c. Sorting Plant

The proposed operation plan is as follows (Figure 13-50).

c.1 Weighbridge

It is used to weigh wastes or recovered materials.

- Wastes delivered to the site is weighed by the weighbridge on arrival.
- After being weighed, wastes are transferred to the sorting plant, compost plant or landfill site depending on their types.

c.2 Waste Reception and Storage Area

The non-compostable wastes are received in and fed to the sorting line from this area.

- The non-compostable wastes, after weighed, are unloaded in this area.
- The wheel loader supplies the unloaded wastes to the feed hopper.
- When the delivered wastes is beyond the plant capacity, the excess will be moved to the storage area by the wheel loader.

c.3 Hand Sorting Section

This section segregate recyclable materials from the non-compostable waste.

- After fed by the feed hopper and the feeding conveyor, plastic bags are torn and opened by the plastic bag breaker and wastes are put on the hand-sorting conveyor.
- The magnetic separator equipped above the hand-sorting conveyor recovers ferrous metal. For the other items, the workers on the both sides of the conveyor pick up specific items pre-assigned to each of them.

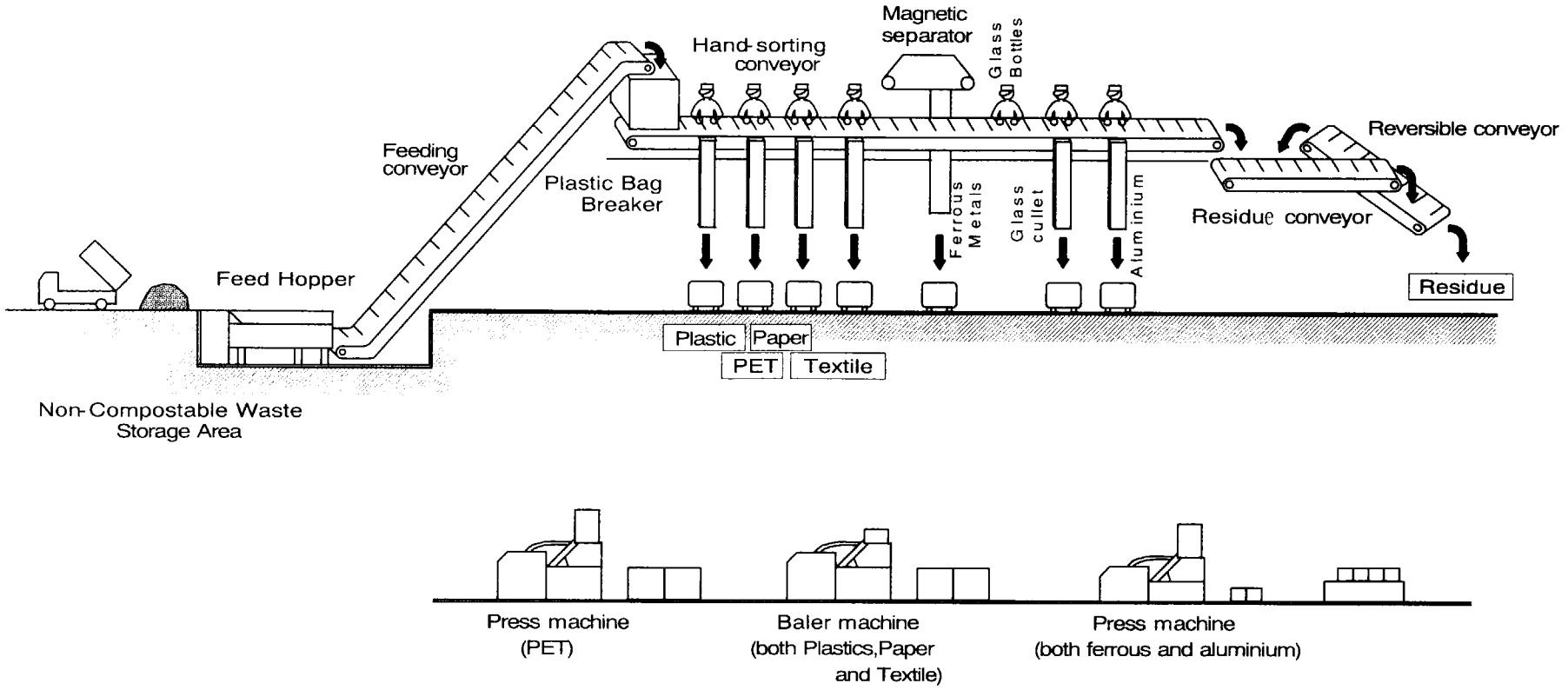


Figure 13-50: Sorting Plant

- The items will be picked up in a following manner.
  - Items of relatively large size, such as paper, plastic film and textile, are picked up in the first stage to facilitate sorting in the following stage.
  - Ferrous metal is sorted by the mechanical equipment in the next stage.
  - Glass bottles and cullet are sorted in the third stage.
  - Finally non-ferrous metals is picked up.
- The sorted recyclable materials are collected through the shoots into the specific boxes downstairs except for the glass bottles which will be collected in boxes provided near the workers to prevent them being broken.

c.4 Product Section

The recovered materials are pressed or baled in this section.

- The boxes for recovered material collection under the shoots have to be replaced when full. The boxes full of materials is moved to the proper place for further processing.
- The press machine handles ferrous metal, aluminium cans and PET bottles while the baler machine handles plastic film, paper and textile.
- The press machine and the baler machine are planned to have large handling capacity for high machine efficiency. They are, thus, used for plural items by turns.

c.5 Stock Yard and Transport Section

Recovered materials would be stored temporally in the stock yard. It will be divided into several sub-sections for the following items.

- Ferrous metal (pressed product)
- Aluminium (pressed product)
- PET bottles (pressed product)
- Paper (baled product)
- Plastic film (baled product)
- Textile (baled product)
- Glass (cullet and bottles)

- Each item is moved to the pre-determined sub-section of the stock yard by the workers.
- The recovered materials are shipped by recycling dealers who are supposed to come to the plant. The plant workers will load the materials on the dealers' trucks by a forklift. The trucks must be weighed on leaving.
- Waste residue remained after sorting recyclable materials are loaded on the dump trucks by the residue conveyor, and disposed of at the landfill site.

d. Compost Plant

The proposed operation plan is as follows.

d.1 Weighbridge

It is used to weigh waste or recovered materials.

- Wastes delivered to the site is weighed by the weighbridge on arrival.
- After being weighed, wastes are transferred to the sorting plant, compost plant or landfill site depending on their types.

d.2 Waste Reception and Storage Area

The compostable wastes are received in and proceed to the pre-treatment process from this area.

- The compostable wastes, after weighed, are unloaded in this area.
- A wheel loader supplies the unloaded waste to a feed hopper.
- When the delivered wastes is beyond the plant capacity, the excess will be moved to the storage area by the wheel loader.

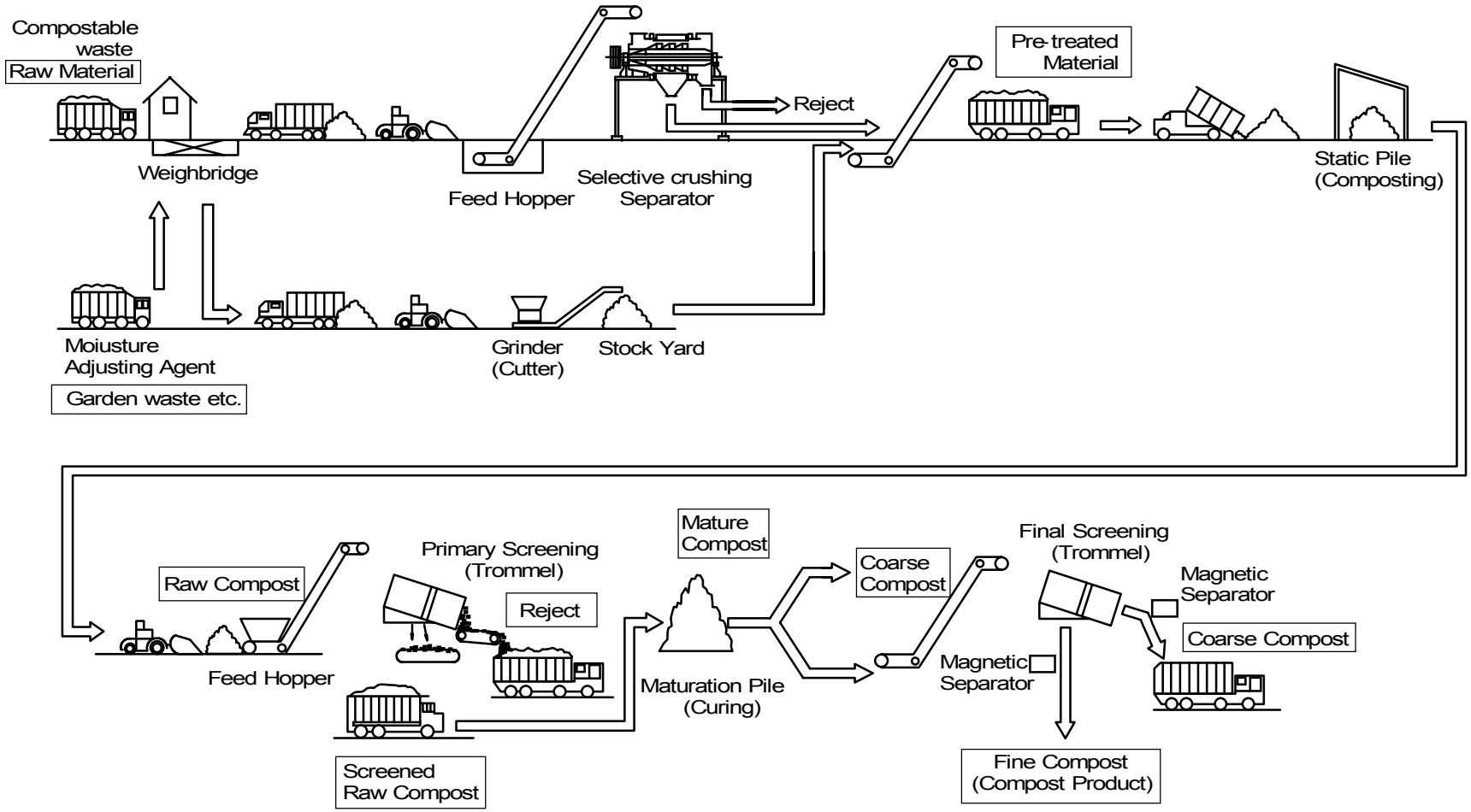


Figure 13-51: Compost Plant

d.3 Pre-treatment Section

The raw materials are selectively crushed and materials unsuitable for composting such as plastics and metals are rejected in this section.

- The key facility is the SCS, which can divided the raw materials into two groups: fragile wastes including kitchen wastes and wet paper, and the other robust or flexible wastes such as plastic sheets, fibres and cans. The former group proceeds to the composting section as pre-treated materials. The latter is called rejects.
- While the raw materials are processed by the SCS, plastic bags are torn and the compostable materials are crushed into pieces.
- The crushed raw materials are sieved and moved to the stock yard by the conveyor equipped with the magnetic separator.
- In the stock yard, the pre-treated materials are loaded onto the dump trucks by the wheel loader and transferred to the composting area.
- Recovered ferrous metal is delivered to the sorting plant.
- The rejects are loaded on the dump trucks by the wheel loader and transported to the sorting plant for material recovery.

The pre-treatment section layout is presented in Figure 13-52.

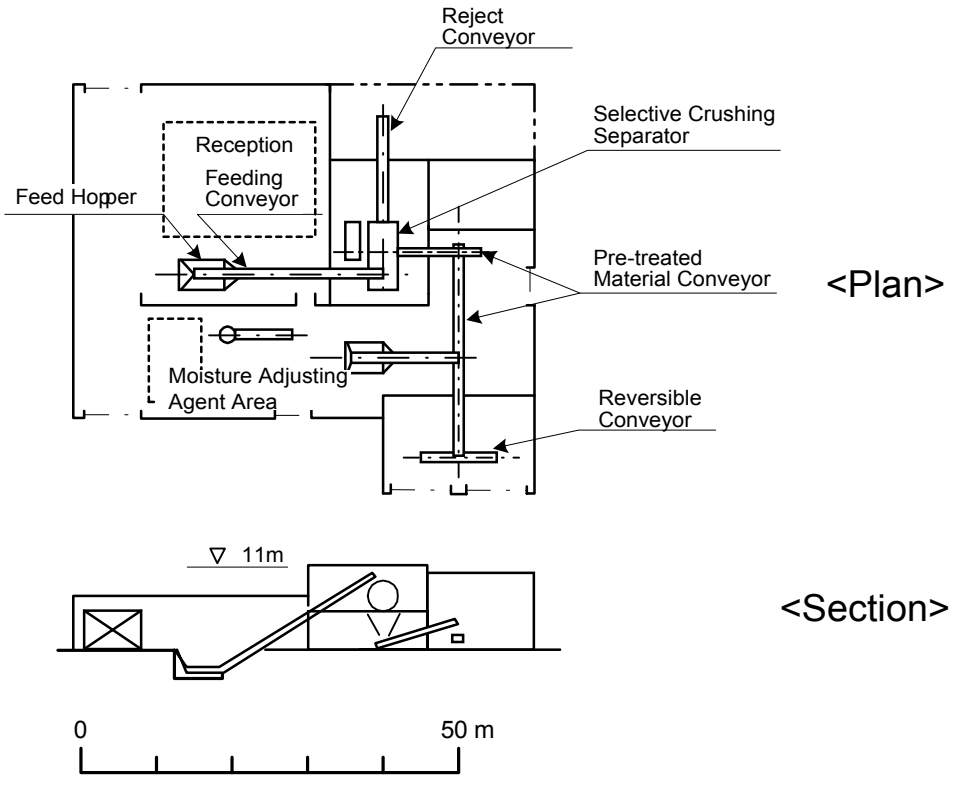


Figure 13-52: Layout of the Pre-treatment Section

d.4 Composting Area (Static piles)

The pre-treated materials undergoes composting in this are which is divided into 28 sections to form 28 static piles.

- The pre-treated materials are unloaded in one section and formed into a pile by a wheel loader.
- After pile formation, the materials require air control in the early stage, turning by the wheel loader, and moistening by the water truck.
- After 28 days of composting period, the raw compost is loaded on the dump trucks by the wheel loader and proceeds to the primary screen process.

The Composting area (Static piles) layout is presented in Figure 13-53.

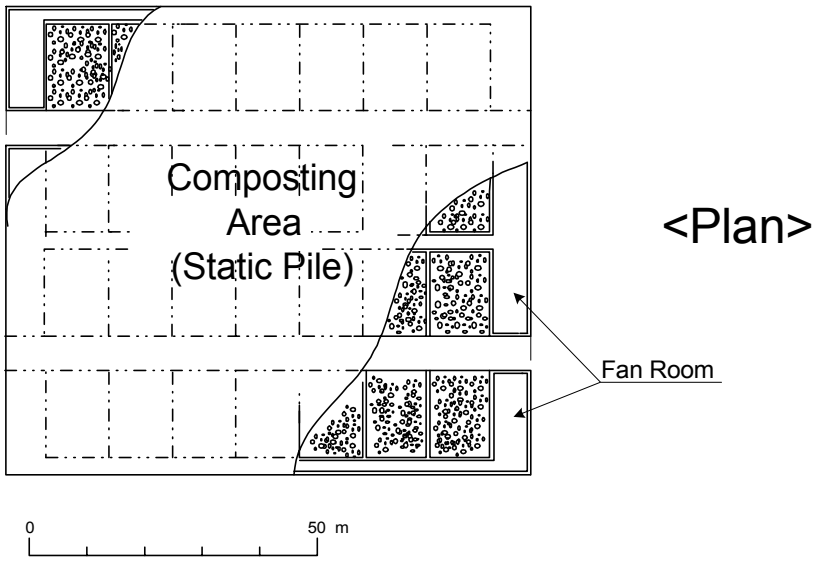


Figure 13-53: Layout of the Composting Area (Static piles)

d.5 Primary Screen Equipment

The primary screen equipment comprises a supplying conveyor, trommel, product conveyor with a magnetic separator, residue conveyor and ballistic inertial separator. The sieve size of the trommel is 25mm. The underflow is the material for further processing and the oversize material is the rejects.

- The raw compost is unloaded in the supply are of the primary screen section.
- The unloaded raw compost is placed on the supplying conveyor by the wheel loader and fed to the trommel.
- The trommel screen sieves the raw compost.
- The underflow materials will be conveyed to their stock yard. Meanwhile, ferrous metal is removed by the magnetic separator and glass and gravel by the ballistic inertial separator.

- The underflow raw compost is loaded on the dump trucks by the wheel loader and delivered to the maturation area.
- The oversize materials remained on the sieves are the rejects to be disposed of at the landfill site.

The primary screen equipment layout is presented in Figure 13-54.

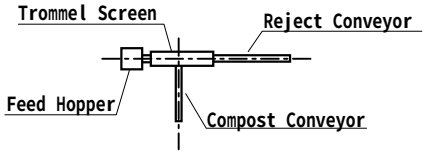


Figure 13-54: Layout of the Primary Screen Equipment

d.6 Maturation Area

The maturation of the screened raw compost takes place in this area. A roof is not necessary. Unlike the composting area, this area is not physically divided into sections but the area should be clearly marked whenever the mature pile is formed. Although the maturation period is to be 60 days, the planned area size is enough to store compost produced in 90 days to allow the adjustment of product shipping in response to the market demand.

The floor of the maturation area will be equipped with pipes so that the area will serve as odour removal facility.

- The screened raw compost is unloaded from the dump trucks and formed into maturation piles by the wheel loader. The pile formation does not require particular skills.
- After the maturation period, the materials are loaded on the dump trucks by the wheel loader and delivered for final screen processing.

d.7 Final Screening Equipment

The final screen equipment is primarily similar to the primary screen equipment but the mesh size of the trommel screen is 12mm, instead of 25mm. The screen should be removable so that the mesh size can be changed depending on market demand.

- The mature compost is unloaded in the supply are of the primary screen section.
- The unloaded mature compost is placed on the supplying conveyor by the wheel loader and fed to the trommel.
- The trommel screen sieves the mature compost.
- The underflow materials will be conveyed to their stock yard. Meanwhile, ferrous metal is removed by the magnetic separator and glass and gravel by the ballistic inertial separator.
- The mature compost can be shipped as it is, or be packed in plastic bags with net weight of 50kg.

- The compost, if shipped without packed, is loaded on the dump trucks by the wheel loader. For the packed compost, a forklift is used.
- The oversize material on the sieves are the rejects to be disposed of at the landfill site.

13.5.3 Impact on Environment and Mitigation Measures

13.5.3.1 Economic Activities

Loss of bases for economic activities(e.g., land) and loss of income for scavengers.

a. Construction

a.1 Negative Impact

No negative impact is expected.

a.2 Positive Impact

It is estimated that the construction of various facilities for Sofulu Site Development Project will employ many workers (labourers, drivers, equipment operators supervisors, etc), thus increasing economic activity in the area. Therefore, this construction will be economically beneficial.

b. Operation

b.1 Negative Impact

The proposed site includes the existing dumping site and the other area. The existing dumping site is approximately 22ha and the other part of the proposed site is approximately 73ha, which consists of grain field, grazing, excavation site and fallow ground at present. Most farmers grow wheat and barley there. On assumption that wheat production per hectare is approximately 4 ton, farmgate price of wheat per ton is 50 million TL and grain field accounts for 50% of the area, the potential value of the land is as follows:

4 ton/ha x 73ha x 0.5 x 50,000,000 TL/ton = 7.3 billion TL

Utilisation of this area for Sofulu Site Development would bring about the loss of 7.3 billion TL.

The present waste dumping system in Adana provides an economic benefit for the scavengers who pick up reusable items from the disposal site. The total number of scavengers is 60-70 at Sofulu dumping site and it is estimated that the recovered waste amount by scavengers at the dumping site totals 9 ton/day. Each scavenger works 6 days a week and receives 3.0 million TL/day. The annual income generated by scavengers is estimated to be 74.3 billion TL. Mainly, recycles items are sold not to middlemen but directly to final users. The transportation of recovered wastes from dumping site is normally arranged by final users or factories. However, as the scavenging activities will not be allowed in the proposed disposal site, the income of them will be lost.

b.2 Positive Impact

Adana Greater Municipality has to prepare a sanitary landfill site anywhere in the city because many citizens are suffered from the landfill fire smoke and offensive odour due to the existing dumping site. As shown in Chapter 6, many alternatives were studied and no suitable candidate site was found within a radius of 20 km except Sofulu candidate site. Therefore, without the proposed Sofulu site, the candidate site must be selected outside a radius of 20 km. Since Sofulu site is located on the boundary of approximately 10 km, the excess cost (US$ 2.2) of transportation for 20 km for round trip can be saved when the proposed site is selected for this project. Total cost 97.4 billion TL will be saved. Therefore, the selection of the proposed site is effective economically.

(20-10) x 2 (round trip) = 20 km

US$ 2.2 x 346 vehicles/day x 300 days = US$ 243,584
97.4 billion TL/year

* 346 vehicles: cf. “5.3.9 Air Pollution” (total collection vehicles per day)
* 300 days : working days per year in Adana
* US$ 2.5 1,000,000 TL

In this project the waste is recycled and reused as the resources. Paper, plastics, bottle and can, etc are separated and reused through the sorting plant. The waste will be changed into the productive materials and produce new economic values. The income due to the recyclable materials will be more than 74.3 billion/year, the present income of scavengers.

The compost plant is also introduced in this project because it is proved that there is the demand for high quality compost in the agricultural land surrounding Adana city. The compostable waste is collected separately and the compost is produced in the plant. The waste will produce new economic values.

Both of intermediate treatment facilities like the sorting plant and the compost plant will require a lot of workers. As the scavengers, who will be prohibited to pick up the recyclable materials at the disposal site, are accustomed to handle and sort the waste, they may have an opportunity to be possibly employed as the workers of the intermediate plants.

The landfill fire smoke and offensive odour will be stopped due to the introduction of sanitary landfill system. The value of the land surrounding the proposed site will increase greatly.

Therefore, it is expected that positive impact is much more than negative impact.

c. Aftercare

c.1 Negative Impact

No negative impact is expected.

c.2 Positive Impact

When the new disposal site is finally completed it is expected that another disposal site will be constructed to replace it. All workers associated with this proposed disposal site in Sofulu (waste vehicle workers, landfill staff, etc.) will presumably be offered employment at another disposal site.

The recommended future land use for the completed disposal site will be recreational purposes. Citizens will get the benefit of physical and/or mental refreshment in the recreational area. It will provide the improvement of economic productivity of people.

13.5.3.2 Public Health

Deterioration of public health and sanitary conditions in the area around the proposed site due to the waste disposal.

a. Construction

a.1 Negative Impact

As described in "5.3.9 Air Pollution", dust generated from the construction activities and exhaust gases from construction vehicles may possibly impact on public health in the surrounding area. However, the dust will be controlled by the regular use of water sprays and exhaust gases are considered to be negligible because the number of construction equipment is low.

a.2 Positive Impact

Before the commencement of operation in phase 1, the existing dumping site is improved. The smoke and offensive odour due to landfill fires will be terminated by covering the waste with soil.

The leachate from the site had been discharged without treatment. However, it has been recently channelled and collected in the regulation pond and circulated to the site without being discharged outside since the circulation system was constructed in the pilot project of JICA Study. Therefore, the impact on public health in the surrounding area will be improved greatly.

b. Operation

b.1 Negative Impact

Waste dumping site often promotes growth in the population of vectors and vermin which give a negative impact on surrounding area. However, in this project it is proposed to operate the disposal site as a sanitary landfill, which will minimise this problem. Moreover, pesticides may be used if required.

Leachate from the waste disposal site may impact on public health. However, since leachate will be collected to the regulation pond and circulated into the disposal site to prevent the downstream area from being polluted, and the infiltration of leachate into the ground is to be prevented by impermeable clay at the bottom of the site and impermeable sheet on the side slope. It is expected there are very few opportunities of groundwater and surface water to be polluted by the leachate.

Landfill fires may impact on public health. However, gases will be ventilated in a controlled manner and landfill fires will be controlled by a sanitary landfill in this project.

It is expected that the overall negative impact on public health will be negligible.

b.2 Positive Impact

Presently there live many dogs at the waste dumping site in Sofulu because the waste has never been covered with soil and waste food is abundant for them to be fed on. On the result of survey concerning the present situation of public health, it is considered that morbidity of suspicious bites can be related to the presence of the dumping site. Hence, the accidents of suspicious bites will be reduced by the introduction of sanitary landfill operation because the dogs will never live in the sanitary landfill site.

Landfill fires have occurred very often at the existing dumping site in Sofulu and smoke with dust has been dispersed. It could have been giving some impact on public health. The apprehension will be got rid of due to the adoption of sanitary landfill system.

Infectious and hazardous medical waste is dumped at the existing dumping site. The scavengers are in danger of being injured by the medical waste and there is possibility of giving some impact on the people in the surrounding area. However, since the medical waste disposal site is to be constructed separately from the municipal waste disposal site and managed sanitarily, the impact on public health by medical waste will be eliminated.

c. Aftercare

c.1 Negative Impact

Leachate and landfill gases will continue to be produced during the aftercare stage after the termination of operation although production rates and strengths will diminish with time. When the site may be used as a recreational area, leachate and gases should be inspected regularly to protect the public health of citizens who may gather there for recreation. The public health will not be hurt because the inspection of leachate and gases is to be conducted according to the monitoring program.

c.2 Positive Impact

Positive impact is not expected.

13.5.3.3 Hazards/ Risks

Increase in natural disasters (e.g., landslides) and man-made hazards (e.g., landfill gas explosions, fires) due to the disposal site

a. Construction

a.1 Negative Impact

The landform will be changed because the site should be excavated until the impermeable stratum appears. However, the amount of alteration is not much since the topographical features of the proposed site are simple and gentle. The site for

intermediate treatment facilities like a sorting plant and a compost plant is not changed much and used as it is.

The site of phase 2 will be excavated during the operation at phase 1 site and the excavated soil will never be transported out of the proposed site because it has to be used for daily cover soil at the site of phase 1. The height formulated by cutting and filling is approximately 15m at most and the gradients of slope by cutting and filling are 1 : 2 and 1 : 3 respectively. They are not high and not steep. Therefore, there will be very little opportunity of landslide.

a.2 Positive Impact

There is the possibility of landfill gas explosion at the existing dumping site. Before the commencement of operation in phase 1, the existing dumping site is improved. Since the ventilation system of gases will be installed, there will be very little possibility of gas explosion.

b. Operation

b.1 Negative Impact

There is the possibility of being exposed to the hazards and risks. Access to the disposal site will be restricted to approved personnel only. Thus, the general public, including scavengers, will not be allowed entry to the disposal site, especially to the medical waste disposal site. This will prevent these people from being exposed to the hazards and risks.

The adoption of the policy to prohibit the disposal of hazardous, toxic, radioactive and liquid wastes, except medical waste at the medical waste disposal site to be separately constructed from the municipal waste disposal site, will help to prevent the leachate from them finding their way into the groundwater or surface waters. They cause direct harm to humans or indirect harm through the food chains. However, there will still be other dangerous objects within the waste accepted for disposal (broken glass, rusty tins, spoiled food) which pose a small risk of injury to the workers for waste collection, treatment and landfill. This risk can be minimised by equipping them with proper clothing and handling equipment(e.g., gloves, boots).

The medical waste disposal site is to be constructed separately from the municipal waste disposal site and controlled strictly to access. A bulldozer of medium type will operate independently to dispose of the medical waste there. The waste will be covered with soil immediately when it is dumped from the collection vehicle. The worker and the driver will wear masks, gloves and boots on the site.

The medical waste disposal site is to be installed with the impermeable sheet, and the leachate including hazardous pollutants will not be discharged outside and treated by circulation and evaporation.

Another operational hazard concerns the occurrence of landfill gas explosions. Uncontrolled generation of gas from the disposal site may also result in spontaneous fires. The proposed disposal site design provides for the ventilation of landfill gases in a controlled manner to the atmosphere, thus minimising this impact.

The likelihood of flooding is very small because the watershed(95ha) is less than 1 km^2 and the water way is to be improved in this project.

Presently at existing dump site in Sofulu the waste is not covered with soil. The outbreak of waste fires is a common problem there all the year round. The fire will pose a similar risk at the new disposal site, but this risk will be minimised by the proper sanitary landfill practices.

The overall negative impact is considered to be low, provided proper sanitary landfill practices are implemented and controlled strictly.

b.2 Positive Impact

Infectious and hazardous medical waste is dumped at the existing dumping site. The scavengers are in danger of being injured by the medical waste and there is possibility of giving some impact on the people in the surrounding area. However, since the medical waste disposal site is to be constructed separately from the municipal waste disposal site and managed sanitarily, the hazards and risks due to medical waste will be eliminated.

c. Aftercare

c.1 Negative Impact

On closure of the disposal site, further decomposition of waste within the landfill will occur, which may result in subsidence of the land over the disposal site. The impact of subsidence will depend on how soon and for what purpose the landfill is put to use after closure. No significant negative impact is expected because it will be used as a green park or a recreational area.

During the aftercare period, the generation of landfill gas continue to occur and hence there is still a risk of consequent fires and explosions. However, no significant impacts are expected provided the gas ventilation facilities are inspected and maintained regularly.

c.2 Positive Impact

Positive impact is not expected.

13.5.3.4 Topography and Geology

Change of valuable topography and geology due to excavation, construction and filling works at the disposal site.

a. Construction

a.1 Negative Impact

As there is no valuable topography and geology in the proposed site, the impact will be negligible.

There will be little construction activities at phase 1. The existing dumping site is to be reformed flat by moving the accumulated waste and covered with soil before beginning of phase 1 operation. The construction of phase 2 site will start during the operation of phase 1 and the cover soil for phase 1 is to be taken from the phase 2 site. Similarly the cover soil for phase 2 will be taken from phase 3 site.

a.2 Positive Impact

Positive impact is not expected.

b. Operation

b.1 Negative Impact

No negative impact may be expected.

b.2 Positive Impact

Sanitary landfill operation requires covering the deposited waste daily with soil. Source of soil is planned to be taken from the site of phase 2 and phase 3. Hence, cover soil should not be taken from virgin areas.

c. Aftercare

c.1 Negative Impact

Although the specific geology of the disposal site will be changed from its original composition to a mixture of compacted waste and soil, the impact on the geology will be negligible. As time passes, decomposition of waste will continue, and the land will subside and get stable.

c.2 Positive Impact

Positive impact is not expected.

13.5.3.5 Groundwater

Changes in groundwater level.

a. Construction

a.1 Negative Impact

There will be little change in groundwater level due to the construction activities because there are not any kinds of earthworks that prevent the surface water from permeating into the ground. On the stage of construction of phase 2 and 3 respectively, permeable soil will be taken away until the surface of impermeable clay appears and the rain water on the clay is to be drained out of the deliberately. Thus, the provision of the water to the aquifer will be less than usual.

a.2 Positive Impact

Positive impact is not expected.

b. Operation

b.1 Negative Impact

The operation areas in every phase are as follows:

Phase 1	25ha
Phase 2	17ha
Phase 3	13ha
(Medical waste site	0.5ha)

Intermediate treatment site 6ha
Other 9ha
Total 70ha
+ buffer zone (green belt): 25ha

Among these area, the impermeable clay/ marl layer will be kept on the site of phase 2 and 3, and impermeable sheet will be installed on the site of medical waste disposal. Thus, the rain water which falls on the area 30ha totally is not permeated into the ground, partly discharged directly into the water way, and partly collected into the regulation pond and circulated to the disposal site in order to promote the evaporation and remove the pollutants.

The sites of phase 2 and 3 are divided into some sections by embankment to reduce the leachate productivity. The leachate in the section in operation will be collected in the regulation pond and circulated onsite. The rainwater on the other parts of the site is discharged separately outside because it is not polluted. Therefore, most of rainwater on 30ha site will be discharged. The amount worthy of rainwater on the 9ha site will decrease.

30ha x (0% - 30%) = - 9ha

30ha: area of impermeable clay and sheet
0%: permeability of impermeable clay and sheet
30%: permeability of existing land

On the other hand, the water retaining capacity of the buffer zone of 25ha will increase because of plantation of green trees. On the assumption that it increases from 30% to 70%, the rain water on the area of 10ha is expected to be provided to the aquifer.

25ha x (70%-30%) = +10ha

The loss of groundwater by impermeable clay and sheet may be made up by the appearance of green zone.

On the result of the groundwater survey, the groundwater is probably charged with the water from the existing dumping site and from the surface flow in this proposed area. Therefore, the amount of water provided to the aquifer will be nearly equal even if this project is implemented. Therefore, the impact on the groundwater will be negligible.

b.2 Positive Impact

Positive impact is not expected.

c. Aftercare

c.1 Negative Impact

Since the surface of the disposal site is to be capped with soil completely after the termination of operation and most of the rain water falling there will be discharged directly out of the site, the volume discharged into the water way will increase. On assumption that the ratio of runoff from the operation site is 50% and it from post-operation site is 70%, the runoff of surface water would increase 20%.

Therefore, the water provision from the surface water to the aquifer through the waterway will increase. Especially, 100% of the rainwater on the medical waste disposal site will be discharged outside because the site is to be capped with impermeable sheet. Hence, it is expected that the impact on groundwater will be less than the case of operation stage.

c.2 Positive Impact

Positive impact is not expected.

13.5.3.6 Hydrological Situation

Change in surface water bodies due to inflow of runoff and the disposal site

a. Construction

a.1 Negative Impact

There is no change in surface water in dry season because rainwater is very little and no water is in the water way. Although there is no change in surface water discharged from the construction site during earthworks, the amount of discharge will increase after permeable soil is taken away and more than 3m of impermeable clay appears at the bottom of the site. The existing waterway will be improved to make the increased surface water run off.

a.2 Positive Impact

Positive impact is not expected.

b. Operation

b.1 Negative Impact

Since there is no water in the water way downstream of the proposed site in the dry season, no impact will be given on the hydrological condition. The operation area will be divided into the sections so that the disposal can be conducted for one year and the production of the leachate can be minimised. All of rain water on the site of phase 2 and 3, except operational section, will be diverted unpolluted from the disposal site and will flow into waterway directly. Thus, the amount of the surface water discharged from the proposed site will increase compared with the present situation.

On the other hand the rain water on the buffer zone will be stored because the zone is planted and water retaining capacity increases. As the difference between the amount of surface water increased by impermeable clay and the amount stored in the ground by buffer zone is not significant, it is expected that there is little impact on the hydrological condition.

Increased volume	Decreased volume
30ha x (100% - 70 %)	<25ha x (70% - 30%)

* 30ha: area covered by impermeable clay and sheet
*100%: run-off coefficient of impermeable clay and sheet
*70%: run-off coefficient of existing land
*25ha: area of buffer zone
*30%: run-off coefficient of buffer zone

b.2 Positive Impact

Positive impact is not expected.

c. Aftercare

c.1 Negative Impact

Since the surface of the disposal site is to be capped with soil finally, 70% of rain water on the site will flow into the waterway without infiltrating into the waste. Hence, the total amount of surface water flowing out of the site will not change in comparison to the present. Therefore, the impact on the hydrological condition will be negligible.

c.2 Positive Impact

Positive impact is not expected.

13.5.3.7 Fauna and Flora

Changes in flora and fauna leading to obstruction of breeding, extinction of species due to the disposal site

a. Construction

a.1 Negative Impact

As there are very few green trees in the project site, the natural environment of the proposed site is not very suitable for flora and fauna. The most part of the site is used as agricultural land. When the landform of the proposed site is changed and the surface soil is removed, flora on the surface will be extinct. However, the impact is not serious because the areas in the similar environmental condition can be found in the vicinity. Some fauna may move to the nearby places in the similar environment.

a.2 Positive Impact

In this project a lot of green trees are to be planted around the proposed site to prevent the disposal activities from being viewed. The length of the zone is 4,500 m and width is 50 m. The area of it is 25ha. The new habitat is created for fauna. The site for buffer zone may be changed into a new natural environment for flora and fauna in the future.

b. Operation

b.1 Negative Impact

Waste dumping site often promotes growth in the population of vectors and vermin, such as flies, mosquitoes, cockroaches and rats, which can have a negative impact on surrounding ecosystems. However, it is proposed to operate the disposal site as a sanitary landfill which will minimise this problem. Furthermore, pesticides may be used if required. Hence, the impact of vectors and vermin associated with the waste disposal site on flora and fauna will be negligible.

Noise from disposal equipment and waste collection vehicles, landfill gas, dust and fumes will have a negligible impact on flora and fauna within the vicinity of the

proposed disposal site because they have been already influenced by current dumping activities.

Leachate will be collected to the regulation pond, circulated into the disposal site without being discharged out of the proposed site. Therefore, it will not give any impact to flora and fauna within the vicinity of the disposal site.

Landfill gases will be ventilated in a controlled manner and should not cause harm to flora and fauna within the vicinity of the landfill.

b.2 Positive Impact

The leachate has been flowing out of the existing dumping site, which may impact on flora and fauna. It will be collected for circulation and not discharged outside. The environment for inhabiting may be improved.

The landfill fires have been occurring very often at the existing dumping site, which may impact on flora and fauna. The waste will be covered with soil daily and fires will be terminated. The environment for inhabiting will be improved.

The existing dumping site is generating gases which may impact on flora and fauna. They will be ventilated and dispersed into the air. The environment for inhabiting will be improved.

c. Aftercare

c.1 Negative Impact

The main impact on flora and fauna during the aftercare stage will be similar in nature to the impact during operation described above. After completion of disposal, leachate and landfill gases will be produced in smaller quantities and be weaker in composition. The monitoring system of gases and leachate should be planned and need to be continued for a long time.

c.2 Positive Impact

It is not long before green trees will be planted on the site and it will be used as a green park or recreation area for citizens. The green trees may possibly attract many birds. The new environment for flora and fauna may be realised in combination with green buffer zone.

13.5.3.8 Landscape/ Aesthetics

Changes in topography and vegetation due to construction and operation of the disposal site, and deterioration in environmental aesthetics

Presently at the proposed site the open dumping of waste is carried out daily without covering with soil. Smoke is rising from the site every day even after the heavy rain and the environmental aesthetics is deteriorated remarkably. Therefore, if only the landfill fire is terminated and open waste is hidden under the soil by the adoption of a sanitary landfill operation, the landscape and environmental aesthetics would be able to restore the original value.

a. Construction

a.1 Negative Impact

Negative impact is not expected. The facilities constructed at the proposed site will not be conspicuous, because the highest building will be 15m on the ground while the surrounding area is open and huge, and the waste disposal site will be prepared below the original ground surface because the ground soil should be excavated to the impermeable stratum.

a.2 Positive Impact

The green trees will be planted around the proposed site to prevent the construction activities from being viewed. The existing dumping site has been improved as part of the pilot project of JICA Study. When the operation of phase 1 starts after the improvement of the existing dumping site, the smoke will be terminated and the existing waste will be hidden under the soil.

b. Operation

b.1 Negative Impact

No negative impact is expected.

b.2 Positive Impact

From the result of landscape survey, it proved that the existing dumping site could be seen from the surrounding settlement like Cinarli village(north to the site), Sofulu village(east), Boynuyogun village(east), Carkipare village (north) and Uzunlar district. Judging from the present view on the photographs the green buffer zone will be effective to prevent the people in the surrounding settlement from viewing the operation at the disposal site.

The landfill fire will be terminated by conduct of a sanitary landfill, and scatter of waste and disperse of offensive odour will be also controlled.

Therefore, the implementation of this project will give a positive impact on the landscape and environmental aesthetics.

The degree of the improvement of landscape can be estimated by the photo-montage shown in Figure 13-55 and Figure 13-56.

c. Aftercare

c.1 Negative Impact

No negative impact is expected.

c.2 Positive Impact

After the termination of operation the site will be capped with soil, and may be planted with green trees and used for a recreational zone. The positive impact will be expected.

Figure 13-55: View of the Existing Proposed Site

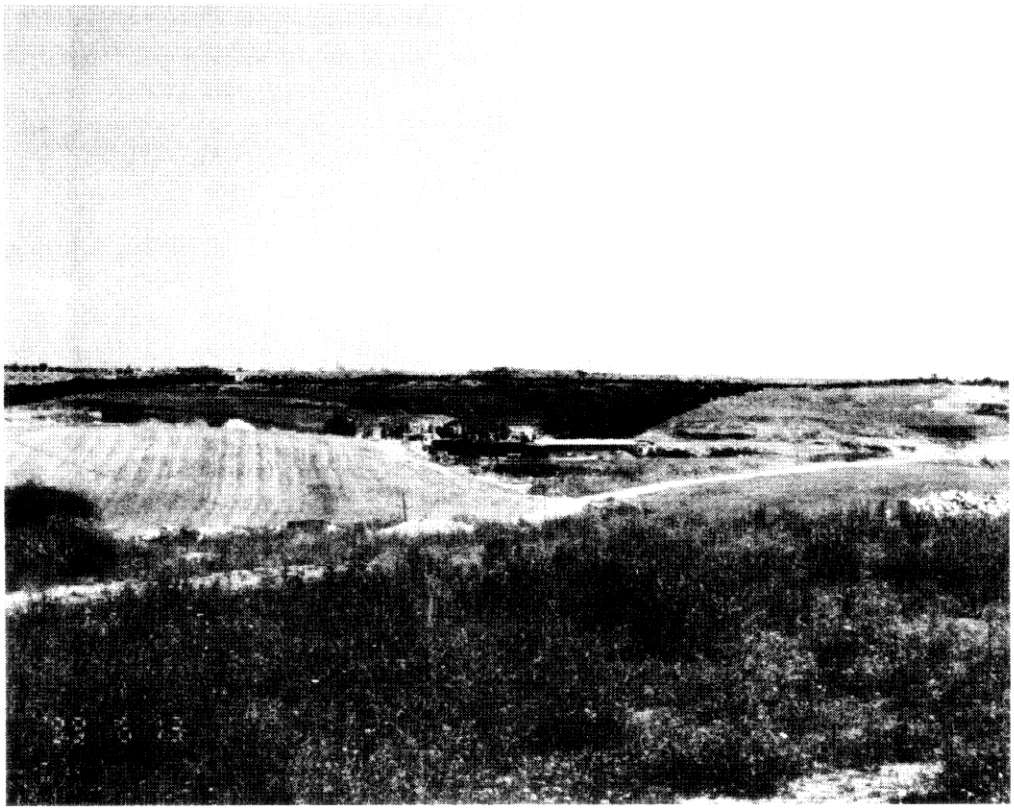


Figure 13-56: View of this Project Site in 2005

13.5.3.9 Air Pollution

Pollution caused by exhaust gases, dust, smoke, etc. from waste collection vehicles and the disposal site.

a. Construction

a.1 Negative Impact

Construction activities will involve small number of earthmoving machines, dump trucks, rollers and a few light vehicles at the site, and transportation vehicles of materials and equipment for construction.

The main sources of air pollution will be dust generated from the construction activities and exhaust gases from construction vehicles at the site. Significant quantities of dust may be produced during the dry season but the regular use of water sprays should minimise dust production.

The effect of exhaust gases from construction vehicles will have a low negative impact as they will mainly affect construction workers and hence appropriate equipment should be worn (e.g., face masks). As very few houses are located within 1,000m from the site and the prevailing winds will disperse airborne pollutants away to the area in NE-NNE or S-SW during dry season, in the direction of which there is no residential settlement within a several kilo-meters, no adverse impacts are expected to occur beyond the site boundary.

a.2 Positive Impact

Positive impact is not expected.

b. Operation

b.1 Negative Impact

Generally, it is expected that operation of the final disposal site will have a low negative impact on air quality. No significant adverse impacts will occur beyond the site boundary due to a buffer zone of 50 m maintained around the site, very few houses being located within 1,000m radius of the site and the prevailing winds dispersing pollutants away in the direction of the area where there is no residential settlement within a several kilo-meters.

b.1.1 Landfill Gas

The biological decomposition processes in a disposal site with municipal solid waste result in the generation of landfill gas. Under normal conditions, landfill gas production rates reach a peak within the first 2 years and then slowly taper off, continuing many cases for periods of up 25 years or more. In most cases, over 90% of the gas volume produced is methane and carbon dioxide. If vented to the atmosphere in an uncontrolled manner, methane can accumulate in the enclosed spaces. When methane concentrations in the air are between 5-15%, it is explosive.

Carbon dioxide, being heavier than air, tends to migrate downwards, often leading to high concentrations of carbon dioxide in the lower part of a disposal site for many years. Ultimately, it can move downwards through the underlying strata, until it reaches the groundwater, where it will usually lower the pH.

The disposal site will be furnished with installations for controlled ventilation of landfill gas to the atmosphere with gas being collected and vented from the top of the disposal site and subsequently dispersed by the wind . Under these conditions neither methane nor carbon dioxide should detrimentally affect air quality near the site.

b.1.2 Dust

Significant quantities of dust may be generated during the dry season due to landfill equipment and waste collection vehicles movements but this can be controlled through the use of water sprays. The impact should be minimal.

b.1.3 Landfill Vehicle

The impact of vehicle fumes on air pollution is considered negligible due to the relatively small number of vehicles operating within the disposal site at one time. The equipment for the sanitary landfill consists of two bulldozers, two dump trucks, one wheel loader, one backhoe and a water tank truck. Regular maintenance of vehicles will help to minimise this problem.

b.1.4 Landfill Fire

The waste disposal will be operated with a relatively small tipping front, and the waste will be compacted and daily soil cover will be applied. These practices will help to minimise the possibility of any spontaneous fires breaking out, which can produce large quantities of smoke and environmentally harmful gases, including dioxins. Any fires which break out must be extinguished immediately.

b.1.5 Waste Collection Vehicle

The amounts of municipal waste at Adana in 1999 and 2005 are shown in Table 13-34. In this project, intermediate treatment facilities like a sorting plant and a compost plant will be introduced, and those plants will be located next to the disposal site. Therefore, both of compostable waste and non-compostable waste will be transported to the proposed site through the same access road. The number of the collection vehicles which came to the existing disposal site in 1999 is shown in Table 13-35. The average number of collection vehicles is 235 vehicles/day from Monday to Saturday. The datum of Sunday was omitted because it is unusual. Since the amount of waste hauled into the existing site is 805t, on assumption of specific gravity of 0.3t/m^3, the average capacity of collection vehicle can be calculated:

805 / 0.3 / 235 11.5 m^3/vehicles

Using this value, the number of collection vehicles can be predicted in 2005:

1192 / 0.3 / 11.5 346 vehicles / day

The increase rate of number of collection vehicles in 2005 to that in 1999 is:

346 / 235 = 1.47

The air pollution caused by vehicles is promoted according to the increase of number of vehicles. On the result of air pollution survey conducted in May and June, 1999, near the access road (Old Kozan) to the existing disposal site, the concentrations of SO_2 and NO_x are:

SO_2 : 61.8 μ g/ m^3
NO_x : 86.9 μ g/ m^3

On the assumption that the general traffic volume would increase in accordance with the growth of population and GNP, the growth ratio of the general traffic volume would be approximately 1.47. Therefore, in 2005 the concentration of air pollution will be:

SO2 : 61.8 x 1.47 = 90.8 μ g/m^3 < 150 μ g/ m^3
NO_x : 86.9 x 1.47 = 99.2 μ g/m^3 < 100 μ g/m^3(NO_2)
< 200 μ g/ m^3(NO)

As in 2005 the concentrations will not exceed Long Term Standards(on right side) from The Air Quality Protection Regulation, it is considered that the impact by waste collection vehicles will be negligible.

Table 13-34: The Amount of Waste in Adana

unit: t/day

YEAR	1999	2005
Generated Waste	834	1,200
Discharged Waste	803	1,169
Collected Waste	780	1,158
Waste to Sofulu Site	805	1,192

Table 13-35: The Number of Collection Vehicles to Existing Disposal Site in Sofulu(1999)

unit: vehicles /day

Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
312	241	225	215	229	187	53

b.2 Positive Impact

Positive impact is not expected.

c. Aftercare

c.1 Negative Impact

As discussed above, landfill gases will continue to be produced in gradually diminishing volumes for periods of up to 25 years or more. On closure, the landfill gas ventilation facilities will remain in place and should be regularly inspected and maintained until it is determined that landfill gas emissions are negligible and no longer pose a safety threat.

Since the disposal site will be capped, grassed and planted, no adverse impact on air quality from dust or fires is expected during the aftercare stages.

c.2 Positive Impact

Positive impact is not expected.

13.5.3.10 Water Pollution

Pollution caused by inflow of soil, leachate and runoff from the disposal site into rivers and groundwater

a. Construction

a.1 Negative Impact

The major construction activities will take place within one watershed, in which all surface water runoff is trapped. The suspended soil in the surface water discharged from the earthworks site will be settled through a sedimentation pond constructed downstream during the rainy season.

During the construction stage, earthworks may have a minor effect on infiltration flows and there will be no negative impact on groundwater quality.

a.2 Positive Impact

Before the commencement of operation in phase 1, the existing dumping site is improved. The leachate had been discharged outside without treatment and might have given an impact on the surrounding area, but it has been recently collected in the regulation pond and not discharged out of the site because the circulation system was constructed in the pilot project of JICA Study. Therefore, the implementation of this project will improve the environment greatly.

b. Operation

b.1 Negative Impact

b.1.1 Final Disposal Site

The disposal site and intermediate treatment plants will be developed within one watershed and divided into three phases. The operation will start at phase 1 after the reforming of the existing dumping site and covering of waste with soil finish. It is assumed that 50% of rainwater on this area infiltrates into the waste and the rest of it flows to the outside of the area as surface water during the operation of phase 1. While the surface water is discharged outside, the leachate is to be channelled and collected into the drain system constructed along the eastern edge of phase 1 area as a pilot project in JICA Study. Approximately 1,600 m^3 of leachate will be circulated per day. The pollutants in the leachate will be reduced during the circulation.

After the operation of phase 1 terminates and the area is capped with a final 1m thick layer of soil, it is assumed that 30% of rainwater on the site would infiltrate into the waste and 70% would go out of the area. The phase 1 area will be grassed and planted to prevent its erosion. The leachate will continue to be produced after the termination of operation although production rates and strengths will diminish with time. Therefore, the monitoring of it should be continued until concentration of leachate will not exceed certain criteria.

Impermeable clay/ marl layer will be kept at the bottom of the site and impermeable sheet will be installed on the side slope, and the site will be divided into sections so that the disposal can be conducted for one year . The section will be separated from the other area by embankment at least 1.5m in height, thus preventing the entry of leachate into the area not yet opened for waste disposal, and the leachate in the section

will be drained to the regulation pond through the pipes. The rainwater in other area will be discharged directly to the waterway because it is not polluted. The operation will be carried out in one section. On completion of the section, the final elevation will be above the surrounding ground level and the top of the section will be capped with a final 1m thick layer of soil, grassed and planted, in order to minimise stormwater infiltration and erosion. All stormwater runoff from completed sections of the disposal site will be collected and channelled to the drain system constructed along the buffer zone towards the nearby waterway.

Therefore, the impact due to the waste water from final disposal site will be negligible.

b.1.2 Medical Waste Disposal Site

In medical waste disposal site the perfectly closed system will be introduced regarding waste water treatment. The impermeable sheet is to be installed to prevent the leachate infiltrating into the ground in accordance with the Regulation on Control of Medical Wastes. The site is divided into many small sections with embankments and the operation is conducted in one section. All rainwater on the section in operation shall not be discharged out of the site because the leachate may be significantly polluted with infectious and hazardous waste, while rainwater on the other sections will be discharged to the outside. The leachate is collected in the regulation pond and circulated to the site in operation. It is expected that during the circulation the pollutants in the leachate will be reduced gradually while the volume of leachate will be also reduced by evaporation.

Therefore, the impact due to medical waste will be negligible.

b.1.3 Sorting Plant

Four types of water will be drained from the sorting plant, i.e., domestic wastewater from the control room, leachate from waste, wastewater from the sorting plant cleansing and surface water from rain.

Domestic water is to be treated in a septic tank and discharged to the leachate regulation pond situated downstream of disposal site. Leachate from waste and wastewater from plant cleansing are treated by rapid filtration installed in the plant and discharged to the leachate circulation facility. Wastewater in the facility will be circulated to the disposal site to reduce the concentration of pollutant. Rainwater is drained to the outside of the plant without treatment by a drain system independent of the other wastewater.

Therefore, the impact on the surface water and groundwater due to wastewater from the sorting plant will be negligible.

b.1.4 Compost Plant

There are four processes in the compost plant, which discharge the wastewater, i.e., pre-treatment section, composting area, maturation area and screening area.

In pre-treatment section, domestic wastewater is treated by simplified septic tank and discharged to the leachate circulation facility for final disposal site .The leachate from the waste and wastewater from cleansing of the section is treated by rapid filtration and discharged also to the leachate circulation facility. Rainwater is drained to the

outside of the plant without treatment by a drain system independent of the other wastewater.

In composting area, a screen is used to remove suspended solids from leachate released from the piles in the early stage, surplus from sprayed water for moisture control, and wastewater from cleansing of the area. These are consequently discharged to the leachate circulation facility for the disposal site.

In maturation area, wastewater from floor cleansing and rainwater in this area will be treated together with wastewater from the composting area.

In screening area, wastewater generated in this area is also treated with wastewater from the composting area and maturation area.

Therefore, the impact due to the wastewater from the compost plant will be negligible.

b.2 Positive Impact

Positive impact is not expected.

c. Aftercare

c.1 Negative Impact

Leachate will continue to be produced after the termination of operation. Although production rate of leachate will diminish with time, it should be inspected regularly according to the monitoring program.

The leachate is to be inspected for 10 years at the medical waste disposal site.
Therefore, negative impact on surface water and groundwater is expected to be minimal.

c.2 Positive Impact

Positive impact is not expected.

13.5.3.11 Soil Contamination

Contamination of soil by leakage of fuel, diffusion of ash and leachate, etc. from the disposal site.

a. Construction

a.1 Negative Impact

During this stage, soil contamination may occur due to possible spillage of oil from construction equipment and vehicles and leakage of fuel. However, the contamination will be negligible because of the small numbers of construction equipment and vehicles.

Since phase 1 area of the proposed site in Sofulu has been already used as an open dumping site, the soil within the site may be possibly contaminated. However, the soil in the surrounding area will never be polluted because the contaminated soil within the site will not be carried out of the site.

a.2 Positive Impact

Positive Impact is not expected.

b. Operation

b.1 Negative Impact

Soil contamination by substances present in the leachate from the deposited waste will occur. However, contamination will be minor as over 82.7%(at year 2005) of the municipal waste will be organic in nature, and hazardous and toxic waste is prohibited. The infectious and medical waste is disposed of at the specially prepared site. Hence, during the operation stage, the extent of contamination of the soil caused by the deposed waste is expected to be negligible.

The soil contamination due to infectious and medical waste can be avoided since the medical waste disposal site is to be installed with the liner to prevent the leachate permeating through the bottom of the site. However, as the medical waste is to be covered with soil every day, medical waste and soil will be accumulated in layers. Thus, the monitoring is to be carried out regularly. The medical waste and cover soil will not be taken out from the site because it will be strictly controlled. According to the monitoring plan of this project, the leachate from regulation pond and the water from the monitoring well will be analysed once in rainy season and dry season respectively. When the unusual pollution is found, the manager can improve effectively the medical waste disposal and make the impact minimal.

The diffusion of ash from the disposal site can be prevented by daily covering waste with soil. Spillage of oil from operational equipment and vehicles and the spillage of fuel may occur, but the impact on soil contamination is likely to be negligible.

b.2 Positive Impact

Positive Impact is not expected.

c. Aftercare

c.1 Negative Impact

During this stage, soil contamination is not likely to be aggravated. The leachate production is significantly reduced because most of the rain water runs down on the sloped surface of cover soil to the drain without penetrating into the accumulated waste.

After the termination of operation, the site may be planted and used for a green park or some recreational area for citizens. The impact on the surrounding area by contaminated soil will not occur since the soil within the site will not be carried out of the site.

As for medical waste, the sustainable monitoring system is indispensable so that the contaminated soil can not be taken out of the site and so that the leachate can not flow away to the outside to contaminate the soil in the surrounding area. According to the monitoring plan the leachate is to be inspected regularly for 10 years. Therefore, the impact on the soil in surrounding area is expected to be minimal.

c.2 Positive Impact

Positive impact is not expected.

13.5.3.12 Noise and Vibration

Noise and vibration generated by construction equipment, landfill site equipment and waste collection vehicles

13.5.3.12.1 Noise

a. Construction

a.1 Negative Impact

There are many kinds of construction works in this project, like planting of green belt in buffer zone, earthworks for disposal site, building of a sorting plant and a compost plant, construction of medical waste disposal site and regulation ponds for leachate. Factors of construction which generate noise are as follows;

1. Construction of green belt
   Trucks for transportation of trees and heavy machines to dig holes for planting
2. Construction of a sorting plant and a compost plant
   Trucks for transportation of materials and equipment to build the plants
3. Construction of final disposal site for municipal waste and medical waste
   Heavy machines for earthworks
4. Construction of ponds for leachate
   Heavy machines for earthworks

Some degree of noise and vibration will be generated in every construction. However, the impact of noise will be negligible because there are very few houses within 1,000 m outside from the boundary of the disposal site. Moreover, it is expected that there will be little probability of new houses to be built around the site because the duration of the construction will be relatively short (1 year).

As for the noise from vehicles on the environment along the road, it is negligible because the frequency of transportation of construction material and equipment will be much less than that of general traffic.

While the new disposal site and recycling facilities like the sorting plant and the compost plant are under construction, waste collection vehicles can not bring the solid waste into the new site. However, as the existing dumping site is to be used until the new site is completed, it is expected that almost the same number of collection vehicles as at present come into and out of the site. Therefore, the noise is generated on the access road as much as now. But this noise should not be included in the impact owing to this project because this is not due to the implementation of the project.

a.2 Positive Impact

Positive impact is not expected.

b. Operation

b.1 Negative Impact

b.1.1 At the Landfill Site

The recommended permanent equipment for the sanitary landfill consists of three bulldozers, three dump trucks, one excavator and a water tank truck. Maximum noise levels will be produced when bulldozers are operating simultaneously.

Maximum noise levels can be calculated on the data of noise level 110dB in Table 13-36, using the following equation:

$$P = 10\log_{10} \quad 10^{Pi/10}$$

Where: P = resulting noise level (dB) from a number of sources
Pi = noise level from each source

This gives maximum noise levels of 114.8dB at the source.

Table 13-36: Noise Power Level of Heavy Machine

No.	Machine for operation	Noise level (power level: dB)	Unit
1	Bulldozer	110	3
2	Dump Truck	100	3
3	Excavator	100	1
4	Water tank truck	80	1

Presently, there are very few houses within 1,000m outside from the boundary of the proposed site. Noise is generally reduced in accordance with the increase of distance from the noise source. In reality, as the noise is reduced with the equation 20log **r** (**r** = distance from the source) , in case that the distance is 1,000m, 60dB is expected to be reduced ($20\log_{10}1{,}000 = 60$) and 114.8dB becomes 54.8 dB at the receiving point. The noise from other heavy machine is also reduced to about 40 dB. Therefore, the impact of noise during operation is negligible.

b.1.2 Sorting Plant and Compost Plant

At sorting plant, major noise sources are wheel loader at reception hall, metals dropped from the magnetic separator and truck for transportation of residue. The noises from feeding conveyor, plastic bag breaker, hand-sorting conveyor, residue conveyor and press machines are negligible because those noises are low.

Since the wheel loader is operated to haul the waste to the feed-hopper and stops the operation when the feed-hopper is full, it does not always produce the noise. Although the power level of noise is at most approximately 110 dB(A), some amount of noise is reduced by the penetration loss of building wall because the waste reception is located in the enclosed building. Furthermore, there are very few houses within 1,000 m from the site of sorting plant. It is expected to be at least 60dB(A) decrease of noise in accordance with the distance between the noise source and receiver.

The noise is produced when the metals like cans caught by the magnetic separator are subsequently dropped into the bucket. However, it will be reduced because the rubber sheet is to be installed on the surface of the bucket to avoid the noise generation.

The truck for transportation of residue stops the engine and parks below the residue conveyor until it is filled with residue. As the amount of residue produced at sorting plant in 2005 will be 167.6 t/day and the operation time is 14 hours, the residue amount per hour will be 12.0 ton /hour (167.6 / 14 = 12.0). This amount can be transported by the truck only several times per hour. Therefore, the impact by noise of the truck is negligible.

At compost plant, major noise sources are wheel loader at reception area and selective crushing separator. The wheel loader is expected to be the same situation as the case of sorting plant.

The selective crushing separator will produce high noise because it crushes the waste. The noise level will be 80 dB(A) at most. However, there are very few houses within 1,000 m from the site of compost plant and it is expected that the reduction of noise will be more than 60dB(A) (20log 1000 = 60) at the surrounding residential areas.

Therefore, the impact by noise generated from the compost plant is negligible on the daily life at surrounding area.

b.1.3 Waste Collection Vehicles

The number of collection vehicles (346/day) can be calculated in "5.3.9 Air Pollution" for 2005, and if the trucks transport the waste to the Sofulu site during 3 hours in the morning and in the evening respectively:

346 vehicles /6hr ＝ 58 vehicles / hr,
Hourly traffic volume at section : 58 vehicles / one lane x 2 lane (come & go)
= 116 vehicles

On assumption that the width is 10m and velocity is 40km/ hour on average, the formula for noise prediction is as follows:

$$Leq = 10 \log_{10} (\Sigma 10^{Ui / 10} \cdot \Delta t \cdot N / T)$$

N: Traffic volume (vehicles / hour)
Ui: Sound pressure level which reaches the prediction point from noise source of No.i
$\Delta t = \Delta D / V$
ΔD: Interval of noise source point
V: Velocity of vehicles (km / hour)
T = 3,600 (seconds)

The noise level in 2005 will be 66.6dB(A) and almost equal to the standards for Zone III or IV defined as follows:

Zone III: City-centre residential area, main roads, workplaces (20m from traffic flow) ; 55-65 dB(A)

Zone IV: Industrial zone or main roads where heavy vehicles and buses pass; 60-70dB(A)

Therefore, the impact on the area along the access road will be negligible.

b.2 Positive Impact

Positive impact is not expected.

c. Aftercare

No impact from noise is expected.

13.5.3.12.2 Vibration

Vibration levels due to landfill equipment and waste collection vehicles have not been estimated by any theoretical method. Instead, the noise level results are considered to be indicative of vibration levels.

a. Construction

a.1 Negative Impact

The impact by vibration from the construction equipment and the vehicles transporting the materials for construction is expected to be negligible because the impact by noise owing the construction is also expected to be negligible.

a.2 Positive Impact

Positive impact is not expected.

b. Operation

b.1 Negative Impact

The reduction of vibration in accordance with the increase of distance is generally expected like that of noise. The impact by vibration from the equipment for operation and waste collection vehicles is expected to be negligible because the impact by noise owing to the operation is likely to be negligible also.

b.2 Positive Impact

Positive impact is not expected.

c. Aftercare

No impact from vibration is expected.

13.5.3.13 Offensive Odour

Generation of offensive odour from the compost plant, the sorting plant and the landfill site.

a. Construction

a.1 Negative Impact

During this stage, the production of offensive odour from construction activities, especially exhaust fumes from earth moving equipment and trucks will be negligible due to the open nature of the area and the long distance almost 1,000m from the construction site to the residential area.

a.2 Positive Impact

Before the commencement of operation in phase 1 area, the existing dumping site is improved. As the waste is to be covered with soil, the offensive odour will be minimised.

b. Operation

b.1 Negative Impact

A low negative impact may result from the handling of waste at the compost plant, the sorting plant and the disposal site.

b.1.1 Compost Plant

At the compost plant, the offensive odour is produced at the waste reception section and on the compost production process. A large proportion of the waste to be handled at the compost plant will be organic in nature and it will decompose during 1 month. In the reception section, air is drawn and deodorised as described below in the maturation area.

The compost plant is situated in the closed building and air suction system is installed under the floor of the static pile in order to supply the oxygen into the waste. When the air goes into the perforated pipes under the floor through the waste, offensive odour is also taken into the perforated pipes. After offensive odour is gathered into the main pipe by the blower, it is sent to the maturation area and deodorised through the floor installed with deodorization system. Therefore, the offensive odour from the compost plant is minimal.

b.1.2 Sorting Plant

The offensive odour at the sorting plant is produced less than at the compost plant because a large proportion of the waste handled at the sorting plant is not organic in nature. The sorting plant is located in the building to prevent the offensive odour leaking outside. As air quality in the waste reception section and the hand-sorting section is deteriorated by odour from waste, a ventilation system will be provided. Air is drawn from the waste reception section and the hand-sorting section, and sent to the deodorization system prepared in the site. In order to improve the environment for workers, fresh air is to be sent through several blowers. Therefore, the impact by offensive odour will be negligible.

b.1.3 Waste Disposal Site

In the waste disposal site organic wastes are decomposed and offensive odour is produced. However, the tipping front will be relatively small and waste will be deposited, compacted and covered with soil daily. These practices should minimise offensive odour problems.

b.1.4 Leachate and Landfill Gas

Offensive odour will also result from the production of leachate and landfill gas. Leachate will be collected within the leachate pond where some of it will evaporate. However, most of the leachate will be circulated to the disposal site through the pipe by the pumping system. The circulation pipes are installed under the cover soil to prevent the offensive odour dispersing into the air. Hence, offensive odour from

leachate should not be problematic. Similarly, landfill gases should not cause a significant odour problem as they will ventilated in a controlled manner and will be dispersed by the wind.

b.2 Positive Impact

Positive impact is not expected.

c. Aftercare

c.1 Negative Impact

Leachate and landfill gases will continue to be produced during the aftercare stage after the termination of operation although production rates and strengths will diminish with time. Some offensive odours may be experienced from the venting of landfill gases. However, this impact is likely to be minor.

c.2 Positive Impact

Positive impact is not expected.

13.5.4 Conclusion of Impact

On the result of environmental assessment of impact, the following impacts should be considered carefully even if mitigation measures would be applied.

Table 13-37: Conclusion of Impact

Phase	Factors of Impact
Construction	Dust from earthworks Flood
Operation	Gas, Fire, Offensive Odour and Safety at disposal site Leachate from medical waste disposal site Offensive Odour from compost plant
Aftercare	Gas, Leachate and Offensive Odour from disposal site Leachate from medical waste disposal site

a. Construction

a.1 Dust

On the stage of construction, the impact by dust and flood should be considered carefully. Dust during earthworks will be controlled by water sprays. Water tank truck has to stand by always during dry season and meteorological information of wind should be transmitted to the workers in advance. When the wind is too strong to give significant impact on the surrounding area, it is necessary to stop the earthworks. In any case the appropriate supervision and control of earthworks are indispensable.

a.2 Flood

In this project the waterway is to be improved in order to make the rain water on the impermeable clay of phase 2 and 3 discharged. However, when a local downpour happens, the downstream area may be possibly suffered from flood. It is expected that flood can be avoid by construction of green buffer zone. Therefore, before the construction of phase 2 and phase 3, buffer zone should be constructed and covered

with green trees. Green zone can increase the water retaining capacity of the land and store most of rain water in the zone without discharging outside. The construction of green zone can control the discharge amount and balance the increased discharge amount with decreased one.

Increased volume Decreased volume

30ha x (100% - 70 %) < 25ha x (70% - 30%)

* 30ha: area covered by impermeable clay and sheet
* 100%: run-off coefficient of impermeable clay and sheet
* 70%: run-off coefficient of existing land
* 25ha: area of buffer zone
* 30%: run-off coefficient of buffer zone

b. Operation

b.1 Gas and Fire, etc. at Disposal Site

Generation of gas, outbreak of landfill fires, production of offensive odour and safety control depend on the management of sanitary landfill. The manager of this work should be trained enough and supervise strictly the relevant workers. As for gas, the ventilation system will be equipped and gases will be dispersed in the air. Although the proposed site is open widely and suitable for gases to diffuse, the workers should be careful not to deal with fire(e.g., cigarette) in the site because the gases are inflammable.

To eliminate the landfill fires and offensive odour, it is indispensable to cover the waste with soil every day. Therefore, whether the covering is complete or not should be inspected by the manager at the end of daily works.

b.2 Leachate from Medical Waste Disposal Site

The impact of leachate from medical waste disposal site must be inspected strictly because the leachate may be significantly polluted by infectious and hazardous waste. The water quality in the monitoring well of surrounding area should be analysed twice a year regularly, and once the unusual figure is found, the operation must be stopped and all processes for medical waste disposal examined.

b.3 Offensive Odour from Compost Plant

Offensive odour from compost plant is to be inspected once a month. The effectiveness of soil deodorization system in maturation area should be often examined and it is necessary to control not to send too much air from static pile and reception section.

c. Aftercare

c.1 Gas, Leachate and Offensive Odour from Disposal Site

Gases and leachate will continue to be produced after the termination of operation although production rates and strength will diminish with time. The water quality in the wells of surrounding area should be inspected regularly and gases should be also monitored.

c.2 Leachate from Medical Waste Disposal Site

The water quality in the monitoring wells should be inspected regularly and strictly according to the monitoring program, because there is possibility of polluted water flowing out of the site.

13.6 Alternatives of the Project

13.6.1 Site Selection Method

Looking at the present land use conditions in the target areas, the construction of SWM facilities within the city periphery would be extremely difficult. In particular, the final disposal site, which is extremely important to SWM, will be located outside of the city. As previously mentioned, the selection of such a site would require the approval of a number of relevant agencies. Given these conditions, the following procedures were adopted for the selection and acquisition of sites for the construction of SWM facilities in Adana.

Table 13-38: Site Selection Procedures

Item	Responsible Agency	Period
1. Proposal of Candidate Sites	Greater Municipalities of Adana	Aug to 31 Oct 1998
2. Rough Survey of Each Candidate Site	Study Team	Aug to 31 Oct 1998
3. Preparation of Assessment Report on Candidate Sites	Study Team	31 Oct 1998
4. Selection of Sites for F/S Implementation	Turkish Steering Committee	Mid-Nov 1998
5. Administrative Procedures for F/S Implementation	Greater Municipalities of Adana	Mid-Feb 1999
6. F/S Implementation	Study Team	Mid-Feb to Oct 1999
7. Site Acquisition Procedure	Greater Municipalities of Adana	From mid-Feb 1999

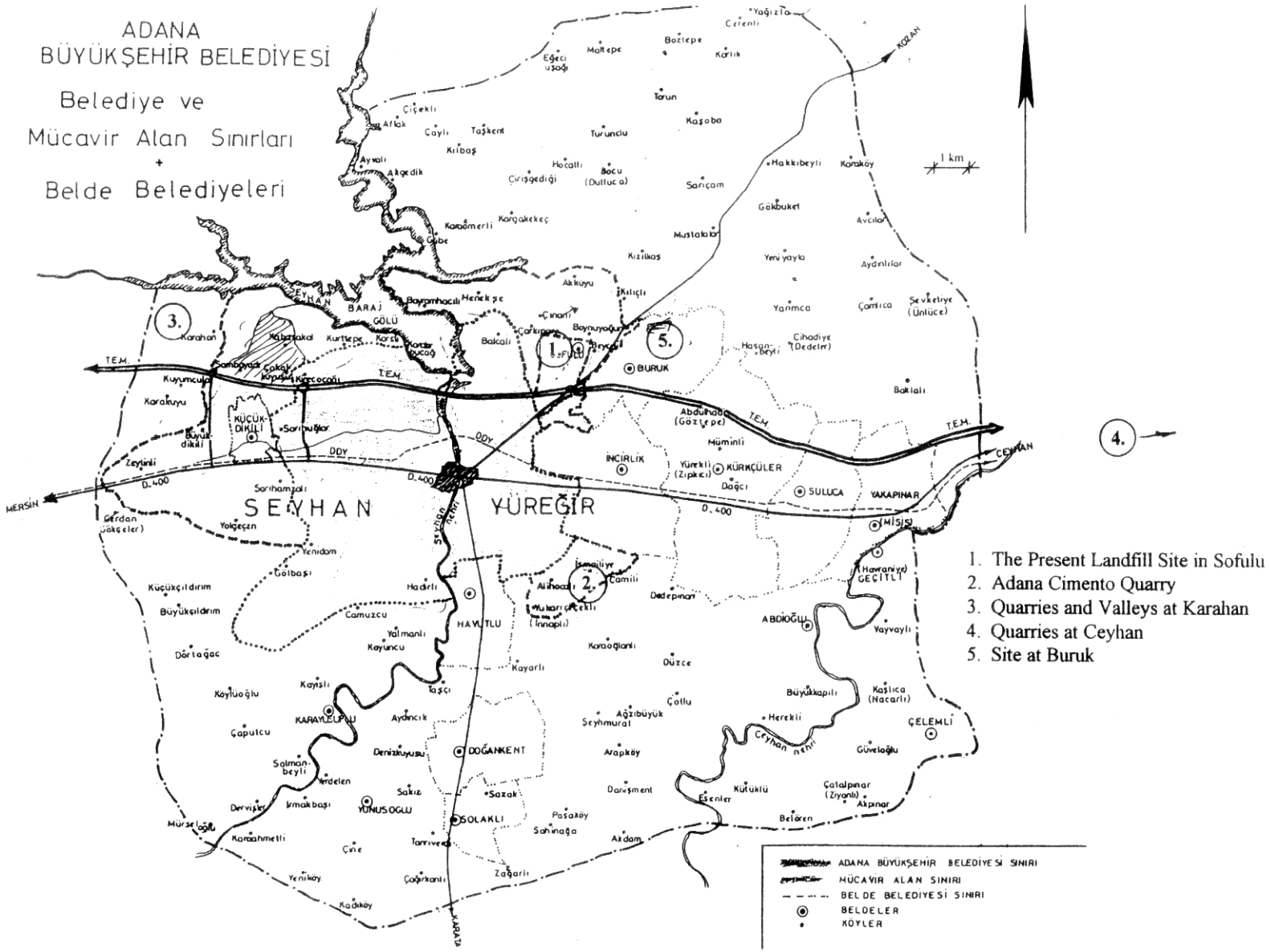
13.6.2 Candidate Disposal Site

A final disposal site is indispensable to an SWM system, regardless of the system's structure, which is outlined in the technical system proposed in the M/P. Accordingly, the study team requested the Turkish counterpart (C/P) to select appropriate candidate disposal sites from the beginning of the study. The C/P presented the following 6 candidate sites:

1. Present landfill site in Sofulu
2. Adana Cimento quarry
3. Adjacent area of Adana Cimento
4. Quarries and valleys at Karahan
5. Quarries at Seyhan
6. Site at Buruk

The study team carried out surveys on the proposed candidate sites and established standards for the evaluation of site conditions. The evaluation of the candidate sites was carried out as described below.

This section of the report describes and evaluates the candidate landfill sites to serve the Greater Municipality of Adana. Recommendations for the future landfill site of Adana are also included. The locations and photos of the candidate sites proposed by the Municipality are shown in Figure 13-57 to Figure 13-59.



1. The Present Landfill Site in Sofulu
2. Adana Cimento Quarry
3. Quarries and Valleys at Karahan
4. Quarries at Ceyhan
5. Site at Buruk

Figure 13-57: Location of Candidate Disposal Sites