatment Equipment | | | | 60,975 | | | | | | | | | | | | | | | | | |
| Common Area Equipment | | | | | | | | | | | | | | | | | | | | | |
| Landfill Construction | | | | | | | | | | | | | | | | | | | | | |
| Leachate Treatment Construction | | | | | | | | | | | | | | | | | | | | | |
| Common Area Construction | | | | | | | | | | | | | | | | | | | | | |
| Investment Cash Flow | 26,482,223 | 8,301,588 | 8,301,588 | 9,879,047 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Financial | | | | | | | | | | | | | | | | | | | | | |
| Principal Drawdown | | 7,471,429 | 7,471,429 | 8,891,142 | | | | | | | | | | | | | | | | | |
| Interest Payment | -21,042,196 | 0 | -597,714 | -1,195,429 | -1,906,720 | -1,843,842 | -1,775,934 | -1,702,594 | -1,623,386 | -1,537,842 | -1,445,454 | -1,345,675 | -1,237,914 | -1,121,532 | -995,839 | -860,091 | -713,483 | -555,146 | -384,142 | -199,459 | |
| Principal Repayment | -23,834,000 | | | | -785,971 | -848,848 | -916,758 | -990,097 | -1,069,305 | -1,154,849 | -1,247,237 | -1,347,016 | -1,454,777 | -1,571,159 | -1,696,852 | -1,832,600 | -1,979,208 | -2,137,545 | -2,308,548 | -2,493,232 | |
| Commitment Fee | | -24,905 | -24,905 | -29,637 | | | | | | | | | | | | | | | | | |
| Financial Cash Flow | | 7,446,524 | 6,848,810 | 7,666,076 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | |
| Before Tax Cash Flow (Excluding Yen Loan Portion) | | | | | | | | | | | | | | | | | | | | | |
| Free Cash Flow Before Financing | 30,821,365 | -8,968,258 | -8,301,588 | -9,879,047 | 3,624,587 | 3,624,587 | 3,624,587 | 3,624,587 | 3,617,377 | 3,624,587 | 3,615,867 | 3,624,587 | 3,624,587 | 3,617,377 | 3,624,587 | 3,624,587 | 3,624,587 | 3,624,587 | 3,624,587 | 3,624,587 | |
| Financing | -21,121,642 | 7,446,524 | 6,848,810 | 7,666,076 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | -2,692,691 | |
| Equity | | 691,575 | 622,619 | 1,225,066 | | | | | | | | | | | | | | | | | |
| Equity (CAPEX) | | 830,159 | 830,159 | 987,905 | | | | | | | | | | | | | | | | | |
| Free Cash Flow After Financing | 14,887,204 | -0 | 0 | 0 | 931,897 | 931,897 | 931,897 | 931,897 | 924,687 | 931,897 | 923,177 | 931,897 | 931,897 | 924,687 | 931,897 | 931,897 | 931,897 | 931,897 | 931,897 | 931,897 | |
| DSCR | | | | | 1.35 | 1.35 | 1.35 | 1.35 | 1.34 | 1.35 | 1.34 | 1.35 | 1.35 | 1.34 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | |
| Tax | | | | | | | | | | | | | | | | | | | | | |
| Taxable Income | 12,238,982 | -0 | 0 | 0 | 844,566 | 837,580 | 830,035 | 821,886 | 805,875 | 803,580 | 784,595 | 782,228 | 770,255 | 750,113 | 743,357 | 728,274 | 711,985 | 694,392 | 675,391 | 654,871 | |
| Tax | -3,059,746 | 0 | 0 | 0 | -211,142 | -209,395 | -207,509 | -205,471 | -201,469 | -200,895 | -196,149 | -195,557 | -192,564 | -187,528 | -185,839 | -182,069 | -177,996 | -173,598 | -168,848 | -163,718 | |
| After Tax Cash Flow | 11,827,459 | -0 | 0 | 0 | 720,755 | 722,502 | 724,388 | 726,425 | 723,218 | 731,002 | 727,028 | 736,340 | 739,333 | 737,158 | 746,057 | 749,828 | 753,900 | 758,299 | 763,049 | 768,179 | |
| Dividend | | | | | | | | | | | | | | | | | | | | | |
| Dividend Paid | 8% | 6,639,977 | | | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | 414,999 | |
| After Dividend Payout | | 5,187,482 | | | 305,756 | 307,503 | 309,389 | 311,427 | 308,219 | 316,003 | 312,029 | 321,341 | 324,334 | 322,160 | 331,059 | 334,829 | 338,902 | 343,300 | 348,050 | 353,180 | |
| Internal Reserve | | | | | 305,756 | 613,259 | 922,649 | 1,234,075 | 1,542,294 | 1,858,297 | 2,170,327 | 2,491,668 | 2,816,002 | 3,138,162 | 3,469,220 | 3,804,050 | 4,142,951 | 4,486,252 | 4,834,302 | 5,187,482 | |
| Project IRR | 9.25% | CF Before Financing (Including Initial CAPEX) | | | | | | | | | | | | | | | | | | | |
| Equity IRR | 7.30% | Equity CF Before W/H Tax | | | | | | | | | | | | | | | | | | | |
| DSCR | 1.35 | | | | | | | | | | | | | | | | | | | | |

Project name: PPP Waste management Project in West Java
Site: NAMBO
Sheet: Capital Cost

Currency USD
Exchange rate 91

| LFC (Landfill Construction - Sanitary Landfill) | | | | | | | | | | |
|---|--|---|-----------|------|------------------|---------|-------------------|------------|---|---|
| Public/Private | no | Item | Quantity | Unit | Unit price (JPY) | Total | Total (USD) | Currency | Notes | Reference (validity of costs) |
| Public | LFC-1 | Cut | 1,508,600 | m3 | 329 | 495,671 | 5,446,934 | USD | Cutting area including grubbing, cleaning and disposal | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-2 | Cut Material Transportation | 538,000 | m3 | 371 | 199,598 | 2,193,385 | USD | Weathered rock (20%) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-3 | Landfill Site Formation | 538,000 | m3 | 624 | 335,712 | 3,889,143 | USD | Embarkment area including grubbing, cleaning and disposal | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-4 | Works (Including Intermediate Treatment Plant Area) | 968,600 | m3 | 497 | 481,394 | 5,290,044 | USD | Temporary stocking within the Site | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-5 | Grading of Cutting Slope | 37,800 | m2 | 415 | 15,687 | 172,385 | USD | Spreading and compacting | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-6 | Grading of Filling Slope | 56,900 | m2 | 484 | 27,526 | 302,626 | USD | Temporary stocking within the Site | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-7 | Slope Mortar Job | 0 | m2 | 0 | 0 | 0 | USD | Cutting slope only | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-8 | Grassing for Slope Protection | 44,500 | m2 | 918 | 40,851 | 448,912 | USD | at all slope without Sealing Sheet. Humus Soil t=15 cm | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-9 | Retention Dam | 0 | m3 | 0 | 0 | 0 | USD | (if necessary) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-10 | Covering Soil Reinforcement | 0 | m2 | 0 | 0 | 0 | USD | (if necessary) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-11 | Earth Wall Reinforcement | 0 | m2 | 0 | 0 | 0 | USD | (if necessary) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-12 | Anchoring of Lining Sheet | 2,708 | m | 4,517 | 12,232 | 134,418 | USD | fixing points for edge of Sealing Sheet | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-13 | Installation of Lining Sheets (bottom) | 94,817 | m2 | 8,124 | 770,233 | 8,464,758 | USD | Double Sheet system | HDPE Sheet is Japanese Product (include import cost from Japan) |
| Public | LFC-14 | Installation of Lining Sheet (Slope) | 45,380 | m2 | 9,742 | 442,090 | 4,950,130 | USD | Double Sheet system | HDPE Sheet is Japanese Product (include import cost from Japan) |
| Public | LFC-15 | Preparation of Lining Base (bottom) | 94,817 | m2 | 657 | 62,294 | 694,549 | USD | t=50cm | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-16 | Protection Layer for Lining Sheet (bottom) | 45,380 | m2 | 5,664 | 257,938 | 2,834,484 | USD | Cutting slope. Mortar t=5 cm | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-17 | Preparation of Lining Base (Slope) | 87,863 | m2 | 1,124 | 98,758 | 1,085,253 | USD | t=50cm | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-18 | Water proof concrete for leachate pond | 6,954 | m2 | 6,144 | 42,725 | 468,505 | USD | Bottom and slope of Leachate Reservoir Pond(t=15 cm) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-19 | Coordination Tower | 1 | unit | 2,615,200 | 2,615 | 28,736 | USD | Concrete Structure | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-20 | Surface Water Collection and Removal Facility / Underground Water Collection and Removal Facility | 8,553 | m | 9,941 | 85,025 | 934,341 | USD | U-Ditch and Drainage Pipe (U300~1100, φ150,300,400) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-21 | Drainage Ditch for Inside of Landfill Area | 414 | m | 20,598 | 8,527 | 93,703 | USD | (Branch-φ200,300 (Perforated pipe), Main-φ600 HP VPI) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-22 | Drainage | 174 | m | 99,964 | 17,393 | 191,132 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-23 | Pipe for ground water collection | 8,102 | m | 6,267 | 50,775 | 557,867 | USD | Perforated pipe (branch pipeφ150, Mat W300, Main Pipeφ) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-24 | Monitoring for ground water | 1 | unit | 6,760,000 | 6,760 | 67,692 | USD | Monitoring well and house | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-25 | Final Collection Pit | 0 | m3 | 0 | 0 | 0 | USD | Including soil work | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-26 | Final Collection Pit | 1 | unit | 38,281,600 | 38,281 | 420,670 | USD | Concrete Structure | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-27 | Collection Pipeline (Trunk Line) | 730 | m | 68,324 | 49,876 | 548,089 | USD | Mainφ400~700 PE Pipe | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-28 | Leachate Collection and Removal Facility | 6,396 | m | 12,451 | 79,636 | 875,121 | USD | Branchφ200 polyethylene Porous Pipe | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-29 | Gas Collection and Removal Piping | 311 | m | 11,806 | 3,609 | 39,659 | USD | polyethylene Porous Pipe, φ200(20 m interval) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-30 | Gas Collection and Removal Piping (Vertical) | 62 | unit | 142,259 | 8,820 | 96,923 | USD | Polyvinyl chloride Pipe, φ300(40 m interval) | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-31 | Waste Carriage Road in Landfill Area (Concrete Rd.) | 12,000 | m2 | 4,225 | 50,700 | 557,143 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-32 | Landfill Management Facility | 22,000 | m2 | 0 | 0 | 0 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-33 | Dump Truck Weighing Scale | 1 | unit | 9,545,200 | 9,545 | 104,890 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-34 | Truck Tire Washing Facility | 1 | unit | 16,545,200 | 16,545 | 181,613 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-35 | Sign Boards and Gates | 1 | unit | 6,440,000 | 6,440 | 70,769 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-36 | Safety and Scattering Prevention Fence | 2,700 | m | 10,220 | 27,594 | 303,231 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-37 | Rain Water Regulating Reservoir | 1 | unit | 0 | 0 | 0 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-38 | Designated Temporary Works | 1 | unit | 0 | 0 | 0 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-39 | Temporary Road for Earth Work | 1 | unit | 84,280,000 | 84,280 | 926,154 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-40 | Temporary Drainage for Earth Work | 1 | unit | 14,028,000 | 14,028 | 154,154 | USD | | All material, labor, equipment will be supplied in Indonesia |
| Public | LFC-41 | Leachate Water Treatment Facility | 1 | unit | 0 | 0 | 0 | USD | leachate V=XXXXXt | All material, labor, equipment will be supplied in Indonesia |
| Public | (Landfill Construction - Sanitary Landfill) Sub Total | | | | | | 42,226,714 | USD | | |

| LTC (Leachate Treatment Construction) | | | | | | | | | | |
|---------------------------------------|--|----------------|----------|------|------------------|-------|------------------|------------|------------------|---------------------------------------|
| Public/Private | no | Item | Quantity | Unit | Unit price (JPY) | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| Public | LTC-1 | Civil Work | | | | | 1,074,000 | USD | | based on the unified local unit price |
| Public | LTC-2 | Machinery Work | | | | | | USD | 37000m³×USD13.32 | |
| Public | LTC-3 | Electricity | | | | | 7,700,000 | USD | | base of the Japanese products level. |
| Public | LTC-4 | Piping | | | | | | USD | | |
| Public | LTC-5 | Other | | | | | | USD | | |
| Public | (Leachate Treatment Construction) Sub Total | | | | | | 8,774,000 | USD | | |

| CAC (Common Area Construction) | | | | | | | | | | |
|--------------------------------|---|-------------------------------------|----------|------|------------------|-------|------------------|------------|---|---------------------------------------|
| Public/Private | no | Item | Quantity | Unit | Unit price (JPY) | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| Public | CAC-1 | Civil Work | | | | | 4,435,201 | USD | Access Road (inside Area (Scope Exclude Access Road)) | based on the unified local unit price |
| Public | CAC-2 | Parking site | | | | | 849,960 | USD | | based on the unified local unit price |
| Public | CAC-3 | Office building | | | | | 37,200 | USD | Pre-FS | |
| Public | CAC-4 | Management building | | | | | 18,688 | USD | Pre-FS | |
| Public | CAC-5 | Lobby/resting area | | | | | 50,890 | USD | Pre-FS (housing for worker/scavenger) | |
| Public | CAC-6 | Equipment for fire services | | | | | | USD | Pre-FS | |
| Public | CAC-7 | Electricity | | | | | 36,300 | USD | GENSET + Reservoir Pre-FS | |
| Public | CAC-8 | water supply | | | | | 39,160 | USD | Pre-FS | |
| Public | CAC-9 | Entrance loading scale installation | | | | | 17,903 | USD | Pre-FS | |
| Public | CAC-10 | Litiging inside | | | | | 320,787 | USD | Pre-FS | |
| Public | CAC-11 | Fence, gates | | | | | 342,265 | USD | Pre-FS | |
| Public | CAC-12 | Security facilities | | | | | 4,159 | USD | | |
| Public | (Common Area Construction) Sub Total | | | | | | 6,151,623 | USD | | |

| SC (Sorting Facility Construction) | | | | | | | | | | |
|------------------------------------|--|--------------------------------------|----------|------|------------------|-------|-------------------|------------|--|---------------------------------------|
| Public/Private | no | Item | Quantity | Unit | Unit price (JPY) | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| SPC | SC-1 | Civil Construction Work | 0.67 | | 16,656,515 | | 9,604,091 | USD | | based on the unified local unit price |
| SPC | SC-2 | Design work | | | | | 470,000 | USD | | |
| SPC | SC-3 | Equipment cost | | | | | 3,920,000 | USD | | |
| SPC | SC-4 | Equipment installation work | | | | | 750,000 | USD | | |
| SPC | SC-5 | Electrical and Instrumentation work | | | | | 330,000 | USD | | |
| SPC | SC-6 | Piping work | | | | | 240,000 | USD | | |
| SPC | SC-7 | Administration cost for construction | | | | | 146,000 | USD | Supposition/1person*6month | based on Japanese products level |
| SPC | SC-8 | Others works | | | | | 24,000 | USD | Supposition/1person*6month | |
| SPC | SC-9 | Weighing machine | | | | | 115,000 | USD | | |
| SPC | SC-10 | Crushing system | | | | | 220,000 | USD | | |
| SPC | SC-11 | Crushing system | | | | | 0 | USD | @¥5,000,000×3units = ¥15,000,000×0.01237\$ | |
| SPC | SC-12 | Wind-force sorting machine | | | | | 0 | USD | @¥5,000,000×30units = ¥150,000,000×0.01237\$ | |
| SPC | SIOM-1 | Heavy equipment | 1.0 | | 1,451,000 | | 1,451,000 | USD | ¥6,000,000/Unit/7m3 bucket/4units | |
| SPC | (Sorting Facility Construction) Sub Total | | | | | | 17,270,091 | USD | | |

| COMC (Compost Facility Construction) | | | | | | | | | | |
|--------------------------------------|--|---------------------|----------|------|------------------|-------|------------------|------------|------|--|
| Public/Private | no | Item | Quantity | Unit | Unit price (JPY) | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| SPC | COMC-1 | Building | 20,000 | m | 337.5 | | 4,750,000 | USD | | Based on experience of a contractor and a consultant in Indonesia |
| SPC | CIOM-1 | Loader | 7 | unit | 150,700 | | 1,054,900 | USD | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | CIOM-2 | Heavy Equipment | 10 | unit | 89,760 | | 897,600 | USD | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | CIOM-3 | Construction Work | 1 | unit | 770,000 | | 770,000 | USD | | Based on inquiry to a maker of a turner. |
| SPC | CIOM-4 | Vibrating strainers | 1 | unit | 162,173 | | 162,173 | USD | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | (Compost Facility Construction) Sub Total | | | | | | 7,634,673 | USD | | |

| LFIOM (Landfill Heavy Equipment) | | | | | | | | | | |
|----------------------------------|---|--|----------|------|------------------|------------|------------------|------------|------|-------------------------------|
| Public/Private | no | Item | Quantity | Unit | Unit price (JPY) | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| SPC | LFIOM-1 | Backhoe (0.7m) | 2 | unit | 15,000,000 | 30,000,000 | 329,670 | USD | | |
| SPC | LFIOM-2 | Heavy equipment construction work | 1 | unit | 27,000,000 | 27,000,000 | 296,793 | USD | | |
| SPC | LFIOM-3 | Landfilling compacting equipment (25t class) | 1 | unit | 45,000,000 | 45,000,000 | 494,505 | USD | | |
| SPC | LFIOM-4 | Dump truck (10t class) | 3 | unit | 12,000,000 | 36,000,000 | 395,604 | USD | | |
| SPC | (Landfill Heavy Equipment) Sub Total | | | | | | 1,516,484 | USD | | |

| LIOM (Leachate Heavy Equipment) | | | | | | | | | | |
|---------------------------------|---|-----------------|----------|------|------------------|-------|-------------|----------|------|-------------------------------|
| Public/Private | no | Item | Quantity | Unit | Unit price (JPY) | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| SPC | LIOM-1 | Heavy Equipment | | | | | 0 | 0 | | |
| SPC | (Leachate Heavy Equipment) Sub Total | | | | | | 0 | 0 | | |

| CAOM (Common Area Heavy Equipment) | | | | | | | | | | |
|------------------------------------|--|-----------------|----------|------|------------------|-------|---------------|----------|------|-------------------------------|
| Public/Private | no | Item | Quantity | Unit | Unit price (JPY) | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| SPC | CAOM-1 | Heavy Equipment | | | | | 60,975 | 0 | | |
| SPC | (Common Area Heavy Equipment) Sub Total | | | | | | 60,975 | 0 | | |

Project name: PPP Waste management Project in West Java
 Site: NAMBO
 Sheet: Annual O&M Cost

Currency: USD/yr
 Exchange rate: 81

| SO (Sorting Facility O&M) | | | | | | | | | | |
|---------------------------|---|----------------------------------|-----------------------------|--------|------------|------------|------------------|---------------|---|---------------------------------------|
| Public/Private | no | Item | Quantity | Unit | Unit price | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| SPC | SO-1 | Site Manager | 1 | person | 26,400 | | 26,400 | USD/yr | 1person*USD2,200/month*12month | |
| SPC | SO-2 | Operating Administration manager | 4 | person | 19,800 | | 79,200 | USD/yr | 8person*USD1,650/month*12month | |
| SPC | SO-3 | Employment cost | Plant equipment operator | 16 | person | 3,960 | 63,360 | USD/yr | 16person*USD330/month*12month | based on the unified local unit price |
| SPC | SO-4 | | Heavy Equipment Operator | 30 | person | 3,960 | 118,800 | USD/yr | 30person*USD330/month*12month | |
| SPC | SO-5 | | Maintenance Worker | 2 | person | 3,960 | 7,920 | USD/yr | 2person*USD330/month*12month | |
| SPC | SO-6 | | Worker (Hand Sorting) | 340 | person | 2,400 | 816,000 | USD/yr | person*USD200/month*12month | |
| SPC | SO-7 | Utility Cost | Electricity expense | | | 3,984,640 | 43,787 | USD/yr | 472kwh*8*16h=4531kwh/day | |
| SPC | SO-8 | Fuel for Heavy Equipment | Diesel oil | | | | 203,000 | USD/yr | Diesel oil unit per cost 7,000Rp/L wheel loader(7 m) : 25L/h*24hr/day*365day/year | |
| SPC | SO-9 | | Water | | | | 0 | USD/yr | | |
| SPC | SO-10 | Chemical Cost | Odor eliminating | 360 | day | 44 | 15,824 | USD/yr | Odor eliminating(600L*5L/day*360day/year=4,400,000) | based on Japanese practice |
| SPC | SO-11 | | Bug repellent | 360 | day | 40 | 14,242 | USD/yr | Bug repellent(4,200L*3L/day*360day/year=4,296,000) →4,736,000 | |
| SPC | SO-12 | Maintenance and Repairs cost | | Lmp | | 4,500,000 | 49,451 | USD/yr | JPY 4500000 | |
| SPC | SO-13 | Access Road Repairs Cost | | | | | 14,000 | USD/yr | | based on the unified local unit price |
| SPC | SO-14 | | Crushing system for compost | | | 14,400,000 | 158,242 | USD/yr | | |
| SPC | SO-15 | | Crushing system | | | | 0 | USD/yr | @40,000,000/year*0.01237\$ | based on Japanese practice |
| SPC | SO-16 | | Wind-force sorting machine | | | | 0 | USD/yr | @40,000,000/year*0.01237\$ | |
| SPC | (Sorting Facility O&M) Sub Total | | | | | | 1,610,225 | USD/yr | | |

| COM (Compost Facility O&M) | | | | | | | | | | |
|----------------------------|---|--------------------|---------------|--------|------------|--------|----------------|---------------|------|--|
| Public/Private | no | Item | Quantity | Unit | Unit price | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| SPC | COM-1 | Manager | 1 | person | 26,400 | | 26,400 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-2 | Equipment Operator | 40 | person | 2,640 | | 105,600 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-3 | Personnel Cost | QC Engineer | 2 | person | 2,640 | 5,280 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-4 | | Mechanic | 4 | person | 2,640 | 10,560 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-5 | | Common Worker | 10 | person | 1,320 | 13,200 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-6 | | Wheel Loader | 8,127 | hour | 19,36 | 157,339 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-7 | Fuel & Oil Cost | Dump Truck | 12,054 | hour | 10,89 | 131,268 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-8 | | Tractor | 2,040 | hour | 49,005 | 99,970 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-9 | | Screen | 5,680 | hour | 4,325 | 24,566 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-10 | Maintenance Cost | Wheel Loader | 8,127 | hour | 16,534 | 134,372 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-11 | | Dump Truck | 12,054 | hour | 6,169 | 74,361 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-12 | | Tractor | 2,040 | hour | 21,901 | 44,678 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | COM-13 | | Screen | 5,680 | hour | 7,851 | 44,594 | USD/yr | | Based on experience of a contractor and a consultant in Indonesia. |
| SPC | (Compost Facility O&M) Sub Total | | | | | | 872,188 | USD/yr | | |

| LFOM (Landfill O&M) | | | | | | | | | | | |
|---------------------|-------------------------------------|--------------------------|--------------------------------|-------------|------------|-------------|----------------|---------------|--|---|--|
| Public/Private | no | Item | Quantity | Unit | Unit price | Total | Total (USD) | Currency | Note | Reference (validity of costs) | |
| SPC | LFOM-1 | Manager | 1 | person | 19,800 | | 19,800 | USD/yr | 1people*USD1,650/month*12/month | Based on the local unit price. | |
| SPC | LFOM-2 | Heavy Equipment Operator | 4 | person | 3,960 | | 15,840 | USD/yr | 4people*USD330/month*12month | Based on the local unit price. | |
| SPC | LFOM-3 | Personnel | Maintenance Worker | 1 | person | 3,960 | 3,960 | USD/yr | 1people*USD330/month*12month | Based on the local unit price. | |
| SPC | LFOM-4 | | Worker | 3 | person | 3,960 | 11,880 | USD/yr | 3people*USD330/month*12month | Based on the local unit price. | |
| SPC | LFOM-5 | | Utility | Electricity | | | | 0 | USD/yr | | |
| SPC | LFOM-6 | Fuel (heavy equipment) | | | | | 275,440 | USD/yr | • Heavy equipments fuel is diesel oil. • Piece rate of diesel oil is 11,000Rp/L • Amount of fuel use(Equipments 1-3) is 8 hours/day, 300 days/year in production. Equipment 4 is for the transfer in plants. Thus they work 8 hours/day, 300 days/year in produc. | Quantity of heavy equipments are determined according to the regulations which set up a minimum of work of landfill in Japan, and calculated based on empirical value in Japan. | |
| SPC | LFOM-7 | | water | | | | 0 | USD/yr | | | |
| SPC | LFOM-8 | | chemicals | | | | 0 | USD/yr | | | |
| SPC | LFOM-9 | maintenance/repairing | | 1 | unit | 526,883,000 | 526,883 | 295,404 | USD/yr | | |
| SPC | LFOM-10 | Leading dike formation | Leading Dike Formation | 243,458 | m3 | 535 | 130,250 | 73,026 | USD/yr | | |
| SPC | LFOM-11 | | Lining Sheet (Slope) | 113,863 | m2 | 1,932 | 219,983 | 123,337 | USD/yr | | |
| SPC | LFOM-12 | | Leachate Drainage | 13,538 | m | 0 | 0 | 0 | USD/yr | | |
| SPC | LFOM-13 | | Gas Collection & Removal | 1,245 | m | 23,770 | 29,593 | 16,592 | USD/yr | | |
| SPC | LFOM-14 | Other | Covering soil | 22,690 | m3 | 355 | 8,054 | 4,516 | USD/yr | | |
| SPC | LFOM-15 | | Daily soil covering | 968,000 | m3 | 355 | 343,640 | 0 | USD/yr | | |
| SPC | LFOM-16 | | Topsoil covering | 55,533 | m2 | 803 | 44,592 | 25,001 | USD/yr | | |
| SPC | LFOM-17 | | Lining Sheet (top) | 55,533 | m2 | 0 | 0 | 0 | USD/yr | | |
| SPC | LFOM-18 | | Grassing on top | 55,533 | m2 | 288 | 14,882 | 8,344 | USD/yr | | |
| SPC | LFOM-19 | | Site protection and water pipe | 1 | unit | 49,804,423 | 49,804 | 27,923 | USD/yr | | |
| SPC | LFOM-20 | | Drainage collection (slope) | 7,352 | unit | 3,776 | 27,775 | 15,572 | USD/yr | | |
| SPC | (Landfill O&M) Sub Total | | | | | | 916,635 | USD/yr | | | |

| LTOM (Leachate Treatment O&M) | | | | | | | | | | |
|-------------------------------|---|--------------------------|--------------------|------|------------|--------|----------------|---------------|--|-------------------------------|
| Public/Private | no | Item | Quantity | Unit | Unit price | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| SPC | LTOM-1 | Personnel | Manager | 1 | person | 19,800 | 19,800 | USD/yr | 1people*USD1650/man*12month | |
| SPC | LTOM-2 | | Maintenance Worker | 2 | person | 3,960 | 7,920 | USD/yr | 2people*USD330/man*12month | |
| SPC | LTOM-3 | Utility | Electricity | | | | 23,300 | USD/yr | (Basic Price) 12month*20,000Rp/kVA*month*184kVA + (usage price) 2300kWh/day*365day*200Rp/kWh | |
| SPC | LTOM-4 | | Chemicals | | | | 560,000 | USD/yr | | |
| SPC | LTOM-5 | Water Quality Monitoring | | | | | 28,800 | USD/yr | Inlet-Outlet Every One Sample *12/year, times per year *USD1200/Sample | |
| SPC | LTOM-6 | Maintenance/Repair | | | | | 80,000 | USD/yr | | |
| SPC | (Leachate Treatment O&M) Sub Total | | | | | | 719,820 | USD/yr | | |

| CAOM (Common Area O&M) | | | | | | | | | | |
|------------------------|--|------------------------|---------------------------|--------|------------|--------|---------------|---------------|---|--------------------------------|
| Public/Private | no | Item | Quantity | Unit | Unit price | Total | Total (USD) | Currency | Note | Reference (validity of costs) |
| SPC | CAOM-1 | Director | 0 | person | 39,600 | | 0 | USD/yr | Directorperson*USD3,300/month*12month | |
| SPC | CAOM-2 | Vice MD Operator/Admin | 0 | person | 33,000 | | 0 | USD/yr | 2persons(Vice MD operator 1person,Vice MD administrator/finance 1person) * USD2,750/month*12month | |
| SPC | CAOM-3 | Personnel | Manager | 2 | person | 19,800 | 39,600 | USD/yr | 2persons (Acceptance & Measure, Accounting)* USD1,650/month*12month | Based on the local unit price. |
| SPC | CAOM-4 | | Back Office Worker | 12 | person | 3,960 | 47,520 | USD/yr | 12persons (Acceptance & Measure, Accounting)*USD330/month*12month | Based on the local unit price. |
| SPC | CAOM-5 | | Other Worker | 0 | person | 3,960 | 0 | USD/yr | Monitoring, Security Guards, Guard Post | |
| SPC | CAOM-6 | Utility | electricity | | | | 396 | USD/yr | • Base cost (Connection cost) :20,000 Rp/kVA*month*20kVA*12 months • Specific cost: 200 Rp/kwh*1400kWh/month*12 months | Based on the local unit price. |
| SPC | CAOM-7 | | Fuel for heavy equipments | | | | 0 | USD/yr | N/A | |
| SPC | CAOM-8 | | Water | | | | 5,400 | USD/yr | Piece rate of diesel oil is 7,000Rp/L | |
| SPC | CAOM-9 | Vehicles/Equipment | | | | | 0 | USD/yr | AQUA 40*30 persons/day*360days/year | Based on the local unit price |
| SPC | (Common Area O&M) Sub Total | | | | | | 92,916 | USD/yr | | |