

### H.2.5.2 Construction details of major components of the landfill facility

#### a. Installation of leachate collection facility

This work includes excavation, installation of perforated concrete pipe and covering with rubble stones, backfilling, moving of extra soil to stock pile yard and disposal of materials. The soil stocked at the yard shall be fully compacted and cured.

#### b. Gas ventilation facility

This work is to construct vertical and horizontal gas ventilation facilities at the designed location in accordance with drawings.

This work includes all required works such as excavation, installation of perforated pipe with rubble stone, moving of extra soil to stock pile yard and disposal of materials, etc according to the drawings.

#### c. Relocation of all existing waste & making gentle slope

This work is to relocate all existing waste and make gentle slope in order to keep the waste landfilling stable and maintain the nice view by minimizing the waste exposed area.

This work includes all required work such as excavation, transportation, dumping, spreading and compaction of all existing waste in accordance with drawings.

#### d. Installation of Bench (terrace)

This work is to construct the bench (terrace) on the gentle slope in accordance with drawings.

This work includes all required work such as excavation, compaction and installation of rip rap in accordance with drawings

#### e. Turfing

The turf shall be placed on the entire slope designated on the drawing and shall be fully taken care until turf is surely rooted.

#### f. Construction of the access road

This work is to construct asphalt paved and gravel faced access road in the Moon Plain landfill site in accordance with drawings. This work includes all required work such as survey, cutting and filling earth and compaction.

The asphalt paved access road is consisted of a road base, spreading and compacting 0-40 mm crushed stones with 4 m width and 25 cm thickness. The thickness of pavement of asphalt is 3cm. The sufficient density shall be obtained by compaction.

The gravel faced access road is consisted of a road base, spreading and compacting 0-40 mm crushed stones with 4 m width and 25 cm thickness. The sufficient density shall be obtained by compaction.

#### g. Construction of the storm water drainage (rip rap)

This work is to construct the rip rap along the slope of the waste filling and bench (terrace) in accordance with drawings. "Type A" shall be constructed along the slope, while "Type B" shall be constructed on the bench.

This work includes all required work such as survey, excavation, purchasing rubble stones, mortar bedding, stone pitching and filling mortar in gaps. The thickness of riprap lining shall be more than 15 cm.

**h. Construction of the earth drain**

This work is to construct the earth drain along the access road at the top of slope to the disposal area in accordance with drawings.

This work includes all required work such as survey, excavation, compacting soil and disposal of extra soil, material etc.

**i. Installation of fence, gate and handrail**

This work is to install the fence, Gate and Handrail in accordance with drawings.

The fence will be placed along the active dumping area. The gate will be installed at the entrance of the landfill site, while the handrail will be installed along the top of slope to the disposal area.

**j. Construction of tire wash pit**

This work is to construct the tire wash pit in accordance with drawings in order to prevent litter the waste or mud, attached to the collection vehicle.

This work includes all required work such as survey, excavation, purchasing material, backfilling, compacting soil, disposal of extra soil, material etc.

**k. Construction of Disposal Pit for Healthcare Waste**

This work is to construct a disposal pit for healthcare waste in accordance with drawings.

The disposal pit will be completely surrounded by a gate and a fence to ensure nobody except the landfill staff can enter.

In order to avoid the leachate generation from healthcare waste, the following facilities to avoid the entry of runoff water into the site will be provided.

- A roof to cover the whole disposal pit
- Drain surrounding the whole disposal pit to intercept the runoff water.

**l. Installation of monitoring well**

This work is to install a monitoring well in accordance with drawings in order to check the quality of ground water. The depth is approximately 10m and diameter is 50mm.

**m. Construction of treatment facility of leachate**

This work is to construct a treatment facility of leachate come from landfill at the end of the proposed landfill disposal area in the valley in accordance with drawings. The leachate treatment facility consists of several tanks filled with coconuts fibre and charcoal filter.

This work includes all required works such as excavation, installation of pipe, moving of extra soil to stock pile yard, backfilling, installation of wall wing and disposal of materials, etc.

**n. Construction of treatment facility of gully suck**

This work is to construct a treatment facility for gully suck discharged by Nuwara Eliya Municipal Council at the designed location in accordance with drawings. The gully suck treatment facility consists of sedimentation tanks and the other tanks fill with coconuts fibre.

This work includes all required works such as excavation, installation of pipe, moving of extra soil to stock pile yard and disposal of materials, etc.

**o. Plantation for wet land**

This work is to plant in order to polish the treated water come from treatment facility at the designed area in accordance with drawings.

**p. Plantation surrounding of the leachate treatment facility**

This work is to plant at the designed area in accordance with drawings in order to maintain the nice view by minimizing the landfill site exposed.

## **H.2.6 Operational Activities**

Operation will be done by Nuwara Eliya Municipal Council.

### **H.2.6.1 Details of operation and maintenance of components of landfill facility**

**a. Turffing on the Finished Slope**

Turffing on the finished slope is required for protection of the slope and mitigation of landscape.

**b. Extension of Gas Ventilation Pipes**

The gas ventilations will be placed at a spacing of 30m to 50m on the landfill cover. The gas ventilation pipes will be extended every layer of operation. The height of each layer is 2.0m; therefore the length of each extended gas is required 3.0m.

**c. Maintenance of Installed Facilities**

Fence, access road will be maintained when these are damaged. The drain will be cleaned every one month in order to prevent from blocking.

**d. Reception of Visitors**

The site will welcome visitors because this will be the model sanitary landfill site for Sri Lanka. Municipal Council staff will explain the design, operation and maintenance system for the landfill operation.

**e. Management of sludge of leachate treatment system**

The leachate treatment facility requires the following O&M works.

- 1) Replacement of coconuts fibre every five years and to be discharged to the landfill site
- 2) Replacement of charcoal filter periodically and to be discharged to the landfill site whenever necessary.
- 3) Removing of sludge periodically and to be discharged to the landfill site whenever necessary

**f. Details of usage of cover material**

The term cell is described the volume of material placed in a landfill during one operating period, usually one day (See

Figure H.2-22). A cell includes the solid waste deposited and the daily cover material surrounding it. The stock piling of extra soil generated by the construction of sanitary landfill site and the dredged soil at the Gregory Lank at Nuwara Eliya is utilized for daily cover material.

The advantages of using daily cover are primarily in preventing windblown litter and odours, birds and vermin and in improving the site's visual appearance. It is also advocated as a means of shedding surface water during the filling sequence, thereby leachate management by reducing infiltration. At sites where daily covered is spread by bulldozer, a thickness less than 150mm will not be feasible, keeping in view the uneven surface of the waste.

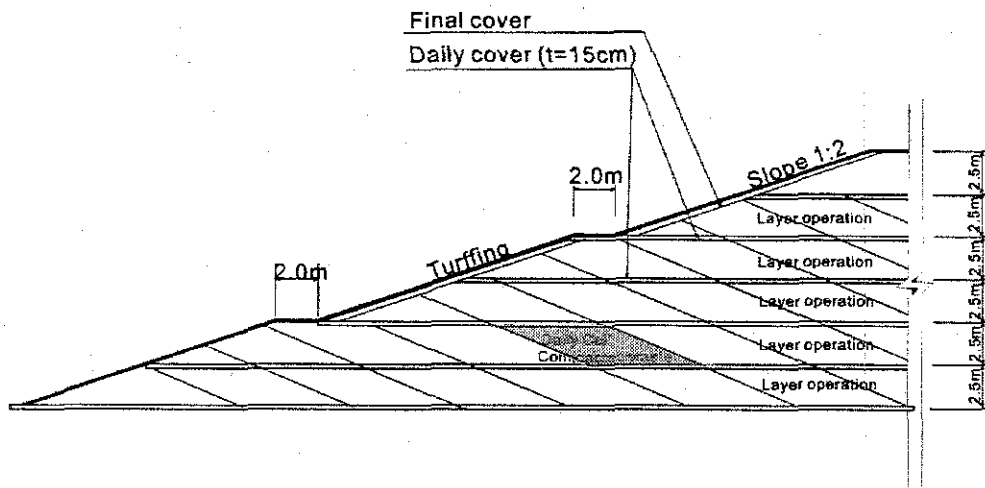


Figure H.2-22: Daily Cell and Daily Soil Cover

A layer is a complete cells over the active area of the landfill. The procedure of layer operation is shown in Figure H.2-23 to Figure H.2-27.

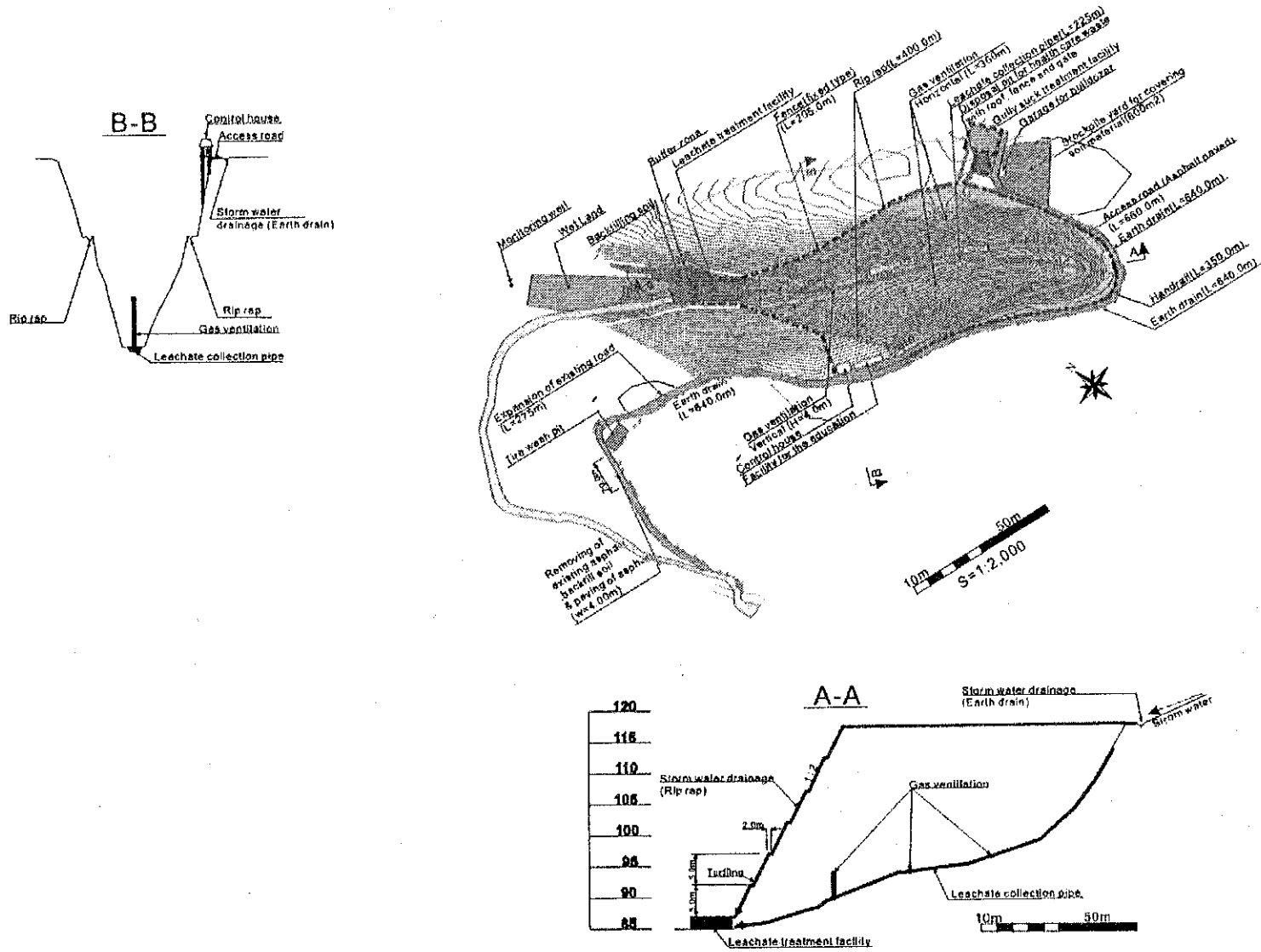


Figure H.2-23: Before Relocation of Existing Waste

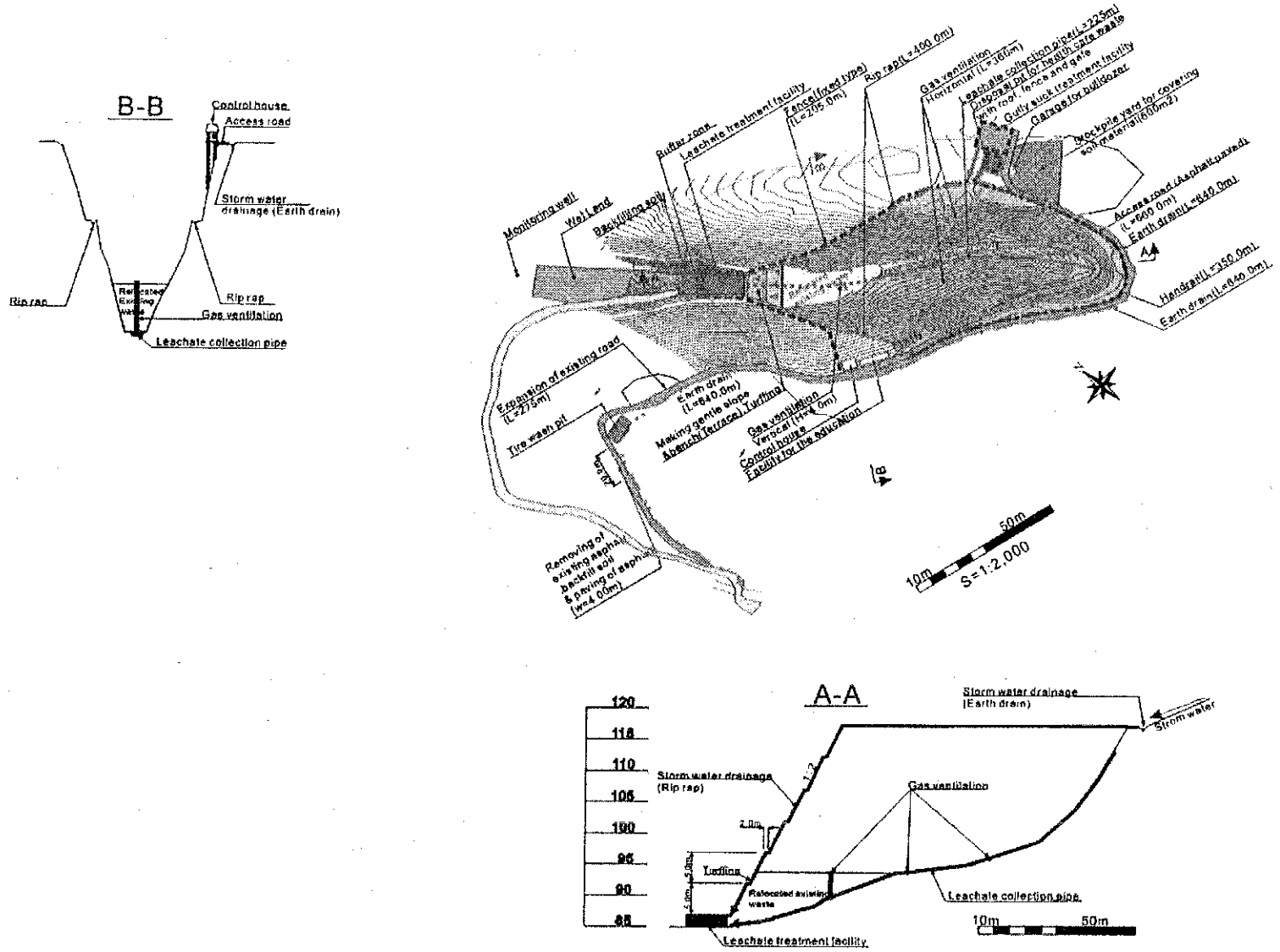


Figure H.2-24: After Relocation of Existing Waste

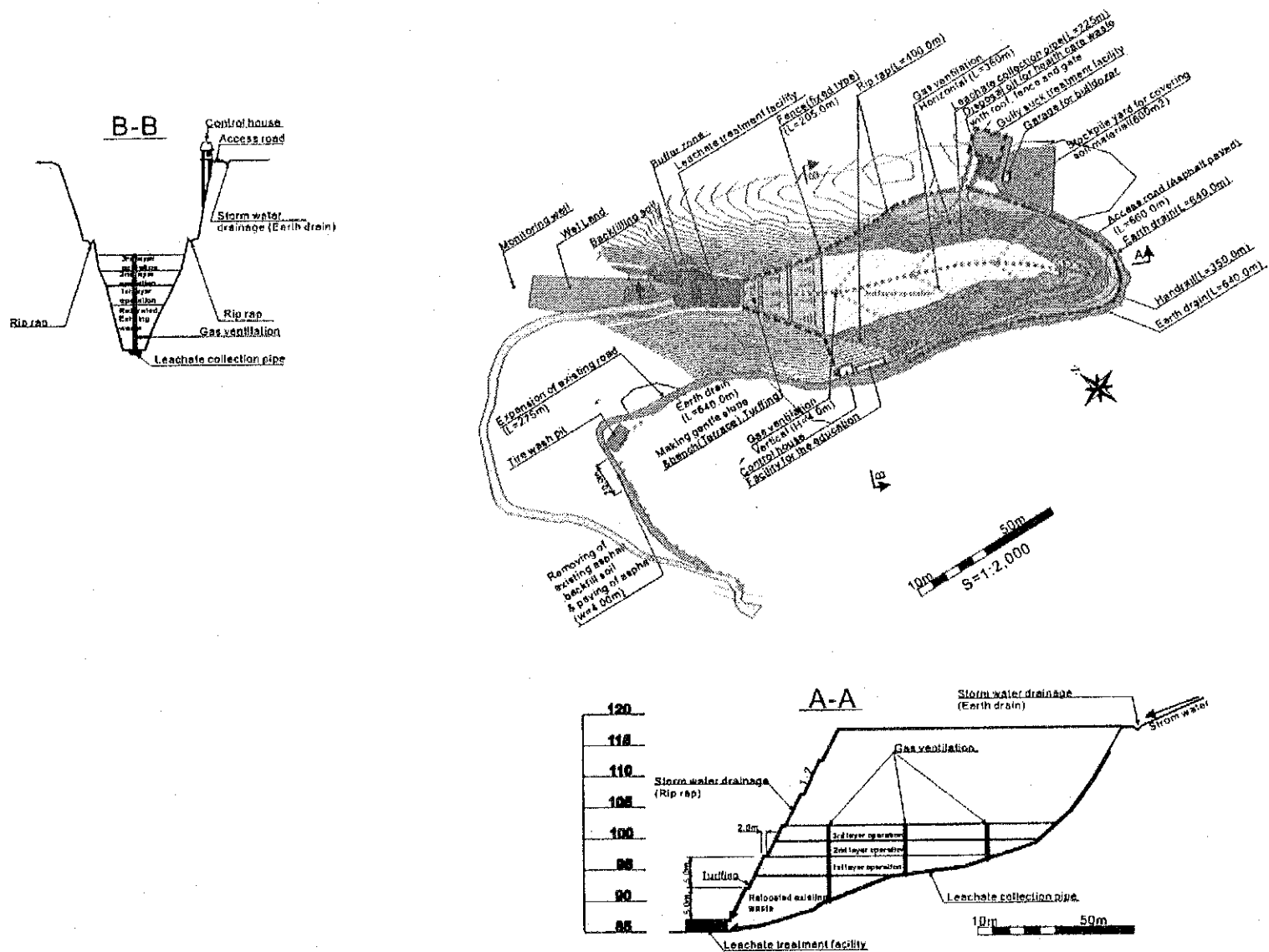


Figure H.2-25: After 3<sup>th</sup> Layer Operation

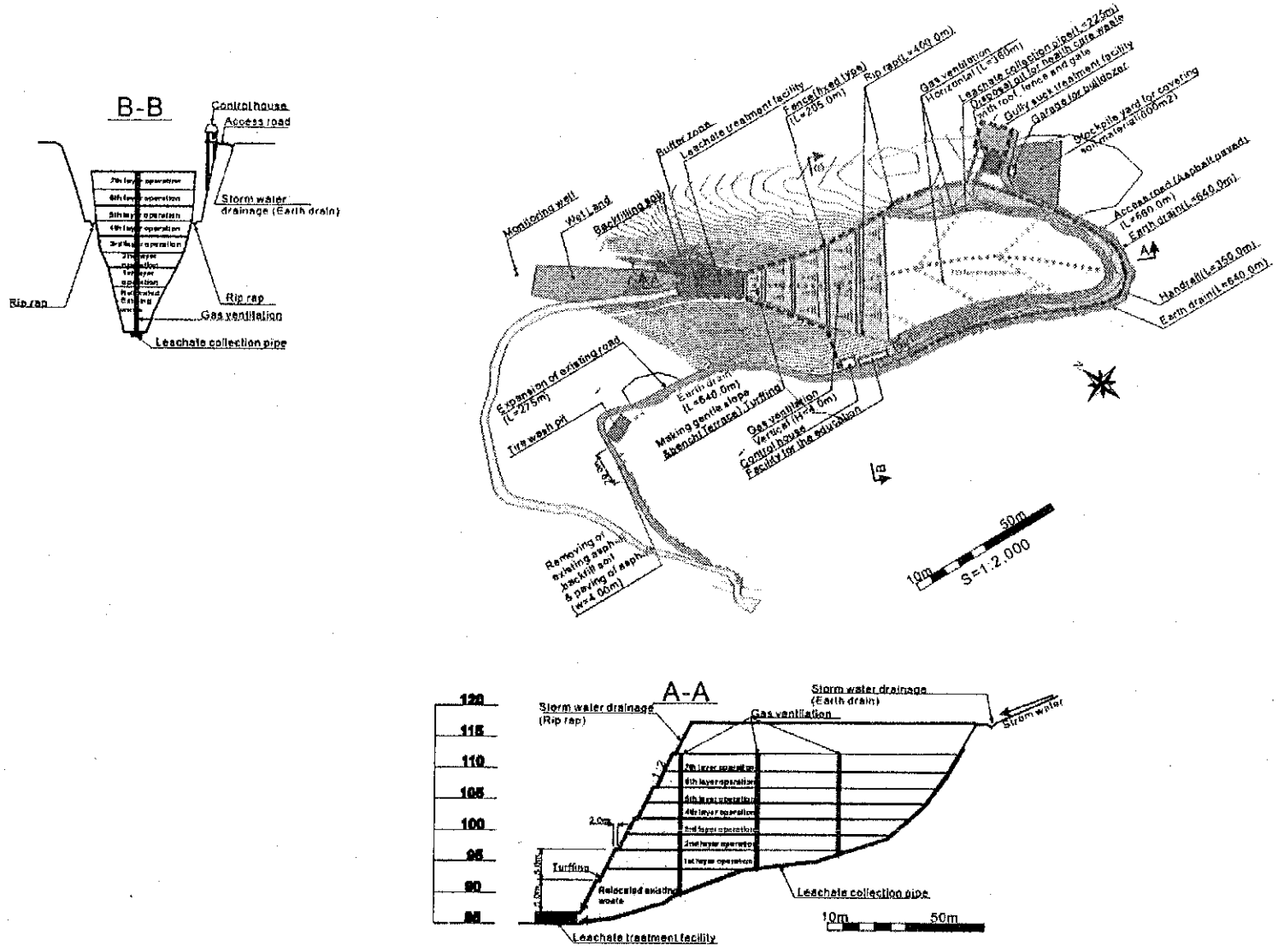


Figure H.2-26: After 7<sup>th</sup> Layer Operation



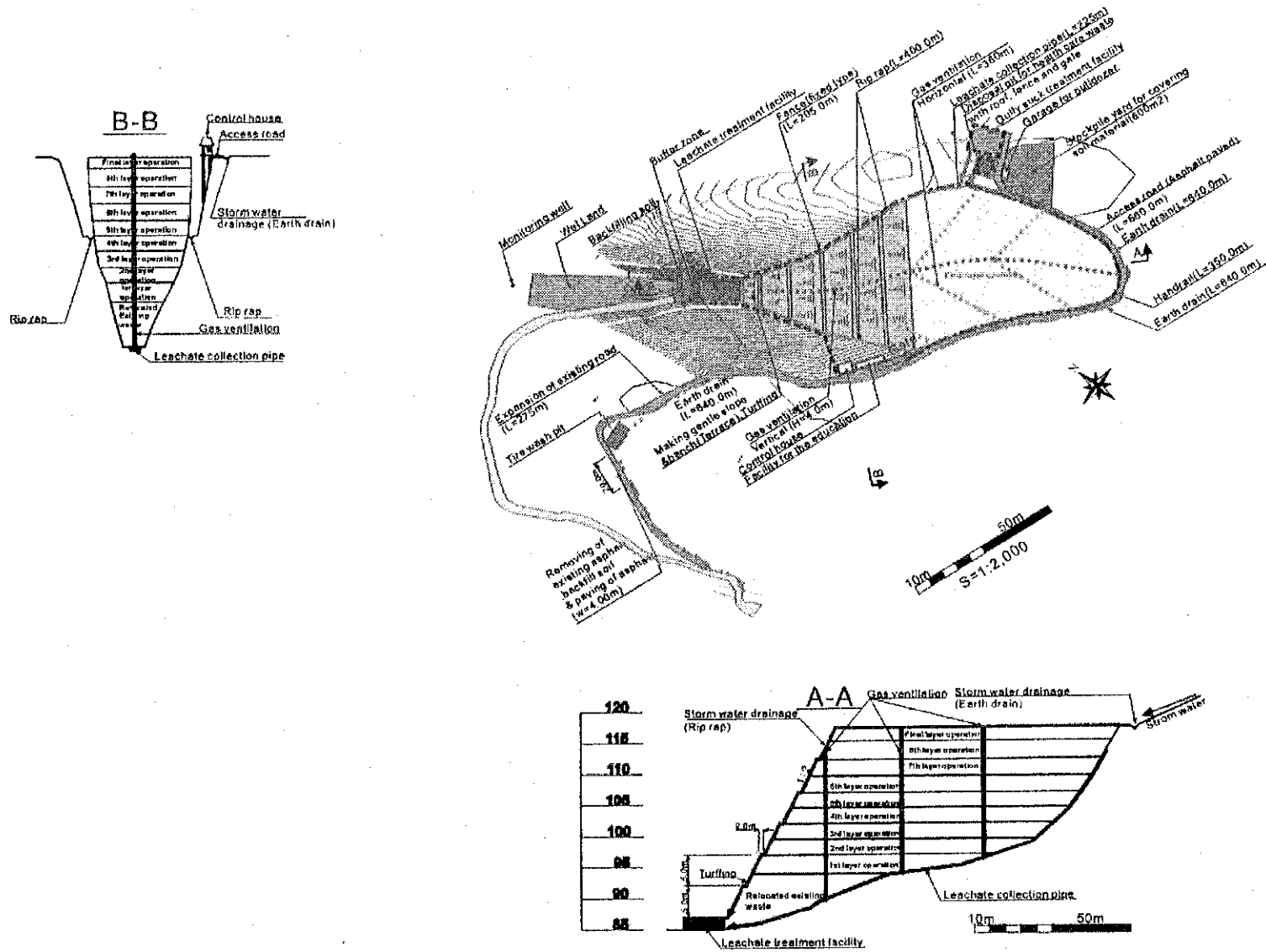


Figure H.2-27: After Final Layer Operation

## H.2.7 Work force, equipment and materials

### H.2.7.1 Requirement of labour and employment of local people

No labour and employment of local people is required for preconstruction and construction. JICA project will arrange necessity labour for the construction.

Nuwara Eliya Municipal Council will arrange following manpower for operation of landfill site.

- Manpower
  - Supervisor (not full time): 1 person
  - Operator of Bulldozer: 1 person
  - Foreman: 1 person
  - Guard & record keeping: 1 person
  - Labour: 2 persons

### H.2.7.2 Heavy equipment

JICA will donate the following necessity heavy equipment, while Nuwara Eliya Municipal Council will supply fuel and lubricant oil for a bulldozer

- A bulldozer (full time) 1 unit

### H.2.7.3 Availability of skilled labour in the area

Unskilled labour is available for operation of sanitary landfill site.

### H.2.7.4 Occupational health and safety provided

Following items will be provided by Nuwara Eliya Municipal Council as Occupational health and safety

- Long rubber boot
- Gloves
- Helmet

### H.2.7.5 Facilities required or provided

Required facilities are as follows,

- Control house
- Garage for Bulldozer

## H.2.8 Evaluation of alternatives

Final disposal is essential component in solid waste management because some of waste will still remain even after being fully reused and recycled. The landfill disposal is, therefore, absolutely necessary component even though the processing or treatment technologies such as composting, incineration, biogas, recycling, etc. are fully employed.

However, the introduction of processing or treatment technology could be the right option, if the solid waste management cost including landfill disposal cost and transportation cost is very expensive due to the difficulty to acquire a new landfill site nearby. As for the Moon Plains Landfill Site, the site near

from the town centre has been acquired. It is, therefore, the transportation cost and land acquisition cost will not affect the decision. Only the investment for the improvement of landfill facility and the operation and maintenance cost should be considered.

Therefore, the landfill operation and maintenance cost and the treatment cost with landfill cost will be examined.

#### H.2.8.1 Treatment with sanitary landfill

Among proven processing or treatment technologies, the composting technology is the most suitable technology for the waste in Nuwara Eliya because of high percentage of organic matters, more than 75%, and in addition there is large demand of compost for active agriculture. However, little income can be expected from compost from waste because the prices of cow dung and poultry manure, which are competitors for waste compost, is now only about 2 Rs. and 1.25 Rs. per kilogram respectively. In order to compete with these, the estimated price of compost is only 2 Rs. per kilogram. This price is not enough to cover even the composting operation cost. Therefore, the required cost for composting without any subsidies is said more than **500 Rs. per ton** of waste. For example, the contract rate including compost process between Colombo Municipal Council and the private company, Burns Trading Co., is 550 Rs/ton.

#### H.2.8.2 Sanitary landfill

The landfill cost is estimated as follows.

Estimated investment for the improvement of Moon Plain landfill site:	9,000,000 Rs.
<u>Waste amount to be received during the life years (20 years):</u>	<u>146,000 ton</u>
Unit cost of investment:	68 Rs./ton
<u>Unit operation cost (daily soil cover, lechate treatment, gas ventilation, etc.):</u>	<u>250 Rs./ton</u>
Total	318 Rs/ton

The landfill disposal is, therefore, the cheapest option for Nuwara Eliya Municipal Council.

## H.3 Description of the exiting environment

### H.3.1 Present Physical Environment Condition of Moon Plains Landfill Site

The present physical environment and operation conditions of the existing open dumping site are summarized below.

Table H.3-1: Present Physical Environment Condition of Moon Plains Landfill Site

Item	Description
1. Name of Landfill site	Moon Plains -- Nuwara Eliya
2. Since	1996
3. Land ownership	Department of Forest
4. Surrounding land use	It is located in the Plantation forest which belongs to the Forest Department. The forest where the landfill site is located is surrounded by agricultural land and tea estate land. The landfill site is located outside of Nuwara Eliya Municipal Council area.
5. Topography	The landfill site is located in a valley where lies from the north east to south west surrounded by plantation forest. The length of valley is approximately 400m and the depth of it is 30m to 40m. There is stream approximately 500m below the valley. The stream finally flows into the Bomuraella reservoir where water is being taken for irrigation as well as for domestic purposes. The valley where the existing landfill site is located catches rainwater within the meadow land owned by agricultural department upside of the valley.
6. Geology and Soil	The overburden consist of a residual formation of sandy clays, clayey sand followed by the stronger layer of very highly weathered rock and end up with hard rock over all the tested area. Thickness of the soil layer is very from 0.85 m to 3.75 m. The permeability (k) of borehole is $0.15-4.28 \cdot 10^{-7}$ m/s.
7. Meteorology	The site is situated in Upcountry Wet-zone that has bimodal rainfall pattern with 2700 mm annual average rainfall. (Annex VII Rainfall Data)
8. Hydrology	There is a seasonal stream (Ephemeral Type) at the bottom of the valley, Which already contaminated with dumped waste. The seasonal steam is connected to perennial stream flow 500 m below the valley. Ground water was not encountered at the distance about 15-20 m from the seasonal stream at the site. Total catchments area including the valley is about 5.8 Hectare. The particular catchments area is located outside of the Nuwara Eliya water intake facilities and there are no shallow or deep wells in lower areas. Underneath of the soil layer There is a impermeable Very highly weathered rock follow by a bedrock. The thickness of the soil layer is 0-3.7m. (Annex VI Geological Survey). Occurrence of flooding is not evident due to high elevation. The quality of the surface water and the Leachate has described in Annex VIII.
9. Land Use (Information of plantation forest)	-Code of Forest: B/SB02/003 -Plantation year: 1975 -Species of trees: <i>E. grandis</i> -Total area of plantation forest: 22.2 ha
10. Surrounding Area	Dumping area: 2.0 ha Catchments area: 5.8 ha -Dumping site: 2.0 ha -Plantation forest: 2.9 ha (mainly above the existing Road) -Agricultural land: 0.9 ha (Mainly part of grassland /Paddocks -Seethaeliya Farm) The land use pattern of surrounding area is described in <u>figure 01</u> .
11. Disposal site	-Disposal method Open dumping method. No environmental protection measures are taken.

Item		Description					
12. Waste discharged	-Municipal waste	Executing organization for collection: Nuwara Eliya M.C. Discharge amount: 20 ton/day in the average					
	-Health care waste	Executing organization for collection: Nuwara Eliya Municipal Council Discharge amount: 0.1 ton/day in the average					
	-Industrial waste	Main discharge source: 1. Inter-Fashion Garment factory 2. Winter World collection Discharge amount: 2 ton/day in the average					
	-Sewage	Executing organization of collection: Nuwara Eliya Municipal Council Discharge amount: 7.0 m <sup>3</sup> /day in the average The types and number of gully sucker tanker: one 7000 litter truck The number of trips per day of gully sucker discharger: 1 trip/day					
13. Air Quality	Inventory of existing emission sources	The emission source is existing dumped waste.					
13. Current condition of Environmental impact	-Odour	There is strong odour throughout the year mainly due to no soil cover.					
	-Pests	There are many pests throughout the year mainly due to no soil cover.					
	-Dogs	There are many dogs throughout the year mainly due to no soil cover.					
	-Fire & Smoke	There is almost always fire and smoke from waste dumped.					
	-Leachate	There is leachate flowing from waste dumped due to lack of covering soils and leachate treatment facilities, although the leachate amount is little.					
	-Sewage	Sewage is discharged to pits excavated near the landfill site. It often overflows from pits and deteriorated the forest.					
14. Facilities	-Control house	1 hut					
	-Gate	None					
	-Fence	None					
	-Weigh bridge	None					
	-Leachate treatment	No facility					
	-Buffer zone	Existing forest is acting as buffer zone					
	-Electricity	None					
	-Water supply	None					
-Telephone line	None						
15. Operation and Maintenance	-Executing organization	Nuwara Eliya Municipal Council					
	-Equipment	<b>One backhoe loader (JCB)</b> -The number of unit: One -Owner: MC Nuwara Eliya -Working hours (normal): 4 hours per Day -Operation & Maintenance cost Diesel: 30,000.00 Rs/month Lubricant: 12,000.00 Rs/month Insurance: 30,514.89 Rs/year					
	-Staff allocations	Position	Duty	Nos.	Monthly Salary	Working hours	
	Supervisor	Supervision	1	Rs: 7929.00	8:00 to 17:00		
	Assistant supervisor	Supervision	1	Rs: 7523.40	8:00 to 17:00		
	Labour	Waste Unloading	4	Rs: 7340.00	8:00 to 17:00		
	Backhoe Operator	Backhoe operation	1	RS: 6000.00	2 hours in day shift		
16. O&M cost	Item	unit	Unit rate	Ratio for SWM	Qty	Cost (Rs/yr)	Remarks
	Supervisor	Rs/yr	95,148	100%	1	95,148	7,929 Rs/m
	Assistant supervisor	R/yr	90,281	100%	1	90,281	7,523.4 Rs/m
	Labour	Rs/yr	88,080	100%	4	352,320	7,340 Rs/m
	Backhoe operator	Rs/yr	72,000	50%	1	36,000	6,000 Rs/m

Item			Description				
JCB (3CXSI DESHI FT)	Diesel	Rs/month	30,000	50%	12	180,000	Working hours (normal): 4 hours per Day
	Lubricant	Rs/month	12,000	50%	12	72,000	
	Insurance	Rs/yr	30,515	50%	1	15,257	
Total cost						841,006	
Total waste disposal amount		tonne/y			7,300	n/a	20ton/day
Unit O&M cost						115.2	(Rs/ton)

### H.3.2 Present Ecological Environment Condition of the Moon plains Site

The present Ecological Environment of the existing open dumping site is summarized below.

Table H.3-2: Present Ecological Environment of the Moon Plains Landfill Site

Item	Description
1. Existing natural habitats Surrounding land	It is located in the Plantation forest which belongs to the Forest Department. The forest where the landfill site is located is surrounded by agricultural land and tea estate land. The diversity of flora and fauna is insignificant within the site due to monoculture forest plantation ( <i>Eucalyptus grandis</i> ). Outside of the site area is also plantation forest surrounding diameter of about 500m Except the lower valley which consist of a strip of Mountain forest.
2. Distribution and density of species identified	The planted tree species is <i>E. grandis</i> with the density of 375 trees per hectare. Most extent of the flora and fauna has already damaged by inappropriate waste disposal and fire.
3. Identification of Rare, threatened and Endemic species	There is a strip of Mountain rainforest along the stream below the existing site starting of about 500 m from the boundary of site. Some common tree species in mountain forests as follows Keena ( <i>Calophyllum walkari</i> ), <i>Syzygium Sp</i> , <i>Stobilanthus Sp</i> , <i>Godonia zeylanica</i> etc. were identified.

### H.3.3 Present Socio- Economic Condition of the Moon plains Site

Socio –Economic Environment conditions of around the existing landfill site are summarized below.

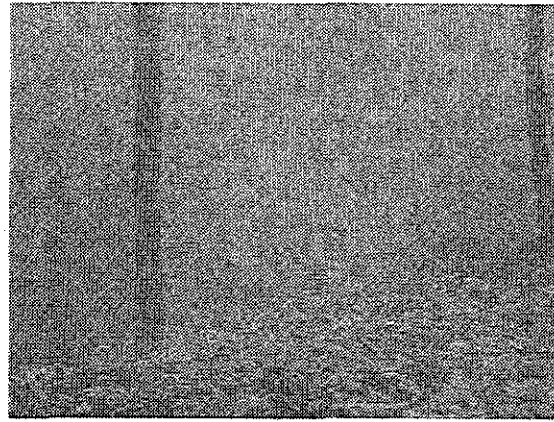
Table H.3-3: Present Socio- Environment Condition of around Landfill Site

Item	Description
1. Location of centres of population and settlement (Surrounding Villages)	<p>1. Moon Plains Village: The total number of household is about 150. Most of the households are middle and low income farm families depend on vegetable cultivation. The least distance from village boundary to the Site is about 600 m.</p> <p>2. Vajirapura Village: The total number of families in the village is around 350. There are high, middle and low income families in the village and village is located more than 1km away from the site.</p> <p>3. Badulu Ella Village: The total number of families is around 80 and Most of the families are farmers. Located 1.5 km away from the Site.</p>
2. Existing Infrastructure facilities	There is no Water or electricity supply to the site. Surrounding villages are facilitating with electricity.
3. Water supply	The domestic and irrigation water requirements are fulfilled by shallow wells and perennial streams around villages but in different catchments demarcated by a mountain range.
4. Religious and cultural centres	The Moon Plains Temple is located around 1km from the Site area and there is no any other than that.
5. Transportation	<p><b>Road Network:</b> The main access road to moon plain village start from the Gregory lake side and connect to the udapussallawa main road near Havaeliya. The access road to the site is started from end of village as a by-lane, distance about 600 m from the boundary of village. Therefore two entrance for the site via Havaeliya and Moon plains.</p> <p>There is no Housing, water supply or electricity to or near the site.</p>

### H.3.4 Existing Problems

Waste is currently just dumped into the valley from the road without any environmental protection measures taken. The existing landfill site has, therefore, caused the following adverse impacts to the surrounding environment.

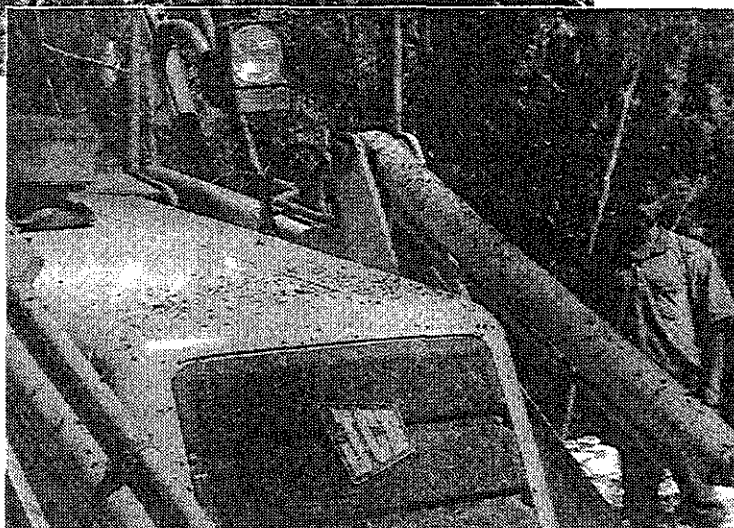
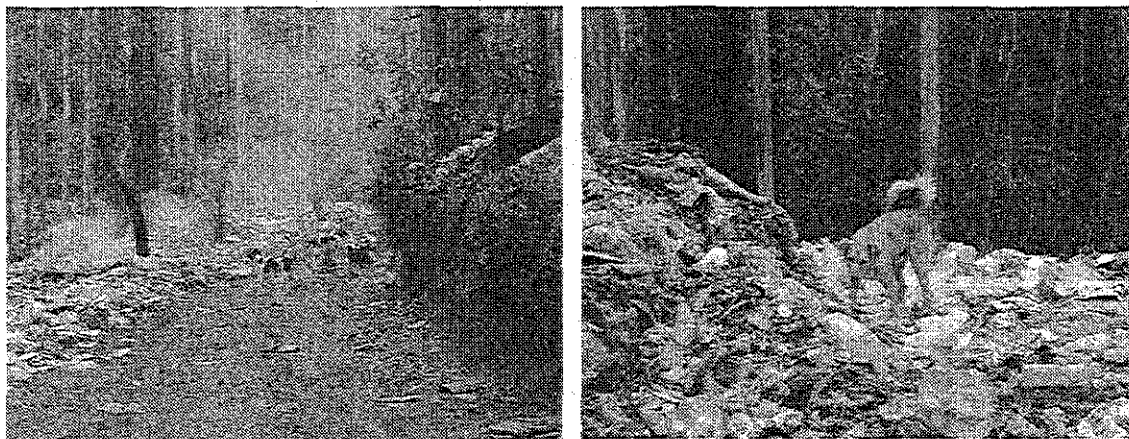
- 1) Almost always some of waste disposed of at the site is burning due to the inflammable waste and it is generating much smoke.



- 2) Many trees inside and near the dumping area are dying.
- 3) The number of existing stray dogs which eat food waste at the landfill site are many, more than one hundred at present. They sometimes attack people in and near the landfill site.







- 4) There are large number of vermin, flies in particular, at the site.

## **H.4 Assessment of Anticipated Environmental Impacts**

This chapter describes the overall effects on the individual environmental components during construction and operation of the Improvement Project of the Moon Plains Landfill Site.

### **H.4.1 Scoping for the Impacts during construction and Operation**

The impact due to construction and operation have been scoped tabular format and described in following Table H.4-1.

Table H.4-1 shows the scoping for the Constructional and Operational Impacts.

Table H.4-1: Scoping for Constructional and Operational Impacts

No.	Environmental Item	Description	Evaluation	Reason
<b>Social Environment</b>				
1	Resettlement	Resettlement due to land acquirement for project(s) (transfer of rights of land ownership/residence).	D	No houses/residents within the site because it has been used for waste disposal since 1996..
2	Economic Activities	Loss of bases for economic activities (e.g. land) and effects on these activities.	C	The site is located within a plantation forest owned by the Ministry of Environment and Natural Recourses and it has been used as a Timber Forest since 1975. Replanting will be, therefore, affected.
3	Traffic and Public Facilities	Impacts on schools, hospitals, etc. and traffic conditions (e.g. increased traffic congestion/accidents).	D	No public facilities in and near the landfill site. There will not be a change in existing traffic condition because the waste collection amount will be unchanged.
4	Division of Community	Division of Community geographically due to project location, interruption of area traffic, etc.	D	No community in and near the site.
5	Cultural Property	Damage to or loss of value of churches, temples, archaeological remains or other cultural assets.	D	No cultural property in and near the site.
6	Water Rights/ Access Rights	Obstruction of fishing rights, water rights and rights of common access.	D	No water/fishing rights will be affected.
7	Public Health	Deterioration of public health and sanitary conditions due to waste generation and increase in pathogens/vermin.	C	Deterioration of public health and sanitary condition has already occurred due to the present open dumping practice. The landfill improvement project should consider to reduce the existing public health risks.
8	Constructional Waste	Generation of construction wastes/debris.	D	All excavated soil will be utilized for covering waste. Therefore, no construction waste will generate.
9	Hazards/Risks	Increase in natural disasters (e.g. landslides) and man-made hazards (e.g. landfill gas explosions, waste fires).	C	The present condition has some of risks, especially the forest fire caused by waste fire. The landfill improvement project should consider to reduce the existing various risks.
<b>Natural Environment</b>				
10	Topography and Geology	Changes of valuable topography and geology due to excavation, construction and/or filling works.	C	Natural environment has already been deteriorated by the current waste open dumping. The scale of construction excavation works should be small but land filling may change the natural slope; some soil may be taken from other areas for covering material for landfill - impact on these other areas should be considered although impact is likely to be small.
11	Soil Erosion	Topsoil erosion by rainfall after earth filling and deforestation.	C	Impact of deforestations and soil erosion after excavation and construction should be considered although it likely to be small.
12	Groundwater	Changes in groundwater level due to infiltration of leachate and run-off from disposal site.	D	Groundwater level will not be affected because the existence of impermeable bed rock layer approximately 3.5 meters below the original ground.

No.	Environmental Item	Description	Evaluation	Reason
13	Hydrological Situation	Changes in river discharge and riverbed condition due to inflow of run-off and landfill.	D	Impact on surface water sources in vicinity of landfill is likely to be small due to small land scale.
14	Coastal Zone	Coastal erosion and changes in vegetation due to coastal reclamation and coastal changes.	D	Project will not impact on coastal zone.
15	Fauna and Flora	Obstruction of breeding and extinction of species due to changes in habitat conditions.	D	Flora has already been damaged up some extend by open dumping operation. Further the risk of extinction of Flora and fauna is likely to be insignificant due to small scale of land area.
16	Meteorology	Changes in temperature, rainfall, wind, etc. due to large scale land changes and building construction.	D	None; scale of landfill is too small to produce such changes.
17	Landscape/ Aesthetics	Changes in topography and vegetation due to earthworks; deterioration in environmental aesthetics.	C	Topography and vegetation will be affected by land filling, although it will be likely to be small due to small land scale. The landfill plan should consider the minimization of impacts to the landscape and aesthetics.
<b>Pollution</b>				
18	Air Pollution	Pollution caused by exhaust/toxic gases, dust, smoke, fumes, etc. from waste collection vehicles and the landfill site.	C	There is air pollution condition caused by open burning, fire and landfill gas emission. The improvement project should target to reduce the present air pollution.
19	Water Pollution	Pollution caused by inflow of sand, silt, leachate and run-off from disposal site into rivers, groundwater and sea near river discharges.	C	There is possibility that some shallow groundwater polluted by leachate due to no leachate collection and treatment facilities at present. The improvement project should target to minimize the negative impact to groundwater within the permissible level.
20	Soil Contamination	Contamination of soil by leakage and diffusion of ash, leachate, etc.	C	Due primarily to leachate and hazardous/toxic substances in waste.
21	Noise and Vibration	Noise and vibration generated by waste collection vehicles and landfill site equipment.	D	The natural forest surrounding landfill site may act as a buffer zone so as to prevent noise and vibration affects on surrounding villages.
22	Land Subsidence	Deformation of land and land subsidence due to lowering of groundwater table.	D	Groundwater level will not be changed because no pumping groundwater.
23	Offensive Odour	Generation of offensive odour from landfill site, associated treatment facilities and during waste transportation.	C	There is odour due to landfill gases, waste smell and leachate from open dumping. The improvement project should consider to mitigate the present offensive odour.
24	Litter	Scattering of litter from landfill site and waste collection vehicles.	C	There are waste scattering in and around the site. The improvement project should consider to mitigate the present waste scattering.

Note: Evaluation categories: A - serious impact expected; B - some impact expected; C - extent of impact unknown (examination needed); D - no impact expected; IEE not necessary

## H.4.2 Evaluation of Environmental Impacts for Each Item

### H.4.2.1 Constructional Impacts

Table H.4-2: Environmental Economic Activities

Item	<b>2. Economic Activities</b>
Description	Loss of bases for economic activities (e.g. land) and effects on these activities
<b>Causes of Impacts</b>	
<ol style="list-style-type: none"> <li>1. Acquisition of extra land area for improvement of disposal site.</li> <li>2. Removal of trees within existing and proposed site area.</li> <li>3. Construction of necessary facilities for the sanitary landfill operation.</li> </ol>	
<b>Possible Environmental Impacts</b>	
<ol style="list-style-type: none"> <li>1. Loss of land area for future forest replantation.</li> <li>2. Reduction in timber production due to uprooting plants/trees.</li> </ol>	
<b>Possible Counter-Measures</b>	
<p>In order to minimize the required land for the landfill development by prolonging the life year of the site, the following measures should be considered.</p> <ol style="list-style-type: none"> <li>1. Reduction of the waste discharge amount by the promotion of 3 Rs (Reduce, Reuse, Recycle).</li> <li>2. The waste treatment technologies to reduce the waste final disposal amount should be considered in future as the next step of the sanitary landfill improvement.</li> </ol>	

Table H.4-3: Hazards/Risks

Item	<b>9. Hazards/Risks</b>
Description	Increase in natural disasters (e.g. landslides) and man-made hazards (e.g. landfill gas explosions, waste fires)
<b>Causes of Impacts</b>	
<ol style="list-style-type: none"> <li>1. Changes in natural environment (topography, ground stability, etc.) due to construction, operation and after-care of disposal site.</li> <li>2. Introduction of man-made hazards due to construction, operation and after-care of disposal site.</li> </ol>	
<b>Possible Environmental Impacts</b>	
<ol style="list-style-type: none"> <li>1. Increased occurrence of natural disasters in area around landfill.</li> <li>2. Increased occurrence of man-made disasters (e.g. landfill gas explosions, waste fires)</li> </ol>	
<b>Possible Counter-Measures</b>	
<ol style="list-style-type: none"> <li>1. To keep the gentle slope of the land filled waste to avoid the landslip.</li> <li>2. Installation and extension of gas ventilation system.</li> <li>3. Conduction of daily soil cover.</li> <li>4. Preparation of operation manual and training of it to staff.</li> </ol>	

Table H.4-4: Topography and Geology

Item	10. Topography and Geology
Description	Changes of valuable topography and geology due to excavation, construction and/or filling works
<p><b>Causes of Impacts</b></p> <ol style="list-style-type: none"> <li>1. Excavation of soil during construction works at landfill site.</li> <li>2. Excavation of suitable soils for covering material of landfill from other areas.</li> </ol> <p>Note: Natural environment of landfill site has already been seriously changed by open dumping operation.</p>	
<p><b>Possible Environmental Impacts</b></p> <ol style="list-style-type: none"> <li>1. Damage to valuable topography and geology due to excavation works during construction and/or obtaining covering material from other areas.</li> </ol>	
<p><b>Possible Counter-Measures</b></p> <ol style="list-style-type: none"> <li>1. Careful construction planning and management with specification of standards/procedures to be followed for all excavation works in project documents.</li> <li>2. Good excavation practice (e.g. minimizing exposure of bare soils; timing of soil movements to suit season; careful storage of excavated soil, etc.).</li> <li>3. Placement, restoration and after-care programs to appropriate standards.</li> </ol>	

Table H.4-5: Soil Erosion

Item	13. Soil Erosion
Description	Topsoil erosion by rainfall after earth filling and deforestation
<p><b>Causes of Impacts</b></p> <ol style="list-style-type: none"> <li>1. Removal of top cover vegetation on slope and soil disturbance.</li> <li>2. Filling up of earth on slope.</li> </ol>	
<p><b>Possible Environmental Impacts</b></p> <ol style="list-style-type: none"> <li>1. Soil erosion will lead to gully erosion and removal of top soil.</li> <li>2. Increase of sediment in downstream flow.</li> </ol>	
<p><b>Possible Counter-Measures</b></p> <ol style="list-style-type: none"> <li>1. Installation and proper maintenance of interceptor drain in order to minimize the entry of runoff water into the site.</li> <li>2. Application of slope protection.</li> </ol>	

Table H.4-6: Water Pollution

Item	<b>19. Water Pollution</b>
Description	Pollution caused by inflow of sand, silt, leachate and run-off from disposal site into rivers and groundwater
<b>Causes of Impacts</b>	
<ol style="list-style-type: none"> <li>1. Inflow of sand and silt from construction of final disposal site.</li> <li>2. Inflow of leachate and run-off into rivers and groundwater.</li> <li>3. Leakage of hazardous substances during rainfall into rivers and groundwater.</li> </ol>	
<b>Possible Environmental Impacts</b>	
<ol style="list-style-type: none"> <li>1. Pollution of groundwater and rivers.</li> <li>2. Obstruction to growth of aquatic life due to deterioration in water quality.</li> <li>3. Occurrence of health problems due to using contaminated water.</li> </ol>	
<b>Possible Counter-Measures</b>	
<ol style="list-style-type: none"> <li>1. Timing of major earthworks to avoid wet season.</li> <li>2. Collection and treatment of leachate with control and monitoring of discharge.</li> <li>3. Segregation and treatment of run-off from waste areas with control and monitoring of discharge.</li> <li>4. Possible use of impermeable liner for landfill, if necessary.</li> <li>5. Exclusion of toxic/hazardous waste from landfill.</li> </ol>	

#### H.4.2.2 Operational Impacts

The impacts expect during operation of the sanitary landfill site are described in following tables. Table

Table H.4-7: Public Health

Item	<b>7. Public Health</b>
Description	Deterioration of public health and sanitary conditions due to waste generation and increase in pathogens
<b>Causes of Impacts</b>	
<ol style="list-style-type: none"> <li>1. Increase in pathogens (micro organisms, insects, rodents, etc.) around disposal site.</li> <li>2. Emission of gases, smoke, fumes, dust from the disposal site and waste collection vehicles.</li> <li>3. Contamination of groundwater and surface water sources around disposal site.</li> <li>4. Presence of health hazards (e.g. syringes, broken glass, contaminated food) in waste at disposal site.</li> </ol>	
<b>Possible Environmental Impacts</b>	
<ol style="list-style-type: none"> <li>1. Animals, birds and insects at final disposal site could become vectors of disease, affecting public health.</li> <li>2. Increased incidence of respiratory diseases from gases, smoke, dust, fumes from the disposal site and waste collection vehicles.</li> <li>3. Increased incidence of water-related diseases due to groundwater/surface water contamination.</li> </ol>	

4. Health hazards to workers if disposal work.
<b>Possible Counter-Measures</b>
1. Conduction of daily soil cover, leachate treatment, gas ventilation.
2. Prevention of pathogens by proper disposal site management including possible use of pesticides (for vermin) and control of stagnant waters to minimise breeding of vectors of disease (e.g. mosquitoes).
3. Exclusion of hazardous/toxic waste from landfill.
4. Public education on sanitation for waste workers to avoid infection.
5. Construction of a secured disposal pit for infectious waste until hospitals starts their own treatment facilities.
6. Construction of net fence around landfill site and a gate at the entrance to prevent common people from the entry to the site.

Table H.4-8: Air Pollution

Item	18. Air Pollution
Description	Pollution caused by exhaust/toxic gases, dust, smoke, fumes, etc. from waste collection vehicles and the landfill site.
<b>Causes of Impacts</b>	
1. Generation of dust and landfill gases at disposal site.	
2. Emission of smoke from occasional waste fires at disposal site.	
3. Generation of dust, exhaust gases and fumes from construction vehicles, waste collection vehicles and landfill site equipment (e.g. bulldozers).	
<b>Possible Environmental Impacts</b>	
1. Increase in respiratory diseases due to dust, gases, smoke and fumes from the disposal site and waste collection vehicles and associated equipment.	
2. Retarding growth of plants due to toxic gases and dust falling on their leaves.	
3. Adverse effects on nests of birds due to gases, dust, etc.	
<b>Possible Counter-Measures</b>	
1. Maintenance of live buffer zone (Existing timber forest around the landfill site is ideal).	
2. Execution of good landfill practice such as compaction of waste and daily soil cover.	
3. Installation and extension of landfill gases ventilation facilities.	

Table H.4-9: Soil Contamination

Item	20. Soil Contamination
Description	Contamination of soil by leakage and diffusion of ash, leachate, etc.
<b>Causes of Impacts</b>	
1. Infiltration of leachate and run-off.	
2. Leakage of hazardous substances during rainfall into soil.	
<b>Possible Environmental Impacts</b>	



<ol style="list-style-type: none"> <li>1. Contamination of soil under and around disposal site.</li> <li>2. Subsequent contamination of groundwater and downstream water sources.</li> </ol>
<p><b>Possible Counter-Measures</b></p> <ol style="list-style-type: none"> <li>1. Exclusion of toxic/hazardous waste from landfill.</li> <li>2. Collection and treatment of leachate.</li> </ol>

Table H.4-10: Offensive Odour

Item	23. <b>Offensive Odour</b>
Description	Generation of offensive odours from landfill site, associated treatment facilities and during transportation of waste
<p><b>Causes of Impacts</b></p> <ol style="list-style-type: none"> <li>1. Putrid smell from waste in disposal site in the case of open dumping without soil cover.</li> <li>2. Leachate and run-off from disposal sites, wash water from washing of waste collection vehicles.</li> <li>3. Emission of landfill gases.</li> <li>4. Waste smells and fumes from waste collection vehicles.</li> </ol>	
<p><b>Possible Environmental Impacts</b></p> <ol style="list-style-type: none"> <li>1. Landfill gases could generate offensive odours, which depending upon wind direction and speed may affect inhabitants.</li> <li>2. Complaints about odour from residents and users of public facilities such as schools and hospitals around the final disposal site and access roads.</li> <li>3. Decrease in property values in the vicinity of the disposal site and along access roads.</li> </ol>	
<p><b>Possible Counter-Measures</b></p> <ol style="list-style-type: none"> <li>1. Execution of daily soil cover.</li> <li>2. Containment, collection and construction of landfill gas venting facilities.</li> <li>3. Collection and treatment of leachate.</li> <li>4. Careful consideration of location of leachate treatment plant.</li> <li>5. Provision of buffer zone.</li> </ol>	

Table H.4-11: Litter

Item	24. <b>Litter</b>
Description	Scattering of litter from landfill site and waste collection vehicles
<p><b>Causes of Impacts</b></p> <ol style="list-style-type: none"> <li>1. Poor design and operation of landfill site.</li> <li>2. Inadequate covering of waste during transportation.</li> </ol>	
<p><b>Possible Environmental Impacts</b></p> <ol style="list-style-type: none"> <li>1. Pollution of the environment and deterioration in aesthetics due to scattering of litter from waste trucks along access road and around disposal site.</li> </ol>	
<p><b>Possible Counter-Measures</b></p>	

1. Usage of the closed type trucks or trailers waste transportation to the disposal site.
2. Execution of daily solid cover to minimize the waste exposed area in the site.
3. Installation of net fence to prevent waste scattering at the necessary parts around landfill site.

Table H.4-12: Ground Water

Item	12. <b>Groundwater</b>
Description	Changes in groundwater level due to infiltration of leachate and run-off from disposal site
<b>Causes of Impacts</b>	
1. Infiltration of leachate and run-off from disposal site into groundwater.	
<b>Possible Environmental Impacts</b>	
2. Changes in groundwater level due to changed infiltration flows.	
3. Depression of groundwater level and land subsidence due to the extraction of groundwater in excavations below the water table.	
<b>Possible Counter-Measures</b>	
1. Possible use of impermeable liner for landfill, if the original ground is permeable.	
2. Collection and treatment of all leachate generated.	
3. Installation and proper maintenance of interceptor drain in order to minimize the leachate generation amount.	
4. Exclusion of hazardous/toxic waste from landfill.	
5. Monitoring of groundwater around and downstream of the disposal site (including base line data).	

Table H.4-13: Impact on borrow areas and transport routes

Item	20. <b>Impact on borrow areas and transport routes</b>
Description	Impact on proposed borrows area (Sediment excavate from Gregory Lake) and transport.
<b>Causes of Impacts</b>	
1. Deep excavation of lake bed and embankment and transport of soil with water (Mud)	
<b>Possible Environmental Impacts</b>	
2. Changes in water level and possibility to increase turbidity. Erosion of earth embankment around the lake.	
3. Scattering of soil along the haulage route.	
<b>Possible Counter-Measures</b>	
1. The amount of extraction should be minimized.	
2. The soil should be in solid form and transport on closed/ covered containers.	
The existing cover soil should be used according with proposed Operational and Maintenance plan to minimize the requirement of extra cover soil.	

## **H.5 Proposed Mitigatory Measures for the Environmental Impacts**

As the results of the environmental examination, the following measures will be required in order to mitigate the negative environmental impacts caused by the landfill operation.

### **H.5.1 During the construction**

- 1) Careful construction planning and management with specification of standards/procedures to be followed for all excavation works in project documents.
- 2) Good excavation practice (e.g. minimising exposure of bare soils; timing of soil movements to suit season; careful storage of excavated soil, etc.).
- 3) Placement, restoration and after-care programmes to appropriate standards.

### **H.5.2 Landfill facility**

- 1) Interceptor drain to minimize the entry of runoff water into the site
- 2) Leachate collection facility
- 3) Leachate treatment facility
- 4) Gas ventilation
- 5) Security facility
- 6) Waste scattering prevention facility
- 7) Separate disposal pit for infectious waste
- 8) To keep the enough buffer zone

### **H.5.3 Landfill operation**

- 1) Daily soil cover
- 2) Operation and maintenance of the leachate treatment facility
- 3) Extension of gas ventilation facilities
- 4) Maintenance of the planned gentle slope of the landfill site
- 5) Protection of the waste filling slope
- 6) Maintenance of the interceptor drain
- 7) Security control
- 8) Monitoring the landfill operation
- 9) Use of closed type trucks or trailers for waste transportation
- 10) Prohibition of the receipt of toxic / hazardous waste

### **H.5.4 Solid waste management policy**

- 1) Promotion of 3 Rs, reduce, reuse and recycle to prolong the life year of the landfill site.
- 2) The introduction of processing or treatment technologies to prolong the life year of landfill site by reducing the waste final disposal amount will be examined ten years later.

## H.6 Monitoring Plan

### H.6.1 The monitoring committee

The monitoring committee will be established for the following purpose.

- to ensure the landfill operation in compliance with the method stated in the landfill operation manual.
- to keep the transparency of the landfill operation.

### H.6.2 Proposed member of the monitoring committee

The proposed monitoring committee members are as follows.

Position	Eligibility
Chairman	Chairman of the health committee
Member 1	a municipal council member elected from the ward near the landfill site
Member 2	a municipal council staff in Health Department
Member 3	a municipal council staff in Works Department
Member 4, 5	representatives of neighbourhoods
Member 6	a Central Environmental Authority staff
Member 7	a staff in local environmental NGO

### H.6.3 Monitoring frequency

Period	Frequency
<p><b>Before the construction</b></p> <p>The first monitoring will be executed before the commencement of the construction work in order to understand and to keep record the original condition.</p>	1 time
<p><b>During the first six months</b></p>	every month
<p><b>After six months</b></p> <p>If the monitoring committee judges that the monthly monitoring is not necessary, the monitoring frequency will be reduced after the six months landfill operation. However, the monitoring has to be done at least every three months.</p>	every three months

### H.6.4 Monitoring check list

JICA Study Team will prepare the check list of the monitoring for the landfill operation. The monitoring committee shall execute according to the monitoring check list.

Table H.6-1: Draft Check List for the Landfill Operation

Check list Monitoring Committee for the Moon Plain Landfill Site						Date:	
						Time:	
<b>Category A: Environmental effect (Before and after construction)</b>							
No	Items	Acceptable	Medium	Terrible	Score	Notes	
A1.	Fire & Smoking	0	1	2			
A2.	Offensive dour	0	1	2			
A3.	Waste water	0	1	2			
A4.	Withering of trees caused by discharged waste	0	1	2			
A5.	Waste scattering	0	1	2			
A6.	Animals (Dogs, monkeys, birds etc.)	0	1	2			
A7.	Vermin (Flies etc.)	0	1	2			
A8.	View	0	1	2			
A9.	Entry of scavenger (If no scavenger is the site : select "0" )	0	-	2			
Total of Category A							
<b>Category B : Function of facilities (After finishing of construction)</b>							
No	Items	Functioning	Medium	No functioning	Score	Notes	
B1.	Drainage system						
	B1-1.Rip pap	0	1	2			
	B1-2.Earth drain	0	1	2			
B2.	Leachate collection & treatment system	0	1	2			
B3.	Gas ventilation system	0	1	2			
B4.	Discharge pit for the health care	0	1	2			
B5.	Gully suck treatment facility	0	1	2			
B6.	Access road						
	B6-1.Asphalt road	0	1	2			
	B6-2.Gravel road	0	1	2			
B7.	Tire wash pit	0	1	2			
B8.	Security facilities						
	B8-1.Gate	0	1	2			
	B8-2.Fence	0	1	2			
	B8-3.Guardrail	0	1	2			
B9.	Waste scattering prevention net fence	0	1	2			
B10.	Turfing	0	1	2			
Total of Category B							
Comment:							
Name & Signature							

#### H.6.4.1 Monitoring efficiency of Leachate Collection and Treatment System

The evaluation of quality of final Treated effluent will be done by the Nuwara Eliya Municipal Council following the scheduled monitoring program as described in 6.1.3. The sampling points will be,

1. A sample of effluent Immediately after the charcoal filter (Effluent discharge point) of the Leachate Treatment system
2. A sample of effluent immediately after the Gully Suck bioreactor (Effluent discharge point).

Those samples should be analyzed in a CEA recommended laboratory for the following parameters which described in Tolerance limits for effluents discharge in to inland surface water - Central Environment Authority.

No	Determinant	Tolerance Limit
01	pH value at ambient temperature	6.5 to 8.5
02	Total Suspended Solids, mg/l max	50
03	Total Dissolved Solids, mg/l	-
04	Biochemical Oxygen Demand(BOD <sub>5</sub> ), mg/l	30
05	Chemical Oxygen Demand (COD), mg/l	250

Note- These values are based on dilution of effluent by at least eight volumes of clean receiving water. If the dilution is below eight times the permissible limits are multiplied by one-eight of the actual dilution.

If the samples exceed the any of above tolerance limit value Nuwara Eliya Municipal Council should adapt to relevant counter measures.

## H.7 Conclusion and Recommendations

The major issues of the sanitary landfill operation are such as,

- ✓ To prevent from fire and smoking
- ✓ To prevent from offensive odour
- ✓ To prevent from vermin, flies, birds and stray dogs
- ✓ To prevent from litter of waste
- ✓ To reduce the generation of leachate
- ✓ To collect and treat the leachate
- ✓ To extend the capacity of lifespan

Have been addressed logically by the formulated Project. Therefore the overall proposal is acceptable. Further Continuous maintenance of Buffer Zone and Monitoring procedures should be adapt to prevent from failure.