PROJECT
FOR
INTEGRATED SOLID WASTE MANAGEMENT
MASTER PLAN
IN
GUJRANWALA

FINAL REPORT

VOLUME 3

SUPPORTING REPORT

SECTION G

ENVAIRONMENTAL AND SOCIAL CONSIDERATIONS

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SECTION G

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

1. INTRODUCTION

This **Section G** describes the environmental and social considerations taken for the Master Plan. These considerations are vital for making a decision on how the negative impact of the Master Plan of Solid Waste Management (SWM) to the environment in Gujranwala can be reduced or avoided.

Monitoring of the environmental and social aspects for the control of impacts is proposed. Firstly, the procedure is explained in terms of SEA (Strategic Environmental Assessment). Secondly, the socio-environmental condition of Gujranwala is explained. Public opinion is summarised as well. This section also includes a summary of the EIA for the Bhakhraywali final landfill site, and the regulatory framework of SWM in Pakistan is overviewed.

Based on this background information, impact forecast is summarised. Thus information reveals the planning of monitoring, and the Environmental Monitoring Plan in 2016 to 2030 is shown. The short-term monitoring plan (2016-2018) is provided as the "Action Plan".

2. ENVIRONMENTAL AND SOCIAL CONSIDERATIONS FOR INTEGRATED SOLID WASTE MANAGEMENT MASTER PLAN

2.1 Introduction

The master plan of integrated solid waste management (ISWM) has been formulated by using the Strategic Environmental Assessment (SEA) technique. Environmental and social issues were taken into consideration to select the preferable options for each technical sector (collection and transportation, 3R and intermediate treatment, and final disposal) in the ISWM for mitigating the probable impacts to the neighbouring areas in the course of project implementation. Furthermore, in the formulation of the Master Plan which is a combination of the selected technical options, the environmental and social perspectives were taken into account in addition to the technological, economic and financial, institutional and organizational aspects for selecting the best combination for Option B.

In this **Chapter 2**, the qualitative impacts to environment and society are discussed in practicing the construction project of the selected Master Plan Option B, and the scoping for the implementation of Environmental Impact Assessment (EIA) or the Initial Environmental Examination (IEE) for the project(s) is prepared.

2.2 Planning Procedures and Selection of the Optimum Master Plan

2.2.1 Planning Procedures for Development of the Master Plan

The SEA principle was conducted on the IEE level (Category B of the JICA Guidelines) to apply for decision-making of planning in the formulation of the Master Plan. Though both EIA and SEA are tools for the assessment of environmental and social impacts, in most cases, EIA deals with impacts from a single project. On the other hand, SEA deals with the comprehensive impacts of projects which cover a wide area (such as the master plan), and complicated impacts from a combination of plural projects, so that public consultation is significant.

One of the important principles in SEA is the "Zero Option". SEA provides an alternative option for the project, and it always has to take into account the case of "no project" implemented in the process of preparing the alternatives.

Figure G.2.1 shows the planning procedures of the Master Plan of this project. In the whole process, selection and decision-making, environmental and social considerations are carried out using the JICA Environmental Checklist for Waste Management.

Firstly, possible options are listed for each technical sector; i.e., Collection and Transportation, Intermediate Treatment and 3R, and Final Disposal. According to the SEA strategy, each approach must have a "Zero Option" which means no action will be made. For example, "Collection and Transportation" has the options of "Present Level Collection and Transport", "Direct Transport", "No Transfer Station for Mini-Dumpers," and "No Intermediate Treatment Facilities and No 3R Activities by GWMC", and so on.

Secondly, the best options are selected from each sector in terms of SEA. All of the selected options shall satisfy the check items in the Environmental and Social Considerations. Thirdly, some drafts of the Master Plan are formulated in combination with the options selected by the previous process. Needless to say, one of the drafts of the Master Plan is "Zero Option". Fourthly, the best Master Plan is formulated. Finally, the "Action Plan", which is defined as the priority project(s) to be implemented in the short-term period, is prepared, i.e., from year 2016 to year 2018 in this Project. The Master Plan includes many main- and sub-projects which break the components of the Master Plan down to the feasible action level. Therefore, a schedule of timing, cost and executing agencies is necessary for the implementation of these main- and sub-projects, and the projects showing these details are called "Action Plan".

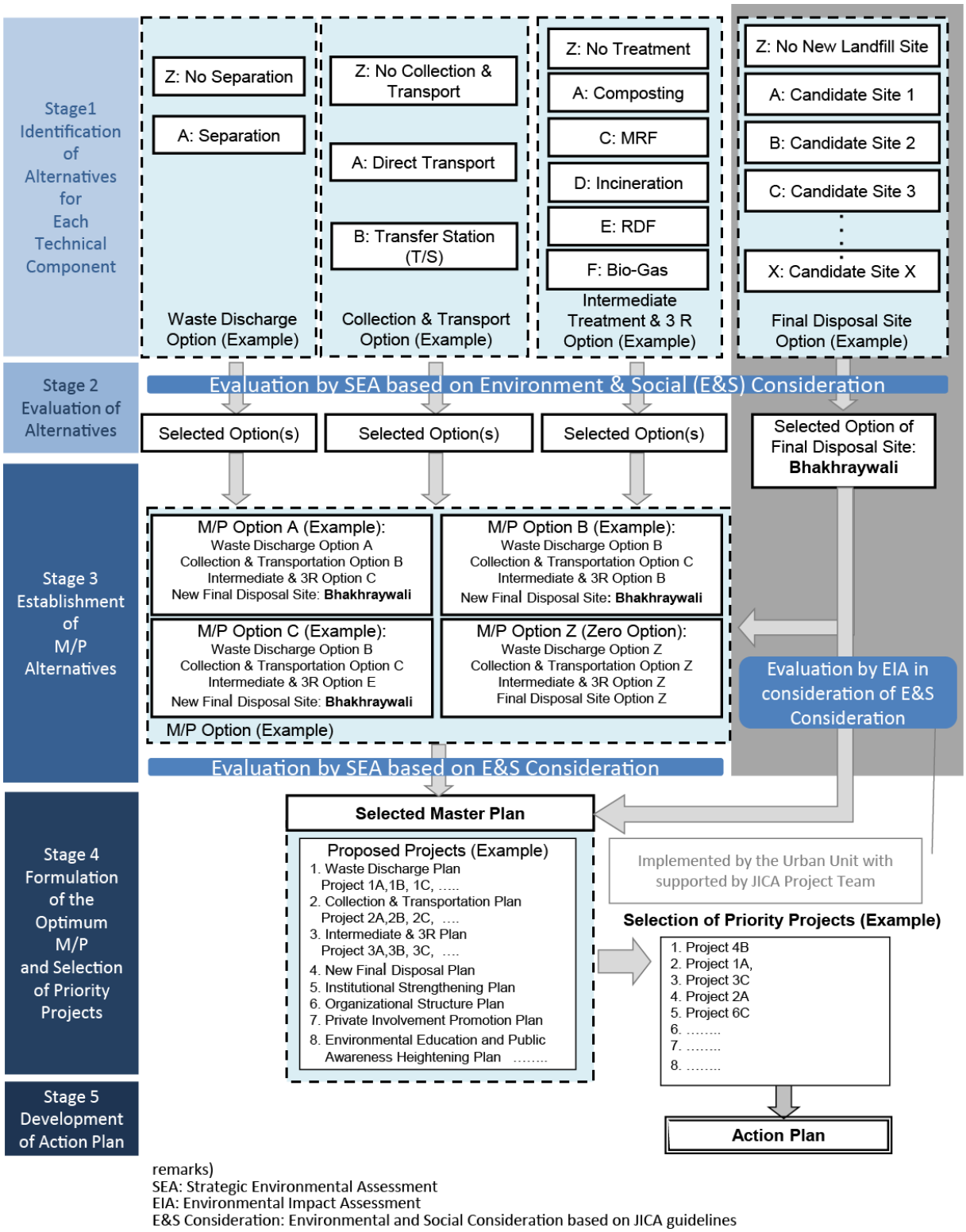


Figure G.2.1 Planning Procedure of the Master Plan with Environmental and Social Considerations

2.2.2 Selection of Optimum Master Plan

The master plan study options are discussed in **Chapter 4 of Volume 2, Main Report.** Option B is selected as the most optimum combination from the technical, environmental, social, financial, institutional and organizational viewpoints. This Option B is comprised of the development plans, programmes and projects listed in the following subsections.

(1) Proposed Development Plans and Programs

The environmental and social considerations should be carried out in the course of formulation of the Gujranwala Integrated Solid Waste Management Master Plan. The Master Plan is composed of the following seven programmes, the details of which are described in **Chapter 4 of Volume 2, Main Report**.

Programme 1: Waste Collection and Transportation Plan

Programme 2: Final Disposal Plan

Programme 3: Intermediate Treatment and 3R Promotion Plan

Programme 4: Environmental Education and Public Awareness Raising Plan

Programme 5: Economic and Financial Plan

Programme 6: Environmental Monitoring Plan

Programme 7: Institutional Strengthening and Organizational Plan

(2) Proposed Technical Options for Achieving Targets of the Master Plan

The technical options that will be implemented to achieve the targets set in the Master Plan are as follows:

- Separate collection;
- Construction and operation of a new final disposal site at Bhakhraywali;
- Improvement work and closure of the existing landfill site in Gondlanwala;
- Closure of the former landfill site in Chianwali;
- Construction and operation of a central compost plant; and
- Construction and operation of RDF plant.

2.3 Baseline of Environmental and Social Conditions

It is essentially required to consider the utmost mitigation of probable impacts to environmental and social aspects in practicing the projects of the selected technical option mentioned in **Section 2.2**. Under this **Section 2.3**, the natural and social conditions of the project site and the vicinities are collected and outlined for the baseline information taken into consideration for carrying out the EIA or IEE for the project(s).

The baseline of environmental and social considerations in this project is summarised based on the EIA report on the construction of a new final disposal site at Bhakhraywali and the result of the Environmental and Social Consideration Survey (E&S Survey).

The EIA report was drafted in February 2015 by the Urban Unit and submitted to the Federal Agency in March 2015. After submission, Public Hearing and Review was carried out on August 17, 2015, and Review and Decision will be made by the Federal Agency by the end of December, 2015 at the latest. The Urban Unit and GWMC conducted the EIA, and the detail of the EIA of the project is described in

the following **Section 2.4**. On the other hand, the E&S survey was carried out in this project in November 2014 (**Photo G.2.1**).

Photo G.2.1 Interviews in E&S Survey

2.3.1 Natural Condition

(1) Climate

Gujranwala has a tropical hot dry climate with long summers when temperature rises to maximum up to 48 degrees Celsius in the months of June and July. The summer season starts from April and continues until the end of September; June is the hottest month with maximum and minimum temperature of 40 degrees Celsius and 27 degrees Celsius, respectively.

The winter season starts from November and continues until March. January is the coldest month with maximum and minimum temperature of 19 degrees Celsius and 4 degrees Celsius, respectively.

The mean annual average temperature for the City of Gujranwala is 22 degrees Celsius.

The monsoon starts from the later part of June and lasts over the period of two and a half months. The eastern part of the district receives more rain. The mean annual rainfall of the region is 81.9 mm.

Maximum values of relative humidifies are observed during the month of January and December. The values range between 76% and 36% during morning and evening times respectively. Whereas minimum values are obtained during the month of May between the morning and evening times i.e., 45% and 22%.

The highest wind speed recorded during February to March. As far as wind direction is concerned for Gujranwala City, the predominant wind direction during the months of January to March, May, June and October to December is North-West, while in the month of April is North-East and in the months of July, August and September is South-East.

(2) Water

Surface Water: Surface water is used mostly for irrigation through irrigation canals. There are six irrigation tributaries in Gujranwala district that serve as main conduit, as follows:

- Gajar Gola Distributary (7.2 km)
- Kot Sujana Minor (7.7 km)
- Shori Branch (7.8 km)
- Muradian Distributary (8.5 km)
- Rakh Chichra Minor (9 km)
- Chandhar Minor (10 km)

Chenab River is the only river in the district. The *Chenab* River forming the northern boundary has been described as a broad shallow stream. There are several *nallahs* (canals) in the district which form channels for floodwater in the rainy season. The most important of them are *Palkhu, Aik, Khot, Beghwala* and *Dekh*.

Groundwater: Groundwater is used mainly for drinking and irrigation in Gujranwala. For drinking, the local population is generally reliant on supply from the hand pumps in rural areas while in urban areas the population use drinking water from the piped water supply scheme.

About 60% of the total housing units in the city had access to potable drinking water in 1998. Some 10.3% of the people use tap water for household use and 80.9% of the housing units in 2007-08 obtain water from hand pumps as compared to the 36.80% in 1998. On the other hand, 0.4% use private wells to meet their need of drinking water, and 0.6% people use water from public standpipes.

(3) Fauna and Flora

Fauna: Due to the extensive cultivation, high population and human activities, there is little wildlife in the project area. However, the Wildlife Department has reported some fauna.

Common mammals reported from the project area are given in **Table G.2.1.** Until a few years ago the wolf (Canis Palfies) was also found in riverine forests, but the species has almost become extinct due to loss of forests. Wild bores are reported to be inflicting serious crop damage, mainly to sugarcane and potato crops. Some degree of illegal hunting, poaching and trapping has been reported from the project area.

Table G.2.1 Common Mammals in the Project Area

Sr. No.	Scientific Name	Common Name
1.	Sus scrofa	Wild-bore
2.	Hyaena straitaa	Hyaen
3.	Vulpes bengalensis	Red Indian Fox
4.	Paleornis torquata	Percupine
5.	Canis Aureus	Jackal

The names of commonly found birds in the area are given in **Table G.2.2**. A large variety of waterfowls and migratory birds also visit the region because of the wetlands associated with barrages along the river systems of the area.

Table G.2.2 Birds in the Project Area

Sr. No.	Scientific Name	Common Name
1.	Accipiter Badius Cenchroides	Hawk
2.	Milvus Migrans Govinda	Kite
3.	Paleornis Torquata	Parrot
4.	Fvancolinus Pondoceraianus Mecrranesis	Partridge
5.	Corvidae Splendens	Common Crow

Due to the hot and humid climate of the region, some population of reptiles has also been reported in the project area. Reptilian and amphibian fauna is not well documented. However, local people have reported that snakes and lizards are common in the region.

Flora: The entire Gujranwala District has no natural forests, mainly due to vast agricultural activities. However, according to an old provincial notification, the trees along canals, provincial highways and rural roads are the responsibility of the Forest Department, which fall in the category of reserved forests.

The project area, which is an agricultural land, is the habitat of several floral species. Common floral species with rooted vegetation are also present near most of the water bodies of the area. The list of flora in the project area is presented in **Table G.2.3**.

Table G.2.3 List of Floral Species in the Project Area

Sr. No.	Scientific Name	Common Name
1.	Dilbergia sisoo	Sheesham
2.	Acacia Arabica	Keekar
3.	Salvadora persica	Peeloo
4.	Ficus Religiosa	Bohar
5.	Tamarix Indica	Gaz
6.	Azadrichta Indica	Nim
7.	Prospis Julifora	Mesquite
8.	Eucalypts Camaldulensis	Sufaida
9.	Zizyphus Numularia	Jharber
10.	Populus Alba	Poplar
11.	Morus Alba	Mulberry
12.	Syzygium Cumini	Jamun

Local farmers practice a small degree of farm-forestry in the project area to meet their fuel-wood and other day-to-day needs. The common species in such plantations are Poplar, Eucalyptus, Keekar, Mulberry and Jamun.

Due to the hot and humid weather, Gujranwala District is also famous for its fruit production, which includes mango, guava, banana, oranges and water melons.

(4) Rainfall

The average rainfall of Gujranwala from 1994-2013 is shown in **Figure G.2.2**. The highest rainfall of more than 300 mm was recorded in the months of July and August, while the lowest was observed during the months of November and December in the range of 8-13 mm.

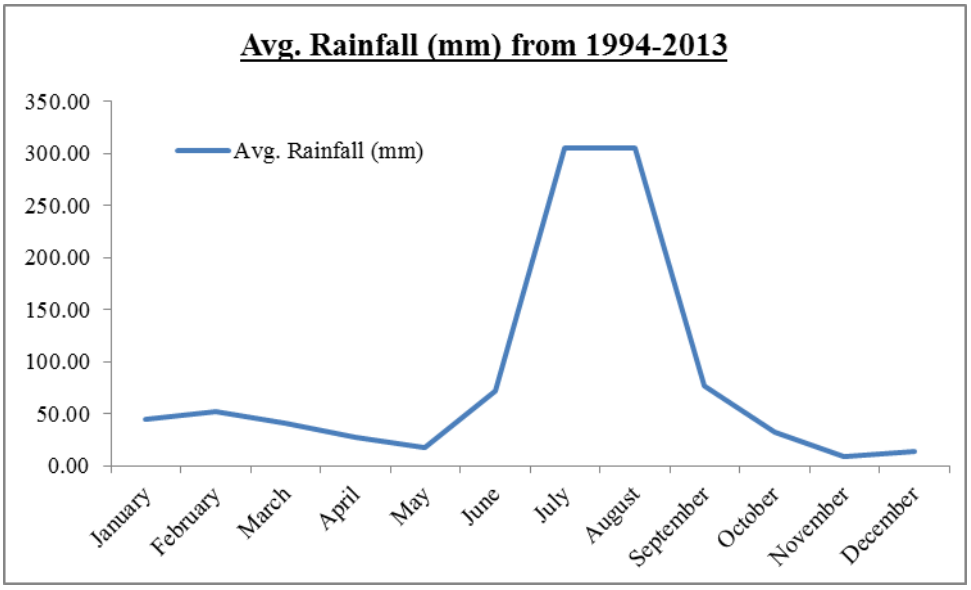


Figure G.2.2 Average Rainfall in Gujranwala

(5) Temperature

Figure G.2.3 presents the average maximum and minimum temperature in Gujranwala over the period of 20 years. The average maximum temperature reaches 39°C in summer (May and June)

and 17°C in winter (January). The average minimum temperature remains almost 5-8°C during winter season (December to February) and for summer it is almost 23°C.

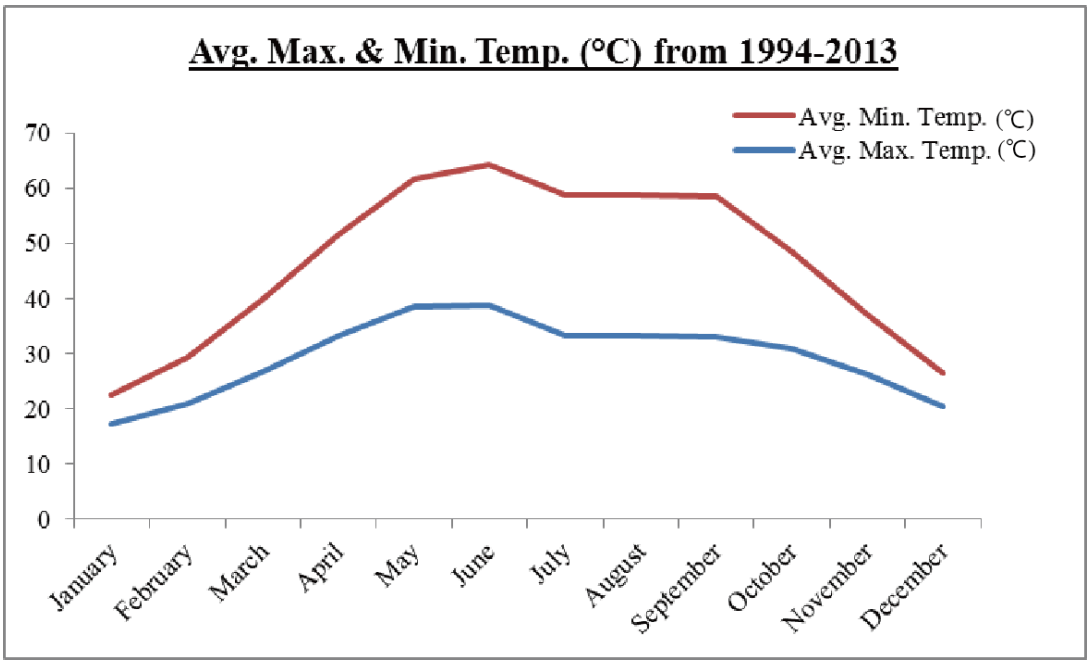


Figure G.2.3 Average Temperature in Gujranwala

(6) Humidity

Humidity is recorded twice a day (morning and evening). The humidity data of Gujranwala is portrayed in **Figure G.2.4.** In winter and monsoon season, the average maximum humidity for mornings is about 80-90% and for evenings, 50-70%.

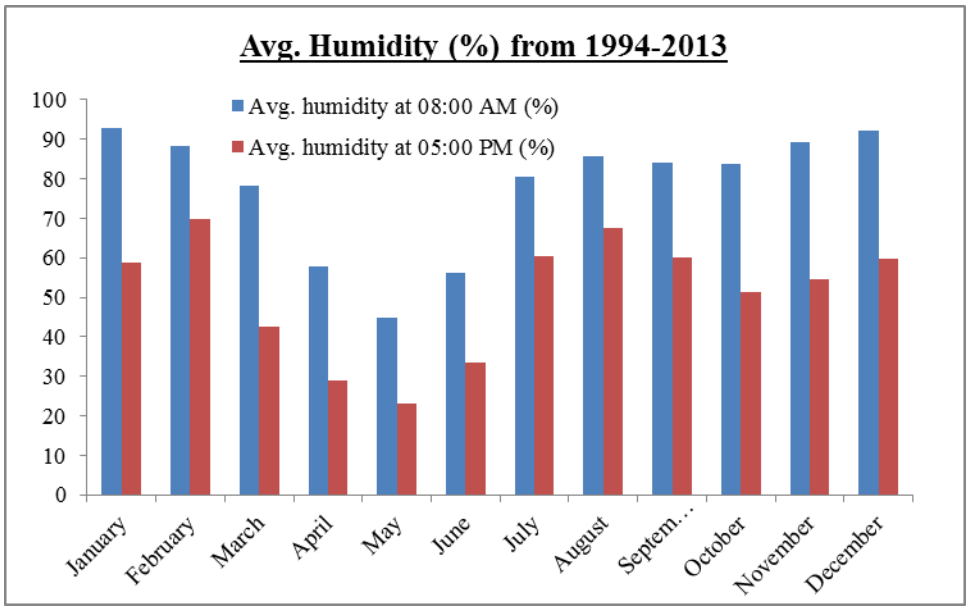


Figure G.2.4 Average Humidity in Gujranwala

(7) Land Use

Lying in the heart of the canal irrigated fertile region of Punjab, Gujranwala is a part of Rachna Doab, slopping from north-east to south-west and crossed by Upper Chenab Canal from north to

south in the eastern part. The project area is plain with the ground surface sloping gently from NE to SW.

The project site of the proposed landfill is an agricultural land with 10-15% uneven land left after the exaction activities. It is also a plain of Alluvial material and scattered rocks at deeper depth. The area is underlain by Pleistocene deposits to a depth of several thousand meters. The first 200 meters of these deposits consist of approximately 70% silty sand interspersed with limited clay layers. The strata are generally heterogeneous with little vertical or lateral continuity.

Risk of earthquake devastations for Pakistan's cities should be realised since it is situated at the junction of three tectonic plates; namely, Indian, Eurasian and Arabian. The seismic hazard map of Pakistan (Figure 4-22, Page-97, EIA Report) shows that the project site lies in an area that can expect an earthquake of low magnitude. The project site is located in Seismic Zone 2A which lies between 3 and 4.5 on the MMI scale. The site is far from the region of High Seismic Hazard Zone.

(8) Air and Noise

Air quality can be considered good due to the absence of significant pollution sources. In view of this, the criteria of Ambient Air Quality Pollutants (NOx, SOx, PM, CO, etc.) in the area are within the acceptable limits. No major anthropogenic sources of air pollution were noted since the proposed site is away from the main city and no industry is situated within 5km range.

Proper Plantation on green belts, avenues and green area will help maintain the air quality of the area in future.

Similarly, noise is a significant environmental problem and originates from many sources such as vehicular traffic (termed as roadway noise), airplanes, heavy machinery employed in construction work, etc. Elevated noise levels significantly affect the physiological and psychological health which includes hearing loss, annoyance, hypertension, aggression, and high stress levels depending upon the magnitude of noise and duration of exposure.

During the site survey, there were no key sources of noise pollution noted.

2.3.2 Opinion of Residents/Landowners

Table G.2.4 shows a summary of public opinion obtained through the interviews in the E&S survey. Sixty persons were interviewed in six locations (10 respondents each). Most of them recognised that a disposal site and waste management are necessary for Gujranwala. Some of them are apprehensive that new environmental problems may occur because of the disposal site. Bad smell, vectors, and dirty environment by the facilities is commonly pointed out, and same trend was shown in other interview survey for local residents (see ***Volume 4, Data Book, Section G, Subsection G.1.4***).

Table G.2.4 Summary of Public Opinions in the E&S Survey

Site	Interview		Major Opinions on the Facility
	No. of Interviewees	Age of Interviewees	
Chianwali	10	From 18 to 50 years	1. Community living in the vicinity have the problem on "bad smell" and "flies". 2. During the survey, respondents also highlighted health problem and disease, and few also highlighted the problem on vectors. 3. Majority of respondents consider that this facility is degrading the water quality.
Gondlanwala	10	From 25 to 55 years old	1. Bad smell, flies and vectors were the major problems of the people living near the Gondlanwala at the time of E&S survey. 2. Ground and surface water quality degradation were also claimed by the respondents. 3. Few of the respondents also claimed damage to their animals due to the dumping of waste at Gondlanwala dumping site. 4. Respondents consider that the waste management company does not properly do clay cover and spray for the vectors which are the leading problems.
Compost 1: Fazal Fruit Market	10	From 24 to 56 years old	1. Majority of the respondents do not have ideas about the compost facility. 2. 50% of the respondents agree with the compost facility at Fazal fruit market. 3. Few respondents show reservation about traffic congestion during the operations at compost facility due to narrow roads.
Compost 2: Main Fruit and Vegetable Market	10	From 18 to 51 years old	1. The community living nearby the main fruit market consider it a good option since it will reduce the waste and it will be easy also for the contractor to dispose fewer amounts from the main fruit and vegetable market. 2. Some people do not want any type of waste related activity in their neighbourhood. 3. Their views are like; they do not want odour and flies in their neighbourhood.
Transfer Station 1: Sialkot Road	10	From 18 to 46 years old	1. Majority of the respondents agree on the transfer station in their vicinity. 2. Furthermore, people are aware that this type of administrative step helps to deal with the waste in a better way. 3. One view is against the transfer station because of the bad smell and the unhygienic conditions. 4. According to the community, it is acceptable to them provided the transfer station is timely cleaned.
Transfer Station 2: Alam Chowk	10	Information on age was not recorded.	1. At the Alam Chowk transfer station, one of the landowners complained about the bad smell. 2. The Alam Chowk transfer station is fenced by the wall, so that most people do not have any problem with the transfer station in their vicinity. 3. However, few people suggested that the bad smell could be removed by timely transportation of wastes to the dumping site and the transfer station should be cleared and cleaned regularly.

2.3.3 Impacts on Environment and Society of Chianwali and Gondlanwala Disposal Sites and the Proposed Sites for Compost Facility and Transfer Station

(1) Impacts on Environment and Society

Impacts on environment and society in six locations are summarised in **Table G.2.5** to **Table G.2.10**. Proposed locations of compost facility and transfer station are shown in **Figure G.2.5**.

- Gondlanwala: Current disposal site

- Chianwali: Closed disposal site
- Main fruit market: Proposed location for compost facility
- Fazal fruit market: Proposed location for compost facility
- Alam Chowk: Proposed location for transfer station
- Sialkot Road: Proposed location for transfer station

According to the result of the impact analysis, negative impacts are recorded at the disposal sites in terms of Air, Water, and Soil. On the other hand, at the proposed sites of transfer station and compost facility, there is degradation of the local environment, especially by odour and infectious diseases, but positive impact is assumed because of new employment opportunities in the new facilities.

(2) Alternatives

In case that Compost Facility and Transfer Station are constructed in the city, odour (from Compost Facility) and scattering of waste in and around garages will be a problem for the neighbouring community. Therefore, the Compost Facility is to be constructed at the Bhakhraywali site, and the site of the Transfer Station has to be decided in consideration of not only the impact to the neighbouring community but also the effectiveness of waste collection.

Table G.2.5 Impacts on Environment and Society in Gondlanwala

No.	Factors which probably make impact to local environment	Current Situation	Probable Impact
Environmental Assessment			
Impacts on Environment			
1	Air	About 60 to 70% pollution is from vehicular emission. Since open dumping is being practiced without any proper plan and lining system, methane gas will emit from the site.	Open dumping will cause a minor negative impact, i.e., air pollution, since toxic gases are emitted.
2	Water	According to the water quality survey in which 14 water quality parameters were tested, the value of turbidity is high in all surface water samples while the values of BOD_5 and COD are also high in one of the samples. Regarding groundwater quality, 7 samples were taken for analysis. Most of the results seem to be satisfactory; however, values of turbidity are higher in 2 samples which may be due to poor quality of casing used in the hand pumps and overall shallow depth of installation.	Open dumping will cause a minor negative impact, i.e., water pollution since there is no leachate control and collection system.
3	Soil	Soil is contaminated since there is no liner system to isolate waste from the soil.	Open dumping will cause a moderate negative impact, i.e., soil contamination, since there is no liner system to isolate waste from soil.
4	Waste	Waste is not covered with soil layer.	Open dumping will cause a minor negative impact since waste is being disposed

No.	Factors which probably make impact to local environment	Current Situation	Probable Impact
			without any liner system and procedure.
5	Accidents	Expansion of waste collection services will lead to the increase in collection and transportation vehicles and hence more traffic congestion and accidents at the site.	There is no direct impact in the form of accidents due to open dumping of waste.
6	Water Usage	According to the Water Quality Survey, the quality of groundwater is satisfactory; only the value of turbidity is high.	Since there is no leachate control and collection system which will cause water contamination by leachate percolation, water will become unfit for use. Open dumping may cause a minor negative impact with regard to water use.
7	Climate Change	Since there is no proper soil cover on the waste, toxic gases maybe emitted from the site.	Since there is no liner system, open dumping will emit toxic gases which may result in deterioration of climate and cause a minor negative impact.
8	Ecosystems	Currently, no impact is observed.	Open dumping without any liner will deteriorate the ecosystem and cause moderate negative impacts.
9	Fauna	Since there is no fauna closed to this site, there is no impact on fauna.	No Impact
10	Flora	Flora is also not present near this site, so that there is no negative impact on flora.	No Impact
Social Assessment			
Impacts on Society			
11	Migration of Population	No migration is observed from the site activity.	No Impact
12	Involuntary Settlement	Currently, such kind of settlement is not observed.	Open dumping will attract waste pickers to involuntary settle in the surrounding area which may cause a minor impact.
13	Employment & Livelihood	Currently, 1 Manager, 2 Assistant Managers and 1 Data Entry Operator are deployed at this dumping site to manage the waste.	Moderate positive impact since employment is generated.
14	Utilisation of Land & Local Resources	Since waste is dumped, this land cannot be used for other purposes unless it is properly closed.	Unplanned dumping will result in quick filling of dumping site and requires more land which will cause moderate negative impact.
15	Social Institutions	There is no social institution near the site.	There is no direct impact on institutions.

No.	Factors which probably make impact to local environment	Current Situation	Probable Impact
16	Social Infrastructures and Services	Currently, infrastructure is poor near the site connecting to villages.	There is no direct impact on infrastructures and services.
17	Vulnerable Social Groups	No such group is observed.	People living around the dumping site will be vulnerable since there is no controlling mechanism at the site.
18	Equality of Benefits and Losses	No Impact	No Impact
19	Equality in the Development Process	No Impact	No Impact
20	Gender	No Impact	No Impact
21	Children's Right	No Impact	No Impact
22	Cultural Heritage	No Impact	No Impact
23	Local Conflicts of Interest	No conflicts	No Impact
24	Infectious Diseases	Since waste pickers separate the valuable materials at the site and all kinds of waste are being dumped, diseases may be caused.	All kinds of infectious waste that will pollute the surroundings and ecosystems are dumped, which may cause minor negative impact.
25	Working Conditions	Currently, access road is unpaved and single which causes traffic congestion. Also rainy season affects the site. When One time cleaning activity starts, number of vehicles at site increase which will cause delay in weighing and dumping at specific point.	Without any intervention the working condition will not be improved which will cause a minor negative impact.

Table G.2.6 Impacts on Environment and Society in Chianwali

	Factor which probably make impact to local environment	Current Situation	Probable Impact
Environmental Assessment			
Impacts on Environment			
1	Air	About 60 to 70% of pollution is from vehicular emission. Since the site is closed, no further waste is being dumped and soil cover is not properly made, methane gas will emit from the site.	Open dumping could cause a minor negative impact, i.e., air pollution, since toxic gases will be emitted.
2	Water	According to the water quality survey in which 14 water quality parameters were tested, the values of BOD5 and COD are high in all surface water samples while the value of suspended solids (SS) is also beyond the limits in one sample. To check the groundwater quality,	Open dumping could cause a minor negative impact, i.e., water pollution, since there is no leachate control and collection system.

	Factor which probably make impact to local environment	Current Situation	Probable Impact
		samples were collected from wells and hand pumps located in that area. The results of all samples are satisfactory except one sample which was taken from hand pump. Arsenic level is high in one sample.	
3	Soil	Soil is contaminated and there is no liner system to isolate waste from the soil.	Open dumping could cause a moderate negative impact of soil contamination since there is no liner system to isolate waste from soil.
4	Waste	The site is closed and no more waste is being dumped at this site.	Open dumping could cause a minor negative impact since waste is being disposed without any plan and procedure.
5	Accidents	No accident since the site is closed	There is no direct impact in the form of accidents.
6	Water Usage	The quality of groundwater is satisfactory. Only one sample shows high limits of arsenic and the reason for this high value is that the sample was taken near the juice factory.	Since there is no leachate control and collection system which will cause water contamination by leachate percolation and water will become unfit for use, open dumping may cause a minor negative impact in case of water use.
7	Climate Change	Since there is no proper soil cover on the waste, toxic gases may emit from this site.	There is no liner system and open dumping will emit toxic gases which may result in deterioration of climate and cause a minor negative impact.
8	Ecosystems	Currently, no impact is observed.	Open dumping without any liner could deteriorate the ecosystem and cause moderate negative impacts.
9	Fauna	Since there is no fauna closed to this site. So no impact on fauna.	No Impact
10	Flora	Flora is also not present near this site, so that there is no negative impact.	No Impact
Social Assessment			
Impacts on Society			
11	Migration of Population	No Impact	No Impact
12	Involuntary Settlement	No Impact	Open dumping will attract waste pickers to involuntary settle in the surrounding area which may cause a minor impact.
13	Employment & Livelihood	Currently, no impact is observed.	Open dumping does not require the management of waste, so that there is no opportunity for employment which will cause

	Factor which probably make impact to local environment	Current Situation	Probable Impact
			minor negative impact.
14	Utilisation of Land & Local Resources	Since waste is dumped at Chianwali, the land cannot be used for other purposes unless it is properly closed.	Unplanned dumping will result in quick filling of dumping site and requires more land which will cause moderate negative impact.
15	Social Institutions	No Impact	There is no direct impact on institutions.
16	Social Infrastructures and Services	No Impact	There is no direct impact on infrastructures and services.
16	Vulnerable Social Groups	No Impact	People living around the dumping site will be vulnerable since there is no controlling mechanism at the site.
18	Equality of Benefits and Losses	No Impact	No Impact
19	Equality in the Development Process	No Impact	No Impact
20	Gender	No Impact	No Impact
21	Children's Right	No Impact	No Impact
22	Cultural Heritage	No Impact	No Impact
23	Local Conflicts of Interest	No Impact	No Impact
24	Infectious Diseases	Stagnant water at the dumping site may lead to vector borne diseases.	All the infectious wastes are dumped that will pollute the surrounding and ecosystem which causes the minor negative impact.
25	Working Conditions	No Impact	Without any intervention the working conditions will not be improved which will cause a minor negative impact.

Table G.2.7 Impacts on Environment and Society in Main Fruit Market

	Factor which probably make impact to local environment	Current Situation	Probable Impact
Environmental Assessment			
Impacts on Environment			
1	Air	By the construction of compost facility at main fruit market, organic waste will be reduced that leads to low emission and odour.	Minor positive impact
2	Water	No impact	No direct impact
3	Soil	Currently, there are some low lying lands and agricultural lands.	Minor positive impact since compost will reduce the use of chemical fertilizers resulting in reducing soil

	Factor which probably make impact to local environment	Current Situation	Probable Impact
			pollution.
4	Waste	Currently, wastes from main fruit market are thrown into the GWMC container.	Minor positive impact since organic waste is used for composting so that less waste is to be handled.
5	Accidents	Currently, no traffic problems	There is no direct impact in the form of accidents.
6	Water Usage	No Impact	No direct impact
7	Climate Change	No Impact	Minor positive impact since compost will reduce the use of fertilizers resulting in protecting the climate.
8	Ecosystems	No Impact	Minor positive impact
9	Fauna	No fauna is found	No direct Impact
10	Floral	No flora is found	No direct Impact
Social Assessment			
Impacts on Society			
11	Migration of Population	No Impact	No impact
12	Involuntary Settlement	No Impact	No Impact
13	Employment & Livelihood	Employment will be generated as compost facility may require the staff.	Moderate Positive Impact
14	Utilisation of Land & Local Resources	Compost will lead to reduction of waste.	Minor Positive Impact
15	Social Institutions	No impact	No impact
16	Social Infrastructures and Services	Roads are not proper. By the compost plant road will also be repaired.	Minor positive Impact
16	Vulnerable Social Groups		No direct Impacts
18	Equality of Benefits and Losses	No Impact	No direct Impacts
19	Equality in the Development Process	No Impact	No direct Impacts
20	Gender	No Impact	No direct Impacts
21	Children's Right	No Impact	No direct Impacts
22	Cultural Heritage	No Impact	No direct Impacts
23	Local Conflicts of Interest	No Impact	No direct Impacts
24	Infectious Diseases	Currently there is a considerable number of flies and mosquitoes.	Minor Positive Impact as compost plant will reduce the waste stream.
25	Working Conditions	Currently organic waste is lifted by GWMC.	Minor Positive Impact

Table G.2.8 Impacts on Environment and Society in Fazal Fruit Market

	Factor which probably make impact to local environment	Current Situation	Probable Impact
Environmental Assessment			
Impacts on Environment			
1	Air	Currently, there are a considerable number of flies in the market area due to organic waste. Organic wastes cause odour problem in the vicinity of fruit market.	Minor positive impact to the construction of compost facility at Fazal Fruit Market; volume of organic waste will be reduced that leads to low emission and odour.
2	Water	No impact	No direct impact
3	Soil	Currently, this is built-up area.	Minor negative impact since the compost facility is built in a congested area which will cause traffic problems in future.
4	Waste	Currently, waste from main fruit market is thrown into the GWMC container.	Minor positive impact since organic waste is used for composting and hence less waste is to be handled.
5	Accidents	Currently, no accidents	Minor negative impact since compost facility will lead to heavy traffic due to compactors and dumpers
6	Water Usage	No direct impact	No direct impact
7	Climate Change	Currently, there are flies and odour due to organic waste.	Minor positive impact since compost will reduce the use of fertilizers result in protecting the climate.
8	Ecosystems	No Impact	Minor positive impact
9	Fauna	No fauna is found since 90% the area is built-up area.	No direct impact
10	Flora	No flora is found since 90% of the area is built-up area.	No direct impact
Social Assessment			
Impacts on Society			
11	Migration of Population	Currently, no direct impact	Moderate negative impact since this is a congested area and acquisition of land for compost facility may result in migration of population.
12	Involuntary Settlement	Currently, no direct impact	No direct Impact
13	Employment & Livelihood	Currently, no direct impact	Moderate positive impact since employment will be generated as the compost facility will need more workers.

	Factor which probably make impact to local environment	Current Situation	Probable Impact
14	Utilisation of Land & Local Resources	Currently, no direct impact	Minor positive impact since compost will lead to reduction of waste.
15	Social Institutions	No impact	No impact
16	Social Infrastructures and Services	Currently, there are narrow roads in this area.	Minor positive impact; roads will be widened for heavy traffic.
16	Vulnerable Social Groups	Currently, No direct impact	No direct impacts
18	Equality of Benefits and Losses	No impact	No direct impacts
19	Equality in the Development Process	No impact	No direct impacts
20	Gender	No impact	No direct impacts
21	Children's Right	No impact	No direct impacts
22	Cultural Heritage	No impact	No direct impacts
23	Local Conflicts of Interest	No impact	No direct Impacts
24	Infectious Diseases	Currently, there is considerable number of flies due to organic waste that might cause infectious diseases.	Minor positive impact since compost plant will reduce the waste stream.
25	Working Conditions	Currently, poor working conditions.	Minor positive impact

Table G.2.9 Impacts on Environment and Society in Sialkot Road

	Factor which probably make impact to local environment	Current Situation	Probable Impact
Environmental Assessment			
Impacts on Environment			
1	Air	Currently, a bucket and blade work all day to collect waste and fill the container due to which engine emits smoke. There is considerable number of flies due to organic waste. Organic waste cause odour problem in the vicinity.	Transfer station will restrict the movement of heavy vehicles resulting in less air pollution which may cause minor positive impact.
2	Water	There is no direct contact of waste with water.	No direct impact
3	Soil	Currently, this is built-up area so that there is no deterioration of soil.	Interaction of waste with soil or leachate might result in soil damage. Minor Negative Impact
4	Waste	Waste spreads around due to scavenging activity; no segregation activity by GWMC.	Minor Positive Impact in case transfer station will encourage segregation which will result in volume reduction.
5	Accidents	Currently, no accident	Minor Positive Impact since transfer station will restrict

	Factor which probably make impact to local environment	Current Situation	Probable Impact
			the movement of heavy vehicles which may result in fewer accidents.
6	Water Usage	No direct impact	No Direct Impact
7	Climate Change	Currently, a bucket and blade work all the day to collect the waste and fill the container due to which engine emits smoke. There are flies and odour due to organic waste.	Minor Positive Impact since transfer station restricts the movement of heavy vehicles which may result in less climate change.
8	Ecosystems	-	Minor Positive Impact since transfer station will isolate the waste from surrounding area resulting in the protection of ecosystem.
9	Fauna	No fauna is found since 90% of the area is built-up area.	No Direct Impact
10	Flora	No flora is found since 90% of the area is built-up area.	No Direct Impact
Social Assessment			
Impacts on Society			
11	Migration of Population	No such activity is observed, but residents have a problem due to smell, flies and vehicles loading at the site.	No Direct Impact
12	Involuntary Settlement	Currently, such settlements are not observed but a number of waste pickers come there to separate valuable materials.	Moderate Negative Impact since mixed waste attracts waste pickers to settle near the transfer station.
13	Employment & Livelihood	Currently, one supervisor is deployed at the transfer station to supervise the activity and record the trips of vehicles.	Moderate Positive Impact since employment will be generated to manage the waste at transfer station.
14	Utilisation of Land & Local Resources	Due to the waste handling activity, people avoid passing by this route.	Minor Negative Impact since transfer station requires land and resources.
15	Social Institutions	No impact	No Direct Impact
16	Social Infrastructures and Services	Currently, there are wide roads in this area.	No Direct Impact
16	Vulnerable Social Groups	Currently, no direct impact	No Direct Impact
18	Equality of Benefits and Losses	No Impact	No Direct Impact
19	Equality in the Development Process	No Impact	No Direct Impact
20	Gender	No Impact	No Direct Impact
21	Children's Right	No Impact	No Direct Impact
22	Cultural Heritage	No Impact	No Direct Impact
23	Local Conflicts of Interest	No Impact	No Direct Impact
24	Infectious Diseases	There is no segregation activity by	Moderate Negative Impact

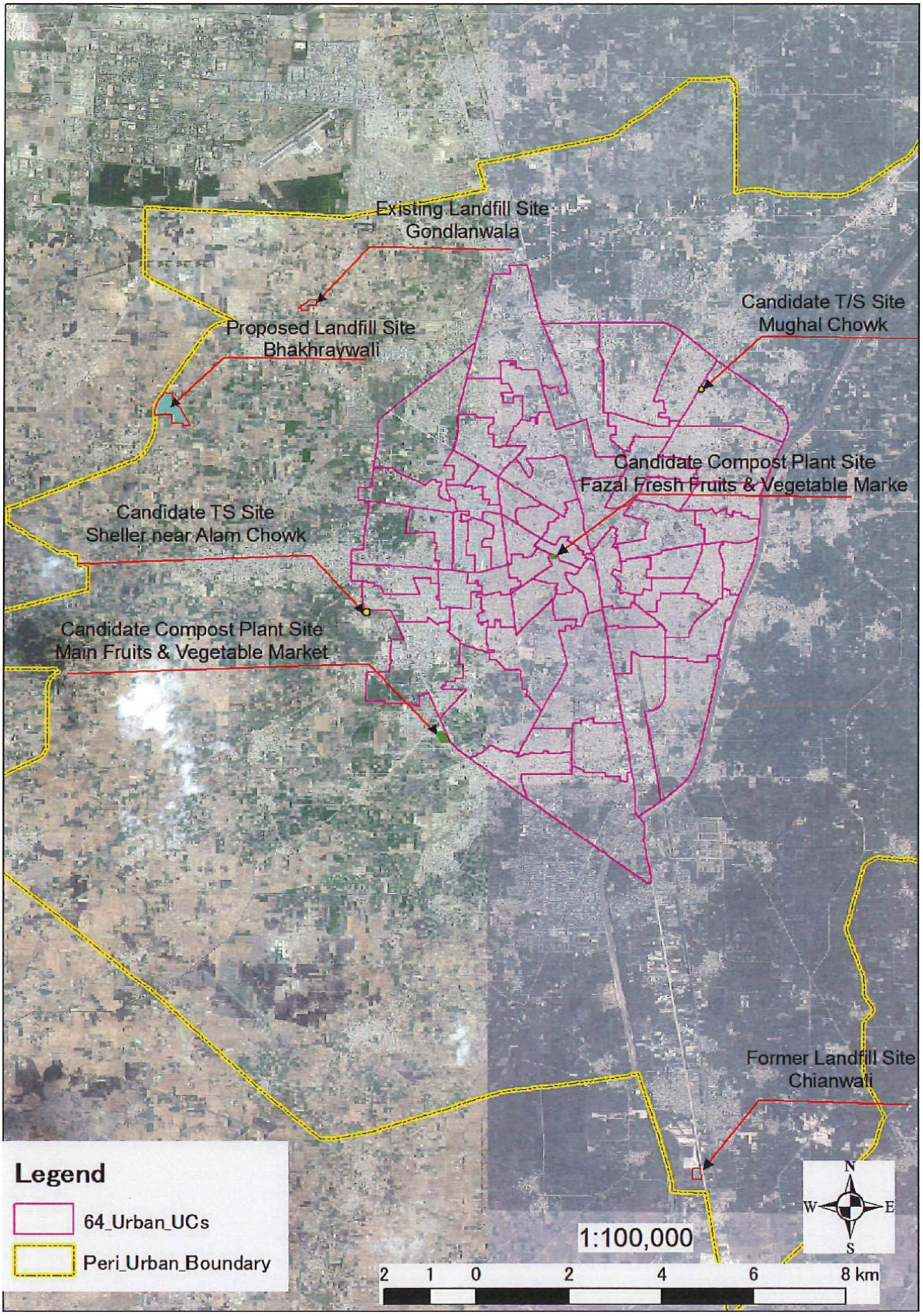
	Factor which probably make impact to local environment	Current Situation	Probable Impact
		GWMC and waste pickers separate the valuable materials for their livelihood. Waste stream at transfer station is mix waste having all types of waste including infectious wastes. No safety gadgets are used by waste pickers and GWMC staff members are present, so that infectious diseases may be caused. There is considerable number of flies due to organic waste that might cause infectious diseases.	since waste without separation will be infectious.
25	Working Conditions	Currently transfer station is an open storage area without any boundary and waste of the trips after 3 PM remained there so looks non-aesthetic.	Minor Positive Impact as proper transfer station will provide better working than open storage areas.

Table G.2.10 Impacts on Environment and Society in Alam Chowk

	Factor which probably make impact to local environment	Current Situation	Probable Impact
Environmental Assessment			
Impacts on Environment			
1	Air	Currently, a bucket and blade work all day to collect waste and fill the container due to which engine emits smoke. There are a considerable number of flies due to organic waste. Organic waste cause odour problem in the vicinity.	Transfer station will restrict the movement of heavy vehicles resulting in less air pollution which may cause Minor Positive Impact.
2	Water	There is no direct contact of waste with water.	No Direct Impact
3	Soil	Currently, this is no built-up area so that soil is mixed with waste.	Interaction of waste with soil or leachate might result in soil damage. Minor Negative Impact
4	Waste	No segregation activity by GWMC.	Minor Positive Impact in case transfer station will encourage segregation which will result in volume reduction.
5	Accidents	Currently, no accidents	Minor Positive Impact since transfer station will restrict the movement of heavy vehicles which may result in less accidents
6	Water Usage	No direct impact	No Direct Impact
7	Climate Change	Currently, there are flies and odour due to organic waste.	Minor Positive Impact since transfer station will restrict the movement of heavy vehicles which may result in less climate change.

	Factor which probably make impact to local environment	Current Situation	Probable Impact
8	Ecosystems	-	Minor Positive Impact since transfer station will isolate the waste from surrounding area resulting in the protection of ecosystem.
9	Fauna	No fauna is found since 90% of the area is built-up area.	No Direct Impact
10	Flora	No flora is found since 90%of the area is built-up area.	No Direct Impact
Social Assessment			
Impacts on Society			
11	Migration of Population	No such activity is observed.	No Direct Impact
12	Involuntary Settlement	Currently, such settlements are not observed but one or two waste pickers go there to separate the valuable materials.	Moderate Negative Impact since mix waste attracts waste pickers to settle near the transfer station.
13	Employment & Livelihood	Currently, one supervisor is deployed at the transfer station to supervise the activity and record the trips of vehicles.	Moderate Positive Impact since employment will be generated to manage the waste at transfer station.
14	Utilisation of Land & Local Resources	-	Minor Negative Impact since transfer station requires land and resources.
15	Social Institutions	No impact	No Direct Impact
16	Social Infrastructures and Services	Currently, there are wide roads in this area.	No Direct Impact
16	Vulnerable Social Groups	Currently, no direct impact	No Direct Impact
18	Equality of Benefits and Losses	No Impact	No Direct Impact
19	Equality in the Development Process	No Impact	No Direct Impact
20	Gender	No Impact	No Direct Impact
21	Children's Right	No Impact	No Direct Impact
22	Cultural Heritage	No Impact	No Direct Impact
23	Local Conflicts of Interest	No Impact	No Direct Impact
24	Infectious Diseases	There is no segregation activity by GWMC and waste pickers separate the valuable materials for their livelihood. Waste stream at transfer station is mixed waste having all types of waste including infectious waste. No safety gadgets are being used by waste pickers and GWMC staff members are present, so that infectious diseases may be caused. There are a considerable number of flies due to organic waste that might cause infectious diseases.	Moderate Negative Impact since waste without separation will be infectious.

	Factor which probably make impact to local environment	Current Situation	Probable Impact
25	Working Conditions	Transfer station is an open storage area without any wall and waste of trips after 3 PM remain in the station so that it looks unclean.	Minor Positive Impact since proper transfer station will provide better working condition than open storage areas.



Note: "Candidate T/S Site Mugal Chowk" is same as "Candidate T/S Sialkot Road"

Figure G.2.5 Map of Candidate Locations for Transfer Station and Compost Facility

2.3.4 Public Consultation

As a component of public consultation, 74 stakeholders were interviewed. Fourteen stakeholders selected from public institutions such as Irrigation Department, Agriculture Department, Environment Protection Department, City District Government Gujranwala, Gujranwala Environmental Organization, and Chaon Foundation were interviewed in the EIA Public Consultation. On the other hand, 60 residents/landowners were interviewed in the E&S survey.

Positive Perceptions: Stakeholders showed affirmative standpoint on the sanitary landfill in Bhakhraywali in terms of benefit to public health and environment.

Negative Perceptions: The common viewpoint is GMWC's negligence of required procedures and the guidelines create new environmental constraint and hazards. Lack of community inclusion and public disclosure is pointed out as well.

2.4 Confirmation of Environmental and Social Considerations Systems and Organizations in Pakistan

2.4.1 Laws and Regulations Related to Environmental and Social Considerations

Pakistan laws related to comprehensive environmental issues are shown in **Table G.2.11** and **Table G.2.12** shows the policy, guidelines, and rules of solid waste management nationwide/provincial-wise.

Table G.2.11 Environmental Laws in Pakistan

Title of the Law	Contents
Pakistan Environmental Protection Act	This act provides for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and promotion of sustainable development. EIA is mentioned in Section 12.
National Environmental Quality Standards (NEQS)	NEQS consists of two parts: • List of laws and regulations in 14 sectors such as Environmental Protection, Land Use, Water Quality and Resource, Solid Waste Management, and so on. • Description of national standards
Pakistan Environmental Protection Agency (Review of IEE & EIA) Regulations 2000	Process of IEE and EIA is described.
National Environmental Policy	The Policy provides an overarching framework for addressing the environmental issues facing Pakistan, particular pollution of freshwater bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. Guidelines are shown in each sector, and one of such sector is "Waste Management".

Table G.2.12 Policy, Guideline, and Rules of Solid Waste Management National/Provincial-Wise

Name	Contents
National Sanitation Policy 2006	The policy stipulates that one of its objectives is to develop and implement strategies for integrated management of municipal, industrial, hazardous and hospital and clinical wastes of national, provincial and local level.
Punjab Municipal Solid Waste Management Guidelines 2011	Various issues in waste management are covered.
Hospital Waste Management Rules 2005	Rules for the management of medical waste generated in hospital are described.

2.4.2 Organizations and Functions Related to Environmental and Social Considerations

The Ministry of Climate Change is the main government organization responsible for the protection of environment and conservation of resources. There are many governmental institutions organised and enforcing the laws and regulations together with the Ministry of Environment as shown in the following **Table G.2.13**.

Table G.2.13 Framework of Environmental Institutions in Pakistan

Functions, policy, plans, strategies and programmes	Status (as of November 2015)
Environmental pollution, ecology, forestry, wildlife, biodiversity, climate change and desertification	Assigned to Planning and Development (P&D) Department, but later transferred to the new Ministry with the establishment of the Ministry of National Disaster Management (NDM). At present, NDM is named as the Ministry of Climate Change with the same portfolio.
Improvement in environmental conditions of air, water and land	Devolved
Incorporation of environmental concerns in development schemes and energy conservation	Devolved
Coordination, monitoring and implementation of environmental agreements with other countries, international agencies and forums	Assigned to the Planning and Development (P&D) Department, but later transferred to the new Ministry with the establishment of the Ministry of National Disaster Management (NDM). At present, NDM is named as the Ministry of Climate Change with the same portfolio.
Pakistan Environmental Protection Agency (Federal EPA)	Assigned to the Capital P&D Department. But later, transferred to the new Ministry with the establishment of the Ministry of National Disaster Management (NDM). At present, NDM is named as the Ministry of Climate Change with the same portfolio. The domain of Federal EPA has been limited to the Federal Area.
Secretariat of Pakistan Environmental Protection Council established under the PEPA97 (XXXIV of 1997)	Assigned to Inter-Provincial Coordination (IPC) Department, but later transferred to the new Ministry. At present, NDM is named as the Ministry of Climate Change with the establishment of the Ministry of National Disaster Management (NDM).
National Council for Conservation of Wildlife (NCCW)	Devolved. The council members were transferred to the P&D Department and later to the Ministry of National Disaster Management. The NDM has been renamed as the Ministry of Climate Change and staff members of the defunct NCCW work in its Forestry Wing.
National Energy Conservation Centre (ENERCON)	Assigned to the Ministry of Water and Power.
Zoological Survey Department (ZSD)	Assigned to Ministry of Science and Technology. But later, with the enactment of Ministry of National Disaster Management (NDM), transferred to new Ministry. At present NDM has been renamed as Ministry of Climate Change with same portfolio.
Forestry Wing of MoE	Staff transferred to P&D Department and later to Ministry of National Disaster Management (NDM). At present NDM has been renamed as Ministry of Climate Change with same portfolio.

2.4.3 Projects Requiring EIA in Pakistan

The Environmental Protection Act of 1997 and the Pakistan Environmental Assessment Procedures of 1997 stipulate the conditions that would require EIA for the project site. The process of EIA is described in "Pakistan Environmental Protection Agency (Review of IEE & EIA) Regulations 2000." The case is filed in the Federal Agency, and the Agency decides whether the case is IEE (Initial Environmental Evaluation) or EIA. According to the Regulations, EIA is required in view of waste management as follows:

- Waste disposal and/or storage of hazardous or toxic wastes (including landfill state, incineration of hospital toxic waste) (for EIA)
- Waste disposal facilities for domestic or industrial wastes, with annual capacity of more than 10,000 cubic metres (for EIA)
- Waste disposal facilities for domestic or industrial wastes, with annual capacity of less than 10,000 cubic metres (for IEE)
- Waste-to-energy generation projects (for IEE)

2.4.4 EIA Process in Pakistan

Figure G.2.6 shows the process of EIA in Pakistan. Once the report is submitted, within 10 working days of application for EIA, the Federal Agency proceeds to the "Preliminary Scrutiny." After "Public Participation" is done, the Federal Agency will carry out its "Review" within 90 days of application for EIA. Upon completion of the Review, the "Decision" of the Federal Agency shall be communicated to the proponent.

2.4.5 EIA of this Project

The Urban Sector Planning and Management Services Unit Ltd. (The Urban Unit), in partnership with the Gujranwala Waste Management Company (GWMC), conducted Environmental Impact Assessment (EIA) for the proposed Bhakhraywali landfill site. The actual survey was carried out by local consultants from 15 August 2014. The contents of the EIA report are shown in **Figure G.2.7**.

The final EIA public hearing was carried out on August 17, 2015. Few processes remain, and it may take few months to acquire the EIA approval.

Major conclusions are as follows:

- According to the future estimate of waste generation in Gujranwala, the building of systematic waste management is very important. The proposed sanitary landfill in Bhakhraywali will play an important role.
- Leachate generation and air pollution will have impact on the physical environment. Therefore, proper management of leachate and landfill gases is necessity.
- Movement of solid waste collection vehicles and workers health will be social problems.
- No significant irreversible impacts to environment and society since there is no biological sensitive area and no heritages.

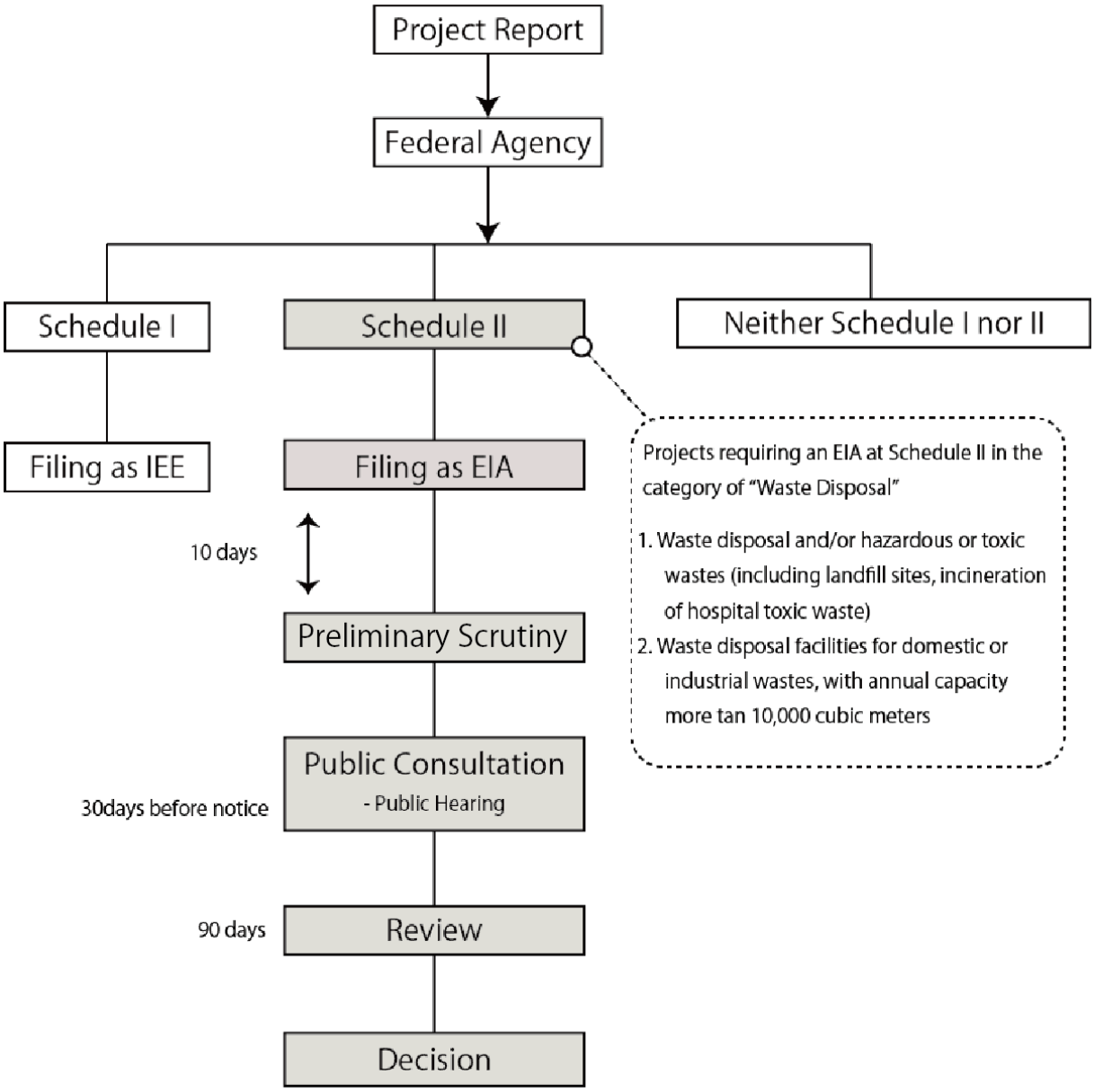


Figure G.2.6 Process of EIA in Pakistan by the "Pakistan Environmental Protection Agency (Review of IEE & EIA) Regulations 2000"

Chapter 1: Introduction
Chapter 2: National and International Policy, Legal and Institutional Framework
Chapter 3: Project Description
Chapter 4: Analysis of the Alternatives
Chapter 5: Baseline Environment and Social Conditions
Chapter 6: Stakeholder Consultation
Chapter 7: Impact Assessment and Mitigation Measures
Chapter 8: Environmental Management Monitoring Plan
Chapter 9: Conclusion

Figure G.2.7 Major Contents of EIA Report (Planned)

2.4.6 JICA Environmental Checklist for Waste Management

This project follows the JICA Guidelines for Environmental and Social Considerations as well as the Pakistani laws and regulations. This project is categorised as "Category B" based on the JICA Guidelines. Categorisation is made based on sector, scale, characteristics and location of the project, and "Category B" is defined as "Less adverse impact than "Category A" (significant adverse impact)".

The JICA Environmental Checklist is issued under the JICA Guidelines, and the Checklist mentions detailed issues and items for avoiding negative impacts to community from the project. The JICA Checklist is a list of conditions which a JICA-funded project needs to follow so as to satisfy the desired quality of the project. For this project, the JICA Environmental Checklist for Waste Management is applied. The Checklist consists of six categories: Permits and Explanation, Pollution Control, Natural Environment, Social Environment, Others, and Note.

According to the comparison between the Pakistani laws and the JICA Environmental Checklist for Waste Management (see **Table G.2.14**), some issues show that there is no conflict between the JICA Checklist and Pakistani laws; for example, both require EIA for project implementation. On the other hand, some differences are identified in the category; for example, "Social Condition" of the JICA Checklist. "Social Conditions" in the JICA Checklist requires consideration of living and livelihood of stakeholders and working condition at the project site. These issues are not clearly mentioned in Pakistani laws.

Application of the JICA Checklist to the project will make a better situation for the future waste management in Gujranwala. The Checklist will contribute especially in the field of social consideration.

2.5 Scoping for Consideration of EIA or IEE Study

The environmental and social impact elements and the degree for the projects are clarified in advance under this **Section 2.5**. The results are summarised as a scoping for consideration to carry out the projects requiring EIA or IEE.

The target project for scoping and its contents are set up based on the information of **Section 2.3** and **Section 2.4**. Accordingly, the scoping is carried out for the intermediate treatment facilities (Compost Plant and RDF Plant) and the final disposal site (new sanitary landfill facilities, improvement of the existing landfill site and safe closure of the former landfill site) that are integral components of the Option B Master Plan.

The results of these scoping tables shall be used as reference while the EIA/IEE of the respective projects is carried out to ensure the appropriateness of Option B projects in the environmental and social aspects.

2.5.1 Scoping of EIA or IEE for Composting and RDF Projects

Table G.2.14 indicates the results of preliminary evaluation of probable environmental and social impacts of composting and RDF projects, which shall be used as the basic scoping to carry out the EIA or IEE for the project concerned.

Table G.2.14 Comparison of Pakistani Laws and Regulations Related to Environmental Protection and Waste Management and JICA Environmental Checklist for Waste Management

Category Environmental Item in JICA Environmental Checklist for Waste Management	Comparison with Pakistani Laws and Regulations
1. Permits and Explanation 1) EIA and Environmental Permits 2) Explanation to the Local Stakeholders 3) Examination of Alternatives	**[Result of Comparison]** ・ No major conflict between the JICA Checklist and the Pakistani laws and regulations **[Related Laws/Regulations]** ・ Guidelines for the Preparation and Review of Environmental Reports (1997) ・ Pakistan Environmental Protection Agency (Review of IEE & EIA) regulations 2000 ・ National Environmental Quality Standards (NEQS) ・ Building Regulation (2007) ・ Punjab Municipal Solid Waste Management Guidelines 2011 ・ Guidelines for Public Consultation (1997)
2. Pollution Control 1) Air Quality 2) Water Quality 3) Wastes 4) Soil Contamination 5) Noise and Vibration 6) Odour	**[Result of Comparison]** ・ Treatment and disposal process of other hazardous and dangerous waste may not be defined. ・ Noise generated by vehicles shall comply with the National Environmental Quality Standard. Noise generated by Facility operation may not be defined. Vibration level by vehicles or facility operation may not be defined. **[Related Laws/Regulation]** ・ National Environmental Quality Standards (NEQS) ・ Punjab Municipal Solid Waste Management Guidelines 2011 ・ Hospital Waste Management Rules (2005)
3. Natural Environment 1) Protected Areas 2) Ecosystem 3) Management of Abandoned Site	**[Result of Comparison]** ・ No major conflict between the JICA Checklist and the Pakistani laws and regulations **[Related Laws/Regulation]** ・ Guidelines for Sensitive and Critical Area (1997) ・ Punjab Municipal Solid Waste Management Guidelines 2011
4. Social Environment 1) Resettlement 2) Living and Livelihood 3) Heritage 4) Landscape 5) Ethnic Minorities and Indigenous People 6) Working Conditions	**[Result of Comparison]** ・ No conflict, basically, but social and environmental considerations shall be accorded to waste pickers in the existing system in accordance with the JICA guidelines. ・ Measures for local landscape protection are not defined in Pakistani laws and regulation. ・ Working condition and environment is not clearly defined in Pakistani laws and regulations although the Labour Policy (2010) mentions labourers' human rights, health and social welfare. **[Related Laws/Regulation]** ・ Guidelines for the Preparation and Review of Environmental Reports (1997) ・ Labour Policy (2010) ・ Antique Act (1975) ・ Punjab Special Premises (Preservation) Ordinance (1985) ・ Guidelines for Sensitive and Critical Area (1997) ・ Punjab Municipal Solid Waste Management Guidelines 2011 ・ National Environmental Policy ・ The World Bank Environmental Assessment Sourcebook Volume I
5. Others 1) Impacts during Construction 2) Monitoring	**[Result of Comparison]** ・ No major conflict between the JICA Checklist and the Pakistani laws and regulations **[Related Laws/Regulations]** ・ Guidelines for the Preparation and Review of Environmental Reports (1997) ・ Punjab Municipal Solid Waste Management Guidelines 2011

Category Environmental Item in JICA Environmental Checklist for Waste Management	Comparison with Pakistani Laws and Regulations
6. Note 1) Reference to Checklist of Other Sectors 2) Note on Using Environmental Checklist	**[Situation]** ・ This issue is not mentioned in the Pakistani laws; therefore, The World Bank Environmental Assessment Sourcebook, Volume I, shall be applied, if necessary. **[Related Laws/Regulations]** ・ Guidelines for the preparation and review of Environmental Reports (1997) ・ The World Bank Environmental Assessment Sourcebook, Volume I

Table G.2.15 Scoping for Composting and RDF Projects

Category	Environmental Item	Compost Plant		RDF Plant		Check Item
		CON	OPE	CON	OPE	
1. Pollution Control	(1) Air Quality	B	C	B	C	Construction Phase: Generation of dust in construction work Operation Phase: Dust in workplace
	(2) Water Quality	B	B	B	B	Construction Phase: Wastewater from construction staff quarter Operation Phase: Wastewater from plant office
	(3) Wastes	C	C	C	C	Construction Phase: Construction waste and garbage Operation Phase: Garbage from plant office
	(4) Soil Contamination	C	C	C	C	Not applicable
	(5) Noise and Vibration	C	B	C	B	Construction Phase: Construction work by heavy machine Operation Phase: Noise of plant machinery and incoming vehicles
	(6) Odour	C	A	C	B	Construction Phase: Not applicable Operation Phase: Odour from incoming raw material
2. Natural Environment	(1) Protected Areas	C	C	C	C	No protected area in the neighbouring area
	(2) Ecosystem	C	C	C	C	Construction Phase: Conversion of agricultural land Operation Phase: Not applicable
	(3) Management of Abandoned Sites	C	C	C	C	Not applicable
3. Social Environment	(1) Resettlement	C	C	C	C	No resident in the site
	(2) Living and Livelihood	C	C	C	C	No resident in the neighbouring area
	(3) Heritage	C	C	C	C	No heritage in the neighbouring area
	(4) Landscape	C	C	C	C	Appearance of plant building
	(5) Ethnic Minorities and Indigenous Peoples	C	C	C	C	Not applicable
	(6) Working Conditions	B	B	B	B	Construction Phase: Accidents in construction work Operation Phase: Accidents and insanitation to plant staff in operation

Notes:
1) Phase of Project Activity: CON: During Construction; OPE: During Operation
2) Impact Level: Negative Impact: A: Serious, B: Some, C: Negligible, Positive Impact: P, - : Not applicable

2.5.2 Scoping for EIA or IEE of Waste Disposal Projects

Table G.2.16 indicates the results of preliminary evaluation of probable environmental and social impacts of the final disposal projects at Bhakhraywali, Gondlanwala and Chianwali, which shall be used as the basic scoping to carry out the EIA or IEE for the project concerned.

Table G.2.16 Scoping for Bhakhraywali, Gondlanwala and Chianwali Landfill Projects

Category	Environmental Item	Bhakhraywali Sanitary Landfill		Gondlanwala Improvement of Existing Landfill		Chianwali Closure of Former Landfill		Check Item
		CON	OPE	CON	OPE	CON	OPE	
1. Pollution Control	(1) Air Quality	B	B	B	B	B	B	Construction Phase: Generation of dust in construction work Operation Phase: Generation of dust in landfill work. Generation of landfill gases
	(2) Water Quality	B	A	B	A	B	B	Construction Phase: Wastewater from construction staff quarters Operation Phase: Wastewater from plant office. Leachate from the landfill area
	(3) Wastes	C	C	C	C	C	C	Construction Phase: Construction waste and garbage Operation Phase: Garbage from plant office
	(4) Soil Contamination	C	C	C	B	C	B	Operation Phase: Contamination by heavy metals in waste
	(5) Noise and Vibration	B	B	B	B	B	C	Construction Phase: Construction work by heavy machine Operation Phase: Noise of landfill machine and incoming vehicles
	(6) Odour	C	A	B	A	B	B	Construction Phase: Odour from the existing landfill site Operation Phase: Odour from incoming waste
2. Natural Environment	(1) Protected Areas	C	C	C	C	C	C	No protected area in the neighbouring area
	(2) Ecosystem	C	C	C	C	C	C	Construction Phase: Conversion of agricultural land Operation Phase: Not applicable
	(3) Management of Abandoned Sites	-	B	-	B	-	B	Operation Phase: Safe closure and post-closure management and monitoring of the landfill site.
3. Social Environment	(1) Resettlement	C	C	C	C	C	C	No resident in the site
	(2) Living and Livelihood	C	C	A	A	C	C	Measures for two residential houses at Gondlanwala landfill site.
	(3) Heritage	C	C	C	C	C	C	No heritage in the neighbouring area
	(4) Landscape	C	B	B	B	B	P	Appearance of the landfill site to the passers-by.
	(5) Ethnic Minorities and Indigenous Peoples	C	C	C	C	C	C	Not applicable
	(6) Working Conditions	B	A	B	A	B	C	Construction Phase: Accidents in construction work Operation Phase: Accidents and insanitation to landfill operation staff
	(7) Waste Pickers in Landfill Site	-	A	B	A	-	-	Construction Phase: Accidents in construction work Operation Phase: Accidents and insanitation to landfill operation staff

Notes:
1) Phase of Project Activity: CON: During Construction; OPE: During Operation,
2) Impact Level: Negative Impact: A: Serious, B: Some, C: Negligible, Positive Impact: P, - : Not applicable

2.6 Impact Forecast

Prior to forecasting the potential environmental impacts of the projects, field surveys were conducted in addition to collecting the baseline data described in **Section 2.3** for clarifying the background condition of candidate sites and surrounding areas. Those surveys include the impacts to be caused in the construction and operation phases of the facilities by the factors influencing daily life (e.g., bad odour, flies and vectors, traffic jam caused by garbage collection vehicles, garbage falling down from collection vehicles without cover on the way to the landfill site) and environmental issues (e.g., water quality, air quality, hydrogeological situation, soil contamination, noise and vibration). In addition to the environmental factors, the opinion of neighbouring residents and waste pickers who are the "key

stakeholders" in the waste management system were collected for analysing the impacts to the communities.

Based on the data and information gathered through the surveys, this section examines the impacts of major influencing factors among the impacts to the environment and social aspects, which were clarified in the scoping of each facility in the preceding **Section 2.5**.

2.6.1 Construction and Operation of Central Compost Plant

(1) Outline of Compost Plant Project

Location of Construction Site	: East side of Bhakhraywali Landfill Site
Site Area	: 5ha
Plant Capacity	: 250t/day
Plant System	: Pre-treatment and windrow type composting process
Input Material	: Separated organic waste

(2) Environmental and Social Impact Elements of Compost Plant Project

Air Quality

Similar to other construction projects, dust is generated during the construction work. The construction work, especially earth works for foundation will cause the dust problem. The surface soil in the project site consists of sandy silt to silty sand, and the small particles of the surface soil is easily blown by the wind and suspended in the air.

The plant does not have a process to exhaust air pollutants. However, during operation of the plant, dust could be generated in the process of segregation of raw materials and turning of compost. The dust problem in operation will result in unsanitary conditions to the operation staff of the plant.

Water Quality

Generally, a camp or quarters for the construction workers will be built in or nearby the construction site. During the construction phase, wastewater discharge from kitchen, toilet and bath will become a potential source for water pollution in the neighbouring area. In the operation phase, similar condition as the construction phase can be seen, so that wastewater discharge from toilet and bath by plant operation staff will have a potential source of water contamination.

Odour

The construction work will not be a source of odour. Raw material for composting is derived from organic waste of municipal waste mostly consisting of fresh market waste, kitchen waste, garden waste, etc., which will generate odour especially under the anaerobic decomposition process.

Working Condition

Risks of accident such as those caused by falling objects, collapse of temporary work and miss-operation of construction machinery always exist among the construction workers and passers. In the operation of the plant, the risks exist in the operation of machinery and, to the plant staff, sanitation or health risk in handling the raw materials.

2.6.2 Construction and Operation of Compost/RDF Plant

(1) Outline of Compost/RDF Plant Project

Location of Construction Site	: East side of Bhakhraywali Landfill Site
Site Area	: 7ha
Plant Capacity (Compost Plant)	: 250t/day

Plant Capacity (RDF Plant)	: 250t/day
Plant System (Compost Plant)	: Pre-treatment and windrow type composting process
Plant System (RDF Plant)	: Pre-treatment and bailing process
Input Material (Compost Plant)	: Separated organic waste
Input Material (RDF Plant)	: Separated combustible waste (plastics &Paper)

(2) Environmental and Social Impact Elements of Compost/RDF Plant

Air Quality

Similar conditions as the construction of compost plant.

Water Quality

Similar conditions as the construction of compost plant.

Odour

Similar conditions as the construction of compost plant. Input raw materials to the RDF plant and segregated combustible materials have less odour impact compared with the raw materials for the compost plant.

Working Conditions

Similar conditions as the construction of compost plant. Segregated combustible materials have less odour impact compared with the raw materials for the compost plant.

2.6.3 Construction and Operation of New Final Disposal Facility at Bhakhraywali

(1) Outline of New Final Disposal Facility at Bhakhraywali

Location of Construction Site	: Bhakhraywali, northwest of the city, approximately 11km from the city centre
Site Area	: 26ha (First phase)
Incoming Waste Amount	: 1,000t/d in 2018, 1,500t/d in 2024 and 2,000t/d in 2030
Type of Incoming Waste	: Municipal solid waste (Residual waste)
Type of Landfill	: Semi-aerobic type sanitary landfill

(2) Environmental and Social Impact Elements of New Final Disposal Facility at Bhakhraywali

Air Quality

Similar to other construction projects, dust is generated during the construction work. The construction works, especially earth works for the construction of waste containment and roads will cause the dust problem. The surface soil in the project site consists of sandy silt to silty sand, and the small particles of the surface soil is easily blown by the wind and suspended in the air.

The landfill facility does not have a process of exhausting air pollutants. However, the biodegradable waste in filled waste turn to landfill gasses in the course of degradation. Landfill gasses include carbon dioxide and/or methane gas, which is a cause of global warming.

Water Quality

During the construction phase, wastewater discharge from kitchen, toilet and bath will become a potential source of water contamination in the neighbouring area. In the operation phase, similar conditions as the construction phase can be seen, so that wastewater discharge from toilets and bath by plant operation staff will be the potential source of water contamination. In addition, wastewater or leachate is generated from the waste layer which may bring water pollution.

Soil Contamination

In the operation phase, domestic hazardous waste mixed with municipal solid waste will have a potential to cause underground soil contamination.

Noise and Vibration

A large number of construction machinery and vehicles are deployed during the construction period. These construction machinery and vehicles will be the sources of noise and vibration in daytime. In the operation phase, collection vehicles in/out from the disposal site and landfill machinery will be the potential sources of noise and vibration.

Odour

The construction work will not be the source of odour. In the operation phase, the decomposition of organic waste in incoming disposal waste will be a potential source of odour.

Management of Abandoned Site

Even after completion of landfill operation, the environmental impact represented by leachate and landfill gases remain for years.

Landscape

Configuration of the land will change from cultivated land to landfill site. At the completion of landfill operation, the landfill area will be higher than the surrounding area.

Working Conditions

Accidents involving the construction workers and the passers by such events as falling objects, collapse of temporary work, and miss-operation of construction machinery always exist during the construction work. In landfill operation, there exist the risks of accidents by landfill machinery and health and sanitation risks to the operation staff handling the wastes.

Waste Pickers in Landfill Site

If the waste pickers are allowed access to the landfill area, work accidents and health risks are assumed to be caused by poor work environment in the working area.

2.6.4 Improvement Works for the Existing Landfill Facility in Gondlanwala

(1) Outline of Existing Landfill Facility in Gondlanwala

Location of Construction Site	: Gondlanwala, north of the city, approximately 10km from the city centre
Site Area	: 5ha
Incoming Waste Amount	: 660t/d in 2016, 830t/d in 2017
Type of Incoming Waste	: Municipal Solid Waste
Type of Landfill	: Controlled open dumping

(2) Environmental and Social Impacts of the Existing Disposal Facility in Gondlanwala

Air Quality

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Water Quality

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Soil Contamination

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Noise and Vibration

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Odour

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Management of Abandoned Site

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Living and Livelihood

There are two residential houses located in the area adjacent to the landfill site. Families who reside in these houses will suffer to some extent from the construction work and landfill operation.

Landscape

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Working Condition

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Waste Pickers in Landfill Area

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

2.6.5 Closure of the Former Landfill Site in Chianwali

(1) Outline of Former Landfill Site in Chianwali

Location of Construction Site	: Chianwali, south of the city, approximately 14km from the city centre
Site Area	: 5ha
Incoming Waste Amount	: Landfill operation finished
Type of Filled Waste	: Municipal Solid Waste
Type of Landfill	: Open dumping

(2) Environmental and Social Impacts of Former Landfill Site in Chianwali

Air Quality

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Water Quality

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Soil Contamination

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Noise and Vibration

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Odour

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Management of Abandoned Site

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

Landscape

Positive effect is envisaged due to final earth cover and safe closure work.

Working Condition

Similar conditions as the construction work of new landfill facility in Bhakhraywali.

2.7 Impact Assessment and Review of the Proposed Project

In this **Section 2.7**, the preliminary impact assessment is carried out for the environmental impact elements discussed in **Section 2.6** and the appropriateness of the selected Master Plan Option B is described in terms of environmental and social considerations.

2.7.1 Impact Assessment of Each Project

Impacts from the project in the construction and operation phases have been evaluated. Impacts in the current situation as well as in the situation that possible measures are implemented were also considered. Major lingering impacts, both negative and positive, are summarised below.

(1) Construction and Operation of Central Compost Plant

Construction Phase: Similar to the construction work of compost plant, the most negative impact will be the dust problem. Surface water contamination by staff quarters and working condition of the construction workers will also cause impacts to the project. On the other hand, the increase of employment opportunity and community development will be the positive impacts.

Operational Phase: Odour, as well as noise and vibration by incoming vehicles will cause environmental impacts to the plant operation. On the other hand, employment opportunity will be the positive impact.

(2) Construction and Operation of Central Compost/RDF Plant

Construction Phase: The most negative impact will be the dust problem. In addition, surface water contamination and working condition of construction workers will also be the cause of impact to the project. On the other hand, the increase of employment opportunity and community development will be the positive impacts.

Operational Phase: Odour due to the handling of organic waste will be the most negative impact. In addition, noise and vibration by incoming vehicles will also be the cause of environmental impact to the plant operation. On the other hand, employment opportunity will be the positive impact.

(3) Construction and Operation of New Final Disposal Facility at Bhakhraywali

Construction Phase: The most negative impact will be the dust problem. In addition, surface water contamination by staff quarters, noise and vibration by construction machinery, and working condition of workers will be the causes of environmental and social problems. On the other hand, the increase of employment opportunity and community development will be counted as positive impacts.

Operational Phase: Leachate and odour will be the environmental impacts most in need of appropriate measures. Working at the disposal site will increase the risk of accidents and health problems to the landfill operation workers and the waste pickers. On the other hand, employment opportunity will be the positive impact.

(4) Improvement Works of Existing Landfill Facility in Gondlanwala

Construction Phase: Similar to the construction work of new landfill facility in Bhakhraywali, the negative impact will be the dust problem, surface water contamination, noise and vibration, and the working condition of construction workers. On the other hand, the increase of employment opportunity and community development will be the positive impacts.

Operational Phase: Similar to the landfill operation at the new landfill facility in Bhakhraywali, the major environmental and social impacts will be generated from leachate, odour, risks of accidents, and health of the landfill operation staff and waste pickers. On the other hand, employment opportunity will be the positive impact.

(5) Closure of Former Landfill Site in Chianwali

Construction Phase: The most negative impact will be the dust problem. In addition, surface water contamination, noise and vibration, and working condition of the construction workers will also give impacts to the environment and the people. On the other hand, the increase of employment opportunity will be the positive impact.

Post-Closure Phase: Groundwater contamination by leachate will be the most negative impact. In addition, the generation of landfill gasses and soil contamination by domestic hazardous waste will be considered as the environmental and social impact. On the other hand, the safe closure with final earth cover and fencing will give positive impacts.

2.7.2 Review of Impact Assessment in Environmental and Social Aspects

This subsection describes the environmental and social considerations carried out for the Master Plan Option B that has been selected as the optimum option through the technical, economic and financial evaluation. Firstly, the components of Option B, specifically, Composting, RDF and Final Disposal, are evaluated in environmental and social aspects. Secondly, the evaluation of Option B in terms of environmental and social considerations is summarised.

(1) Construction and Operation of Central Compost Plant

Composting has a good impact to the natural and social environment. Since organic waste is biodegraded by the composting procedure, the amount of waste will be reduced. Reduction of the amount of organic waste contributes to the reduction of negative environmental impact and environmental load in the landfill site. Less amount of organic waste means less generation of odour, vectors and methane gas in the landfill site. These make the lifetime of landfill site longer.

Another feature of composting is the utilisation of local resources. Currently, it is planned that 125 tons of compost will be produced by 250 tons of organic waste in the proposed compost facility. Using natural compost is environmentally friendly, and soil contamination by agricultural activities may be avoided compared to the use of chemical fertilizers. However, the use of natural compost in agriculture is not currently popular in Gujranwala, so that awareness campaign and the development of end-market are necessary.

Basically, compost facilities are environmentally safe and have no specific risk in the working process, but odour, especially the odour of ammonia, would be a problem. This problem must be carefully considered in case a compost facility is constructed in a residential area. However, in the proposed Option B, the composting facility is constructed in the compound of the landfill site, and the site is distant from the neighbouring community. Therefore, odour from the compost facility would not be a problem to the residents in the situation of Option B.

For the application of compositing in ISWM, separate collection at the waste generation point is preferably applied in advance. Organic wastes collected separately could be applied to the composting process directly. On the other hand, collecting organic waste in mixed waste takes time and requires additional working process and labour force. Mixed wastes waiting to be separated have to be carefully handled; otherwise, they will cause the problem of odour and dirty environment.

(2) Construction and Operation of RDF Plant

RDF has a good feature for waste management. It has a positive impact to waste management and contributes to the utilisation of local resources because the RDF process transforms useless material into solid fuel. In addition, introducing the new system like RDF may stimulate residents' interest on solid waste management. RDF also requires separate collection in advance because the production of RDF utilises the waste that remains after organic materials are separated.

There are some difficulties in the operation of RDF facilities. The famous negative impact of RDF is the generation of dioxin in the production process. Since RDF is a relatively new technology, producing RDF is high-cost and the quality of RDF is relatively low compared to other solid fuels. End market for the sale of RDF and the customers must be carefully considered because RDF is not competitive in the market with regard to quality as solid fuel.

The storage of RDF must be carefully controlled because it has the possibility of causing fire accidents. Once a fire happens in the storage, its extinction will take a long time and dangerous since RDF is a type of fuel.

It is strongly recommended that difficulties are discussed with the Lahore Compost, the compost company that is operating the RDF plant in Lahore, before implementation of the RDF facility in Gujranwala.

(3) Construction and Operation of New Final Disposal Site at Bhakhraywali

Although the proposed construction site is surrounded by farmland, the final disposal site at Bhakhraywali is located in a remote area away from the residential area, which is the most important factor for siting a construction site. The landfill facility is designed as what is called as sanitary landfill.

A sanitary landfill is superior to the conventional landfill types practiced in Pakistan. The introduction of sanitary landfill is required to minimise the environmental and social impacts, and it becomes possible to realise the functions of the facilities and to practice suitable landfill management.

The basic requirements for designing the proposed sanitary landfill facility in order to mitigate the impacts caused by the project are as follows:

- Waste containment, approach road and unloading platform for waste vehicles;
- Perimeter road for monitoring, inspection and maintenance of the facilities;
- Perimeter drainage to prevent surface runoff from entering the landfill containment;
- Liner system to prevent leachate infiltration into the groundwater aquifer;
- Leachate collection and circulation system for evaporation within the landfill area;
- Buffer zone and peripheral wall to separate the landfill area from the public road; and
- Buildings for site office, weighbridge equipment, parking, etc.

The landfill operation is to be carried out in accordance with the requirements in the Operation Manual to be prepared by GWMC, and regulated on a daily, weekly and monthly basis. The contents of the Operation Manual shall include, at least, the following:

- Incoming waste control for measuring, recording and analysis of waste disposal;
- Designation of landfill area for the day, week and month;
- Regular earth covering work;
- Control of leachate circulation system;
- Control of odour;

- Control of landfill gases;
- Regular health check of the landfill operation staff;
- Regular monitoring and maintenance of the facilities; and
- Environmental monitoring in the site and the surrounding area.

These functions and operation works shall be assured by at least one supervisor and inspector(s) deployed for the monitoring, inspection and restoration of defective works and operation to meet the requirements for the sanitary landfill.

By fulfilling the proposed means, the sanitary landfill in Bhakhraywali could be a successful model for introduction to other municipalities in Punjab and in the whole country of Pakistan.

(4) Improvement Works and Closure of Existing Landfill Site in Gondlanwala

According to the result of the interview survey conducted in the E&S Survey, opinions of the stakeholders in the vicinity of the Gondlanwala and the Chianwali disposal sites are similar. The opinions of stakeholders represented by neighbouring residents, GWMC staff and waste pickers are summarised in the following paragraphs.

All stakeholders in both sites answered that they have experienced problems related to the disposal site. Dirty access roads, odour and flies, and environmental pollution especially groundwater degradation are the common responses. In terms of benefit derived from the waste collection system, a majority recognise that the disposal site is beneficial for Gujranwala, and the benefit is "Collection system keeps avoiding the waste from spreading around" and "Waste does not have to be treated or carried to any disposal point by each household separately." On the other hand, some negative opinions were also recorded such as "It (disposal site) creates environmental problems."

With regard to the management staff of GWMC, the major opinion is addressed to the current situation that no soil cover to the site deteriorates the landscape and the bad quality of the sprayed insecticide.

The issue on waste pickers is common to solid waste management in developing countries. It is estimated that 35 to 40 waste pickers work regularly in the current disposal site at Gondlanwala. Their working environment is dangerous: They do not have protective gear, such as gloves and proper shoes, and the dirty environment increases their health risk (The World Bank, 1999).

Since waste pickers do not have an alternative way to earn, they go back to work in the disposal site although the authorities prohibit their activity. Many efforts trying to drive them away without giving alternative income sources had resulted in failure in other developing countries. Therefore, in order to consider the long-term solution, supporting efforts will be required to cope with the waste pickers issue instead of just trying to drive them away from the project site. In addition, some residents already recognised that works of waste pickers had been contributed to reduce amount of waste since they categorised waste and take all usable and valuable things to sell (see ***Volume 4, Data Book, Section G, Subsection G.1.4.2***).

In fact, there are many difficulties to improve the existing landfill to a satisfactory condition due to the current situation under the widely spread landfill area. However, the proposed improvement plan will be effective to mitigate the environmental and social impacts to the minimum level. The improvement plan is to be carried out similarly with the development plan for the Bhakhraywali sanitary landfill system.

The basic measures for the improvement or construction of the landfill facilities are as follows:

- Prevention of surface runoff from entering the landfill containment;
- Collection of leachate and its circulation/evaporation within the landfill area; and
- Installation of landfill gas vent.

Similar to the landfill operation proposed for Bhakhraywali, the landfill operation at Gondlanwala shall be improved through the regulation of daily, weekly and monthly operation, monitoring and maintenance. By technical and operational measures, the environment of Gondlanwala landfill site will be revived and the complaints of stakeholders described above resolved.

The improvement works for the existing landfill at Gondlanwala could be a successful model of mitigating the environmental and social problems for dissemination to other municipalities in Punjab and in the whole of Pakistan.

(5) Closure of Former Landfill Site in Chianwali

The former landfill in Chianwali is situated along the G.T. Road which goes into the city of Gujranwala, and discarded waste heaps are easily visible from the passing vehicles. Although the foul odour from the abandoned disposal site has decreased with the passage of time, organic matter in the filled waste layer has not decomposed completely and it still has the nature to cause odour and leachate problems.

In order to mitigate these problems, the site should be closed properly by implementing/installing the following major works/facilities to prevent it from generating the pollution source:

- Grading of the site and execution of final earth cover;
- Installation of landfill gas vents;
- Construction of premise road for maintenance and monitoring;
- Installation of leachate collection pipes, leachate pump well and leachate circulation piping; and
- Improvement of peripheral wall.

Regular environmental monitoring has to be carried out to check the degree of environmental impact for the consideration of necessary countermeasures for repair and restoration of the installation.

Appearance of the site will be improved drastically through the safe closure of the abandoned landfill site, and maintained through the monitoring plan.

2.7.3 Overall Evaluation of Selected Master Plan Option B

Option B has a great combination of the processes involved in waste management: separate collection, composting, and RDF. In this combination, the following good features are expected, and some issues need to be considered for reducing any negative impact in future.

(1) Expected Positive Impacts

- The technical process mutually contributes to each other in such that separate collection contributes to the easiest application of waste to composting/RDF, and composting/RDF utilises separated waste to make useful materials such as natural compost and one type of fuel;
- This combination effectively contributes to reduction of amount of waste;
- It reduces negative environmental impact such as odour, vectors and methane gas;
- It makes life longer for the final disposal site;
- Separate collection and composting are not environmentally harmful and have no serious negative impact;
- Composting/RDF contributes to utilisation of local materials;
- Using natural compost in agriculture will contribute to reduction of environmental load compared to chemical fertilizer;

- Separated waste is easy to control compared to mixed waste; and
- Separated organic waste reduces generation of odour and vectors.

(2) Issues for Consideration

- The effectiveness of the combination depends on the residents' cooperation regarding waste separation at household level. Awareness and environmental education become very important;
- Development of end-market of natural compost produced by the compost facility and RDF is necessary; and
- Generation of dioxin and other difficulties in the production of RDF is to be controlled before the implementation of RDF in Gujranwala.

2.8 Stakeholder Meeting

2.8.1 First Stakeholder Meeting

The first stakeholder meeting was held on 23 September 2014 at Mugal Mahal Hotel in Gujranwala (**Photo G.2.2**).

A summary of the meeting is shown in **Table G.2.17**. In addition to the major stakeholders who are landowners and residents in the project site, related organizations participated in the meeting. Contents of the Project, current situation of waste management in Gujranwala, and point of environmental and social considerations in the Project were discussed at the meeting. According to the discussions, stakeholders are interested in the direction of waste management in Gujranwala.

Photo G.2.2 First Stakeholder Meeting,

Table G.2.17 Summary of the First Stakeholders Meeting, Mugal Mahal Hotel, 23 September 2014

Date and Venue	23 September 2014 Mugal Mahal Hotel, Gujranwala
Type of Participants (Participating Organizations)	Residents/Landowners in the project site, Gujranwala Waste Management Company (GWMC), JICA Pakistan Office, City District Government Gujranwala (CDGG), Local NGOs
Number of Participants	32 people
Presentation Title	- Project Introduction [Dr. Haq, Managing Director of Gujranwala Waste Management Company (GWMC)] - Brief Overview of the JICA Project for Integrated Solid Waste Management in Gujranwala (Mr. Takasugi, JICA Expert for Final Disposal Plan) - Applying JICA Environmental Checklist for Waste Management (Ms. Tsutsui, JICA Expert for Environmental and Social Considerations)
Discussion/List of questions from the participants (selected)	- Will GWMC implement the JICA Master Plan and what can be the constraints for its implementation? - What is the status of dumpsites? - How will GWMC utilise waste in future? - What is the plan of GWMC for at-source separation? - Which step has GWMC taken for better unloading of waste by handcarts into the waste containers? - What is GWMC's strategy to avoid waste littering during transportation and to guide the sanitary workers at their assigned duty place? - What are the plans to monitor sanitary workers by operational staff?

2.8.2 Second Stakeholder Meeting

The second stakeholder meeting was held at Rachna Hotel in Gujranwala on the 9th of June 2015 to explain the contents of the master plan (**Photo G.2.3**).

A summary of the meeting is shown in **Table G.2.18**. From the project side, contents of the Project, collection and transportation plan, and disposal plan in the Project were discussed at the meeting. Sustainability and management policy of GWMC were mainly asked from the attendees. At the end of the meeting, the Urban Unit appreciated GWMC's great effort for capacity building in the last one year.

Photo G.2.3 Second Stakeholder Meeting, Rachna Hotel, 09 June 2015

Table G.2.18 Summary of the Second Stakeholders Meeting, Rachna Hotel, 9 June 2015

Date and Venue	09 June 2015 Rachna Hotel, Gujranwala
Type of Participants (Participating Organizations)	- Gujranwala Waste Management Company (GWMC) - Landowners - Representative/residents of UC (Gondlanwala) - JICA Pakistan Office - Lahore Waste Management Company (LWMC) - Urban Unit - City District Government Gujranwala (CDGG) - Local NGOs, Consulting companies, etc.
Number of Participants	79 people
Presentation Title	- Outline of the project (Mr. Maeda) - Collection and transportation plan presentation (Mr. Nakamura) - Disposal Plan Presentation (Mr. Takasugi)
Discussion/List of questions from the participants (selected)	- Would the JICA Project be sustainable with political influence? - How will the involvement of sanitary workers as the basic unit of SWM system be ensured? - What procedure is being followed by GWMC?

3. PLANNING DIRECTIONS OF ENVIRONMENTAL MONITORING PLAN

3.1 Objective

The objective of the Environmental Monitoring Plan is to monitor the environmental quality to avoid new negative impacts which might be caused by the disposal sites, and mitigate current negative impacts of the disposal sites to the social and natural environment in Gujranwala.

3.2 Planning Policy

- Environmental monitoring shall be practiced for not only the proposed landfill site at Bhakhraywali, but also the current disposal site at Gondlanwala and the abandoned disposal site at Chianwali.
- Environmental monitoring shall be carried out in long-term perspective.

3.3 Planning Strategy

- A system of environmental monitoring should be established and implemented.
- Practical and initial solid waste recycling activities should be carried out with the inclusion of waste pickers' activities.

4. FORMULATION OF ENVIRONMENTAL MONITORING PLAN

4.1 Necessity of Environmental Monitoring

Environmental management is essential to specify the monitoring work for finding problems and improvement points predictable at the disposal sites of Bhakhraywali, Gondlanwala and Chianwali, collection and transport, and composting. Contents of monitoring and implementation schedule are given at the end of this section.

Regarding the new landfill site at Bhakhraywali, GWMC, the agency responsible for landfill management, shall prepare the quarterly environmental compliance and project performance reports in order to foresee the environmental and social impacts of the new landfill site. Major issues of the internal reports shall be health, safety, and environmental performance of the landfill site. The reports must be filed as a part of project archives and the environmental database as an EIA Report. EIA is required for the construction of the final disposal site, and construction of the proposed compost/RDF plant may require an EIA/IEE, although the Environment Protection Department (EPD) of Punjab will be the final judge.

In the EIA, specific environmental monitoring items (**Table G.4.1**) are recommended to be measured by professional environmental consultancy. Proposed items are air quality, water quality, noise level, smelly gas (landfill gasses), treated wastewater effluent, leachate, vegetation/plantation, and safety and traffic. Most of these items should be monitored quarterly except vegetation and plantation, as well as safety and traffic that are measured annually as shown in **Table G.4.1**. Reference of standards is "National Environmental Quality Standard, Pakistan (NEQS)" and "National Standards for Drinking Water Quality (NSDWQ)" (**Figure G.4.1**, **Table G.4.2**). This proposed plan seems to be an operation phase of the proposed landfill site.

However, details of the Environmental Monitoring Plan are not shown in the EIA report. One of the proposed Environmental Monitoring in the landfill site is described in the following **Section 4.2**.

Table G.4.1 Environmental Monitoring Plan Proposed in EIA Report for Bhakhraywali

Environmental Component	Parameters	Standard	Frequency
Ambient Air Quality	SPM, PM_{10}, SO_2, NO_2, CO, CO_2, Vapours	NEQS NSDWQ	Quarterly
Groundwater Quality	pH, Temperature, TDS, Conductivity, Fluoride, Nitrate, DO, Hardness, Turbidity, Colour, Chloride, Arsenic, etc.	NEQS NSDWQ	Quarterly
Noise Level	dB(A)	N/A	Quarterly
Smelly Gases (Landfill Gases)	SO_2, H_2S, CH_4	NEQS	Quarterly
Treated Wastewater Effluent	BOD, COD, TOC, TSS, DO, Chloride, Sulphate, Turbidity, Conductivity, Oil and Grease, Colour, TKN, Heavy metals	NEQS	Quarterly
Leachate	BOD, COD, TOC, TSS, DO, Chloride, Sulphate, Turbidity, Conductivity, Oil and Grease, Colour, TKN, Heavy metals	NEQS	Quarterly
Vegetation and Plantation	Visual inspection of plant species survival rate and status of maintenance	N/A	Annual Report
Safety and Traffic	1) Inspection of Signage 2) Faulty, overloaded and speeding of vehicles	N/A	Annual Report

NEQS: National Environmental Quality Standard, Pakistan
NSDWQ: National Standards for Drinking Water Quality
N/A: Not applicable
Source: EIA Report

National Environmental Quality Standards for municipal and liquid industrial effluenets (mg/l, unless otherwise defined)

Serial No.	Parameter	Existing Standards	Revised Standards		
			Into Inland Waters	Into Sewage Treatment	Into Sea
1	Temperature / Temperature increase*	40°C	≤3°C	≤ 3°C	≤ 3°C
2	pH value	6-10	6-9	6-9	6-9
3	5-days Biochemical Oxygen Demand (BOD) at 20°C. (1)	80	80	250	80**
4	Chemical Oxygen Demand (COD) (1)	150	150	400	150
5	Total suspended solids	150	200	400	200
6	Total dissolved solids	3500	3500	3500	3500
7	Grease and oil	10	10	10	10
8	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9	Chloride (as Cl)	1000	1000	1000	SC
10	Fluoride (as F)	20	10	10	10
11	Cyanide (as CN) total.	2	1	1	1
12	An-ionic detergents (as MBAS) (2)	20	20	20	20
13	Sulphate (SO_4)	600	600	1000	SC
14	Sulphide (S)	1.0	1	1	1
15	Ammonia (NH_3)	40	40	40	40
16	Pesticides, herbicides, fungicides and insecticides (3)	0.15	0.15	0.15	0.15
17	Cadmium (4)	0.1	0.1	0.1	0.1
18	Chromium (trivalent & hexavalent) (4)	1.0	1	1	1
19	Copper (4)	1.0	1	1	1
20	Lead (4)	0.5	0.5	0.5	0.5
21	Mercury (4)	0.01	0.01	0.01	0.01
22	Selenium (4)	0.5	0.5	0.5	0.5
23	Nickel (4)	1.0	1	1	1
24	Silver (4)	1.0	1	1	1
25	Total toxic metals	2.0	2	2	2
26	Zinc	5.0	5	5	5
27	Arsenic (4)	1.0	1	1	1
28	Barium (4)	1.5	1.5	1.5	1.5
29	Iron	2.0	8	8	8
30	Manganese	1.5	1.5	1.5	1.5
31	Boron (4)	6.0	6	6	6
32	Chlorine	1.0	1	1	1

1. Summing minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means for example, that for each one cubic meter of treated effluent the recipient water body should have 10 cubic meter of water for dilution of this effluent.
2. Modified Benzene Alkyl Sulphate; assuming surfactant as bio-degradable.
3. Pesticides. herbicides, fungicides, and insecticides.
4. Subject to total toxic metals discharge.
5. Applicable only when and where sewage treatment is operational and BOD5=80 mg/l is achieved by the sewer treatment system.
6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

SC Discharge concentration at or below Sea concentration.

* The effluent should not result in temperature increase of more than 3C at the edge of the zone where initial mixing and dilution take place. In case zone is not defined, use 100 meters from the point of discharge.

Note: Dilution of gaseous emissions and liquid effluents to bring them to the NEQS limiting value is not permissible through excess air mixing/blowing in to the gaseous emissions or through fresh water mixing with the effluent before discharge into environment.

** The value of BOD and COD is 200 and 400 respectively

National Environmental Quality Standards for industrial gaseous emission (mg/nm3 unless otherwise defined)

Serial No.	Parameter	Source of Emission	Existing Standards.	Revised Standards
1	Smoke (1)	Smoke opacity not to exceed	40% or 2 (Ringlemann scale)	40 %
2	Particulate matter (2)	Boilers and furnaces:		
		(i) Oil fired.	300	300
		(ii) Coal fired.	500	500
		(iii) Cement Kilns.	200	200
		Grinding, crushing, clinker coolers and related processes, metallurgical processes, converter, blast furnaces and cupolas	500	500
3	Hydrogen Chloride (3)	Any.	400	400
4	Chlorine (3)	Any.	150	150
5	Hydrogen fluoride (3)	Any.	150	150
6	Hydrogen sulphide (3)	Any.	10	10
7	Sulphur Oxides	Sulphuric acid plant	400	5000
		Others.		1700
8	Carbon monoxide (3)	Any.	800	800
9	Lead (3)	Any.	50	50
10	Mercury (3)	Any.	10	10
11	Cadmium (3)	Any.	20	20
12	Arsenic (3)	Any.	20	20
13	Copper (3)	Any.	50	50
14	Antimony (3)	Any.	20	20
15	Zinc (3)	Any.	200	200
16	Oxides of Nitrogens	Nitric acid manufacturing unit.	400	3000
		Gas fired.	400	400
		Oil fired		600
		Coal fired		1200

1. Or 2 on the Ringlemann scale
2. Based on the assumption that the size of the particulates is 10 micron or more.
3. Any source
4. In respect of emissions of sulphur dioxide and nitrogen oxides, the power plants operating on oil or coal as fuel shall, in addition to national Environmental Quality Standards (NEQS) specified above, comply with the following standard.

Sulphur dioxide and nitrogen oxide ambient air requirements

A. SULPHUR DIOXIDE

Sulphur Dioxide Background Levels (ug/m3)

Background Air Quality (SO_2 Basis)	Annual Average (ug/m3)	Max. In 24 Hour Interval (ug/m3)	Standards: Criterion I — Max. SO_2 Emission (Tons/day/ Plant)	Standards: Criterion II — Max. Allowable Ground Level Increment To Ambient (One year average, ug/m^3)
Unpolluted	<50	<200	500	50
Moderately Polluted*				
Low	50	200	500	50
High	100	400	100	10
Very Polluted**	>100	>400	100	10

* For intermediate values between 50 and 100 µg/m^3 linear interpolations should be used

** No project with sulphur dioxide emissions will be recommended

B. NITROGEN OXIDES

Ambient air concentrations of nitrogen oides, expressed as NO2, should not exceed the following:-

Annual Arithmetic Mean	100 ug/m3 (0.05 ppm)

Emission levels for stationary sources discharges, before mixing with the atmosphere, should be maintained as follows:

For fuel fired stream generators, as nanogram (10E-9 gram) per joule of heat input:

Liquid fossil fuel	130
Solid fossil fuel	300
Lignite fossil fuel	260

Figure G.4.1 National Environmental Quality Standard, Pakistan (NEQS)

Table G.4.2 National Standards for Drinking Water Quality (NSDWQ)

Bacterial			
PROPERTIES /PARAMETERS		**STANDARD VALUES FOR PAKISTAN**	
All water intended for drinking (e.Coli Or Thermotolerant Coliform Bacteria)		Must not be detectable in any 100 ml sample	
Treated water entering the distribution system (E.Coli or thermos tolerant coliform and total coliform bacteria)		Must not be detectable in any 100 ml sample	
Treated water in the distribution system (E.coli or thermos tolerant coliform and total coliform bacteria)		Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12- month period.	
Physical			
PROPERTIES /PARAMETERS	**STANDARD VALUES FOR PAKISTAN**	**PROPERTIES /PARAMETERS**	**STANDARD VALUES FOR PAKISTAN**
Colour	≤15 TCU	Total hardness as CaCO3	< 500 mg/l
Taste	Non objectionable/Acceptable	TDS	< 1000
Odour	Non objectionable/Acceptable	pH	6.5 – 8.5
Turbidity	< 5 NTU		
Chemical			
Essential Inorganic	***mg/Litre***	***Toxic Inorganic***	***mg/Litre***
Aluminum (Al) mg/1	<0.2	Cyanide (CN)	<0.05
Antimony (Sb)	<0.005 (P)	Fluoride (F)*	<1.5
Arsenic (As)	< 0.05 (P)	Lead (Pb)	<0.05
Barium (Ba)	0.7	Manganese (Mn)	< 0.5
Boron (B)	0.3	Mercury (Hg)	<0.001
Cadmium (Cd)	0.01	Nickel (Ni)	<0.02
Chloride (Cl)	<250	Nitrate (NO3)*	<3 (P)
Chromium (Cr)	<0.05	Selenium (Se)	0.01(P)
Copper (Cu)	2	Residual chlorine	0.2-0.5 at consumer end 0.5-1.5 at source
		Zinc (Zn)	5.0
Radioactive			
Alpha Emitters bq/L or pCi	0.1	Beta emitters	1

4.2 Environmental Monitoring for Final Disposal Site

4.2.1 Monitoring of Leachate and Surface Water

Water quality of leachate and surface water is one of the most important factors in environmental monitoring for the final disposal site and shall be monitored and analysed periodically in order to determine the conditions of the landfill and the potential impact to the environment. The water quality data of leachate can also be used to determine the state of stabilisation of the landfill.

(1) Monitoring Points of Leachate and Receiving Water Body

Monitoring point(s) of leachate shall be the outlet point(s) of leachate from the landfill site and outlet point(s) of leachate treatment facilities and/or recirculation facilities. In addition, several monitoring points shall be determined at the water receiving body to check the influence of

discharge of leachate. The recommended leachate monitoring points are indicated, but not limited to the following sites:

Raw Leachate Quality

- Outflow/Outlet points from the landfill site or influent water of the leachate treatment/recirculation facilities
- Leachate of instantaneous and total flows must be recorded according to the Punjab Solid Waste Management Guidelines (2011).

Treatment/Recirculation of Leachate

- Outlet points of leachate treatment/recirculation facilities or effluent water

Leachate Influence to the Water Receiving Body

- Upstream and downstream side of outfall of leachate to the water receiving body

(2) Sampling/Monitoring Conditions

Leachate quality shall be monitored periodically at the regular sampling points. In addition, the leachate quality under the maximum/minimum flows shall be monitored. Sampling day of leachate for periodical/regular monitoring may be determined as a day after consecutive fine/cloudy days or more than 24 hours after stop of falling rain to minimise the influence of rain.

The conditions of monitoring/sampling shall be recorded to include, at least, the following conditions:

- Name of person in charge
- Name of sampling points
- Date and time
- Weather conditions
- Water temperature and ambient temperature
- Flow rate as required
- Photos of sampling work

Table G.4.3 shows the required parameters described in the EIA report and the recommended parameters as well. The water quality parameters shall be analysed by the accredited laboratory.

Table G.4.3 Parameters for Leachate Monitoring

	Parameters Specified in EIA Report	Recommended Parameters
General Items	COD, BOD_5, Total Suspended Solids, Electric Conductivity, Oil/Grease, Sulphate, Turbidity, Colour, TIN	Water Temperature, pH, Settleable Solids, Total Dissolved Solids, Surfactants (MBAS), Phenolic Substances as Phenols, Total Coliform Count
Heavy Metals	Name of parameters are not specified	Arsenic, Cadmium, Chromium (hexavalent), Cyanide, Lead, Mercury (Tot.), PCB, Formaldehyde

Source: EIA report

(3) Frequency of Monitoring

The minimum frequency of monitoring of leachate is four (4) times in a year or quarterly basis.

4.2.2 Monitoring of Groundwater Quality

Poor lining system and inappropriate leachate control will cause a potential contamination source of groundwater quality. A sign of groundwater contamination appears with the change of water quality parameters. Accordingly, the groundwater quality shall be monitored periodically for the representative water quality parameters, and a series of recorded data analysed to grasp any significant change in groundwater quality.

(1) Monitoring Points of Groundwater

Monitoring of groundwater should consist of the following items according to the Punjab Solid Waste Management Guidelines (2011):

- At least one groundwater monitoring well should be installed hydraulically above the gradient of the landfill and at least three monitoring wells should be installed hydraulically below the gradient direction;
- The monitoring well system should include a sufficient number of multi-level well nests for measurement of vertical gradients;
- Locations of the monitoring wells should be sufficiently close to the active disposal area to allow early detection of contamination and implementation of remedial measures; and
- The monitoring wells are to be retained throughout the lifespan of the facility.

(2) Sampling/Monitoring Conditions

Groundwater quality shall be monitored periodically under the maximum/minimum groundwater table. Special sampling tools shall be used to take the groundwater to meet the types of well and spring. Specified parameters in EIA are pH, Temperature, TDS, Conductivity, Fluoride, Nitrate, DO, Hardness, Turbidity, Colour, Chloride, and Arsenic (see **Table G.4.2**).

(3) Frequency of Monitoring

Frequency of monitoring of groundwater shall be at least on quarterly basis. Water quality parameters shall be determined with reference to the drinking water quality.

4.2.3 Monitoring of Landfill Gasses

Landfill gasses include harmful substances such as hydrogen sulphide, methane gas, etc. Monitoring of landfill gasses is essentially required to protect the health and safety of operation staff and the neighbouring residents. The concentration and odour from the gasses shall be monitored and analysed periodically in order to grasp the condition of the landfill and the potential impact to the environment. The data can also be used to determine the state of stabilisation of the landfill.

(1) Monitoring Points

Monitoring of landfill gasses shall be made at the final disposal site, and the detailed measuring points will be decided in the action plan.

(2) Sampling/Monitoring Conditions

Monitoring of landfill gasses shall be carried out by portable gas detector, sampling at site and laboratory analysis. Special monitoring on a calm day after the rain may be required. The monitoring/sampling conditions shall be recorded in conformity with the requirements stipulated. Parameters specified in the EIA are hydrogen sulphide (H_2S), methane gas (CH_4) and ammonia (NH_3).

(3) Frequency of Monitoring

Frequency of monitoring of landfill gasses shall be, at least, on a quarterly basis. In addition, the daily observation of odour and gas by smelling is important for the operators during implementation of the landfill work.

4.2.4 Monitoring of Odour

The landfill activities should be carried out properly and managed effectively to reduce the emission of the unpleasant odour and minimise the impact to the surrounding residents.

(1) Monitoring Points

The state or degree of unpleasantness can only be determined by smelling the air depending on the prevailing atmospheric conditions. The measurement of odour can only be expressed in distance from the source where the odour can be detected.

(2) Sampling/Monitoring Conditions

The smell or unpleasantness will have to be determined by odour concentration and substance, i.e., how bad it smells and what does it smell like.

(3) Frequency of Monitoring

Offensive odour shall be monitored daily by smelling or as-and-when necessary for some specific offensive odour substances as long as it is not having a major impact or nuisance to the communities.

4.2.5 Monitoring of Noise and Vibration

The landfill activities should be carried out properly and managed effectively to reduce the excessive noise and vibration caused by the vehicles and operation of machinery and landfill equipment. The noise and vibration levels should be minimal and comply with the relevant regulation as set out for the protection of occupational safety and health. The measurement method must be in accordance with internationally accepted protocols and procedures.

(1) Monitoring Points

The noise and vibration monitoring measurement should be carried out at or near the generation source. Other monitoring locations could be along the perimeters of the landfill or at nearby residential areas.

(2) Sampling/Monitoring Conditions

Sampling and monitoring conditions for noise and vibration shall be decided in the action plan.

(3) Frequency of Monitoring

The recommended frequency of monitoring should not be less than once a year. Quarterly monitoring is recommended in the EIA.

4.3 Environmental Monitoring for Post-Closure of Final Disposal Site in Gondlanwala and Chianwali

Post-closure monitoring shall be applied for Gondlanwala and Chianwali sites after the completion of safe closure process. According to the Punjab Solid Waste Management Guideline of 2011, the duration of post-closure monitoring is 25 years, and the specified monitoring items are groundwater, surface

water, landfill gas, and erosion and settlement. Frequency of monitoring is not mentioned in the Guideline, so that it can be suggested as once in a year. Monitoring method and sampling points are the same as those in the operational phase.

4.4 Environmental Monitoring for Collection and Transport Work

For the collection and transport work, a clean environment around garbage containers is important. Dirty environment with garbage scattered around the containers takes more time for collection and transport compared to the container and its neighbouring area kept clean. Another problem is that dirty containers and unsanitary environment around the container can be the origin of foul odour and vectors.

Waste separation at household level is essential for separate collection and intermediate treatment. Practice of waste separation at household level will be gradually increased during implementation of the Master Plan. Therefore, ratio of waste separation at household level has to be recorded periodically, and the monitoring result shall be utilised for the planning of awareness programme.

4.4.1 Monitoring of Cleanness of Garbage Containers

(1) Monitoring Points

All or selected garbage containers in Gujranwala shall be monitored.

(2) Sampling/Monitoring Conditions

Sanitary workers and UC members in each area can be in charge of this monitoring. Problems and feedback shall be given to the residents by the UC members.

(3) Frequency of Monitoring

The recommended frequency of monitoring is daily.

4.4.2 Monitoring of Waste Separation at Household Level

(1) Monitoring Points

Monitoring points shall be selected in urban and peri-urban areas. Different types of areas should be monitored, such as high/low density area.

(2) Sampling/Monitoring Conditions

Samples shall be selected by gender, age, income level, and area.

(3) Frequency of Monitoring

The recommended frequency of monitoring should be annually. Residents practicing waste separation in their household will be interviewed. Whether or not the respondent agrees or disagrees with waste separation, his reason or opinion shall be utilised for the awareness programme.

4.5 Environmental Monitoring for Intermediate Treatment (Compost Facility)

In this section, the environmental monitoring of intermediate processes, especially, about the compost facility is discussed. Basically, the compost facility is harmless to the environment and not dangerous in the labourers working process. However, odour (ammonia, etc.) from the facility shall be monitored.

4.5.1 Monitoring of Odour (Ammonia Odour)

(1) Monitoring Points

The odour of ammonia around the compost facility shall be measured.

(2) Sampling/Monitoring Conditions

The measurement method must be in accordance with the internationally accepted protocols and procedures. Sampling and monitoring conditions for odour will be decided in the action plan.

(3) Frequency of Monitoring

The recommended frequency of monitoring is quarterly, probably the same with the quarterly monitoring in the landfill site.

4.6 Implementation Schedule of Environmental Monitoring Plan

Monitoring is to be implemented in accordance with the schedule shown in **Figure G.4.2**. Timing of monitoring implementation is the same as the timing of service or start of operation.

Time Framework of the Master Plan		Short-Term Plan Period												Mid-Term Plan Period						Long-Term Plan Period					
Year		2016				2017				2018				2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Quarter		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4												
WBS for Short-Term Plan																									
S-0-1	Monitoring of Collection and Transport Work																								
S-0-2	Monitoring of Final Disposal Site in Bhakhraywall																								
S-0-3	Monitoring of Post-Closure Final Disposal Sites in Gondlanwala and Chianwall																								
WBS for Mid-Term Plan																									
M-0-1	Monitoring of Collection and Transport Work																								
M-0-2	Monitoring of Final Disposal Site in Bhakhraywall																								
M-0-3	Post-Closure Monitoring of Gondlanwala and Chianwall Landfill Sites																								
M-0-4	Monitoring of Intermidiate Process (Compost Facility)																								
WBA for Long-Term Plan																									
L-0-1	Monitoring of Collection and Transport Work																								
L-0-2	Monitoring of Final Disposal Site in Bhakhraywall																								
L-0-3	Post-Closure Monitoring of Gondlanwala and Chianwall Landfill Sites																								
L-0-4	Monitoring of Intermidiate Process (Compost Facility)																								

Figure G.4.2 Implementation Schedule of the Environmental Monitoring Plan

4.7 Project Cost of the Environmental Monitoring Plan

Table G.4.4 shows the project cost for the Master Plan and **Figure G.4.3** shows the Project Cost and Responsibilities under the Environmental Monitoring Plan.

Table G.4.4 Implementation Cost for the Environmental Monitoring Plan

WBS No.	WBS	Total Budget (Thousand Rs.)	Annual Cost														
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Programme 6: Environmental Monitoring Plan																	
Short-Term Plan																	
S-6-1	Monitoring of Collection and Transport Work	GWMC	0	0	0												
S-6-2	Monitoring of Final Disposal Site in Shakhraywall	2,455	435	570	1,150												
S-6-3	Environmental Monitoring for Post-Closure Final Disposal Sitein Gondianwala and Chianwali	140	0	0	140												
	Sub-Total	2,595	435	570	1,290	0	0	0	0	0	0	0	0	0	0	0	0
Mid-Term Plan																	
M-6-1	Monitoring of Collection and Transport Work	GWMC				0	0	0	0	0	0						
M-6-2	Monitoring of Final Disposal Site in Shakhraywall	8,295				1150	1150	1585	2020	1150	1150						
M-6-3	Environmental Monitoring for Post-Closure Final Disposal Sitein Gondianwala and Chianwali	840				140	140	140	140	140	140						
M-6-4	Monitoring of Intermidiate Process (Compost Facility)	GWMC				0	0	0	0	0	0						
	Sub-Total	9,045				1,290	1,290	1,725	2,160	1,290	1,290						
Long-Term Plan																	
L-6-1	Monitoring of Collection and Transport Work	GWMC										0	0	0	0	0	0
L-6-2	Monitoring of Final Disposal Site in Shakhraywall	9,510										1585	2020	1150	1585	2020	1150
L-6-3	Environmental Monitoring for Post-Closure Final Disposal Sitein Gondianwala and Chianwali	840										140	140	140	140	140	140
L-6-4	Monitoring of Intermidiate Process (Compost Facility)	GWMC										0	0	0	0	0	0
	Sub-Total	10,350										1,725	2,160	1,290	1,725	2,160	1,290
	Grand Total	21,990	435	570	1,290	1,290	1,290	1,725	2,160	1,290	1,290	1,725	2,160	1,290	1,725	2,160	1,290

Programme No.	WBS No.	WBS	Legal Action (Required=●)	Name of Act/Regulation/By-law	Budgetary Arrangment (Required=●)	Total Budget (Thousand Rs.)	Responsibility Assignment Matrix: M=Main Responsibility, S=Sub Responsibilities. B=Budgetary Arrangement, L=Legal Action, P=Participation in Discussions																
							GWMC/Operation Unit	GWMC/P&C Unit	GWMC/Financial Unit	GWMC/HR & Administration Unit	City District Government Gujranwala (CDGG)	The Urban Unit, Government of the Punjab	P&D Dept., Government of the Punjab	Local Gov't Dept., Government of the Punjab	Environment Protection Department (EPD)	Donor Organisations	Private Contractors/Consultants	Recyclers	CBOs & NGOs	Waste Pickers	PAPs around Gondianwala Disposal Site	PAPs around Bhakhraywall Disposal Site	Gujranwala Citizens
Programme 6: Environmental Monitoring Plan																							
Short-Term Plan																							
	S-6-1	Monitoring of Collection and Transport Work			●	GWMC	M		B			S						P		P			P
	S-6-2	Monitoring of Final Disposal Site in Bhakhraywall			●	2455	M		B			S					P						
	S-6-3	Monitoring of Post-Closure Final Disposal Site in Gondianwala and Chianwall			●	140	M		B			S					P						
		Sub-Total				2,595																	
Mid-Term Plan																							
	M-6-1	Monitoring of Final Disposal Site in Bhakhraywall				8205	M		B			S					P						
	M-6-2	Post-closure Monitoring of Gondianwala and Chianwall				840	M		B			S					P						
	M-6-3	Monitoring of Collection and Transport Work				GWMC	M		B			S						P		P			P
	M-6-4	Monitoring of Intermidiate Process (Compost Facility)				GWMC	M		B			S					P						
		Sub-Total				9,045																	
Long-Term Plan																							
	L-6-1	Monitoring of Final Disposal Site in Bhakhraywall				9510	M		B			S					P						
	L-6-2	Post-closure Monitoring of Gondianwala and Chianwall				840	M		B			S					P						
	L-6-3	Monitoring of Collection and Transport Work				GWMC	M		B			S						P		P			P
	L-6-4	Monitoring of Intermidiate Process (Compost Facility)				GWMC	M		B			S					P						
		Sub-Total				10,350																	
		Grand Total				21,990																	

Figure G.4.3 Project Cost and Responsibilities under the Environmental Monitoring Plan

5. PROPOSAL FOR THE ACTION PLAN

5.1 Selection of the Priority Project

Priority projects are defined as the projects for the short-term period of the Master Plan which will be developed into the action plans in this chapter. Based on the detail discussions in **Chapter 4,** the following are selected as the priority projects:

1. Project for Environmental Monitoring of Collection and Transportation Work
2. Project for Environmental Monitoring of Final Disposal Site in Bhakhraywali
3. Project for Environmental Monitoring of Safe Post-Closure of the Final Disposal Sites in Gondlanwala and Chianwali

5.2 Project for Environmental Monitoring of Collection and Transportation Work

5.2.1 Monitoring of Cleanness of Garbage Containers

(1) Objectives of Monitoring

The monitoring process shall be carried out for making well-organized waste collection spaces and keeping clean environment for the following purposes:

- To avoid vector and odour;
- To keep the clean and aesthetic view of the vicinity; and
- To avoid dirty environment with garbage scattered around the containers.

(2) Methodology of Monitoring

(a) Location of Monitoring

The monitoring shall be carried out all over Gujranwala City, but it is actually made at the location of containers. For example, nearly 60 container locations have been identified in Zone 6 and they should be targeted for monitoring. The container locations in Zone 6 are as indicated in **Figure G.5.1.**

(b) Monitoring Items

Following items shall be monitored:

- Cleanness of container;
- Whether or not any waste is scattered around the container; and
- Whether waste is separately collected or mixed.

(c) Monitoring Data Collection System

Data shall be collected through everyday inspection of containers by sanitary supervisors who shall record the situation in the monitoring format prepared by the Operation Unit of GWMC. This activity will be started by the beginning of 2016.

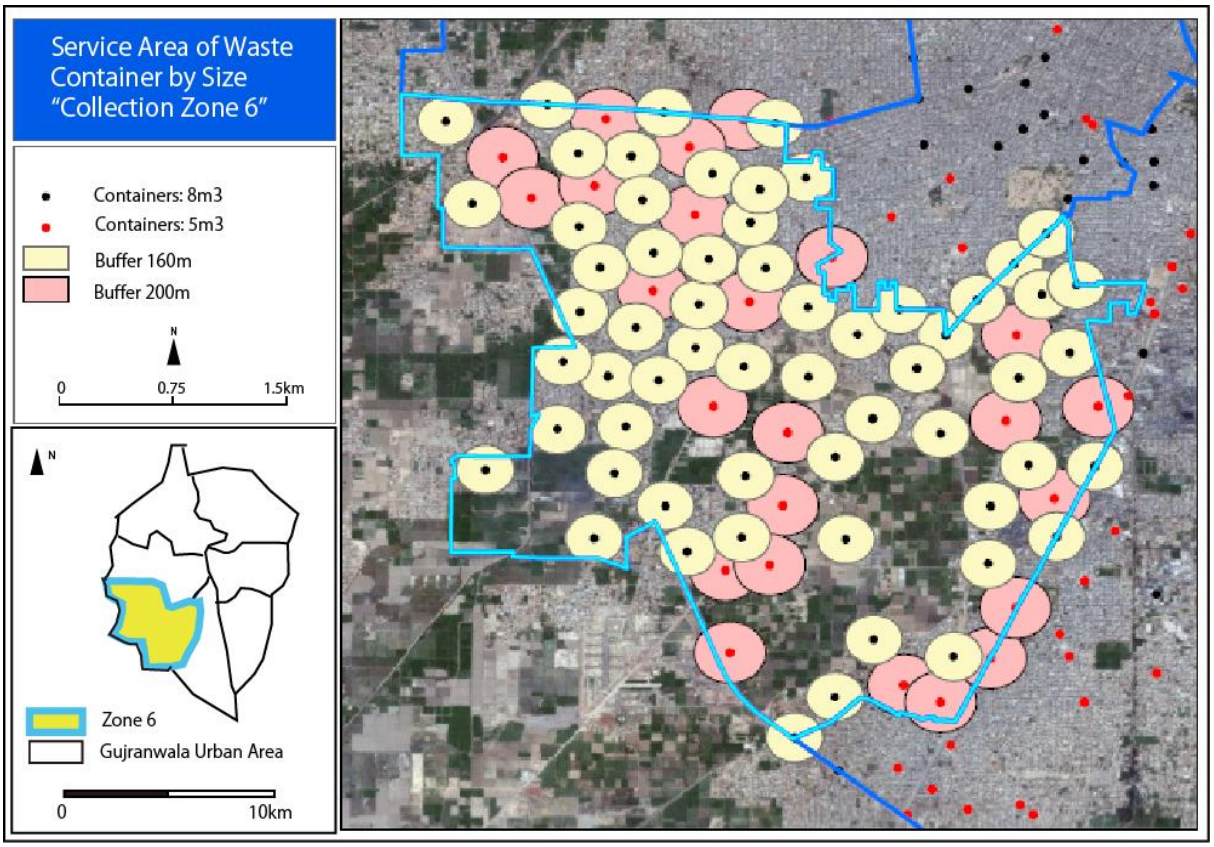


Figure G.5.1 Location Map of Containers in Zone 6 (Base Map: Figure B.5.1)

(d) Monitoring Feedback System

Sanitary supervisors shall monitor their responsible working areas every day. They shall check the garbage containers in their individual working areas and record the situation in the monitoring format. Inspectors shall check the record, and the record shall be submitted to the Assistant Manager for Operations who should file and control the data. In case the dirty situation of garbage container and its environment is serious, the case shall be reported to the Senior Manager Disposal, and immediate measures should be implemented in a timely manner.

(e) Cost of Monitoring

The monitoring work shall be carried out as part of the daily work of sanitary supervisors, so that no extra cost is required for its implementation.

5.2.2 Monitoring of Waste Separation at Household Level

(1) Objectives of Monitoring

Waste separation at the household level is an essential issue for building the 3R system that will result in the efficient and effective waste collection and transportation work. However, currently, residents do not have the custom of waste separation, and implementation may have some difficulties and confusion. Therefore, this monitoring shall be conducted with the following objectives:

- To keep records on how households separate wastes in daily life;
- To evaluate the degree of diffusion of waste separation at household level; and

- To utilise the result of the evaluation for the awareness programme formulation.

(2) Methodology of Monitoring

(a) Location of Monitoring

Targets of household monitoring shall be selected all over Gujranwala. As the first stage of monitoring, 100 households shall be selected as monitoring samples from the 64 Urban Union Councils (UCs) that belong to the four major towns, Qila Didar Singh, Khiali Shah Pur, Aroop and Nandi Pur, and 25 households in each town shall be selected.

(b) Monitoring Items

The situation of the residents' waste separation at household shall be monitored. In the Short-Term Period, the monitoring shall focus on three items: (i) Kitchen waste; (ii) Paper and plastic bags; and (iii) Recyclable waste (e.g. valuable metals). Regarding the three items, the following interview questions shall be made:

Q1. How do you keep the three wastes in the house until you throw them away? Are they separately stored or mixed?

Q2. Where do you throw away the three wastes?

Q3. Do you know that (1) Kitchen waste and (2) Paper and plastic bags should be thrown away separately in different containers?

Monitoring items, questions, and expected answers from the residents are shown in **Table G.5.1**.

Table G.5.1 Monitoring Items, Questions, and Expected Answers

Monitoring Item	[Q1] How do you keep the three wastes in the house until you throw them away? Are they separately stored or mixed?	[Q2] Where do you throw away the three wastes?	[Q3] Do you know that (1) Kitchen waste and (2) Paper and plastic bags should be thrown away separately in different containers?
(1) Kitchen waste	(1) and (2) are mixed in waste container in the house	Any container in neighbourhood (do not know the difference of colour or type of container)	No
(2) Paper and plastic bags			
(3) Recyclable waste	Separately stored in the house	Sell to someone who will pay for it	

Note: Expected answers are shown in Italic letter.

(c) Monitoring Data Collection System

This monitoring shall be carried out once a year. The Assistant Manager for Environmental Education shall select the respondents and prepare the questionnaire, and field operation staff members shall conduct the interviews. Data shall be compiled and summarised by the Assistant Manage for Environmental Education and the results shall be submitted to the Senior Manager for Communication. The results of monitoring shall be utilised for the public awareness activities to improve the achievement of separate waste collection.

Since one of the major public awareness programmes is planned in every April, preparation for monitoring shall be started in January 2016, the interviews shall be carried out in January, and a summary of the results shall be prepared by the middle of March.

(d) Monitoring Feedback System

Monitoring results shall be filed in the Environmental Education Section of the Communication Unit for utilisation in the awareness programmes. After the results are summarised by the Assistant Manager of the Environmental Education Section, the Manager for Communication, together with the Assistant Manager for Communication in GWMC, shall review the results and feedback some of the results to the contents of the public awareness programme.

(e) Cost of Monitoring

This monitoring will be carried out by GWMC employees, so that no extra cost is required for its implementation.

5.3 Project for Environmental Monitoring of Final Disposal Site in Bhakhraywali

Seven monitoring activities are planned in the project as follows:

- Monitoring of Ambient Air Quality
- Monitoring of Groundwater Quality
- Monitoring of Noise Level
- Monitoring of Landfill Gases
- Monitoring of Treated Wastewater Effluent (Leachate Pond Effluent)
- Monitoring of Leachate (Leachate Pond Influent)
- Monitoring of Vegetation and Plantation
- Monitoring of Safety and Traffic

(1) Objectives of Monitoring

The objectives of the monitoring are as follows:

- To monitor and record the environmental situation in the Bhakhraywali site; and
- To take countermeasures in case any negative impact is recorded, to reduce environmental damage.

(2) Methodology of the Monitoring

Since GWMC does not have a facility for the measurement and analysis of environmental quality, the actual monitoring shall be outsourced to an environmental monitoring laboratory (a private company). GWMC shall manage the contract for the monitoring work, the feedback of monitoring results and documentation. Quarterly monitoring is to be carried out in January, April, July, and October, and annual monitoring in April, which is between the dry season and the rainy season.

(a) Location of Monitoring

Location of monitoring is shown in **Figure G.5.2**. Leachate in leachate pond shall be monitored. Two kinds of groundwater shall be monitored: groundwater from shallow aquifer of about 20m in depth and groundwater from aquifer of about 60m in depth. Considering the

water flow of a canal at the north side of the Bhakhraywali site, groundwater may flow from north to south. Therefore, one pair of sampler shall be set at the north side of the disposal site, one pair around the office and storage, and another pair at the south side of the site. In the north side, the sampling location shall be set 50m away from the office and storage because human drainage water from the office will be mixed in shallow aquifer. Monitoring for vegetation and plantation shall be carried out in the Bhakhraywali site and its vicinity, and monitoring for safety and traffic shall target the access roads to the Bhakhraywali site.

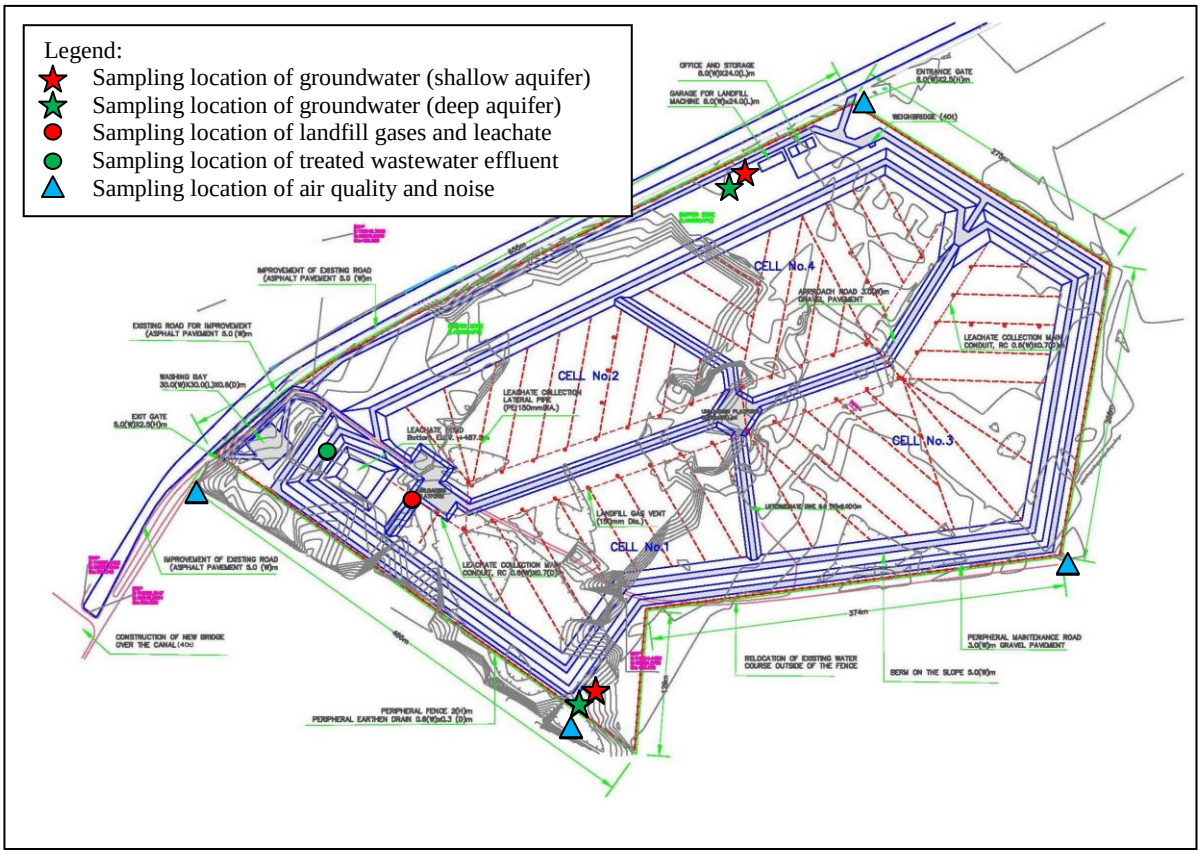


Figure G.5.2 Sampling Locations in Bhakhraywali (Base Map: Figure C.5.2)

(b) Monitoring Items

Table G.5.2 shows the monitoring items in the project.

(c) Monitoring Data Collection System

Data shall be collected by a private environmental laboratory, and the report is to be submitted to the Senior Manager for Operations in GWMC. Frequency of monitoring of the data collection system is 4 times in a year (quarterly) except the "Situation of Vegetation and Plantation" and the "Situation of Safety and Traffic". These two items shall be carried out only once a year since they may not change drastically and, therefore, annual measurements will be enough. All monitoring in the year 2016 will be half since the construction work will start in Bhakhraywali from the second half of 2016.

(d) Monitoring Feedback System

After the result of monitoring is sent to GWMC, the Assistant Manager for Operations shall check the results. If any serious environmental problem is found in the results, the Assistant Manager for Operations shall inform the Senior Manager for Operations and provide a

solution in consultation with the Senior Manager for Operations and the other related managers. In case no major problem is reported, the results shall be reviewed by the Managing Director and filed in the Operation Section.

(e) Cost of Monitoring

The total cost of the project is Rs. 2,455,000. Cost estimate for the project is shown in **Table G.5.3** while the unit price of each monitoring item is referred to the Environmental Monitoring Plan in the EIA report (Source: Urban Unit: *"Environmental Impact Assessment (EIA) of Proposed Landfill Site at Gujranwala"*, 2015, Table 8-2: Environmental Monitoring Plan, pp. 223-225). The monitoring items in the construction stage are different from those of the operation stage. The monitoring items in the construction stage are "Ambient Air Quality", "Groundwater Quality", "Noise Level", "Situation of Vegetation and Plantation", and "Situation of Safety and Traffic". On the other hand, "Smelly Gas Quality", "Treated Wastewater Effluent Quality", and "Leachate Quality" will be additionally measured in the operation stage.

Frequency of monitoring is 4 times in a year (quarterly) in most of the items. However, the monitoring for "Vegetation and Plantation" and "Safety and Traffic" shall be carried out once a year since the situations may not change drastically and annual monitoring will be enough. All monitoring in the year 2016 will be half since construction will start in Bhakhraywali at the second half of 2016. The unit price of each monitoring item is referred to the Environmental Monitoring Plan in the EIA report.

Table G.5.2 Monitoring Items in the Project for Environmental Monitoring of the Final Disposal Site in Bhakhraywali

Type of Monitoring	Frequency of Monitoring	Location of Monitoring	Parameters (Monitoring Items)
Ambient Air Quality	Quarterly*	Four corners of the site	SPM, PM_{10}, SO_2, NO_2, CO, CO_2, Vapour
Groundwater Quality	Quarterly*	North side of the disposal site around the office and storage; and South side of the site	pH, Temperature, TDS, Conductivity, Fluoride, Nitrate, DO, Hardness, Turbidity, Colour, Chloride, Arsenic, etc.
Noise Level	Quarterly*	Four corners of the site	dB(A)
Smelly Gases (Landfill Gasses)	Quarterly*	At the pit in the pump station	SO_2, H_2S, CH_4
Treated Wastewater Effluent (Leachate Pond Effluent)	Quarterly*	At the exit of leachate pond	BOD, COD, TOC, TSS, DO, Chloride, Sulphate, Turbidity, Conductivity, Oil and Grease, Colour, TKN, Heavy metals
Leachate (Leachate Pond Influent)	Quarterly*	At the pit in the pump station	BOD, COD, TOC, TSS, DO, Chloride, Sulphate, Turbidity, Conductivity, Oil and Grease, Colour, TKN, Heavy metals
Vegetation and Plantation	Once a year**	Vicinity of the site	Visual inspection of plant species survival rate and status of maintenance
Safety and Traffic	Once a year**	Vicinity of the site	1) Inspection of Signage 2) Faulty, overloaded and speeding of vehicles

Note: *Quarterly: January, April, July and October
**Once a year: April

Table G.5.3 Estimated Cost of the Project for Environmental Monitoring of the Final Disposal Site in Bhakhraywali

Check Item	Year	2016		2017		2018		Total
	Stage	Construction		Construction		Operation		
	Unit Price*	Frequency	Price	Frequency	Price	Frequency	Price	
Ambient Air Quality	40	2	80	4	160	4	160	400
Groundwater Quality	30	2	60	4	120	4	120	300
Noise Level	10	2	20	4	40	4	40	100
Smelly gases	10	N/A	0	N/A	0	4	40	40
Treated Wastewater effluent	30	N/A	0	N/A	0	4	120	120
Leachate	30	N/A	0	N/A	0	4	120	120
Vegetation Plantation	500	0.5	250	1	500	1	500	1,250
Safety and Traffic	50	0.5	25	1	50	1	50	125
Total	-		435		870		1,150	2,455

Price Unit: Rs. 1,000
Note: *EIA Report, Table 8-2: Environmental Monitoring Plan (pp.223-5). The preparation of environmental compliance and project performance report are included in the price.

5.4 Project for Environmental Monitoring of Safe Post-Closure of Final Disposal Sites in Gondlanwala and Chianwali

For the safe post-closure monitoring, Groundwater Quality, Smelly Gasses, and Leachate are selected since the impact to environment will be low compared to the operational stage of disposal site. Therefore, three monitoring processes are set for the safe post-closure monitoring of Gondlanwala and Chianwali.

- Monitoring of Groundwater Quality
- Monitoring of Landfill Gases (Smelly Gases)
- Monitoring of Leachate

(1) Objectives of Monitoring

There are three objectives of the monitoring:

- To record the environmental situation for the safe post-closure of disposal sites;
- To monitor safety of the closure process; and
- To take countermeasures in case any negative impact is recorded, to reduce environmental damage.

(2) Methodology of Monitoring

As in the preceding project, the monitoring shall be outsourced to an environmental monitoring laboratory (private company) due to the lack of measurement equipment in GWMC. GWMC shall supervise the monitoring, feedback and documentation. Monitoring shall be carried out in April since this month is between the dry season and the rainy season.

(a) Location of Monitoring

Two kinds of groundwater shall be monitored: groundwater from shallow aquifer of about 20m in depth and groundwater from aquifer of about 60m in depth. Regarding landfill gas and leachate, construction of a pumping station with manhole is to be planned for the clearing purpose, and landfill gasses and leachate are collected from the manhole. Therefore, the sampling point of landfill gasses and leachate is the same as the location of pump station. All the sampling locations in Gondlanwala and Chianwali are shown in **Figure G.5.3** and in **Figure G.5.4**, respectively.

(b) Monitoring Items

For the safe post-closure monitoring, "Groundwater Quality", "Smelly Gas Quality" and "Leachate Quality" are selected since the impact to environment will be low compared to the operation stage of disposal site. **Table G.5.4** shows the monitoring items of the project.

(c) Monitoring of Data Collection System

Data is to be collected by a private environmental laboratory, and the report is submitted to the Senior Manager for Operations in GWMC.

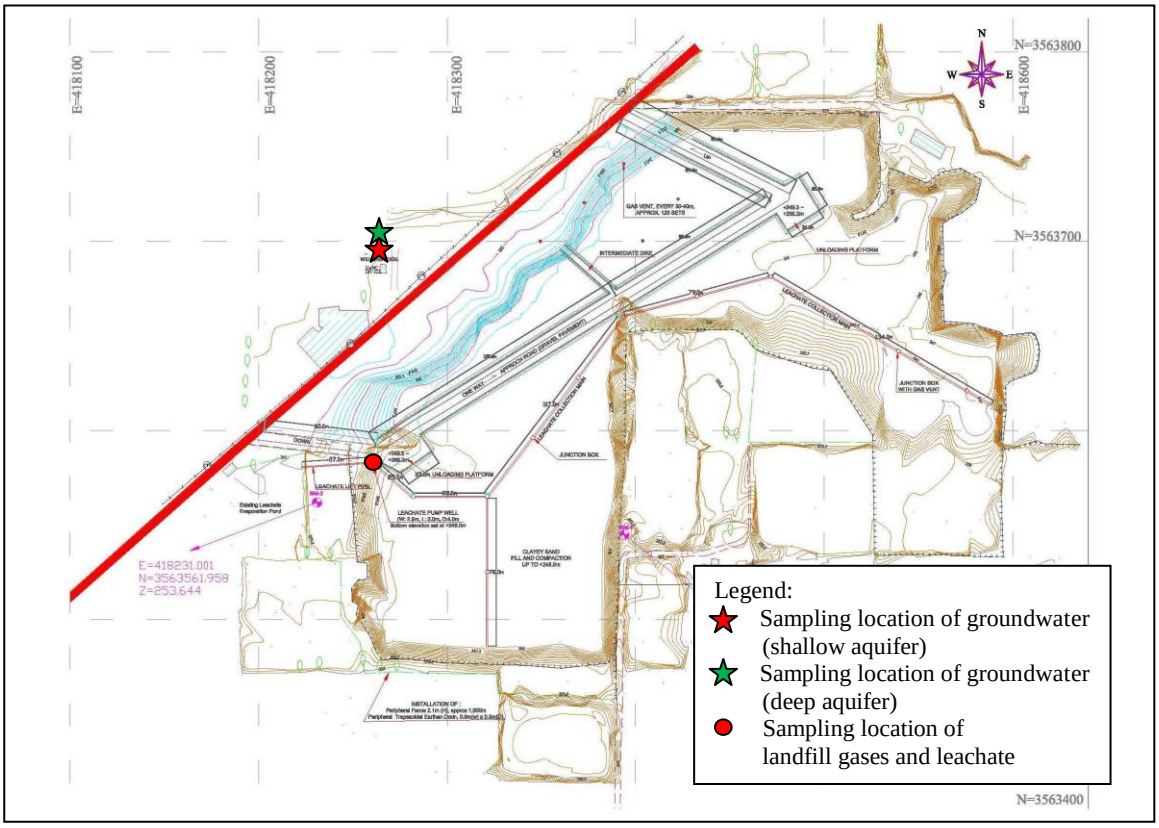


Figure G.5.3 Sampling Locations in Gondlanwala (Base Map: Figure C.5.7)

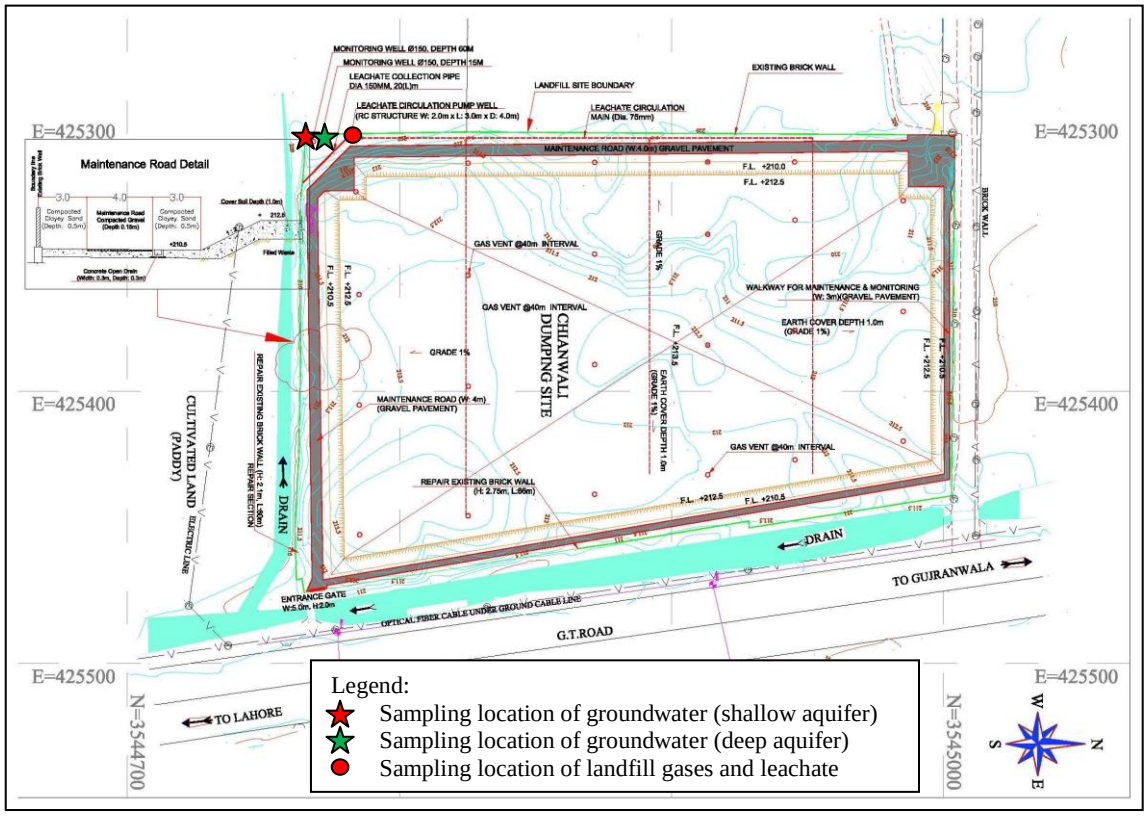


Figure G.5.4 Groundwater Monitoring Points in Chianwali (Base Map: Figure C.5.10)

Table G.5.4 Monitoring Items in the Project for Environmental Monitoring of Safe Post-Closure of Final Disposal Sites in Gondlanwala and Chianwali

Type of Monitoring	Frequency of Monitoring	Location of Monitoring		Parameters (Monitoring Items)
		Gondlanwala	Chianwali	
Groundwater Quality	Once a year (April)	Around the office/ weighbridge	At the northwest corner of the site	pH, Temperature, TDS, Conductivity, Fluoride, Nitrate, DO, Hardness, Turbidity, Colour, Chloride, Arsenic, etc.
Smelly Gases (Landfill Gasses)	Once a year (April)	At the leachate pump station	At the leachate pump station	SO_2, H_2S, CH_4
Leachate	Once a year (April)	At the leachate pump station	At the leachate pump station	BOD, COD, TOC, TSS, DO, Chloride, Sulphate, Turbidity, Conductivity, Oil and Grease, Colour, TKN, Heavy metals

(d) Monitoring Feedback System

The monitoring is to start in April 2016. The Assistant Manager for Operations in GWMC shall check the results. In case any important environmental problem is found, the Assistant Manager Operations shall inform the Senior Manager for Operations, and solutions shall be provided. In case no major problem is reported, the result shall be reviewed by the Managing Director and filed in the Operation Section.

(e) Cost of Monitoring

The total cost of the project is Rs. 210,000. The breakdown of cost estimate for the project is shown in **Table G.5.5**. The unit price of each monitoring item is referred to the Environmental Monitoring Plan in the EIA report.

Table G.5.5 Cost Estimate of the Project for Environmental Monitoring of Safe Post-Closure of the Final Disposal Sites in Gondlanwala and Chianwali

Check Item	Year	2016		2017		2018		Total
	Stage	Construction		Construction		Operation		
	Unit Price*	Frequency	Price	Frequency	Price	Frequency	Price	
Groundwater Quality	30	0	0	0	0	1	30	30
Smelly gases	10	0	0	0	0	1	10	10
Leachate	30	0	0	0	0	1	30	30
Total for 1 location								70
Total for 2 locations								140

Price Unit: Rs. 1,000

Note: * EIA Report, Table 8-2: Environmental Monitoring Plan (pp.223-5). The preparation of environmental compliance and project performance report are included in the price.

5.5 Plan of Operations and Cost of Action Plan

Figure G.5.5 shows the Plan of Operation of the Environmental Monitoring Plan (Short-Term) and **Table G.5.6** shows the Estimated Cost of the Environmental Monitoring Plan (Short-Term).

Time Framework of the Master Plan		Short-Term Plan Period											
Year		2016				2017				2018			
Quarter		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WBS for Short-Term Plan													
S-6-1	Environmental Monitoring for Collection and Transport Work												
S-6-1-1	Monitoring of Cleanness of Garbage Container												
S-6-1-2	Monitoring of Waste Separation at Household Level												
S-6-2	Environmental Monitoring for Final Disposal Site in Bhakhraywall												
S-6-2-1	Monitoring of Ambient Air Quality												
S-6-2-2	Monitoring of Groundwater Quality												
S-6-2-3	Monitoring of Noise and Vibrations												
S-6-2-4	Monitoring of Smelly gases												
S-6-2-5	Monitoring of Treated Waste Water Effluent												
S-6-2-6	Monitoring of Leachate												
S-6-2-7	Monitoring of Vegetation Plantation												
S-2-6-8	Monitoring of Safety and Traffic												
S-6-3	Environmental Monitoring for Safe Post-Closure Final Disposal Sites in Gondlanwala and Chianwali												
S-6-3-1	Monitoring of Leachate and Surface Water												
S-6-3-2	Monitoring of Groundwater Quality												
S-6-3-3	Monitoring of Landfill Gases												

Figure G.5.5 Plan of Operations of the Environmental Monitoring Plan (Short-Term)

Table G.5.6 Cost of Operations for the Environmental Monitoring Action Plan

WBS No.	WBS	Total Budget (Thousand Rs.)	Annual Cost		
			2016	2017	2018
Programme 6: Environmental Monitoring Plan					
Short-Term Plan					
S-6-1	Environmental Monitoring for Collection and Transport Work	0	0	0	0
S-6-1-1	Monitoring of Cleanness of Garbage Container	0	0	0	0
S-6-1-2	Monitoring of Waste Separation at Household Level	0	0	0	0
S-6-2	Environmental Monitoring for Final Disposal Site in Bhakhraywall	2,455	435	870	1,150
S-6-2-1	Monitoring of Ambient Air Quality	400	80	160	160
S-6-2-2	Monitoring of Groundwater Quality	300	60	120	120
S-6-2-3	Monitoring of Noise and Vibrations	100	20	40	40
S-6-2-4	Monitoring of Smelly gases	40	0	0	40
S-6-2-5	Monitoring of Treated Waste Water Effluent	120	0	0	120
S-6-2-6	Monitoring of Leachate	120	0	0	120
S-2-6-7	Monitoring of Vegetation Plantation	1,250	250	500	500
S-2-6-8	Monitoring of Safety and Traffic	125	25	50	50
S-6-3	Environmental Monitoring for Post-Closure Final Disposal Sites in Gondianwala and Chianwali	140	0	0	140
S-6-3-1	Monitoring of Leachate and Surface Water	60	0	0	60
S-6-3-2	Monitoring of Groundwater Quality	20	0	0	20
S-6-3-3	Monitoring of Landfill Gases	60	0	0	60
	Total (Short-Term)	2,595	435	870	1,290

6. CONCLUSION

6.1 Environmental Monitoring for the Final Disposal Site in Bhakhraywali

The EIA for the Bhakhraywali site is one of the important events in this section. The EIA was completed during the Master Plan preparation. Regarding the public hearing and opinion survey for the residents, all of the stakeholders have a relatively positive impression on the new disposal site and they believe the new disposal site is necessary for Gujranwala. On the other hand, some of them are anxious about future environmental pollution and negative impacts to society. To minimise the negative impact to environment, some monitoring in Bhakhraywali has been planned in **Chapter 4**, and the monitoring will be carried out both in the construction stage and the operational stage for the measurement of future impact to the Bhakhraywali site.

6.2 Environmental Monitoring for the Post-Closure of Final Disposal Sites in Gondlanwala and Chianwali

The environmental situation in former disposal sites, such as Chianwali and Gondlanwala, shall be taken into account in the future plan. Since no environmental monitoring has been carried out in the two disposal sites before the Master Plan preparation, negative impacts to environment in the long-term perspective is somewhat difficult to estimate. Post-closure monitoring is thus planned as in **Chapter 4**, and it may continue for 25 years as recommended in the Punjab Waste Management Guidelines of 2011.

6.3 Other Future Aspects

In terms of safety of the working environment, waste pickers in Gondlanwala site are working around in a dangerous and hazardous situation posing risks to their health. Though the waste pickers are not official employees, GWMC has to take the responsibility for anyone who actually work in the Gondlanwala site. Therefore, there is a plan to hire waste pickers as employees in the Compost Facility. The official inclusion of waste pickers not only in the Compost Facility but also in the other GWMC activities is highly recommended.

As a long-term perspective, the regulatory framework for environmental and social protection in waste management must be improved. The Strategic Environmental Assessment (SEA) has been applied for planning the Master Plan, but it is not a requirement of Pakistan under the present situation. In comparison with the JICA Guidelines, social issues such as worker's rights and safety in the work environment tend not to be mentioned in Pakistani laws on waste management. It is recommended that social aspects as well as environmental issues are added to the regulatory framework for the future waste management in Pakistan.

7. RECOMMENDATIONS

Budget, schedule, and feedback are important for implementation of the monitoring work proposed in the Master Plan. They are essential issues in terms of carrying out monitoring in every year in the same timing for the entire duration of the Master Plan. Therefore, it is recommended that the three issues should be taken into consideration.

7.1 Securing the Budget for Implementation of the Monitoring

Since there is no environmental laboratory in GWMC, most of the environmental monitoring will be carried out by a private laboratory. Therefore, the budget for outsourcing these works is essential.

7.2 Being Strict to the Schedule

Timing of the monitoring is important. Environmental monitoring should be carried out at the same time of the year. The system provides a series of environmental data in every year, and it makes comparable data of environmental impact. Some monitoring is related to the other activities such as public awareness, so that delay of monitoring will affect these related activities.

7.3 Establishment of Effective and Efficient System of Feedback

Monitoring is meaningful only if the results are utilised for environmental conservation and in avoiding future problems. All monitoring results should be reviewed by GWMC, and decisions must be made on whether or not further action is necessary.

REFERENCES

1. Urban Unit, "Environmental Impact Assessment (EIA) of Proposed Landfill Site at Gujranwala", 2015
2. World Bank, “What a Waste: Solid Waste Management in Asia”. http://web.mit.edu/urbanupgrading/urbanenvironment/resources/references/pdfs/WhatAWasteAsia.pdf [Last visit: August 20, 2015]、1999.