JAPAN INTERNATIONAL COOPERATION AGENCY

CITY DISTRICT GOVERNMENT GUJRANWALA
LOCAL GOVERNMENT AND COMMUNITY DEVELOPMENT DEPARTMENT
GOVERNMENT OF THE PUNJAB
ISLAMIC REPUBLIC OF PAKISTAN

# PROJECT FOR INTEGRATED SOLID WASTE MANAGEMENT MASTER PLAN IN GUJRANWALA

## FINAL REPORT
## VOLUME 1 EXECUTIVE SUMMARY

## NOVEMBER 2015


CTI ENGINEERINGINTERNATIONAL CO., LTD.

NJS CONSULTANTS CO., LTD.

EX RESEARCH INSTITUTE LTD.


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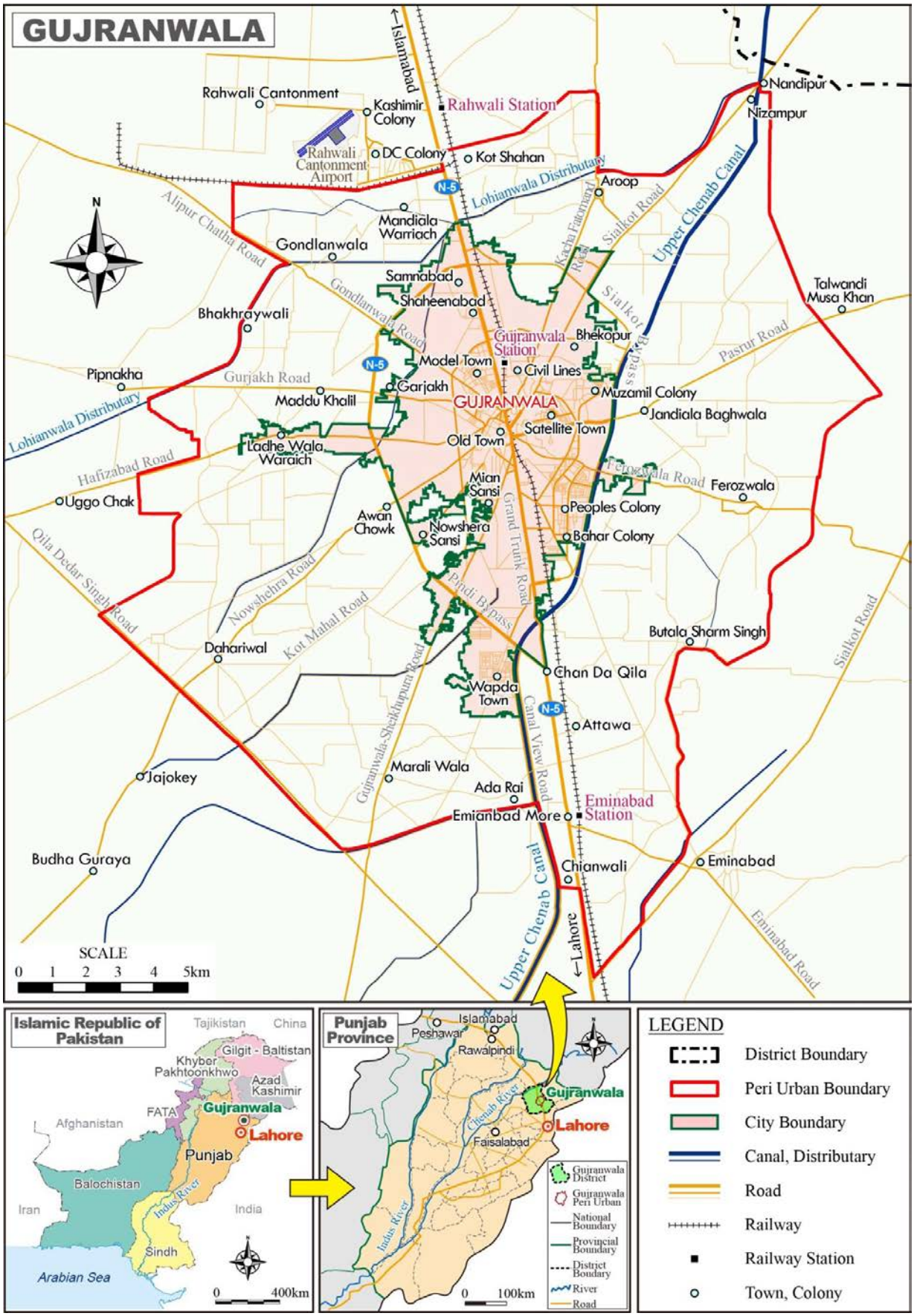
All Pakistan Rupee amounts including project costs shown in this report are stated in 2015 prices unless otherwise indicated. The amounts are estimated on the basis of foreign prices by applying the interbank currency exchange rates as of 1st of September 2015, namely; USD1 = Rs. 102.92 = JPY 121.22.




**LOCATION MAP**

## COMPOSITION OF FINAL REPORT

# OUTLINE OF THE PROJECT

## 1. GENERAL

### 1.1 Objective of the Project

The objectives of the Project are as follows:

(1) To develop a Master Plan of Integrated Solid Waste Management (ISWM) for Gujranwala City including the peri-urban area of Gujranwala;

(2) To enhance the institutional capacity for implementation of the ISWM Master Plan; and

(3) To draw lessons and best practices for replication of the master plan in other major cities in Punjab.

### 1.2 Project Site

The Project covers the whole area of Gujranwala City including the peri-urban area of Gujranwala.

### 1.3 Types of Solid Waste

The types of solid waste to be surveyed are limited to household waste, market waste, commercial waste, street sweeping waste and office waste. The survey on hospital waste and industrial waste is limited to only the policy suggestions and recommendations in the Master Plan.

## 2. IDENTIFICATION OF KEY ISSUES AND PROBLEMS

The major problems enumerated below are considered to be the key issues on master plan formulation, and low level of waste collection service coverage and lack of public awareness are identified as the two core problems that shall be sorted out.

- Low level of waste collection service coverage
- A large number of illegal dumpsites
- Inappropriate landfill operation at the existing final disposal site
- No proper closed landfill site
- Absence of formal intermediate treatment and 3R facilities
- Lack of awareness of residents on intermediate treatment and 3R, and other SWM problems
- Health risk of sanitary workers and waste pickers
- Lack of management staff and technical expertise of GWMC
- Lack of financial independence and pricing mechanism in SWM services
- Few involvement of the private sector

## 3. FRAMEWORK OF THE MASTER PLAN

### 3.1 Vision of Integrated Solid Waste Management in Gujranwala

The vision of integrated solid waste management in Gujranwala is decided, as follows:

***"Transformation of Gujranwala to the Cleanest City of Punjab"***

### 3.2 Mission of Integrated Solid Waste Management in Gujranwala

The mission of integrated solid waste management in Gujranwala is proposed, as follows:

(1) To improve and protect the public health of Gujranwala residents and visitors;

(2) To deliver efficient and effective waste collection and disposal services to the residents of Gujranwala;

(3) To maximise resource recovery and recycling through the participatory approach; and

(4) To ensure greener and safer environment at final disposal sites.

## 3.3 Goals of Integrated Solid Waste Management in Gujranwala

The goals of integrated solid waste management in Gujranwala are proposed, as follows:

(1) To significantly extend and formalise resource recovery activities, including but going beyond the creation of enabling environments and the development of markets and industries for recyclables;

(2) To develop awareness and capacity for waste handling and source separation as essential components of sustainable waste management;

(3) To restructure and extend efficient and equitable collection of source-separated waste streams with the view of protection of public health and the environment;

(4) To build environmentally sound infrastructure and systems for safe disposal of residual waste, replacing the current disposal site and transfer station which must be rehabilitated; and

(5) To reduce the burden on the disposal site and increase its life span by using intermediate treatment and 3R approach.

## 3.4 Planning Directions of the Master Plan

The ISWM Master Plan for Gujranwala is formulated in three implementation stages, namely; the first implementation stage (Short-Term Plan covering the period from 2016 to 2018); the second implementation stage (Mid-Term Plan covering the period from 2019 to 2024); and the third implementation stage (Long-Term Plan covering the period from 2025 to 2030). The action plans covered in the first implementation stage are formulated through two approaches: (1) technical approach, and (2) institutional and financial approach. The major planning items of the Master Plan are summarised as the following seven programmes:

**Technical Approach of Master Plan**

Programme 1: Waste Collection and Transportation Plan

Programme 2: Final Disposal Plan

Programme 3: Intermediate Treatment and 3R Promotion Plan

**Institutional and Financial Approach of Master 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

# 4. BASELINE PROJECTION OF POPULATION AND SOLID WASTE GENERATION

The population projection shows the growth rate of approximately 3.79% per annum from 2014 to 2030, and the future solid waste generation by the year 2030 is estimated based on the field survey results, as shown below.

**Baseline Projection of Population and Solid Waste Generation in Gujranwala**

| Year | 2014 | 2018 | 2024 | 2030 |
|---|---|---|---|---|
| Population ('000) | 2,964 | 3,439 | 4,299 | 5,374 |
| Waste Generation (ton/day) | 1,200 | 1,600 | 2,304 | 3,346 |

# 5. FORMULATION OF THE MASTER PLAN

## 5.1 Main Goals and Major Project Components

The main goals and major project components of the Master Plan are as tabulated below.

**Main Goals and Major Action Plans of the Master Plan**

| Programme | Main Goals | Major Project Components |
|---|---|---|
| **Technical Approach** | | |
| Programme 1: Waste Collection and Transportation Plan | • 100% of collection coverage rate in 64 UCs in 2018<br>• No illegal dumping sites in 64 UCs<br>• 100% of collection coverage rate in 98 UCs in 2030 | • Introduction of Separate Collection and Alternate day Collection through Implementation of Pilot Project<br>• Procurement of Waste Collection Vehicles and Containers<br>• Conducting Street Cleaning<br>• Collection of Construction and Demolition Waste and Bulky Waste<br>• Cleaning Up of Illegal Dumping Sites<br>• Construction of Parking Area<br>• Outsourcing of Waste Collection and Transportation Services |
| Programme 2: Final Disposal Plan | • Construction of sanitary landfill facilities in Bhakhraywali<br>• Safety closure of the landfill site in Gondlanwala<br>• Safety closure of the landfill site in Chianwali | • Construction of Sanitary Landfill Facilities in Bhakhraywali<br>• Procurement and Replacement of Landfill Machinery<br>• Safety Closure and Post-Closure Monitoring of the Landfill Site in Gondlanwala<br>• Safety Closure and Post-Closure Monitoring of the Landfill Site in Chianwali<br>• Site Selection of Sanitary Landfill Site |
| Programme 3: Intermediate Treatment and 3R Promotion Plan | • Start of operation of the Gujranwala Central Compost Plant (GCCP) in 2020<br>• Enlargement of the GCCP and additionally RDF production in 2029 and start of the plant operation from 2030<br>• Enactment of Recycling Laws in Punjab, Pakistan | • Awareness and IEC Campaign on Resource Recovery<br>• Implementation of Simplified WACS<br>• Establishment of the proposed Gujranwala Central Compost Company (GCCC)<br>• Construction, Operation and Maintenance of the GCCP<br>• Construction, Operation and Maintenance of the RDF Plant in addition to the GCCP |
| **Institutional and Financial Approach** | | |
| Programme 4: Environmental Education and Public Awareness Raising Plan | • Establishment of proper coordination among relevant bodies<br>• Establishment of proper educational prgrammes<br>• Establishment of proper awareness creation system | • Capacity Development of Communication Unit to Strengthen the Coordination among Relevant Bodies<br>• Development and Implementation of Educational Programmes Targeting Primary School Teachers and Students<br>• Development and Implementation of Educational Programmes Targeting General Public<br>• Development and Management of Educational Facilities and its Utilisation Plan |
| Programme 5: Economic and Financial Plan | • Achievement of the self-cost recovery for the operation and maintenance cost of SWM services<br>• Establishment of the financial long-term performance monitoring system through a wide range of financial key performance indicators<br>• Full-scale introduction of the selected new user charge system in all service areas from 2025 | • Establishment of Sustainable Cost Recovery<br>• Implementation of Accurate Total Costing<br>• Introduction of Proper Tariff Charging System<br>• Implementation of Financially Efficient Private Sector Involvement |
| Programme 6: Environmental Monitoring Plan | • Establishment of environmental monitoring system for waste collection and transportation work<br>• Establishment of environmental | • Implementation of environmental monitoring for waste collection and transportation work<br>• Implementation of environmental monitoring for Bhakhraywali, Gondlanwala and Chianwali<br>• Implementation of environmental monitoring for |

| Programme | Main Goals | Major Project Components |
|---|---|---|
| | monitoring system for Bhakhraywali, Gondlanwala and Chianwali<br>• Establishment of environmental monitoring system for the composting facility | the composting facility |
| Programme 7: Institutional Strengthening and Organizational Plan | • Establishment of proper organization to provide satisfactory SWM services<br>• Strengthening of the technical and managerial capacities of GWMC staff<br>• Enactment of Gujranwala Solid Waste Management By-Law | • Improvement of Organizational Restructuring of GWMC<br>• Capacity Development of GWMC staff<br>• Establishment of Gujranwala Solid Waste Management By-Law |

## 5.2 Financial and Economic Evaluation

The total project cost based on financial and economic prices is as summarised below.

**Project Cost of the Master Plan (in Million Rs.)**

| No. | Name of Programme | Cost | |
|---|---|---|---|
| | | Financial | Economic |
| 1 | Waste Collection and Transport Plan | 14, 021 | 10,706 |
| 2 | Final Disposal Plan | 4,883 | 3,843 |
| 3 | Intermediate Treatment and 3R Promotion Plan | 1,025 | 840 |
| 4 | Environmental Education and Public Awareness Raising Plan | 122 | 104 |
| 5 | Environmental Monitoring Plan | 22 | 17 |
| 6 | Institutional Strengthening and Organizational Plan | 424 | 403 |
| **Total Cost** | | **20,497** | **15,913** |

The Financial Internal Rate of Return (FIRR) is figured out to be 7.4%, and the Economic Internal Rate of Return (EIRR) is 9.6%. Taking into account these results of the evaluation, the selected option of the master plan might be economically feasible and financially viable thereby the master plan is worth implementing. However, the cost recovery rate is 32.4 percent out of the total operation and maintenance cost in 2025 even after the full-scale introduction of the tariff system in all areas which is in line with the current willingness to pay, and the remaining 67.6 percent of the total operation and maintenance cost should be replenished by other stable financial sources and/or subsidies from the provincial government.

## 5.3 Operation and Effect Indicators for Project Evaluation

Monitorable operation and effect indicators of the Project or activities formulated in the ISWM Master Plan were determined, and the Master Plan should be monitored and updated regularly based on these indicators.

# 6. PROPOSAL FOR THE ACTION PLAN

The action plan is proposed as priority projects that shall be implemented in the short-term period of the ISWM Master Plan, i.e., three years between 2016 and 2018. The project components of each programme and required cost are summarised below.

**Project Components and Cost of the Action Plan**

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| **Programme 1: Waste Collection and Transportation Plan** | | | | |
| Introduction of Separate Collection and Alternate-Day Collection through Implementation of a Pilot Project | 52,343 | 40,523 | 50,659 | 143,525 |
| Increase of Waste Collection Rate in 64 UCs up to 100% in 2018 | 288,028 | 394,639 | 966,732 | 1,649,399 |

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| Conducting Street Cleaning in 64 UCs | 67,328 | 6,528 | 6,528 | 80,384 |
| Collection of Bulky Waste | 23,730 | 4,130 | 4,130 | 31,990 |
| Cleaning Up of Illegal Dumping Sites in 64 UCs | 22,382 | 1,391 | 0 | 23,773 |
| Construction and Demolition Waste Collection | 7,690 | 7,690 | 7,690 | 23,070 |
| Construction of Parking Area | 126,424 | 3,546 | 393,510 | 523,480 |
| Sub-Total of Programme 1 | 587,925 | 458,447 | 1,429,249 | **2,475,621** |
| **Programme 2: Final Disposal Plan** | | | | |
| Procurement of Sanitary Landfill Site | 1,500,000 | 0 | 0 | 1,500,000 |
| Engineering Service for Sanitary Landfill Facilities (Stage 1) | 49,840 | 49,840 | 0 | 99,680 |
| Construction of Sanitary Landfill Facilities (Stage 1) in Bhakhraywali | 492,751 | 504,051 | 0 | 996,802 |
| Procurement of Landfill Machinery | 31,500 | 38,850 | 0 | 70,350 |
| Operation and Maintenance of Landfill Facilities | 18,669 | 21,859 | 31,623 | 72,151 |
| Improvement Work of the Existing Landfill in Gondlanwala | 55,902 | 0 | 0 | 55,902 |
| Safe Closure of the Landfill Site in Gondlanwala | 0 | 0 | 26,196 | 26,196 |
| Safe Closure of the Landfill Site in Chianwali | 0 | 0 | 34,544 | 34,544 |
| Monitoring of Final Disposal in Bhakhraywali | - | - | - | GWMC |
| Post-Closure Monitoring of Gondlanwala and Chianwali Disposal Sites | - | - | - | GWMC |
| Sub-Total of Programme 2 | 2,148,662 | 614,600 | 92,363 | **2,855,625** |
| **Programme 3: Intermediate Treatment and 3R Promotion Plan** | | | | |
| Awareness & IEC Campaign on Resource Recovery | - | - | - | GWMC |
| Implementation of Simplified WACS | - | - | - | GWMC |
| Preparation for PPP & Formulation of a Committee of the BOD of GWMC | - | - | - | BOD/GWMC |
| Implementation of Land Preparation by GWMC | - | - | - | BOD/GWMC |
| Engineering Service for Detailed Design of the Compost Plan by SPV | 0 | 0 | 40,000 | 40,000 |
| Sub-Total of Programme 3 | 0 | 0 | 40,000 | **40,000** |
| **Programme 4: Environmental Education and Public Awareness Raising Plan** | | | | |
| Capacity Development of Communication Unit to Strengthen the Coordination among Relevant Bodies | 3,002 | 1,829 | 1,906 | 6,736 |
| Development and Implementation of Educational Programmes Targeting Primary School Teachers and Students | 965 | 349 | 416 | 1,730 |
| Development and Implementation of Educational Programmes Targeting General Public | 287 | 301 | 315 | 903 |
| Sub-Total of Programme 4 | 4,254 | 2,479 | 2,637 | **9,370** |
| **Programme 5: Economic and Financial Plan** | | | | |
| Establishment of Sustainable Cost Recovery (Preparatory Phase) | - | - | - | GWMC |
| Implementation of Accurate Total Costing (Preparatory Phase) | - | - | - | GWMC |
| Introduction of Proper Tariff Charging System (Preparatory Phase)* | (62) | (62) | (62) | (186) |
| Implementation of Financially Efficient Private Sector Involvement (Preparatory Phase)* | - | - | (196 | (196) |
| Sub-Total of Programme 5* | (62) | (62) | (258) | **(382)** |
| **Programme 6: Environmental Monitoring Plan** | | | | |
| Monitoring of Collection and Transportation Work | - | - | - | GWMC |
| Monitoring of Final Disposal Site in Bhakhraywali | 435 | 870 | 1,150 | 2,455 |
| Environmental Monitoring of Post-Closure Final Disposal Sites in Gondlanwala and Chianwali | 0 | 0 | 140 | 140 |
| Sub-Total of Programme 6 | 435 | 870 | 1,290 | **2,595** |
| **Programme 7: Institutional Strengthening and Organizational Plan** | | | | |
| Improvement of Organizational Restructuring of GWMC | 8,180 | 13,234 | 17,443 | 38,858 |
| Capacity Development of GWMC Staff | 6,109 | 1,284 | 1,302 | 8,695 |
| Establishment of Gujranwala Solid Waste Management By-Law | - | - | - | GWMC |
| Sub-Total of Programme 7 | 14,289 | 14,518 | 18,745 | **47,552** |
| **Grand Total of the Action Plan** | **2,755,565** | **1,090,914** | **1,584,284** | **5,430,763** |

Note:* The cost required for these projects are covered by the GWMC staff training programmes proposed under Programme 7, the Institutional Strengthening and Organizational Plan.

## 7. CONCLUSION

The Vision of solid waste management for Gujranwala City, i.e., *"Transformation of Gujranwala to the Cleanest City of Punjab"*, is the ultimate goal for all the residents of Gujranwala. To realise it, the target collection rate of 100% for the area of 64 urban UCs in year 2018 and for the area of 34 peri-urban UCs in addition to the 64 UCs in 2030 should firstly be achieved with dedication and dispatch. For pursuing this goal, the proposed projects in the Master Plan should be carried out as well since implementation of these projects will bring large benefits to the Gujranwala residents.

## 8. RECOMMENDATIONS

The JICA Project Team recommends that the Government of the Punjab (GOPb), the City District Government Gujranwala (CDGG) and the Gujranwala Waste Management Company (GWMC) should carry out the action plans in the ISWM Master Plan from year 2016. Major recommendations are described as follows:

- The required number of waste collection vehicles and containers shall be procured appropriately to achieve 100% waste collection firstly for the area of the 64 UCs. Also, the project for the introduction of separate collection through the implementation of a pilot project shall be carried out simultaneously.
- The land acquisition at Bhakhraywali should be completed immediately and the design and engineering works should be started accordingly. Safe post-closure work for the former landfill site in Chianwali and improvement work for the existing landfill site in Gondlanwala should also be conducted by using the Government and GWMC's own budget.
- GOPb, CDGG and GWMC should commence the environmental education programmes and public awareness raising campaigns to disseminate the waste separation at source and to proceed to the next stage of project implementation smoothly.
- A more detailed study including situation analysis should be carried out in terms of hospital, industrial, and construction and demolition waste management.

**PROJECT**
**FOR**
**INTEGRATED SOLID WASTE MANAGEMENT**
**MASTER PLAN IN GUJRANWALA**

**FINAL REPORT**

**VOLUME 1**

**EXECUTIVE SUMMARY**

## TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES

## ABBREVIATIONS AND ACRONYMS

| | | |
|---|---|---|
| 3R | : | Reduce, Reuse, Recycle |
| ATP | : | Affordability to Pay |
| BOD | : | Board of Directors |
| BOT | : | Build-Operate-Transfer |
| CBO | : | Community-Based Organization |
| C&D | : | Construction and Demolition |
| CDGG | : | City District Government Gujranwala |
| CDM | : | Clean Development Mechanism |
| CVM | : | Contingent Valuation Method |
| DCO | : | District Coordination Officer |
| EAD | : | Economic Affairs Division |
| EIA | : | Environment Impact Assessment |
| EIRR | : | Economic Internal Rate of Return |
| FIRR | : | Financial Internal Rate of Return |
| GCCC | : | Gujranwala Central Compost Company |
| GCCI | : | Gujranwala Chamber of Commerce and Industry |
| GCCP | : | Gujranwala Central Compost Plant |
| GOJ | : | Government of Japan |
| GOP | : | Government of Pakistan |
| GOPb | : | Government of the Punjab |
| GWMC | : | Gujranwala Waste Management Company |
| IEC | : | Information, Education and Communication |
| IEE | : | Initial Environmental Examination |
| ISWM | : | Integrated Solid Waste Management |
| JCC | : | Joint Coordinating Committee |
| JICA | : | Japan International Cooperation Agency |
| LWMC | : | Lahore Waste Management Company |
| MD | : | Managing Director |
| MIS | : | Management Information System |
| NGO | : | Non-Governmental Organization |
| NPV | : | Net Present Value |
| O&M | : | Operation and Maintenance |
| PEPA | : | Pakistan (or Punjab) Environmental Protection Act |
| PMU | : | Project Management Unit |
| PPP | : | Public-Private-Partnership |
| PR | : | Public Relations |
| R/D | : | Record of Discussions |
| RDF | : | Refuse Derived Fuels |
| Rs. | : | Pakistan Rupee |
| SEA | : | Strategic Environmental Assessment |
| SLF | : | Sanitary Landfill |
| SPV | : | Special Purpose Vehicle |
| SWM | : | Solid Waste Management |
| TOR | : | Terms of Reference |
| USD | : | United States Dollar |
| UU | : | The Urban Unit |
| WACS | : | Waste Amount and Composition Survey |
| WSS | : | Water Supply, Sewerage and Sanitation |
| WTP | : | Willingness to Pay |

# 1. GENERAL

## 1.1 Background of the Project

Solid Waste Management (hereinafter referred to as "SWM") has become a serious problem in Punjab due to rapid urbanisation, uncontrolled population, lack of resources, institutional weaknesses and lack of civic sense towards solid waste disposal. The average solid waste collection efficiency in Punjab is only around 50%, causing spread of multiple diseases such as diarrhea and dengue fever. Whatever quantity of waste collected is, normally seen as waste dumped in open areas along the roadside, canal bank and low-lying areas. Soil contamination is affecting the quality of groundwater from shallow depth. Un-collected waste is illegally piled on sidewalks, in open spaces, sewer lines, or even in canals, and blockage of wastewater flow in the sewers are seen, causing additional problem by the local government.

In the Punjab Vision 2020, waste management is located under the priority area of water supply, sewerage and sanitation (hereinafter referred to as "WSS"), and through the Urban Unit (hereinafter referred to as "UU") of the Government of the Punjab (hereinafter referred to as "GOPb"), solid waste management strategy was developed as the *Guidelines of Solid Waste Management* issued in 2007. GOPb has been tackling the issues which contribute to an improvement of SWM based on the guidelines. However, the budget for SWM in Punjab is restrictive, and about 80% of the budget is spent on personnel expenses or institutional administrative expenses. Moreover, although SWM is to be performed under the responsibility of each district government under the law, the manner on how to conduct SWM effectively and efficiency under their limited human resources and budget has been an important issue to be solved, since the laws or guidelines on SWM are not fully implemented.

In 2009, the Japan International Cooperation Agency (hereinafter referred to as "JICA") commissioned a sector study to take stock of the current status, problems, and necessity of assistance in the SWM sector in seven major cities of Punjab Province: Faisalabad, Gujranwala, Lahore, Multan, Rawalpindi, Sargodha and Sialkot. Through the study, the degree of assistance necessary for SWM, SWM related budget, number of related department personnel, existence of master plan, existence of other donor support, existence of self-financed activities, motivation/commitment of top management, etc., were investigated. Based on the results of the study, followed by a series of discussions made by GOPb and JICA, the necessity of assistance for the SWM sector was ascertained, and in addition, Gujranwala City was identified as the highest priority among the surveyed cities considering the highly motivated top management and SWM related staff, non-existence of donor support, the problem of conducting waste collection under the limited budget, etc.

The Government of Japan (hereinafter referred to as "GOJ") received the official request for the Technical Cooperation to formulate the Master Plan to address improvement of SWM in Gujranwala from the Economic Affairs Division (hereinafter referred to as "EAD"), which was submitted by the City District Government Gujranwala (hereinafter referred to as "CDGG") through UU on 30 July 2010. GOPb has also a plan to replicate the results of the Project to other major cities in Punjab.

In response to the request from the Government of Pakistan (hereinafter referred to as "GOP"), the Japanese Detailed Planning Study Team (hereinafter referred to as "the Team") was dispatched by JICA to Pakistan for the purpose of discussing and confirming the scope of work for the ***Project for Integrated Solid Waste Management Master Plan in Gujranwala*** (hereinafter referred to as "the Project") from 28 September to 19 October 2011.

The Project was started in February 2014 upon agreement on the "Record of Discussions" (hereinafter referred to as "R/D") that was reached between GOP and JICA on the 20th of February 2013.

After the commencement of the Project, the Pakistani side requested JICA to amend the R/D in March 2014. In response to the request, JICA held a series of discussions with the authorities concerned of GOP, GOPb and CDGG. As a result, both sides agreed on the second amendment and signed the Minutes of Meetings on the 14th of May 2014.

### 1.2 Objective of the Project

The objectives of the Project are set out as follows:

- To develop a Master Plan of Integrated Solid Waste Management for Gujranwala City including the peri-urban area of Gujranwala;
- To enhance the institutional capacity for implementation of the SWM Master Plan; and
- To draw lessons and best practices for replication of the master plan in other major cities in Punjab.

### 1.3 Project Site

The Project covers the whole area of Gujranwala City including the peri-urban area of Gujranwala, as shown in the Location Map.

### 1.4 Project Schedule and Administration

The Project was carried out through the field works in Pakistan and the home office works in Japan from end of February 2013 to end of November 2015. The Project was divided into three phases, namely; Phase I, which focused on situation analysis based on implementation of a wide variety of site surveys; Phase II, which formulated the master plan; and Phase III, which proposed for the action plan that should be conducted between 2016 and 2018 as priority projects.

JICA Project Team, CDGG and GOPb had created the Project Management Unit (hereinafter referred to as "PMU") which is implementing and managing the Project. The Joint Coordinating Committee (hereinafter referred to as "JCC"), comprising the Secretary of Local Government and Community Development Department, the Secretary of Planning and Development Department, District Coordination Officer (DCO) Gujranwala and other persons related to the Project, was established to facilitate inter-organizational coordination through reviewing the Project progress and achievements and providing advice.

### 1.5 Limitations of the Project

Since an appropriate Integrated Solid Waste Management (hereinafter referred to as "ISWM") system requires a long period of time to achieve because the system is in general complicated and is composed of many integrated sub-systems related to technical, social, environmental and political issues that influence each other, adjustments are required, especially in the way of raising public awareness that shall be supported by local governments and communities which is necessary in the long run. In addition, impacts on local communities by the introduction of proposed systems, including waste collection, waste charges and composting, shall be carefully examined even after completion of the Project due to the extremely limited time of execution of the Project. The results of hospital waste and industrial waste study shall also be reviewed and updated after more detailed surveys and analyses because it is beyond the scope of the Project and the difficulty of data collection limits the completeness of the discussions in this report.

## 2. IDENTIFICATION OF KEY ISSUES AND PROBLEMS

There are many causes preventing the Gujranwala Waste Management Company (hereinafter referred to as "GWMC") from conducting better SWM services. These key issues and problems are identified as shown in **Table S.2.1** below.

**Table S.2.1 Identification of Key Issues and Problems on Solid Waste Management in Gujranwala**

| Problem | Description of Problem | Issues for Solving the Problems |
|---|---|---|
| **Waste Collection and Transportation** | | |
| 1. Not fully covered waste collection service for 64 urban UCs | Uncollected area and partially collected area exist in the current collection area, and 100% of the area or the entire area of 64 urban UCs has not always been collected. Therefore, as a result, waste is scattered in the streets and open spaces in the uncollected area and the partially collected area in the town area. | The method of waste discharge and temporary storage, type of collection vehicles, collection frequency, etc., shall be reviewed for improvement of the primary and secondary collection services that should cover the entire city area. |
| 2. No waste collection service in rural 34 UCs | Waste collection work is being carried out only within the area of 64 urban UCs resulting in the scattering of waste in 34 rural UCs. GWMC will be responsible to cover the waste collection and transportation service with these extended areas in the future. | Waste collection service area in the developed area and the urbanised area of 34 peripheral UCs should be expanded to prevent the scattering of waste and tentative clean-up operation in the affected areas should be carried out continuously. |
| 3. Insufficient number of waste container and arm-roll truck | The number of collection vehicles and waste containers is insufficient for the collection of all wastes generated in the city. As a result, it is causing obstacles to traffic, overflowing of waste from the waste containers and increase of illegal dumpsites in the town area. Such a situation has become a nuisance to daily life of the neighbouring residents. | Formulation and implementation of overall waste collection and transportation plan is required for future upgrading of the service. In particular, appropriate types of waste collection vehicle should be carefully considered to be fitted for the site conditions, such as road width, accessibility, space for container placement and so on. |
| 4. Inadequate management of waste containers | Discharged waste by the residents overflows around the container. In addition, some residents misbehave the waste disposing to the container. As a result, the waste is scattered around the containers and it causes odour and deteriorates the environment in the city. | Implementation of the education program is required to raise awareness of the waste generators to discharge waste properly into the waste container. In addition, the collection work should be regulated to clean-up around the container by the collection worker and/or by street sweeper. |
| 5. Low efficiency by using a tractor trolley | Most of the tractor trolleys are old; consequently, fuel consumption is high and travel performance is low. The number of workers is insufficient for the waste loading work onto the tractor trolleys. Due to these causes, the low waste collection efficiency of tractor trolley has resulted in the difficulty to execute regular waste collection service in the designated service area. | In accordance with procurement of new vehicles, the use of tractor trolleys should be declined and shifted to arm-roll trucks and mini-dumpers. The retired trucks should be used for the other collection area that will be expanded outside of 64 UCs. |
| 6. Small haulage amount and cause of nuisance by mini-dumper | The work efficiency is low because the mini-dumpers could transport only small amounts of waste to the far landfill site and return again for the next collection service. In addition, wastes collected by mini-dumpers are unloaded at an open space beside the waste containers to be transported by arm-roll trucks, causing nuisance to the neighbouring residents. | GWMC is planning to deploy the mini-dumpers only for waste collection in surrounding areas with about 5-7 trips per shift and transfer the collected waste to large loading capacity trucks for transportation to the landfill site. For this purpose, two waste transfer stations for mini-dumpers that are located in the north-east side and the south-west side of the city have been planned, and one of them started the operation. |
| 7. High risk of disease infection for sanitary workers | Sanitary workers are not provided any protective gear, such as masks, safety shoes and gloves in their operation. The sanitary workers pick up wastes and put them into their handcarts by hands. There is high risk of handling hazardous materials and infectious wastes directly. | It is essentially required to provide protective gear for all sanitary workers. It is also important to train them to handle the waste properly and to take a medical check on a regular basis. |
| 8. A large number of illegal dumpsites | Many dumpsites exist illegally in the town area causing environmental degradation in the surrounding area. These illegal sites are located in areas adjacent to residential houses and have become a nuisance to the residents. In view of the situation, GWMC has started the programme of One Time Cleaning Activity since June 2014. | The One Time Cleaning Activity by GWMC and/or outsourcing should be accelerated to remove the cause of nuisance to residents, including execution of measures that shall not allow the sites to be used again as waste dumping site.<br>Preparation of urgent project programmes for the clean-up operation and execution of well-planned work are indispensable. |

| Problem | Description of Problem | Issues for Solving the Problems |
|---|---|---|
| **Final Disposal** | | |
| 1. Solid waste management without sanitary landfill facilities | Gujranwala City has never developed sanitary landfill facilities and the disposal sites tentatively used in the past have caused environmental degradation in the surrounding area.<br>The existing landfill site in Gondlanwala procured for provisional use was not developed to function as an engineered sanitary landfill facility and with the continued inappropriate landfill operation by open dumping, the surrounding area is facing the problem of environmental degradation. | Urgent development of sanitary landfill facilities should be made so as not to cause secondary pollution from the landfill site.<br>To solve this problem, a site selection study for new landfill facilities has been carried out by the Urban Unit, and the site in Bhakhraywali was selected for the proposed construction site. EIA study and obtaining approval is one of them and the EIA study is now underway. |
| 2. Delay of procurement procedures for proposed landfill site in Bhakhraywali | The site in Bhakhraywali was advertised as the proposed landfill site but the site has not been procured yet due to delay of payment. This will cause the delay of construction work.<br>If the start of construction work is delayed, the new landfill facilities will not be completed within the lifetime of the temporary disposal site in Gondlanwala. This will thus require other provisional landfill sites. | Procurement of the proposed landfill site through coordination among the relevant agencies of the government should be required for accelerating the procurement process.<br>Immediate action by CDGG/GWMC is required to appeal the urgency of the project and the necessity to avoid further environmental degradation in order to increase the priority of subsidy payment by the provincial government agency(s). |
| 3. No development work of landfill facilities of the existing landfill site in Gondlanwala | The existing landfill site in Gondlanwala utilises the abandoned borrow pit without facility development. Most of the troubles in landfill operation occur due to inappropriate site condition, which bring about environmental degradation especially groundwater contamination, breeding of pests such as flies, etc. to the surrounding area. | Implementation of rehabilitation work to install and/or construct the facilities should be carried out for mitigating environmental pollution. |
| 4. Inappropriate landfill operation and management at the existing landfill site in Gondlanwala | Landfill management was not properly implemented at the existing landfill site in Gondlanwala. As a result, the existing landfill site might be causing a negative impact on the environment of the surrounding area. | Minimising the environmental impact of the existing landfill site should be implemented through emergency measures and introduction of landfill operation and maintenance manual, procurement of sufficient number of landfill machines, equipment, materials and deployment of staff. |
| 5. Not proper closed/abandoned landfill site in Chianwali | The Chianwali landfill site was not closed properly and thus causing secondary pollution to the surrounding area. The site is located just along the G.T. Road. Therefore, in addition to the risk of groundwater contamination, visual pollution to landscape and waste scattered by wind are causing the negative environmental impacts. | Mitigating the environmental impacts should be required through implementation of safe closure work of the landfill site.<br>According to Punjab Municipal Waste Management Guidelines 2011, "Closure Plan", Chapter 8, the post-closure maintenance and monitoring works shall be provided for a minimum period of 25 years. |
| **Intermediate Treatment and 3R Promotion** | | |
| 1. Absence of formal intermediate treatment and 3R facilities | Gujranwala City has not developed intermediate treatment or 3R facilities until now. | GWMC should introduce formal intermediate treatment and 3R facilities with consideration on not only budget but also the awareness of residents. To determine the necessary and sufficient facilities, the result of WACS shall be fully considered. |
| 2. Lack of awareness of residents on intermediate treatment and 3R | People who do not want to get little money from recyclables are not interested in the segregation of waste. In addition, almost all people neither bring bags for shopping nor conduct pre-treatment like pressing and dewatering. On the other hand, GWMC has not started educational programmes for intermediate treatment and 3R. | GWMC should raise the residents' awareness regarding the intermediate treatment and 3R. Even if there are enough facilities and systems related to the intermediate treatment and 3R, they will not be effective without the consciousness of the residents. |
| 3. Health Risk of Waste Pickers | Waste pickers never wear protective equipment like shoes, masks, gloves and helmets to protect themselves from injury or sickness. Although they sometimes disturb operation like unloading and collecting, GWMC should not oversimplify this | Instead of imposing a limit on their work to improve operation efficiency, GWMC should provide alternative opportunities for them to make a living. The countermeasure for Problem 1 in this table must be considered first to determine the |

| Problem | Description of Problem | Issues for Solving the Problems |
|---|---|---|
| | problem. It cannot be solved by prohibiting their activities since they do not have any other means to earn a living except waste picking at present. | countermeasure for this problem. |
| 4. Ambiguous flow of recyclables | Although there are no formal facilities and systems for the intermediate treatment and 3R in Gujranwala City, there are so many people involved in the recovery of recyclables. There seem so many flows of recyclables, and the amount of recyclables in each flow or point cannot be identified at this moment. | In order to set reasonable goals of intermediate treatment and 3R plan, it is necessary to grasp the current situation quantitatively or the recovery rate. It is also needed to measure the effect of several plans related to intermediate treatment and 3R. Therefore, GWMC should take measures to calculate the recovery rate periodically. |
| 5. Not well known quality & effect of compost products of the Lahore Compost / RDF Plant | Compost produced at the Lahore Compost Plant seems not to go well because a half or more of the compost products seem to remain unsold. The users do not trust the safety and quality of compost produced at the plant. | A regular quality control in the compost production process should be carried out. A periodical quality inspection system by the public institutions or agencies should also be established for certification of the compost products. Additionally, it is needed to perform a continuous IEC activity on the needs of 3R and the running the compost plant for the integrated solid waste management project in Gujranwala. |
| 6. Lack of laws and regulations related to 3R | There is no enforced legal system such as laws and regulations on SWM and 3R activities in Gujranwala, Punjab, to support GWMC's 3R activities and promotion. | Participation of representatives of all stakeholders involved in the intermediate treatment & 3R promotion activities i.e., waste generators to the recycled goods manufacturers should be ensured during recycling law formulation stage. Hence all stakeholders would be legally obliged to follow the law and the system would be improved. |
| **Environmental Education and Public Awareness Raising** | | |
| 1. Poor coordination among government agencies and departments | There is a lack of coordination among departments including school education, GWMC and environment. Since awareness raising campaign or environmental education activity has been carried out without much coordination among relevant bodies, thus messages were not focused nor spread among target population. | Coordination among the relevant departments like environment, school education, etc., is necessary for the implementation of environmental education and public awareness raising activities. A mechanism to address environmental awareness should be developed among the agencies concerned to realise effective and coherent effort on environmental education. The relevant bodies may include Planning and Development, Education, Water and Sanitation, and Environment. |
| 2. Inappropriate school curriculum on the environment | The curriculum is different for public and private schools. Inevitably, students in public schools, especially, primary schools, learn less about the environment. | It is necessary to increase the practical applications and classes regarding the environment in the school curriculum. Some environmental education packages for the kids as well as training for the teachers may also be implemented. |
| 3. Lack of awareness among public | There is a tendency among the public that the government has the sole responsibility of taking care of the environment. Awareness programme and campaign can be developed through community groups which may be comprised of area representatives, religious persons and students. | Patient effort is necessary to edify the public on environment, especially, waste management. In this sense, collaboration with grassroots group or even religious body (mosque) needs to be considered in order to raise awareness among the public. In addition, feminist groups may pose strong influence to each household's waste management practices through a network of wives. The efforts can include waste reduction, reuse/recycle, source separation, and proper waste discharge. |
| 4. Irregular informal education on the environment | There is no continuous informal education except once a year during such event as Earth Day. There is no strategy defined for the public information department regarding informal environmental education. | The government should initiate concrete efforts in highlighting the importance of environment through implementation of public information for the environment as well as cooperation with various groups working for environmental issues. |

| Problem | Description of Problem | Issues for Solving the Problems |
|---|---|---|
| **Economic and Financial Aspects** | | |
| 1. Insufficient financial independence in SWM services | GWMC is not in a position to meet its financial needs from the internal financial sources. It falls back on subsidies from the GOPb. This dependence on the budget of CDGG is not sustainable in the long term, and GWMC needs to increase its financial resources to meet its statutory obligations instead of solely depending on the budget of CDGG which is subsidised from the Provincial Government. | The proper revenue generation mechanism such as the introduction of tariff system by GWMC should be carefully studied. Transparency for setting the tariff level as well as a wide range of activities raising users' willingness to pay for SWM services is also required. The continuous financial monitoring mechanism for GWMC should be also established in the framework of the institutional strengthening the headquarters of GWMC. |
| 2. Not well identified cost structure for SWM services | GWMC is required to accurately identify how much is spent for the various components of SWM services in Gujranwala to establish strategies to minimise the cost of the services. However, at present, GWMC is not sufficiently capable of grasping the variable costs, the fixed costs and even the break-even point for the provision of SWM services. | In order to set proper tariffs for users, all the costs associated in providing SWM services by GWMC should be reflected as accurately as possible and streamlined as fixed costs and variable costs. |
| 3. Lack of pricing mechanism for SWM services | Currently, there is no substantial pricing mechanism for SWM services in Gujranwala. GWMC currently does not levy any SWM tax, nor does it impose user fees for SWM services.<br>Inadequate cost recovery mechanisms by GWMC limits the extent of operation as well as new investments of SWM services. | To secure the budget for financially sustaining SWM services, GWMC needs to consider its revenue raising capabilities by introducing a proper user charging system for SWM services. The pricing mechanism such as charging user fees need to be considered and adopted. |
| 4. Few involvement of the private sector | GWMC is not currently working with the private sector although it is exploring the possibilities to introduce the option of private sector participation. Due to the limited resources available, GWMC is looking towards improvement of its SWM services through outsourcing to the private sector. | GWMC should explore the possibilities of involving the private sector in SWM services to provide efficient services cost-effectively with minimum costs.<br>The objectives of involving the private sector include 1) enhancing efficiency; and 2) mobilise the investment resources of the private sector. |
| **Institutional Strengthening and Organizational Restructuring** | | |
| 1. Difficulty to understand and comply with laws and regulations | There is no comprehensive law on Solid Waste Management in Gujranwala that is understandable to officials and residents.<br>In addition, regulations are written only in English so that most of the residents cannot read them. CDGG/GWCM has not implemented any awareness raising activity on SWM rules that residents should follow. | Currently, the committee concerned in the Punjab Province is drafting a by-law, referring to the Indian Municipal Solid Waste Management Rules (Draft) (2013). This by-law should integrate the latest version of laws and regulations related to SWM in the Punjab Province, so that it becomes one single comprehensive by-law to comply with.<br>In order to make residents understand and comply with the by-law, it is advisable to translate and interpret it in Urdu and implement awareness raising activity on SWM rules. |
| 2. Lack of management staff (especially managers) | There is a high vacancy rate in managerial level. All four manager positions are still vacant due to difficulty to recruit suitable persons. As a result, there is too much burden on MD and the Company Secretary. | In order to attract human resources with adequate expertise on solid waste management, the working environment must be attractive enough. Therefore, it is advisable to introduce the following systems:<br>• Performance Based Salary;<br>• Provision of Incentives such as monthly award for outstanding performance;<br>• Gifts and incentives on Eid and Christmas holidays;<br>• Rationalisation of working hours: work in three shifts without extra burden;<br>• Provision of social welfare and old age benefits to secure the minimum quality of life of workers; and<br>• Health screening and other facilities.<br>In addition, in order to develop the capacity of CDGG/GWMC staff continuously, it is essential to provide training regularly. |
| 3. Lack of expertise of technical staff | Technical staff does not have enough expertise and are not required to have any qualification. As a result, there is a lack of reliable data and improper management and maintenance of vehicles and equipment. Therefore, GWMC cannot provide efficient waste management services.<br>In addition, there is no institutional arrangement among technical staff, resulting in ambiguous reporting line. | |

| Problem | Description of Problem | Issues for Solving the Problems |
|---|---|---|
| 4. Lack of financial independence of GWMC from the government | Since the GWMC budget (including staff salary) is covered by CDGG, it is difficult to get funds at the right time. In addition, technical staff such as sanitary workers still belong to CDGG and impossible to lay-off as GWMC needs. This means that GWMC cannot allocate staff flexibly | In order to achieve financial independence from CDGG, it is necessary to introduce user charge. For this purpose, it is quite important to raise awareness of residents and to increase the willingness to pay. As for the technical staff transfer, it is usually difficult to simply transfer them from the public sector (CDGG) to the private sector (GWMC) due to several reasons such as social welfare. Thus, it is recommended to decrease CDGG technical staff gradually as they retire and outsource the service to the contractor. |
| 5. Too high cost of outsourcing compared to direct service | It is difficult to involve the private sector due to the small market size and immature local private sector.<br>In Gujranwala, direct service (GWMC service) cost is much cheaper than outsourcing cost (800PKR/3500PKR). This is because the market is too small for economy of scale to function. It is also because the local private sector in SWM is still immature and results in outsourcing to Lahore/international contractor. | In order to improve efficiency, it is also advisable to introduce outsourcing of collection and transportation service. In 2025, the population of Gujranwala is estimated to be big enough for economy of scale to work and for the private sector to make profit. By this time, outsourcing cost will decrease as the technologies are localised such as production of machinery and equipment. |
| 6. Extremely low acceptance of new SWM system | There is a quite serious lack of understanding of residents on SWM. Most of them take SWM service as free of charge. This leads to quite low willingness to pay and possible strong resistance to introduce user charge. | It is necessary to raise awareness of residents on a long-term basis. The emphasis should be given to the financial aspect in order to raise understanding on SWM cost and responsibility of each stakeholder. In order to facilitate the process, GWMC should provide good service enough for residents to appreciate the service. |
| **Hospital Waste Management** | | |
| 1. Lack of data on medical facilities | The District Health Office does not even have up to date data regarding the number of clinics and hospitals at present in the Gujranwala District. | Updated database should be required regarding the number of medical facilities including government and private owned for the quantification of waste generated. |
| 2. No check and balance mechanism on private contractors | Major hospitals and clinics have a contract with the A.T. Waste Management, a private company, for the waste collection. However, no such information and check and balance mechanism exists regarding safely disposal of the hazardous risk waste by private contractors. | Private sector does not provide any quality and environmental compliance certification to the clients. The government office also should monitor the performance of the public sector. |
| 3. No enforcement mechanism | Hospital Waste Management Rules address only large scale hospitals and does not address small scale clinics nor regulate enforcement mechanism for the implementation of rules and regulations especially in terms of waste from private medical facilities. | In connection with the problem mentioned above, reinforcement of the current rules and regulations, and their implementation are key issues. |
| 4. Mixing of risk waste with non-risk waste | It was observed that risk waste from smaller medical facilities is mixed with municipal waste, resulting in a major risk to sanitary workers. | No separate collection system of the smaller medical facilities is established in the urban and peri-urban areas by any government agency. |
| 5. Risk waste as a recyclable material | It was also observed that risk waste is collected and sold by waste pickers and some of the sanitary staff of medical facilities, and finally reaches the recyclers. This is a very hazardous and alarming situation and leads to the high possibility of infection of various diseases to waste pickers, sanitary staff and recyclers. | Waste pickers and recyclers are not being regulated by any government agencies. At least disposal of the risk waste should be strictly regulated and monitored by legislation. |
| 6. Budget constraints | The District Health Office does not have any budget to provide BHU for hospital waste management. | No allowance of budget for the waste at BHU level comes from higher management. However, appropriate waste management needs a certain amount of money. |

| Problem | Description of Problem | Issues for Solving the Problems |
|---|---|---|
| 7. Lack of awareness | Sanitary staff of medical facilities is not aware of the hazardous nature of e risk waste and they do not bother to use any personal protective equipment at the time of sweeping. | Training for sanitary staff should be carried out to handle risk waste with special care. |
| **Industrial Waste Management** | | |
| 1. Unavailability of industrial data | Industrial data of the entire city is not available from any government or private department. Only the list of industries that have membership with GCCI is available. Most industries are reluctant to cooperate with surveys that are going to try to clarify their activities. They normally reject disclosure of any information regarding their types and sales of production, number of employees, disposal of industrial waste, etc., to avoid payment of taxes. | It is the duty of industrial departments to collect the data and update the inventory of industries based on cooperation from them. It is essential to obtain the data for estimating the amount of waste produced from industries and formulating the waste management plan. |
| 2. No proper enforcement of laws and regulations | There is no proper enforcement of laws, by-laws and regulations in Pakistan dealing with management of the waste discharged from industries. Although PEPA 2012 includes some clause related to industrial waste, it does not clearly demonstrate the responsibilities of industries regarding the solid waste management. | Rules and regulations that clearly mention the responsibility with strict enforcement are necessary. |
| 3. Mixing of industrial waste with municipal waste | Most of the small scaled industries are in the residential area and waste is mixed with municipal waste. Due to no service by any company in the industrial area, waste of industrial estates is also mixed with the waste generated from households. | A separate collection system for industries and households is important to establish the proper solid waste management system in the city. |
| **Construction and Demolition (C&D) Waste Management** | | |
| 1. Ambiguity of classification and responsibility for C&D waste | Although C&D waste is categorised into municipal waste under the Punjab Municipal Solid Waste Management Guidelines 2011, the amount is too large to deal with municipal waste collected from households and commercial entities in general. The other laws and regulations do not clearly define the classification and responsibility for C&D waste. | The provincial government should firstly make some by-laws or regulations for C&D waste management in which rules and responsibilities should be clearly defined. Simultaneously, GWMC should consider introduction of tariff for C&D waste collection and propose it to the provincial government or city district government. |
| 2. No reliable data on C&D waste generation amount and composition | The estimation by LWMC in terms of C&D waste amount and composition in Gujranwala is wrong so that no reliable data exists. Special surveys at the sites are indispensable for obtaining the data and will take a lot of time and resources. | The waste amount and composition data are basis of development of the management plan. Without the data, any plan covering the waste collection method and required number of vehicles and personnel cannot be prepared accurately. |
| 3. Many illegal dumping of C&D waste | C&D wastes are piled up in front of houses, vacant plots, along the roadsides, etc., and accumulate day by day. According to the LWMC report, there are 46 of such sites in Gujranwala and the total amount is estimated at 3,555 tons. | GWMC has started the One-Time Cleaning Activity to remove the accumulated waste including C&D waste in the city area. This activity should be conducted continuously until all the illegal dumpsites are cleared by the allocation of suitable sets of vehicles and machinery. |

# 3. PLANNING POLICIES OF SOLID WASTE MANAGEMENT IN GUJRANWALA AND FRAMEWORK OF THE MASTER PLAN

## 3.1 Establishment of Principles for ISWM in Gujranwala

As a result of a series of discussions and meetings between the JICA Project Team and the Pakistani side, principles and planning policies for ISWM of the Gujranwala Waste Management Company (GWMC) are as prepared and presented in the following sections. These principles and planning policies are the

basis on which the planning strategies of the SWM for GWMC and CDGG, as well as the Government of the Punjab and framework of the Master Plan, shall be formulated hereinafter.

### (1) Waste Category and Management Responsibility

Non-municipal solid waste is waste that is not under GWMC's responsibility but the responsibility of waste generators. Since the Punjab Municipal Solid Waste Management Guidelines 2011 do not have a legally binding force, based on the above argument, waste categories and their management responsibilities are proposed as summarised in the table below.

**Table S.3.1 Waste Category and Management Responsibility**

| Kinds of Waste | Management Responsibility | Remarks |
|---|---|---|
| 1. Municipal Solid Waste<br>1-1 Domestic waste<br>1-2 Commercial waste<br>1-3 Institutional waste<br>1-4 Street sweeping waste (including carcasses)<br>1-5 Garden waste<br>1-6 Drain waste (Drain width: less than 2 feet) | GWMC | GWMC may collect bulky waste upon receipt of a request from residents by charging a special tariff. |
| 2. Non Municipal Solid Waste<br>2-1 Non-hazardous industrial waste<br>2-2 Commercial waste of large amount<br>2-3 Construction & Demolition waste<br>2-4 Agricultural waste<br>2-5 Discarded vehicles & machinery<br>2-6 Hazardous waste including infectious hospital waste | Generators of waste<br><br>(GWMC and CDGG should monitor generators' management of non-municipal waste until they establish a proper management system for these wastes.) | GWMC may collect non-municipal waste except waste item 2-6 upon receipt of a request from the generator by charging a special tariff.<br>GWMC may also accept these categories of waste except waste item 2-6 at its disposal site on full cost recovery basis.<br>The central government should establish hazardous waste management (treatment) facilities. |

### (2) Responsibility of Federal Government, Local Government, Business Waste Generators and Residents

GWMC must have the power and responsibility for organizing integrated solid waste management (ISWM). As shown below, there are other stakeholders involved in ISWM.

- Federal Government
- Government of the Punjab
- CDGG
- GWMC
- Business (Industrial and Commercial) Waste Generators
- Residents

The proposed principal responsibilities of respective stakeholders are given below.

**Table S.3.2 Parties Involved in Solid Waste Management and Their Responsibilities**

| Involved Parties | Responsibilities |
|---|---|
| 1. Federal Government | 1) To formulate a national policy with respect to waste reduction, recycling and solid waste management.<br>2) To formulate and pass a national SWM law.<br>3) To set technical standards.<br>4) To research on solid waste management.<br>5) To ensure that the laws and regulations are applied. |

| Involved Parties | Responsibilities |
|---|---|
| | 6) To provide guidance to local governments. |
| 2. Government of the Punjab | 1) To formulate a provincial policy and prepare provincial strategies and plans (short and long term).<br>2) To enact Acts, Ordinances, Guidelines, etc. related to SWM.<br>3) To finance the district governments.<br>4) To levy a waste tax or tariff.<br>5) To formulate regulations.<br>6) To formulate guidelines with respect to:<br>a) Methods of discharging waste (types of containers to be used);<br>b) Waste reporting requirements of business waste generators; and,<br>c) Recycling (types of waste to be recycled). |
| 3. CDGG | 1) To formulate a local policy and prepare local strategies and plans (short and long term).<br>2) To finance SWM.<br>3) To supervise performance of GWMC.<br>4) To enforce bye-laws and regulations. |
| 4. GWMC | 1) To provide waste collection, haulage, treatment, disposal and street sweeping services under contractual arrangements. |
| 5. Business (Industrial and Commercial) Waste Generators | 1) To manage (collection, treatment and disposal) their waste except those accepted by the local government as municipal solid waste.<br>2) To submit reports on their waste (types, quantity, pre-treatment and other information) as required by the municipal regulations. |
| 6. Residents | 1) To conduct 3R (Reduce, Reuse, Recycle) activities.<br>2) To comply with the local government's waste collection procedure.<br>3) To avoid littering waste.<br>4) To dispose of discarded vehicles by using commercial enterprises. |

## 3.2 Vision, Mission and Goals of Integrated Solid Waste Management in Gujranwala

### (1) Vision of Integrated Solid Waste Management in Gujranwala

The vision of integrated solid waste management in Gujranwala is decided, as follows:

***"Transformation of Gujranwala to the Cleanest City of Punjab"***

### (2) Mission of Integrated Solid Waste Management in Gujranwala

The mission of integrated solid waste management in Gujranwala is proposed, as follows:

(a) To improve and protect the public health of Gujranwala residents and visitors;

(b) To deliver efficient and effective waste collection and disposal services to the residents of Gujranwala;

(c) To maximise resource recovery and recycling through the participatory approach; and

(d) To ensure greener and safer environment at final disposal sites.

### (3) Goals of Integrated Solid Waste Management in Gujranwala

The goals of integrated solid waste management in Gujranwala are proposed, as follows:

(a) To significantly extend and formalise resource recovery activities, including but going beyond the creation of enabling environments and the development of markets and industries for recyclables;

(b) To develop awareness and capacity for waste handling and source separation as essential components of sustainable waste management;

(c) To restructure and extend efficient and equitable collection of source-separated waste streams with the view of protection of public health and the environment;

(d) To build environmentally sound infrastructure and systems for safe disposal of residual waste, replacing the current disposal site and transfer station which must be rehabilitated; and

(e) To reduce the burden on the disposal site and increase its life span by using intermediate treatment and 3R approach.

## 3.3 Planning Strategy for ISWM in Gujranwala

To solve the problems and achieve the goals, the strategic approach to formulate the ISWM Master Plan for Gujranwala are proposed with the following six items in consideration of solving the implicated constraints of the city towards improvement of technical and institutional deficiencies:

- Heightening of public awareness and participation
- Development of SWM operational capacity of GWMC
- Securing of a proper sanitary landfill site
- Strengthening of SWM financial capacity
- Maximisation of public sector involvement in SWM
- Promotion of 3R (Reduce, Reuse, Recycle)

## 3.4 Planning Direction of the Master Plan

The ISWM Master Plan for Gujranwala is formulated in three implementation stages, namely; the first implementation stage (Short-Term Plan covering the period from 2016 to 2018); the second implementation stage (Mid-Term Plan covering the period from 2019 to 2024); and the third implementation stage (Long-Term Plan covering the period from 2025 to 2030). The action plans covered in the first implementation stage are formulated through two approaches: (1) technical approach, and (2) institutional and financial approach. The major planning items of the Master Plan are summarised as the following seven programmes:

**Technical Approach of the Master Plan**

Programme 1: Waste Collection and Transportation Plan

Programme 2: Final Disposal Plan

Programme 3: Intermediate Treatment and 3R Promotion Plan

**Institutional and Financial Approach of the Master 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

# 4. BASELINE PROJECTION OF POPULATION AND SOLID WASTE GENERATION

## 4.1 Population Projection

Considering the rapid growth of the city in the recent years, the annual population growth rate of 3.79% is adopted for the estimation of future population in the Project. Population projection is carried out based on the population census in 1998 as the base year.

**Table S.4.1 Estimated Population in the Project Area for ISWM Plan (unit: 1,000 persons)**

| UCs | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Urban UCs | 2,054 | 2,132 | 2,212 | 2,296 | 2,383 | 2,473 | 2,567 | 2,665 | 2,766 | 2,870 | 2,979 | 3,092 | 3,209 | 3,331 | 3,457 | 3,588 | 3,724 |
| Peri-urban UCs | 910 | 944 | 980 | 1,017 | 1,056 | 1,096 | 1,137 | 1,180 | 1,225 | 1,272 | 1,320 | 1,370 | 1,422 | 1,476 | 1,531 | 1,589 | 1,650 |
| **Total Project Area** | **2,964** | **3,076** | **3,192** | **3,313** | **3,439** | **3,569** | **3,704** | **3,845** | **3,991** | **4,142** | **4,299** | **4,462** | **4,631** | **4,807** | **4,988** | **5,177** | **5,374** |

## 4.2 Projection of Waste Generation

Waste generation amount in the Project Area is carried out separately for domestic waste, and commercial and institutional waste in 64 urban UCs and peri-urban UCs.

**Table S.4.2 Estimated Waste Generation Amount in the Project Area**

(Unit: t/d)

| UCs | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Domestic 64 UCs | 821 | 861 | 903 | 946 | 991 | 1,039 | 1,089 | 1,140 | 1,195 | 1,251 | 1,311 | 1,373 | 1,438 | 1,506 | 1,580 | 1,658 | 1,739 |
| Domestic 34 UCs | 318 | 334 | 351 | 368 | 386 | 406 | 425 | 446 | 468 | 491 | 515 | 540 | 566 | 593 | 622 | 652 | 683 |
| Commercial | 61 | 90 | 126 | 169 | 223 | 250 | 286 | 327 | 372 | 422 | 478 | 536 | 598 | 668 | 746 | 831 | 924 |
| **Total Project Area** | **1,200** | **1,285** | **1,380** | **1,483** | **1,600** | **1,694** | **1,800** | **1,913** | **2,035** | **2,165** | **2,304** | **2,449** | **2,602** | **2,766** | **2,948** | **3,140** | **3,346** |

## 4.3 Waste Stream

Waste amount is estimated for each stage of waste management operation based on the waste generation, planned waste collection ratio, intermediate treatment and 3R promotion planning including recovery of recyclable materials, composting of organic waste, and final disposal.

**Table S.4.3 Waste Amount for Major Elements in Waste Management Stream from 2014 to 2030**

| Item | 2014 | 2018 | 2024 | 2030 |
|---|---|---|---|---|
| Total Waste Generation Amount (t/d) | 1,200 | 1,600 | 2,304 | 3,346 |
| Uncollected Waste Amount (t/d) | 724 | 391 | 206 | 0 |
| Waste Collection Ratio in 64 Urban UCs (%) | 54 | 100 | 100 | 100 |
| Waste Collection Ratio in 34 Peri-urban UCs (%) | 0 | 0 | 64 | 100 |
| Waste Discharge Amount for Collection (t/d) | 476 | 1,209 | 2,098 | 3,346 |
| Waste Generation Prevention Amount (t/d) | 0 | 0 | 0 | 201 |
| Recovery Amount of Resource Materials (t/d) | 66 | 163 | 330 | 602 |
| Intermediate Treatment Amount (Composting/RDF) (t/d) | 0 | 0 | 252 | 510 |
| Waste Collection Amount (t/d) | 410 | 1,046 | 1,515 | 2,033 |
| Recovery of Resource Materials at Disposal Site (t/d) | 4 | 10 | 15 | 20 |
| Waste Disposal Amount (t/d) | 406 | 1,036 | 1,500 | 2,013 |
| Total Waste Diversion Amount (t/d) | 70 | 174 | 598 | 1,334 |
| Waste Diversion Rate (%) | 15 | 14 | 28 | 40 |

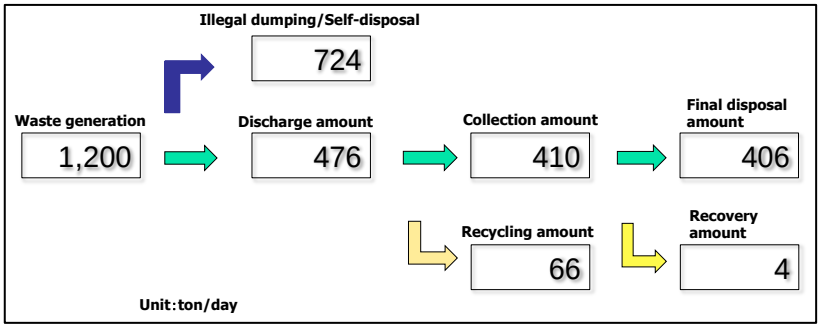



**Figure S.4.1 Waste Management Flow and Estimated Waste Amount in 2014**

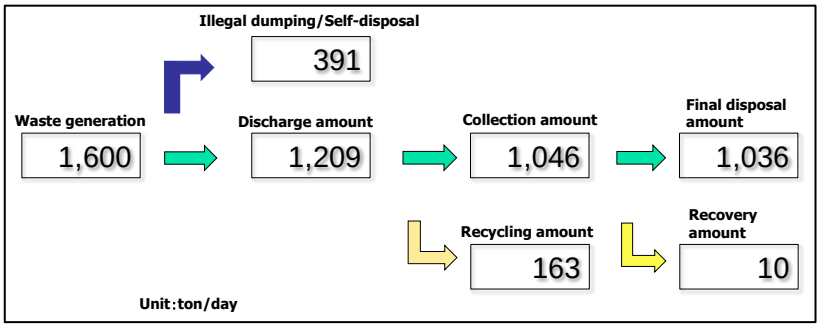



**Figure S.4.2 Waste Management Flow and Estimated Waste Amount in 2018**

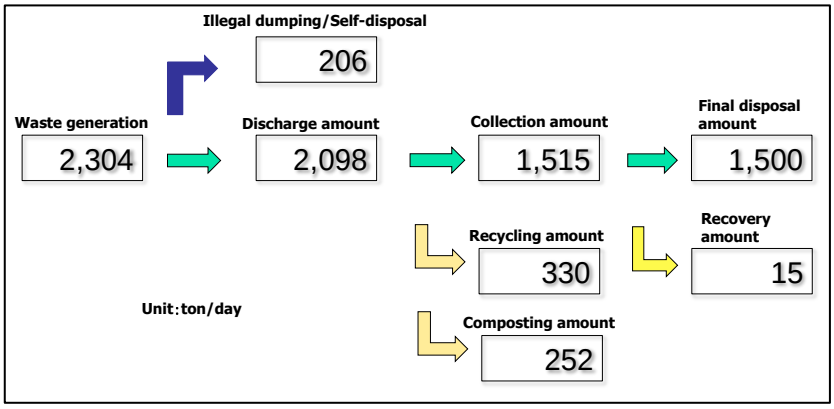



**Figure S.4.3 Waste Management Flow and Estimated Waste Amount in 2024**

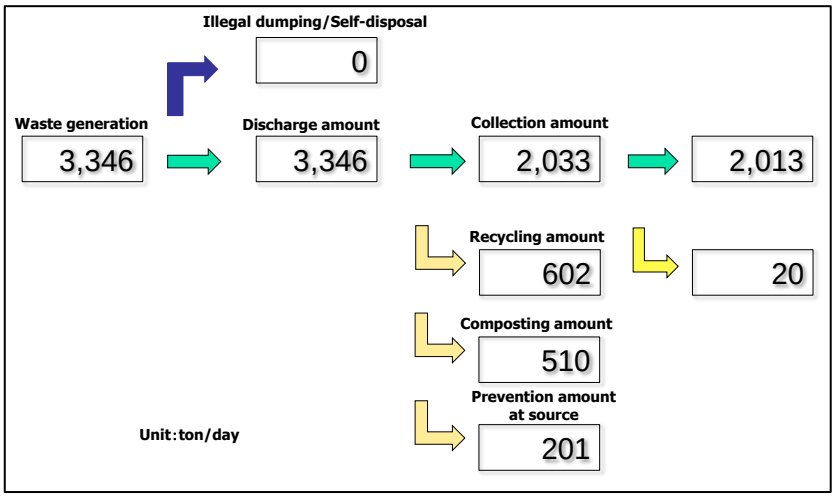



**Figure S.4.4 Waste Management Flow and Estimated Waste Amount in 2030**

# 5. FORMULATION OF THE MASTER PLAN

## 5.1 Waste Collection and Transportation Plan

### (1) Objective

The objective of Waste Collection and Transportation Plan is to improve the existing collection service activities and expand the coverage area in Gujranwala City in order to maintain public sanitation and cleanliness of the city.

### (2) Planning Policy

- The development plan of the waste collection and transportation plan shall be cover 64 UCs in the year 2018, and the planning area shall start expanding to 34 UCs in the year 2019.
- Targeted waste in the master plan shall be municipal waste.
- Construction and demolition (C&D) waste shall be handled in a different operation from the ordinary waste collection and transportation work.

### (3) Planning Strategy

- Type of municipal solid waste shall be defined for the objective waste for the waste collection and transportation plan.
- Technical alternatives on waste collection and transportation system shall be studied by evaluating the most efficient result in terms of waste collection and transportation from generation source to final disposal site, as well as evaluation from the viewpoint of less impact to society and the environment.
- Separate collection system shall be established under the conditions with involvement of all the waste generators in the future.
- Implementation of waste collection and transportation is carried out based on the phased procurement of a sufficient number of waste containers and waste collection vehicles. The procurement plan for waste collection vehicles and containers on waste collection and transportation plan shall be determined as the most optimum system of collection and transportation.
- Urgent clean-up work shall be promoted for illegal dumping sites in the city.
- Street cleaning work shall be conducted.
- Collection of bulky waste shall be conducted.
- Construction of necessary parking areas shall be conducted.

### (4) Goal

**Short-Term Plan (2016-2018)**

- Introduction of separate collection and alternate-day collection through implementation of pilot project on the designated Zone in 64 UCs.
- Increase of collection rate in 64 UCs from the current 43% to 100% in 2018.
- Improvement of City's sanitary environment through the clean-up of illegal dumping sites in the 64 UCs.
- Improvement of collection and transport system through procurement of collection vehicles and introduction of the container system in the 64 UCs.
- Conduct of street cleaning through procurement of collection vehicles.
- Conduct of collection of bulky waste through procurement of collection vehicles.
- Collection of construction and demolition waste.
- Construction of necessary parking areas for procured vehicles.

**Mid-Term Plan (2019-2024)**

- Planning/Implementing for the method of separate collection in 98 UCs.
- Increase of the collection rate in 34 UCs from 0% to 60% in 2024.
- Sustenance of collection rate in 64 UCs with 100% in 2019.
- Improvement of collection and transport system through procurement of collection vehicles and introduction of the container system in 98 UCs.
- Conduct of street cleaning through procurement of collection vehicles.
- Conduct of collection of bulky waste through procurement of collection vehicles.
- Collection of construction and demolition waste.
- Construction of necessary parking areas for procured vehicles.

**Long-Term Plan (2025-2030)**

- Introduction of separate collection through implementation of designated pilot project area in 2028 and promotion of separate collection in other Zones in 2029.
- Increase of collection rate in 98 UCs to 100% in 2030.
- Sustenance of collection rate in 64 UCs from the present with 100% in 2030.
- Improvement of collection and transport system through procurement of collection vehicles and introduction of the container system in 98 UCs.
- Conduct of street cleaning through procurement of collection vehicles.
- Conduct of collection of bulky waste through procurement of collection vehicles.
- Collection of construction and demolition waste.
- Construction of necessary parking areas for procured vehicles.

## (5) Recommendations

- Necessary budget for the procurement of a sufficient number of waste collection vehicles and containers should be secured on a timely manner.
- Effective and efficient waste collection and transportation system should be established based on the detailed design of waste collection vehicles and containers as well as the allocation plan.
- The budget for the clean-up of illegal dumping sites should be secured to eliminate all of the illegal dump sites in the 64 UCs.

## (6) Proposed Project Components

**Short-Term Plan (2016-2018)**

- Introduction of Separate Collection and Alternate day Collection through Implementation of Pilot Project
- Increase of Waste Collection Rate in 64 UCs up to 100% in 2018
- Conducting Street Cleaning in 64 UCs
- Collection of Bulky Waste
- Cleaning Up of Illegal Dumping sites in 64 UCs
- Construction and Demolition Waste Collection
- Construction of Parking Area

**Mid-Term Plan (2019-2024)**

- Planning/Implementing for the Method of Separate Collection in 98 UCs
- Increase of Waste Collection Rate in 34 UCs from 0% to 60% in 2024
- Sustaining the Waste Collection Rate in 64 UCs with 100% in 2024

- Procurement of Waste Collection Vehicles and Containers in 98 UCs
- Monitoring of Improvement of Waste Collection and Transportation in 98 UCs
- Conducting Street Cleaning in 64 UCs
- Collection of Bulky Waste
- Collection of Construction and Demolition Waste
- Construction of Parking Area

**Long-Term Plan (2025-2030)**

- Introduction of Separate Collection through the Implementation of Designated Pilot Project Area in 2028 and Promotion of Separate Collection to Other Zones in 2029
- Increase of Waste Collection Rate in 34 UCs to 100% in 2030
- Sustaining Waste Collection Rate in 64 UCs from the Present to 100% in 2030
- Procurement of Waste Collection Vehicles and Containers in 98 UCs
- Monitoring of Improvement of Waste Collection and Transportation in 98 UCs
- Conducting Street Cleaning in 64 UCs
- Collection of Bulky Waste
- Outsourcing of Waste Collection and Transportation Services to a Private Company in 2025
- Collection of Construction and Demolition Waste
- Construction of Parking Area

## 5.2 Final Disposal Plan

### (1) Objective

The objective of Final Disposal Plan is to be provided as the last process of solid waste management to dispose waste for storing eternally and for stabilising the waste of no value for resource materials and/or waste conversion for further use and protect the surrounding area from secondary pollution.

### (2) Planning Policy

- The development plan of final disposal facilities shall be formulated until 2030 for the final target year of the master plan.
- Only treated or residual municipal solid waste shall be the objective waste acceptable to the final disposal facility of Gujranwala.
- Among the several types of final disposal facilities, the sanitary landfill facility is superior to any other type for disposal of municipal solid waste from technical, economic and environmental viewpoints. Hence the final disposal plan shall formulate the development plan for construction and operation of new sanitary landfill facilities in Bhakhraywali.
- The improvement plan of the existing landfill in Gondlanwala and the safe post-closure plan of the former landfill site in Chianwali shall be included as an integral part of the final disposal plan.

### (3) Planning Strategy

- The development work of new sanitary landfill shall be carried out by stage-wise construction work in consideration of the financial capacity of the project proponent.
- The improvement plan of the existing landfill site and the safe post-closure of the former landfill site shall be carried out to attain the satisfactory level for mitigating the current negative impacts in consideration of economic efficiency.

## (4) Goal

**Short-Term Plan (2016-2018)**

- Construction of sanitary landfill facilities (Stage 1) in Bhakhraywali.
- Operation and maintenance of sanitary landfill facilities in Bhakhraywali.
- Improvement of the existing landfill in Gondlanwala.
- Safety closure of the landfill site in Gondlanwala.
- Safety closure of the landfill site in Chianwali.
- Monitoring of final disposal in Bhakhraywali and post-closure monitoring of Gondlanwala and Chianwali.

**Mid-Term Plan (2019-2024)**

- Operation and maintenance of sanitary landfill facilities in Bhakhraywali.
- Monitoring of final disposal in Bhakhraywali and post-closure monitoring of Gondlanwala and Chianwali.
- Site selection, EIA and procurement of future final disposal facilities (Stage 2 & Stage 3).
- Design of sanitary landfill facilities (Stage 2) in Bhakhraywali.
- Construction of sanitary landfill facilities (Stage 2) in Bhakhraywali.

**Long-Term Plan (2025-2030)**

- Operation and maintenance of sanitary landfill facilities in Bhakhraywali.
- Monitoring of final disposal in Bhakhraywali and post-closure monitoring of Gondlanwala and Chianwali.
- Design of future sanitary landfill facilities (Stage 3).
- Construction of future sanitary landfill facilities (Stage 3).

## (5) Recommendations

- Implementation of the final disposal plan should be carried out starting from development of the new Bhakhraywali sanitary landfill site at first, secondly improvement of the existing Gondlanwala disposal site, and then finally safe closure of the former Chianwali disposal site.
- Construction of the second and third phases of final disposal facilities should be required other than the first phase of the Bhakhraywali site.
- Appropriate operation and maintenance of the final disposal sites should be indispensable for sustaining sanitary landfill operation by sufficient personnel and budget.
- Environmental and social impacts in the surrounding area of Gondlanwala and Chianwali disposal sites should be improved.

## (6) Proposed Project Components

**Short-Term Plan (2016-2018)**

- Procurement of Sanitary Landfill Site
- Engineering Service for Sanitary Landfill Facilities (Stage 1)
- Construction of Sanitary Landfill Facilities (Stage 1) in Bhakhraywali
- Procurement of Landfill Machinery
- Operation and Maintenance of Landfill Facilities
- Improvement Work of the Existing Landfill in Gondlanwala
- Safe Closure of the Landfill Site in Gondlanwala
- Safe Closure of the Landfill Site in Chianwali

- Monitoring of Final Disposal in Bhakhraywali
- Post-Closure Monitoring of Gondlanwala and Chianwali Landfill Sites

**Mid-Term Plan (2019-2024)**

- Operation and Maintenance of Landfill Facilities
- Monitoring of Final Disposal in Bhakhraywali
- Post-Closure Monitoring of Gondlanwala and Chianwali Landfill Sites
- Engineering Service for Sanitary Landfill Facilities (Stage 2)
- Construction of Sanitary Landfill Facilities (Stage 2)
- Procurement of Additional Landfill Machinery (Two (2) Bulldozers [Chain Dozers]; One (1) Wheel Dozer; One (1) Excavator; and Three (3) Bucket Tractors for replacement)
- Site Selection of Sanitary Landfill Site (Stage 2 and Stage 3)
- Procurement of Sanitary Landfill Site (Stage 2 and Stage 3)

**Long-Term Plan (2025-2030)**

- Operation and Maintenance of Landfill Facilities
- Monitoring of Final Disposal in Bhakhraywali
- Post-Closure Monitoring of Gondlanwala and Chianwali Landfill Sites
- Engineering Service for Sanitary Landfill Facilities (Stage 3)
- Construction of Sanitary Landfill Facilities (Stage 3)
- Replacement and Procurement of Landfill Machinery (Five (5) Bulldozers [Chain Dozers] including two (2) replacement; Three (3) Wheel Dozers including one (1) replacement; and Two (2) Excavators including one (1) replacement)

## 5.3 Intermediate Treatment and 3R Promotion Plan

### (1) Objective

The objective of Intermediate Treatment and 3R Promotion Plan is for reduction of domestic waste generation, recovery of resources, reuse, recycling, intermediate treatment and resource circulation.

### (2) Planning Policy

- The development plan of intermediate treatment and 3R promotion activities shall be formulated in 2030 as the final target year of the master plan.
- The plans should be implemented with consideration for not only limited budget but also informal activities related to intermediate treatment and 3R promotion.
- The intermediate treatment plan shall be implemented through privatisation while the municipal solid waste management in collection, transportation and disposal shall be carried out and managed by the GWMC.

### (3) Planning Strategy

- The appropriate quality control of compost shall be indispensable to maintain the proposed central compost and RDF plant to be operated by a new compost company of Special Purpose Vehicle in Gujranwala.
- The awareness raising and IEC campaign on the intermediate treatment and 3R promotion activities shall be exercised upon public, schools and stakeholders in Gujranwala by continuous lead of GWMC.
- The recycling law shall be enacted or legislated to promote 3R activities and formalise the rapidly growing informal resource recovery activities.

## (4) Goal

**Short-Term Plan (2016-2018)**

- Implementation of awareness and IEC (Information, Education and Communication) campaign on intermediate treatment and 3R at source.
- Implementation of monitoring survey of simplified WACS periodically.
- Establishment of PPP for a compost plant and formation of a committee of BOD of GWMC.
- Design of a compost plant by SPV (Special Purpose Vehicle).

**Mid-Term Plan (2019-2024)**

- Continuous IEC campaign on resource recovery at source and registration of waste pickers and recycling industries.
- Establishment of the proposed Gujranwala Central Compost Company (GCCC) by SPV and start of operation of the Gujranwala Central Compost Plant (GCCP) in 2020.
- Operation and maintenance of the GCCP.
- Monitoring of the GCCP.

**Long-Term Plan (2025-2030)**

- Continuous IEC campaign on resource recovery at source and registration of waste pickers and recycling industries
- Enlargement of construction works for the GCCP for compost and additionally RDF production in 2029 and start of the plant operation from 2030.
- Operation and maintenance of the GCCP.
- Monitoring of the GCCP
- Enactment of recycling laws in Punjab, Pakistan.

## (5) Recommendations

- GWMC should set up the PPP contract for SPV/Gujranwala Central Compost Company on priority basis under the supervision of the established committee.
- GWMC should promote 3R activities in the society through IEC campaign.
- Utilisation of organic waste should be enhanced by introduction and promotion of separate collection of waste, and the production process should be controlled by the key parameters such as C/N ratio, moisture, temperature, oxygen, etc. for producing better quality compost.
- A demonstration farm should be operated by GWMC/SPV (special purpose vehicle) for promoting utilisation of compost.
- Raw material input to the RDF plant should be segregated to improve the quality of the final product by installation of sorting unit as part of the plant.
- A separate comprehensive law dealing with and promoting intermediate treatment and 3R activities should be enacted, and the Recycling Law should be enforced strictly.

## (6) Proposed Project Components

**Short-Term Plan (2016-2018)**

- Awareness and IEC Campaign on Resource Recovery
- Implementation of Simplified WACS
- Preparation for PPP and Formation of a Committee of the BOD of GWMC
- Implementation of Land Preparation by GWMC
- Engineering Service for Detailed Design of a Compost Plant by SPV

**Mid-Term Plan (2019-2024)**

- IEC Campaign on Resource Recovery at Source/Registration of Waste Pickers and Recycling Industries
- Purchase of Land for the Compost Plant
- Construction Work for the Gujranwala Compost Plant owned by SPV including Procurement of Equipment
- Operation and Maintenance of the Compost Plant
- Monitoring of Implementation of the Compost Plant

**Long-Term Plan (2025-2030)**

- IEC Campaign on Resource Recovery at Source/Registration of Waste Pickers and Recycling Industries
- Engineering Service for Detailed Design of the RDF Plant owned by SPV
- Construction of the RDF Plant owned by SPV including Procurement of Equipment
- Operation and Maintenance of the Compost & RDF Plant
- Monitoring of Implementation of the Compost & RDF Plant
- Preparation and Enacting of Recycling Laws in Punjab, Pakistan

## 5.4 Environmental Education and Public Awareness Raising Plan

### (1) Objective

The objective of Environmental Education and Public Awareness Raising Plan is to raise awareness of the general public as well as selected target groups (e.g., elected officials/representatives, religious scholars) at the Union Council, Tehsil and District levels of SWM.

### (2) Planning Policy

- The plan should be formulated to promote better understanding of the resident through public and school environmental education by establishing coordination mechanisms in GWMC.
- The plan should be continuous and formulated to promote more involvement of public and selected target groups' participation by providing opportunities to actively participate.

### (3) Planning Strategy

- Capacity of communication unit of GWMC should be strengthened to facilitate and coordinate numerous education routes, i.e., facilitating educational materials and coordinating relevant bodies.
- GWMC needs to inform the public of the measures to be taken to improve SWM in the city. A properly structured communication strategy should be developed.
- A public environmental education and awareness programme should be carried out to raise awareness and involve the public in the initiatives for better SWM in the city.
- The introduction of SWM in the primary education curriculum should be considered to make school children more aware on solid waste issues. In addition, the development of educational materials for teachers and students should be considered essential as a tool to promote environmental education and create awareness among educational community.

### (4) Goal

**Short-Term Plan (2016-2018)**

- Strengthening of coordination among relevant bodies, i.e., education board, school officials, area representatives and other relevant bodies.
- Enhancement of the knowledge/awareness of teachers and students in primary schools on

SWM and 3R.

- Enhancement of the knowledge/awareness of general public on SWM and promotion of 3R.

**Mid-Term Plan (2019-2024)**

- Maintenance and expansion of the coordination capacity among relevant bodies, i.e., education board, school officials, area representatives, and other relevant bodies.
- Continuance and expansion of knowledge and awareness on SWM and 3R among teachers and students in primary schools.
- Continuance and expansion of knowledge and awareness on SWM and 3R in general public.
- Establishment and enhancement of the environmental education facility.

**Long-Term Plan (2025-2030)**

- Maintenance and expansion of coordination capacity among all relevant bodies.
- Continuance and expansion of knowledge and awareness on SWM and 3R among all teachers and students in primary schools.
- Continuance and expansion of knowledge and awareness on SWM and 3R in general public.
- Enhance knowledge / awareness on SWM and 3R among teachers/students and general public through environmental education facility.

## (5) Recommendations

- The budget for establishment of the Communication Unit should be secured to ensure proper implementation of environmental education.
- Educational materials/program should be fine-tuned depending upon the results of feedback from each session, or awareness survey which is planned to be carried out in every 5 years.

## (6) Proposed Project Components

**Short-Term Plan (2016-2018)**

- Capacity development of Communication Unit to strengthen the coordination among related bodies
- Development and implementation of educational programmes targeting primary school teachers and students
- Development and implementation of educational programmes targeting general public

**Mid-Term Plan (2019-2024)**

- Capacity development of Communication Unit to strengthen the coordination among related bodies
- Development and implementation of educational programmes targeting primary school teachers and students
- Development and implementation of educational programmes targeting general public
- Development and implementation of monitoring plan
- Development of environmental education facility and its utilisation plan

**Long-Term Plan (2025-2030)**

- Capacity development of Communication Unit to strengthen the coordination among related bodies
- Development and implementation of educational programmes targeting primary school teachers and students
- Development and implementation of educational programmes targeting general public
- Development and implementation of monitoring plan

- Development of environmental education facility and its utilisation plan

## 5.5 Economic and Financial Plan

### (1) Objective

The objective of Economic and Financial Plan is to establish the optimum cost recovery in the SWM operations of GWMC, thereby achieving the long-term financial sustainability of providing SWM services to be planned in the Master Plan.

### (2) Planning Policy

- Cost recovery for the provision of SWM services should be achieved through the ample generation of stable revenues from users and taxation.
- Current operating costs required for SWM services should be accurately and continuously reviewed and estimated.
- Revenues required for the cost recovery should be mainly generated from the tariff charging system which reflects the cost of SWM services.
- Outsourcing of part of SWM services should be introduced for the purpose of utilising the efficient private sector.

### (3) Planning Strategy

#### (a) Optimum cost recovery to cover the operation and maintenance cost for SWM services should be achieved for the long-term financial sustainability based on the following strategies:

- Establishment of the long-term road map for the full recovery of the operation and maintenance cost by user charges and subsidies from the provincial government;
- Establishment of a wide range of financial monitoring indicators together with the standard procedures for monitoring the cost recovery; and
- Preparation of manual and training of GWMC's staff for the management of the cost recovery.

#### (b) Operation and maintenance cost for SWM services should be accurately estimated based on the following strategies:

- Establishment of an independent accounting system for the financial autonomy of GWMC;
- Establishment of organizational setting such as a focal point inside GWMC in charge of accurately managing and estimating the operation and maintenance cost for SWM services; and
- Establishment of proper monitoring of the operation and maintenance cost for SWM services together with the minimisation of operation and maintenance cost to attain the operational efficiency of SWM services.

#### (c) Revenue generation through the proper tariff charging system should be introduced based on the following strategies:

- Selection and introduction of proper user charge system to cover the operation and maintenance cost for SWM services;
- Selection and introduction of stable financial resources to cover the financial shortages from the provincial government through subsidies or taxation;
- Preparation of official tariff table for the selected user charge system;
- Establishment of a wide range of financial monitoring indicators together with the

standard procedures for setting and revising the tariff level; and

- Improvement of users' willingness to pay through raising of public awareness for the payment of user charges.

**(d) Efficient private sector involvement should be introduced by outsourcing part of SWM services to private service operators as the following strategies:**

- Selection and introduction of an efficient service contract for collection and transport services; and
- Establishment of a wide range of performance monitoring indicators together with the standard procedures for monitoring the financial performance of private service operators.

## (4) Goal

**Short-Term Plan (2016-2018)**

- Preparation of the cost recovery strategies for sustainable SWM services by partially recovering the operation and maintenance cost together with subsidies or financial support from stable financial resources of the provincial government.
- Establishment of the short-term financial performance monitoring system through a wide range of financial key performance indicators to monitor costs, revenues and cost recovery rates during the short-term period.
- Accurate identification of the operation and maintenance cost for SWM services for the planned cost recovery strategies.
- Preparation for the future introduction of the proper tariff charging system to secure the stable revenue to cover the operation and maintenance cost for SWM services based on the survey results of the willingness to pay of users.
- Preparation for the involvement of the private sector through the service contract for the collection and transportation services in all service areas.

**Mid-Term Plan (2019-2024)**

- Updating of the cost recovery strategies for sustainable SWM services by partially recovering the operation and maintenance cost together with subsidies or financial support from stable financial resources of the provincial government.
- Commencement of negotiations for requesting the provincial government to provide subsidies or revenues from the property tax to fund the gap between the collected user charges and the required operation and maintenance cost.
- Establishment of the financial mid-term performance monitoring system through a wide range of financial key performance indicators to monitor costs, revenues and cost recovery rates during the mid-term period.
- Establishment of the independent cost accounting system and accurate updating of the operation and maintenance cost for SWM services for the planned cost recovery strategies.
- Introduction of the selected new user charge system in high-income and middle-income service areas in addition to the stable financial sources from the property taxation system of the provincial government from 2022.
- Preparation for the partial involvement of the private sector through the service contract for the collection and transportation services in all service areas.

**Long-Term Plan (2025-2030)**

- Achievement of the self-cost recovery for the operation and maintenance cost of SWM services to the extent in which the user charges will be actually collected in all service areas.
- Establishment of the financial long-term performance monitoring system through a wide range

of financial key performance indicators to monitor costs, revenues and the cost recovery rates during the long-term period.

- Accurate updating of the operating cost and maintenance cost for SWM services for the planned cost recovery strategies.
- Full-scale introduction of the selected new user charge system in all service areas in addition to the stable financial sources from the property taxation of the provincial government from 2025.
- Involvement of the private sector through the service contract for the collection and transportation services in all service areas from 2025.

### (5) Recommendations

- Negotiations with GOPb on revenue generation through the provincial financial sources such as the property tax should be started as soon as possible to secure stable financial sources in addition to the proposed tariff charging system.
- The operation and maintenance cost for SWM services should be regularly monitored and updated by collecting financial key performance indicators through the management information system (MIS) unit of GWMC.
- Tariff system based on a result of continuous surveys on users' willingness to pay (WTP) and affordability to pay (ATP) should be introduced.
- LWMC's experiences for private sector involvement should be continuously reviewed for examining the availability and capacities of private service providers.
- Project feasibility based on continuous updating of financial data should be monitored.

### (6) Proposed Project Components

**Short-Term Plan (2016-2018)**

- Establishment of Sustainable Cost Recovery (Preparatory Phase)
- Implementation of Accurate Total Costing (Preparatory Phase)
- Introduction of Proper Tariff Charging System (Preparatory Phase)
- Implementation of Financially Efficient Private Sector Involvement (Preparatory Phase)

**Mid-Term Plan (2019-2024)**

- Establishment of Sustainable Cost Recovery (Phase 1)
- Implementation of Accurate Total Costing (Phase 1)
- Introduction of Proper Tariff Charging System (Phase 1)
- Implementation of Financially Efficient Private Sector Involvement (Phase 1)

**Long-Term Plan (2025-2030)**

- Establishment of Sustainable Cost Recovery (Phase 2)
- Implementation of Accurate Total Costing (Phase 2)
- Introduction of Proper Tariff Charging System (Phase 2)
- Implementation of Financially Efficient Private Sector Involvement (Phase 2)

## 5.6 Environmental Monitoring Plan

### (1) Objective

The objective of 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 social and natural environment in Gujranwala.

## (2) Planning Policy

- Environmental Monitoring shall be applied for not only the proposed landfill site at Bhakhraywali but also the current disposal site at Gondlanwala and the closed disposal site at Chianwali.
- Environmental Monitoring shall be carried out in long-term perspective.

## (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 inclusion of waste pickers' activities.

## (4) Goal

**Short-Term Plan (2016-2018)**

- Commencement of environmental monitoring for waste collection and transport work.
- Commencement of environmental monitoring in Bhakhraywali.
- Commencement of environmental monitoring including post-closure monitoring in Gondlanwala and Chianwali disposal sites.

**Mid-Term Plan (2019-2024)**

- Continuation of environmental monitoring of waste collection and transport work.
- Continuation of environmental monitoring in Bhakhraywali, Gondlanwala and Chianwali disposal sites.
- Commencement of environmental monitoring for the composting facility.

**Long-Term Plan (2025-2030)**

- Continuation of environmental monitoring for waste collection and transport work.
- Continuation of environmental monitoring in Bhakhraywali, Gondlanwala and Chianwali disposal sites.
- Continuation of environmental monitoring for the composting facility.

## (5) Recommendations

- The budget for implementation of the monitoring should be secured.
- Environmental monitoring should be carried out at the same time of the year.
- Effective and efficient system of feedback for reviewing the all monitoring results by GWMC should be established.

## (6) Proposed Project Components

**Short-Term Plan (2016-2018)**

- Monitoring of Collection and Transportation Work
- Monitoring of Final Disposal Site in Bhakhraywali
- Monitoring of Post-Closure Final Disposal Sites in Gondlanwala and Chianwali

**Mid-Term Plan (2019-2024)**

- Monitoring of Collection and Transportation Work
- Monitoring of Final Disposal Site in Bhakhraywali
- Post-Closure Monitoring of Gondlanwala and Chianwali Final Disposal Sites
- Monitoring of Intermediate Process (Compost Facility)

**Long-Term Plan (2025-2030)**

- Monitoring of Collection and Transportation Work
- Monitoring of Final Disposal Site in Bhakhraywali
- Post-Closure Monitoring of Gondlanwala and Chianwali Final Disposal Sites
- Monitoring of Intermediate Process (Compost Facility)

## 5.7 Institutional Strengthening and Organizational Plan

### (1) Objective

The objective of Institutional Strengthening and Organizational Plan is to comprehensively reorganize the functions of the GWMC, to comprehensively strengthen human resources capacities of the managerial and technical staff of the GWMC to support its functions; and to establish a comprehensive Solid Waste By-Law for Gujranwala.

### (2) Planning Policy

- Responsibilities and obligations of the new organization should not be fragmented or overlapping among the staff and workers;
- Linkages and coordination arrangements between different departments in the new organization should be efficient and effective;
- The organizational structure should be optimised in line with the selected structure for Public-Private Partnership;
- Human resources development for providing solid waste management services shall be comprehensively designed and implemented based on the results of the capacity assessment;
- All rules and regulations related to SWM should be integrated; and
- Integrated By-Law should be translated in Urdu.

### (3) Planning Strategy

- An efficient and rationalised organizational structure with clear reporting lines, reasonable spans of control and number of levels of managerial and technical staff, and the appropriate vertical structure to attain the operational efficiency of the solid waste management;
- A clear assignment and delegation of responsibilities and adequate authority to managers and supervisors with accountability for individual performance as well as a simple workflow for a quick decision process;
- A streamlined workflow based on the practical basis to avoid the overlapping of organizational structure;
- Clear-cut directing functions from the strategic level down to middle management and supervisors;
- Effective and appropriate management information systems and other procedures;
- Periodic assessment and feedback of management systems and other procedures based on agreed performance targets and criteria;
- A department or unit in charge of managing and regulating the proper Public-Private Partnership scheme;
- More practical human resources development including on-the-job training programme based on the capacity assessment and feedback system to share job skills among staff and workers should be implemented; and
- Raising public awareness on best practices in solid waste management such as rules and regulations, recycling, segregation, re-use, and recovery as well as inculcating the culture of waste reduction and proper storage among producers and consumers.

## (4) Goal

**Short-Term Plan (2016-2018)**

- Restructuring of GWMC in order to enhance its capacity in complaint management, awareness raising, intermediate treatment and 3R by the end of 2018.
- Strengthening of the technical and managerial capacities of the GWMC staff through implementation of a comprehensive capacity development programme.
- Assisting for CDGG to establish Gujranwala Solid Waste Management By-Law.

**Mid-Term Plan (2019-2024)**

- Improvement of the organisational structure of GWMC based on feedback of results of the mid-term performance monitoring and assessment.
- Development of staff capacities of GWMC based on feedback of results of the mid-term performance monitoring and assessment of the capacity development programme.
- Enactment of Gujranwala Solid Waste Management By-Law.
- Implementation of public awareness raising activities in terms of Gujranwala Solid Waste Management By-Law especially with emphasis on rules residents must follow and cost of solid waste management.

**Long-Term Plan (2025-2030)**

- Improvement of the organisational structure of GWMC based on the feedback of results of the long-term performance monitoring and assessment.
- Development of staff capacities of GWMC based on the feedback of results of the long-term performance monitoring and assessment on the capacity development programme.

## (5) Recommendations

- The budget for recruiting new staff of GWMC should be secured.
- Schedule adjustment of training programmes should be considered in order not to disturb daily work.
- Suitable SWM By-Law should be established by examining its contents, and discussing it with all stakeholders concerned.

## (6) Proposed Project Components

**Short-Term Plan (2016-2018)**

- Improvement of Organizational Restructuring of GWMC
- Capacity Development of GWMC staff
- Establishment of Gujranwala Solid Waste Management By-Law

**Mid-Term Plan (2019-2024)**

- Improvement of Organizational Restructuring of GWMC
- Capacity Development of GWMC staff
- Establishment of Gujranwala Solid Waste Management By-Law

**Long-Term Plan (2025-2030)**

- Improvement of Organizational Restructuring of GWMC
- Capacity Development of GWMC staff

## 5.8 Recommendations on Hospital, Industrial, and Construction and Demolition Waste Management

### (1) Hospital Waste Management

Recommendations in hospital waste management are as follows:

- It is necessary to treat infectious waste separately from domestic waste. The inappropriate disposal of infectious waste not only causes direct damage to the health of waste collection staff in hospitals and waste pickers, etc., on disposal sites, but also the re-use of medical implements such as syringes, etc., can adversely affect ordinary patients.
- Segregating potentially infectious material from municipal solid waste at the point of generation may apply and in this way both volume and cost can be reduced.
- The Gujranwala Waste Management Company (GWMC) should make plans/guidelines and provide the services to the medical facilities by charging service fee. In this way GWMC can generate revenue.
- Training should be given to the sweepers on how to handle hospital wastes since these are toxic and hazardous. Sweepers are unaware of the diseases spread through direct contact with medical waste; if they know they will definitely use personal protective equipment.
- From 2016, based on the estimation of unit cost for collecting and disposing hospital wastes, GWMC should prepare the tariff setting plan for the hospital waste management with reference to waste generators' willingness to pay. The tariff collection method will be a direct collection system from waste generators by charging the individual tariff calculated from the estimated unit cost and the generated hospital waste amount.

### (2) Industrial Waste Management

Recommendation in industrial waste management is as follows:

- GWMC should prepare plans/guidelines and provide waste collection services to industries by charging some fee from the industries.
- From 2016, based on the estimation of unit cost for collecting and disposing industrial wastes, GWMC should prepare the tariff setting plan for the industrial waste management with reference to waste generators' willingness to pay. The tariff collection method will be a direct collection system from waste generators by charging the individual tariff calculated from the estimated unit cost and the generated industrial waste amount.

### (3) Construction and Demolition Waste Management

Recommendations in hospital waste management are as follows:

- On the basis of situation analysis it is recommended that provincial government should make some rule and regulations for Construction and Demolition (C&D) waste management in which rules and responsibilities should be clearly defined.
- As the generator itself is responsible for the management of C&D waste, the Lahore Waste Management Company (LWMC) propose to set a tariff for the C&D waste collection service to the generator. Therefore, it is important that the provincial government or the city district government make some laws or by-laws to provide legal shelter for the GWMC and the penalties should be also incorporated in the laws or by-laws.
- LWMC proposed one time cleaning of the 46 sites filled with C&D waste by itself or by private contractor or to outsource the operations for the C&D waste collection. GWMC should use LWMC's per ton and per kilometre calculated cost for the C&D waste from all the four towns of the city and also use recommendations from the LWMC plan stated below.
- It is recommended that the City District Government Gujranwala and GWMC shall engage demolition contractors who have expertise, new techniques, tools, proper demolishing system,

and health safety and environment working systems on board. For this, bidders shall be qualified technically in all towns and shall be called upon to bid on reserve prices set by the concerned department after having input from engineering wing.

- The demolition contractors shall be bound to barricade properly and dump the debris to the GWMC designated crushing site. This would be the stage when actual estimation of C&D waste should be designated by considering the following data:
  1. Amount of area demolished
  2. Exact percentage range for demolished material
  3. Exact percentage range for recycled material
  4. Exact percentage range for reusable material
  5. Revenue detail and bringing this demolishing activity in tax net in future
- After at least 2.5 years to 3.0 years, the exact form of data regarding Construction and Demolition Waste shall start to be developed.
- From 2016, based on the estimation of unit cost for collecting and disposing construction and demolition wastes, GWMC should prepare the tariff setting plan for the construction and demolition waste management with reference to waste generators' willingness to pay. The tariff collection method will be a direct collection system from waste generators by charging the individual tariff calculated from the estimated unit cost and the generated construction and demolition waste amount.

# 6. PROJECT EVALUATION

## 6.1 Development of the Master Plan Alternatives

### (1) Optimum Options for Each Component of the Master Plan

Based on the preconditions mentioned in the preceding sections, the ISWM Master Plan is to be formulated. The ISWM Master Plan is composed of seven programmes in technical, and institutional and financial arrangement. To develop the Master Plan alternatives, the optimum options for each component will be selected by focusing on four (4) components, i.e., (1) the waste collection and transportation plan; (2) the final disposal plans; (3) the intermediate treatment and 3R promotion plan; and (4) the environmental education and public awareness raising plan, as presented in the following:

**Waste Collection and Transportation Plan**

The waste collection and transportation plan will be formulated depending primarily on the way of waste discharge from the generation sources. There is no doubt that the waste separation at source is the preferable option in the initial stage of the ISWM scheme. The following three options are considered:

- Door-to-door collection by using mini-compactors (Narrow streets); and Waste container (small type) by using compactor (Wide streets) based on waste separation at source.
- Door-to-door collection by using mini-compactors (Narrow streets); and Waste container (small type) by using compactor (Wide street), based on no waste separation at source.
- No other additional vehicles for waste collection and transportation (status quo).

**Final Disposal Plan**

The Pakistani side already selected Bhakhraywali as a new final disposal site for Gujranwala city after comparisons of some of candidate sites. The option of the final disposal plan will be the following two:

- Construction of a new final disposal site at Bhakhraywali
- No construction of any new final disposal sites (status quo)

**Intermediate Treatment and 3R Promotion Plan**

Since the optimum alternatives in terms of intermediate treatment and 3R promotion are limited in view of the past experiences in Gujranwala and the surrounding cities, workability of technologies and economic feasibility, two options will be listed in the comparison of the master plan alternatives.

- Composting and RDF
- No intermediate treatment and 3R promotion activities (status quo)

**Environmental Education and Public Awareness Raising Plan**

Environmental education and public awareness raising activities are indispensable for implementation of the ISWM Master Plan because most residents in Gujranwala are indifferent to SWM as shown in the result of the Public Awareness Survey. Educating the people and raising their awareness towards improvement of the public health and SWM in the city is crucial to achieve the vision, mission and goal of ISWM in Gujranwala. Thus, the options to be considered are "with" and "without" these actions in this case.

- Implementation of environmental education and public awareness raising activities
- No environmental education and public awareness raising activities (status quo)

### (2) Master Plan Alternatives by Combination of the Optimum Options for Each Component

The optimum options for each component to be selected are to be combined and the master plan alternatives are then developed accordingly. The following five (5) cases as shown in **Table S.6.1** below will be evaluated in the next section.

**Table S.6.1 Master Plan Alternatives by Combination of the Optimum Options for Each Component**

| Master Plan (MP) Options | Waste Collection & Transportation | | Final Disposal | Intermediate Treatment & 3R Promotion | Environmental Education & Public Awareness Raising |
|---|---|---|---|---|---|
| | Separation at Source | Collection & Transportation Method | | | |
| MP Option A | Done | Door-to-door + Mini-compactor (narrow street)<br>Small container + Compactor (wide street) | Construction of a new final disposal site at Bhakhraywali | None (Status quo) | Environmental education & public awareness raising activities |
| MP Option B | Done | -ditto- | -ditto- | Composting & RDF | -ditto- |
| MP Option C | None | -ditto- | -ditto- | None (Status quo) | -ditto- |
| MP Option D | None | -ditto- | -ditto- | Composting & RDF | -ditto- |
| MP Option Z (Zero Option) | None | None (Status quo) | None (Status quo) | None (Status quo) | None (Status quo) |

## 6.2 Evaluation of the Master Plan Alternatives

The master plan alternatives developed in the previous section are evaluated by the following aspects:

- Technical Aspects: The technical aspects are evaluated in terms of workability, stability and ease of operation and maintenance (O&M) of the applied technology, and so forth. The past experiences in Gujranwala and the surrounding cities should also be considered.
- Environmental and Social Impact Aspects: The environmental and social impact aspects are evaluated based on the result of the Environmental and Social Consideration Survey (E&S Survey). The E&S Survey was carried out on the conditions that the expected locations for transfer stations for waste collection and transportation, composting facilities and RDF plants are assumed.

- Economic and Financial Aspects: The rough scale of initial investment and O&M costs required for each option are relatively judged for comparison.
- Institutional and Organizational Aspects: The vehicles additionally procured for the waste collection and transportation, for example, necessitate additional human resources and sometimes creation of new divisions or departments. Also, new or amended laws and regulations might be required for enforcement of the introduction of the new system.

The result of evaluation of each alternative and concludes that the Master Plan Option B is the optimum master plan. The reasons this option is chosen are summarised as follows:

- Technically speaking, by applying the waste separation at source, it will be easier to collect and transport the waste, and promote intermediate treatment and 3R activities. In addition, the waste disposal amount will be reduced and it will result in longer life of the final disposal site;
- In terms of environmental and social consideration, the waste separation, and intermediate treatment and 3R activities will bring a good impact on residents' awareness and cooperation with proper SWM in the community level. The reduction of landfill gas emission will also be expected in accordance with the waste amount reduction;
- The initial investment required for provision of new collection vehicles and construction of a new landfill site is large; however, more economically efficient SWM services can be provided compared to "Zero Option (MP Option Z)";
- The life cycle cost of construction of the final disposal site might be the cheapest; that is, this option will be the most economically feasible because the cost of the construction is dominantly huge amount in the total project cost; and
- Although introduction of waste separation at source and Composting & RDF requires organizational strengthening and institutional arrangements additionally, these inputs are also crucial to the other option and this is therefore not a serious disadvantage.

## 6.3 Evaluation of the Optimum Master Plan

### (1) Technical Evaluation

Based on the detailed comparative study, the collection and transportation plan in Option B does not include large-scale civil works unlike the final disposal sector. The proposed collection and transportation system is to be a combination of use of mini-dumpers for narrow streets and compactors for wide streets depending on the road width. Since private waste collectors have not been operating in Gujranwala, these vehicles should be procured by GWMC through subsidy from the local government and operated under the management of GWMC at the beginning. Therefore, the system to be newly introduced in the city should be workable and sustainable under the local conditions, accordingly. In this respect, it is judged that the proposed waste collection and transportation system meets these requirements.

The only concern in terms of the new system of collection and haulage of waste is the commencement of waste separation at source. Although it seems to be difficult to disseminate this new idea widely at the grassroots level from the beginning, GWMC should take a strong leadership by supporting the local government and provincial government organize and manage an environmental education programme and public awareness heightening campaign. This is an integral part of the ISWM Master Plan and a key of success of implementation of the Master Plan.

Promotion of 3R is also a key issue for ISWM. Considering the local condition of Gujranwala, promotion of composting is the best option because composting does not require any special mechanisation and huge investment. Moreover, a private company in Lahore has produced composting material by using incoming waste to the final disposal site. Based on this experience and with appropriate institutional arrangements including government support, composting plants will be introduced depending on socio-economic circumstances such as income level, types of housing, and location and volume of waste. RDF that is also operated in Lahore by private

involvement will be programmed after segregation of waste to provide the suitable waste for the plant in the late stage of the Master Plan.

To minimise negative impacts on the environment, the present official disposal site in Gondlanwala should be operated properly until the end of its life and the former disposal site in Chianwali should be decommissioned in the right manner. Simultaneously, preparation for a new landfill site in Bhakhraywali should be started while another new site will be additionally required in the long run. The process of decision making and budget allocation is always delayed like EIA for example, and so the earliest preparation and actions will be necessary at any rate.

## (2) Environmental and Social Impact Evaluation

Environmental and social considerations are carried out for Master Plan Option B. The detailed evaluation is presented in **Chapter 7**, and the result of the evaluation is summarised that Option B has a great combination of the processes involved in waste management and good features for natural and social environment through Separate Collection, Composting and RDF.

## (3) Financial and Economic Evaluation

### (a) Financial Evaluation

#### (i) Total Project Cost

The total cost for the master plan on the financial price basis is estimated at Rs. 20,497 million for the period of 15 years from 2016 to 2030, summing up the investment cost, the operation and maintenance cost and the replacement cost of all project components. The contingencies for the project cost are separately added.

#### (ii) Total Project Benefit

The financial project benefits of the master plan are calculated based on the market prices as of August 2015. The benefit accrued from the methane gas reduction is excluded from the financial project benefits, since the benefit cannot actually be converted into real monetary values. Other unquantifiable benefits are also excluded from the financial project benefits.

The total benefit of the master plan on the financial price basis is estimated at Rs. 24,225 million for the period of 15 years from 2016 to 2030, summing up a wide range of the economic benefits, social benefits and environmental benefits.

#### (iii) Cases of Evaluation

The timing of the introduction of the tariff system and the involvement of the private sector through outsourcing are major variations to affect the financial viability of the master plan. The following three (3) cases including the base case (Case A) together with two (2) variations are the cases of the financial evaluation in the master plan.

- Case A: Base Case of Master Plan
- Case B: Based on the current level of users' willingness to pay, the tariff system will be introduced from 2019 at the early stage of the master plan.
- Case C: Outsourcing to the private sector (service contract of the collection and transport) will be introduced from 2025 based on the basic organizational and institutional setting up of the master plan.

#### (iv) Results of Financial Evaluation

- For Case A, the base case of the master plan, in which the full-scale tariff system will be introduced in all areas from 2025 and the outsourcing to the private sector will not be carried out, the FIRR and the NPV are estimated at 7.42 per cent and Rs. 429 million, respectively.

- For Case B in which the full-scale tariff system will be introduced from 2019 at the early stage of the master plan from and the outsourcing to the private sector will not be carried out, the FIRR and the NPV are estimated at 8.19 per cent and Rs. 663 million, respectively.
- For Case C in which the full-scale tariff system will be introduced in all areas from 2025 and the outsourcing to the private sector will be carried out from 2025, the FIRR and the NPV are estimated at 8.45 per cent and Rs. 794 million, respectively.

## (b) Tariff Review

### (i) Cases of Evaluation

The cases of the tariff review analysis are the following four (4) cases to be assumed based on the variations of two (2) variables: i) the collection efficiency of the tariff; and ii) the timing for the full-scale introduction of the tariff system, and their combinations.

**Table S.6.2 Cases of Evaluation for Tariff Review Analysis**

| Case | Willingness to Pay (Rs. per month per household) | | | Collection Efficiency (Per cent) | | | Full-scale Tariff Introduction Timing | |
|---|---|---|---|---|---|---|---|---|
| | Low | Medium | High | Low | Medium | High | 2022 | 2025 |
| Case 1 | 25 | 50 | 100 | 50.0 | 60.0 | 70.0 | | X |
| Case 2 | 25 | 50 | 100 | 60.0 | 70.0 | 80.0 | | X |
| Case 3 | 25 | 50 | 100 | 50.0 | 60.0 | 70.0 | X | |
| Case 4 | 25 | 50 | 100 | 60.0 | 70.0 | 80.0 | X | |

### (ii) Results of Tariff Review

**Cost Recovery Rate**

The major findings on the cost recovery for the above four (4) cases are as follows:

- For Case 1, in which the collection efficiency of the tariff is relatively lower and the full-scale introduction of the tariff system in all areas will start from 2025 in the first year of the long-term period, the cost recovery rate against the full recovery of the operation and maintenance cost is estimated at 32.4 per cent.
- For Case 2, in which the collection efficiency of the tariff is relatively higher and the full-scale introduction of the tariff system in all areas will start from 2025 in the first year of the long-term period, the cost recovery rate against the full recovery of the operation and maintenance cost is estimated at 37.9 per cent.
- For Case 3, in which the collection efficiency of the tariff is relatively lower and the full-scale introduction of the tariff system in all areas will start from 2022 in the fourth year of the mid-term period, the cost recovery rate against the full recovery of the operation and maintenance cost is estimated at 35.8 per cent.
- For Case 4, in which the collection efficiency of the tariff is relatively higher and the full-scale introduction of the tariff system in all areas will start from 2022 in the fourth year of the mid-term period, the cost recovery rate against the full recovery of the operation and maintenance cost is estimated at 42.0 per cent.

**Required Tariff Level for Full Cost Recovery**

Since it is obvious that the cost recovery rate is 32.4 per cent out of the total operation and maintenance cost in 2025 even after the introduction of the tariff system which is in line with the current willingness to pay, the remaining balance should be replenished by other stable financial sources and/or subsidies from the provincial government. Taking an example of Case 1, the required monthly tariff level for the full recovery of the operation and maintenance cost is estimated at Rs. 77.2 per month per household in low-income

areas, Rs. 154.4 per month per household in middle-income areas, Rs. 308.8 per month per household in high-income areas, respectively. The said tariff level in case of low-income areas is 3.09 times as much as the assumed level of the tariff of Rs. 25.0 based on the social study.

## (c) Economic Evaluation

### (i) Total Project Cost

The economic costs are estimated based on the financial costs required for extending the improved SWM services in the master plan. The economic costs consist of all resources required to put in place and maintain SWM services in the selected master plan as well as other costs that result from the implementation of the master plan. These costs include investment cost, operation and maintenance costs, and replacement costs. The total cost for the master plan on the economic price basis is estimated at Rs. 15,913 million for the period of 15 years from 2016 to 2030, summing up the investment cost, the operation and maintenance cost, and the replacement cost of all project components. The contingencies for the project cost are also included.

### (ii) Total Project Benefit

The total benefit for the master plan on the economic price basis is estimated at Rs. 19,712 million for the period of 15 years from 2016 to 2030, summing up a wide range of the economic, social and environmental benefits.

### (iii) Cases of Evaluation

The timing of the introduction of the tariff system and the involvement of the private sector through outsourcing are major variations to affect the economic viability of the master plan. The following three (3) cases including the base case (Case A) together with two (2) variations are the cases of the economic evaluation in the master plan.

- Case A: Base Case of Master Plan
- Case B: Based on the current level of users' willingness to pay, the tariff system will be introduced from 2019 at the early stage of the master plan.
- Case C: Outsourcing to the private sector (service contract of the collection and transport) will be introduced from 2025 based on the basic organizational and institutional setting up of the master plan.

### (iv) Results of Economic Evaluation

- For Case A, the base case of the master plan, in which the full-scale tariff system will be introduced in all areas from 2025 and the outsourcing to the private sector will not be carried out, the EIRR and the NPV are estimated at 9.62 per cent and Rs. 916 million, respectively.
- For Case B in which the full-scale tariff system will be introduced in all areas at the early stage of the master plan from 2019 and the outsourcing to the private sector will not be carried out, the EIRR and the NPV are estimated at 10.01 per cent and Rs. 970 million, respectively.
- For Case C in which the full-scale tariff system will be introduced in all areas from 2025 and the outsourcing to the private sector will be carried out from 2025, the EIRR and the NPV are estimated at 10.60 per cent and Rs. 1,221 million, respectively.

## (4) Overall Conclusions for Financial and Economic Evaluation

### (a) Project Feasibility

The results of the economic evaluation show that the implementation of the selected option of the master plan might be economically feasible and financially viable on the condition that the following recommendations will be taken into account for the implementation of the master plan. The sensitivity analysis reveals that the master plan is financially and economically vulnerable to the increase of costs and the decrease of benefits. The cost recovery levels for the full coverage of the operation and maintenance costs remain approximately one-third of those costs, implying the necessity of other alternative stable financial sources. However, taking into account a spectrum of various unquantifiable benefits which cannot be converted to monetary values, the selected option of the master plan might be economically feasible and financially viable thereby the master plan is worth implementing.

### (b) Recommendations

In order to implement the selected optimum option of the master plan, the following recommendations should be taken into account in terms of economic feasibility and financial viability.

- Although the selected option of the master plan proves to be economically feasible and financially viable, the capital investment should be funded by subsidies from the provincial government and/or a sort of concessional loan whose interest rate is relatively lower than those of commercial banks.
- Since the project is rather vulnerable to such risks as the increase of costs as well as the decrease of benefits, the financial statements such as cash flow statements should be continuously monitored by GWMC. ***The continuous financial monitoring on revenues, expenditures and the cost recovery rate by GWMC*** is absolutely necessary to avoid any risks to enlarge the gap between the projected cash flow and the actual cash flow. GWMC's headquarters should be institutionally strengthened so that the financial statements would be readily prepared in comparison with the original calculation tables of the FIRRs.
- ***The construction of the final disposal site should not be delayed*** to generate the project benefits at least from 2018 which is the last year of the short-term period, since the project is extremely vulnerable to the cost increase in the early stage of the master plan.
- It is revealed that the earlier the introduction of the tariff system is, the higher the EIRR and FIRR are, implying that ***the early introduction of the proposed tariff system is a key to the financial stability*** of the master plan.
- The cost recovery by the introduction of the optimum variable-rate user charge system is not sufficient to fully cover the operation and maintenance cost required for the implementation of the master plan.
- ***The cost recovery rate is 32.4 percent out of the total operation and maintenance cost*** in 2025 even after the full-scale introduction of the tariff system in all areas which is in line with the current willingness to pay, and ***the remaining 67.6 percent of the total operation and maintenance cost should be replenished by other stable financial sources and/or subsidies from the provincial government***.
- In order to fully cover the total operation and maintenance cost in 2025 which is the first year of the full-scale introduction of the tariff system in all areas, ***the required tariff level per month per household is estimated at approximately three (3) times as much as the current level of the users' willingness to pay***.
- The introduction of the revenue generation through the provincial property tax as the stable financial source should be urgently explored to cover the shortage of revenues. The

negotiation with the provincial government on this revenue generation through the provincial property tax should be commenced as soon as possible.

- ***The users' willingness to pay should be transformed into the actual payment of user charges under the official tariff table*** so that the stable revenue generation for SWM services can be secured. However, the user charge system in low-income areas whose willingness to pay is extremely low should be carefully introduced by the delayed timing of implementation of the full-scale tariff system in all areas.
- The budget request to the provincial government for the capital investment cost as well as the request to CDGG for the recurrent cost should be applied in time for each financial year of GWMC, and those requests should be based on the cash flow statement of the master plan.
- ***The financial key performance indicators (KPIs) should be monitored*** by the management information system (MIS) unit to keep the financial performance well controlled by the management of GWMC.
- The recurrent cost such as operating, personnel and maintenance costs should be minimised based on the cost minimisation plan by GWMC.
- Since ***the benefits accrued from the methane gas reduction cannot be converted into the actual cash flow*** due to the current situation of the CDM as well as the international market of carbon prices, the financial IRR is relatively low. However, in addition to the environmental monitoring, the traded price level of carbon credits in the international market should be continuously monitored for the identification of the environmental impacts by monetary values.

### (5) Institutional and Organizational Evaluation

From the perspective of institutional and organizational aspect, Option B is most preferable. This is because it is most important for GWMC/CDGG to comply with laws and regulations that is the provision of waste collection and transportation services in City and Sadar areas. For this purpose, although it requires initial investment, it is essential to solve the problems of collection and transportation and final disposal. Introduction of separation at source and intermediate treatment is recommended as it decreases the running cost of collection & transport and final disposal.

### (6) Overall Evaluation

The target collection rate of 100% for covering 98 UCs in year 2030 is an ideal goal for all the residents of Gujranwala, so that the plans for pursuing this goal should be carried out with dedication and dispatch. To realise the Vision of ISWM for Gujranwala City, the proposed projects in the Master Plan should be carried out since implementation of these projects will bring large benefits to the residents of Gujranwala.

A significant feature of public awareness in Gujranwala is characterised that the residents are displaying indifference towards SWM issues. GWMC, therefore, should conduct firstly all technical improvements as well as support for start-up of environmental education and public awareness raising programmes. The 3R promotion activities should be initiated from introduction of waste separation at source that is a basis of the new collection and transportation scheme, and they are integral parts of the new ISWM Master Plan. Public awareness raising and the implementation of environmental education are thus indispensable for the promotion of 3R even if the visible effects on ISWM will take quite a long time to appear.

In order to establish effective and sustainable provision of SWM services, financial stability of GWMC is required. However, GWMC cannot collect waste charges or tariff from the residents due to uncooperative people and political issues. In addition, since private involvement has not been matured in the sector of SWM, GWMC should take lead to carry out the required actions in the early stage of the Master Plan, based on the subsidy of the local government and the provincial government.

A new final disposal site is necessary to secure the proposed ISWM system in any cases and needs a huge amount of money. Therefore, the Government of Pakistan, including the Government of the Punjab, should consider that some financial arrangements are indispensable for the implementation of the action plans. It should also be recognised that the implementation of a proper SWM requires to some extent a financial burden from the government, but the responsibility should be shared equally by the government or public sector, the private collectors or private sector, and the residents or people.

## 6.4 Operation and Effect Indicators for Project Evaluation

Monitorable operation and effect indicators of the Project or activities formulated in the ISWM Master Plan were determined through consultations with the Pakistani side. **Table S.6.3** shows the values of operation and effect indicators in the current year (2014/2015) and the planned values for the years 2020 and 2030 which are the base values for comparison.

**Table S.6.3 Current and Planned Value of Operation and Effect Indicator**

| Planned Project/ Operation and Effect Indicator | Current Value (2014/2015) | Planned Value in 2020 | Planned Value in 2030 | Evaluation Method |
|---|---|---|---|---|
| **Programme 1: Waste Collection and Transportation Plan** | | | | |
| Waste Collection and Transportation Amount (t/day) | 410 | 1,459 | 3,346 | Analyse the truck scale records to calculate the daily average value. |
| Waste Collection Service Rate (%) | Urban UC: 43<br>Peri Urban: 0<br>98UC Avg.: 34 | Urban UC: 100<br>Peri-Urban: 20<br>98UC Avg.: 81 | Urban UC: 100<br>Peri-Urban: 100<br>98UC Avg.: 100 | -ditto- |
| Status of Illegal Dumping (Collection amount of waste from the illegal dump sites) (t/day) | 60 | 0 | 0 | Analyse the truck scale records to calculate the average value of the discarded waste by the OTC (One Time Cleaning) activity. |
| Rate of Remaining Number of Illegal Dump Sites (%) (Alternative) | 100 | 0 | 0 | Carry out the field reconnaissance and record the status of all the remaining illegal dump sites. |
| **Programme 2: Final Disposal Plan** | | | | |
| Final Waste Disposal Amount (t/day) | 406 | 991 | 2,013 | Analyse the truck scale data to calculate the average incoming waste amount per day. |
| Waste Diversion Rate (%) | 15 | 32 | 40 | Carry out the interview survey to the recyclers/junk shops/waste pickers to estimate the resource material recovery amount. |
| **Programme 3: Intermediate Treatment and 3R Promotion Plan** | | | | |
| Per Capita Waste Generation Amount (g/c/day) | Urban UC:400<br>Peri-Urban:350 | Urban UC:424<br>Peri-Urban:374 | Urban UC:467<br>Peri-Urban:414 | Carry out the Waste Amount and Composition Survey (WACS) to estimate the per capita domestic waste generation amount. |
| Resource Material Recovery Amount (t/day) | 70 | 218 | 622 | Carry out the interview survey to the recyclers/junk shops/waste pickers to obtain the resource material recovery amount. |
| Compost Plant Input Waste Amount (t/day) | 0 | 250 | 250 | Analyse the truck scale record to calculate the average incoming raw material amount to the plant. |
| Status of Compost Production - Production Amount (t/day) | 0 | 125 | 125 | Analyse the truck scale record to calculate the average amount of final compost product. |
| **Programme 4: Environmental Education and Public Awareness Raising Plan** | | | | |
| No. of School Classes for Environmental Education (class/year) | 0 | 200 | 710 | Record the number of classes that carried out the environmental education |

| Planned Project/ Operation and Effect Indicator | Current Value (2014/2015) | Planned Value in 2020 | Planned Value in 2030 | Evaluation Method |
|---|---|---|---|---|
| | | | | programme. |
| No. of Education Programmes for General Public (times/year) | 1 | 3 | 4 | Record the number of environmental education programmes carried out for the general public. |
| Raising Public Awareness (%) | 38 | 60 | 80 | Carry out the public awareness survey and analyse the awareness of the residents for the SWM services. |
| **Programme 5: Economic and Financial Plan** | | | | |
| FIRR (Financial Rate of Return) (%) | 9.18 | 9.18 | 9.18 | Collect the actual annual cost and income up to the previous evaluation year. |
| EIRR (Economic Rate of Return) (%) | 10.88 | 10.88 | 10.88 | Collect the economic annual cost and gross benefits up to the previous evaluation year. |
| Required Amount of Subsidy for O&M Cost (1000 Rs.) | 212,290 | 475,063 | 629,544 | Collect the actual annual cost and income up to the previous year. |
| Level of Waste Fee for Recovering 100% O&M Cost (Low-income Area) (Rs./month/household) | 77.2 | 77.2 | 77.2 | Recalculate the level of waste fee required in 2020 based on the actual cost and income up to 2019. |
| Level of Waste Fee for Recovering 100% O&M Cost (Middle-income Area) (Rs./month/household) | 154.4 | 154.4 | 154.4 | -ditto- |
| Level of Waste Fee for Recovering 100% O&M Cost (High-income Area) (Rs./month/household) | 308.8 | 308.8 | 308.8 | -ditto- |
| **Programme 6: Environmental Monitoring Plan** | | | | |
| Number of Environmental Monitoring at Bhakhraywali (times/year) | 0 | 4 | 4 | Record the number of environmental monitoring surveys implemented per year. |
| Number of Monitoring at Gondlanwala (times/year) | 0 | 1 | 1 | -ditto- |
| Number of Monitoring at Chianwali (times/year) | 0 | 1 | 1 | -ditto- |
| **Programme 7: Institutional Strengthening and Organization Plan** | | | | |
| Number of Capacity Development Programs (Unit: cumulative number of training) | 0 | 11 | 27 | Record the number of respective training courses implemented and obtain the cumulative number of times. |
| Number of Management Staff of the Organization (Unit: person) | 46 | 70 | 76 | Count and record the total number of management staff of the organization. |

## 6.5 Number of Direct and Indirect Beneficiaries of the Project

### (1) Project Area Population - Waste Collection Target Area Population (Direct Beneficiaries)

The Project will impact directly on the Project Area, i.e., the waste collection target area, and its population of the current year (2014), 2020 and 2030 is estimated at 2,964 thousand, 3704 thousand and 5,373 thousand, respectively on the basis of the 1998 Census population.

### (2) Gujranwala District Population (Indirect Beneficiaries)

The Project can be realised to contribute to the Gujranwala District indirectly since the increase of the waste collection rate up to 100% in the urban UCs by 2018 followed by the peri-urban UCs by 2030 will impact on the remaining areas of the District. The current population of Gujranwala District in 2014 based on the 1998 Population Census is estimated at 4,667 thousand (Source: page 287, Punjab Development Statistics 2014, http://www.bos.gop.pk/system/files/Dev-2014.pdf).

## 6.6 Implementation Schedule and Cost

Actions and costs required for the implementation of each component of the Master Plan are summarised in **Figures S.6.1 and S.6.2**.

| Implementation Programme (Programme 1 to 3) | Cost (thousand Rs.) | |
|---|---|---|
| **Programme 1: Waste Collection & Transportation Plan** | | |
| 1-1 Itroduction of Separate Collection & Alternate-Day Collection through Implementation of Pilot Project | | 143,525 |
| 1-2 Increase of Waste Collection Rate in 64 UCs up to 100% in 2018 | | 1,649,399 |
| 1-3 Planning/Implementing for the Method of Separate Collection in 98 UCs | GWMC | |
| 1-4 Increase of Waste Collection Rate in 34 UCs from 0% to 60% in 2024 | GWMC | |
| 1-5 Sustaining Waste Collection Rate in 64 UCs from the Current with 100% | GWMC | |
| 1-6 Increase of Waste Collection Rate in 34 UCs to 100% in 2030 | GWMC | |
| 1-7 Procurement of Waste Collection Vehicles and Containers in 98 UCs | | 10,555,881 |
| 1-8 Monitoring on Improvement of Waste Collection and Transportation in 98 UCs | GWMC | |
| 1-8 Outsourcing the Waste Collection and Transportation Service to a Private Company | GWMC | |
| 1-9 Conducting Street Cleaning | | 316,400 |
| 1-10 Collection of Bulky Waste | | 97,350 |
| 1-11 Cleaning Up of Illegal Dumping Sites in 64 Ucs | | 23,773 |
| 1-12 Collection of Construction and Demolition Waste | | 115,350 |
| 1-13 Construction of Parking Area | | 1,119,112 |
| **Sub-Total of Programme 1** | | **14,020,790** |
| **Programme 2: Final Disposal Plan** | | |
| 2-1 Procurement of Sanitary Landfill Site | | 450,000 |
| 2-2 Engineering Service for Sanitary Landfill Facilities | | 294,495 |
| 2-3 Construction of Sanitary Landfill Facilities in Bhakhraywali | | 2,990,400 |
| 2-4 Procurement and Replacement of Landfill Machinery | | 332,100 |
| 2-5 Operation and Maintenance of Landfill Facilities | | 698,915 |
| 2-6 Improvement Work of the Existing Landfill in Gondlanwala | | 55,902 |
| 2-7 Safe Closure of the Landfill Site in Gondlanwala | | 26,196 |
| 2-8 Safe Closure of the Landfill Site in Chianwali | | 34,554 |
| 2-9 Monitoring of Final Disposal in Bhakhraywali | GWMC | |
| 2-10 Post-Closure Monitoring of Gondlanwala and Chianwali Landfill Sites | GWMC | |
| 2-11 Site Selection of Sanitary Landfill Site (Stage 2 - Stage 3) | GWMC | |
| **Sub-Total of Programme 2** | | **4,882,562** |
| **Programme 3: Intermediate Treatment and 3R Promotion Plan** | | |
| 3-1 Awareness & IEC Campaign on Resources Recovery | | in Programme 4 |
| 3-2 IEC Campaign for Resource Recovery at Source/Registration of Waste Pickers and Recycling Industries | | in Programme 4 |
| 3-3 Implementation of Simplified WACS | GWMC | |
| 3-4 Preparation for PPP & Formation of a Committee of the BOD of GWMC | GWMC | |
| 3-5 Implementation of Land Preparation by GWMC | GWMC | |
| 3-6 Engineering Service for Detailed Design of the Compost (& RDF) Plant by SPV | | 44,000 |
| 3-7 Purchase of Land for the Compost Plant | | 42,000 |
| 3-8 Construction Work for the Gujranwala Compost Plant owned by SPV including Procurement of Equipment | | 430,000 |
| 3-9 Operation and Maintenance of the Compost (& RDF) Plant | | 508,911 |
| 3-10 Monitoring of Implementation of the Compost (& RDF) Plant | SPV | |
| 3-11 Preparation and Enacting of Recycling Laws in Punjab, Pakistan | Gov..of the Punjab | |
| **Sub-Total of Programme 3** | | **1,024,911** |
| **Total of Programme 1 to 3** | | **19,928,263** |

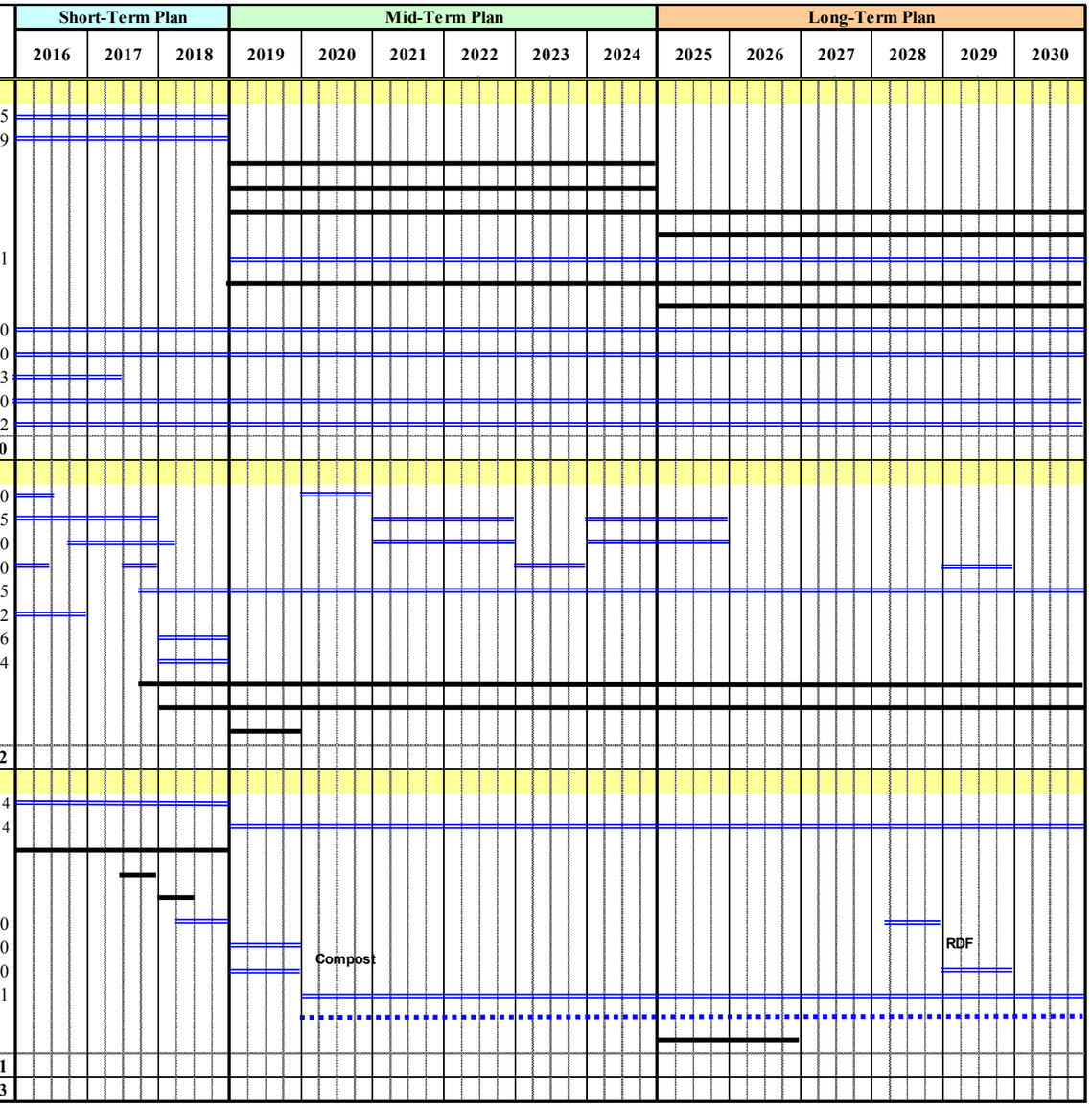



**Figure S.6.1 Summary of Implementation Schedule and Cost of the Master Plan (1)**

| Implementation Programme (Programme 4 to 7) | Cost (thousand KSh) | | Short-Term Plan | | | Mid-Term Plan | | | | | | Long-Term Plan | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| **Programme 4: Environmental Education and Public Awareness Raising Plan** | | | | | | | | | | | | | | | | | |
| 4-1 Capacity Development of Communication Unit to Strengthen the Coordination among Relevant Bodies | | 62,135 | | | | | | | | | | | | | | | |
| 4-2 Development and Implementation of Educational Programmes Targeting Primary School Teachers and Students | | 42,136 | | | | | | | | | | | | | | | |
| 4-3 Development and Implementation of Educational Programmes Targeting General Public | | 12,514 | | | | | | | | | | | | | | | |
| 4-4 Development and Implementation of Monitoring Plan | | 4,125 | | | | | | | | | | | | | | | |
| 4-5 Development of Environmental Education Facility and its Utilisation Plan | | 400 | | | | | | | | | | | | | | | |
| 4-6 Managment of Environmental Education Facility and its Utilisation | | 1,100 | | | | | | | | | | | | | | | |
| **Sub-Total of Programme 4** | | **122,410** | | | | | | | | | | | | | | | |
| **Programme 5: Economic and Financial Plan** | | | | | | | | | | | | | | | | | |
| 5-1 Establishment of Sustainable Cost Recovery | GWMC | | | | | | | | | | | | | | | | |
| 5-2 Implementation of Accurate Total Costing | GWMC | | | | | | | | | | | | | | | | |
| 5-3 Introduction of Proper Tariff Charging System | | in Programme 7 | | | | | | | | | | | | | | | |
| 5-4 Implementation of Financially Efficient Private Sector Involvement | GWMC | in Programme 7 | | | | | | | | | | | | | | | |
| **Sub-Total of Programme 5** | | | | | | | | | | | | | | | | | |
| **Programme 6: Environmental Monitoring Plan** | | | | | | | | | | | | | | | | | |
| 6-1 Monitoring of Collection and Transport Work | GWMC | | | | | | | | | | | | | | | | |
| 6-2 Monitoring of Final Disposal Site in Bhakhraywali | | 20,170 | | | | | | | | | | | | | | | |
| 6-3 Monitoring of Post-Closure Final Disposal Sites in Gondlanwala and Chianwali | | 1,820 | | | | | | | | | | | | | | | |
| 6-4 Monitoring of Intermidiate Process (Compost Facility) | GWMC | | | | | | | | | | | | | | | | |
| **Sub-Total of Programme 7** | | **21,990** | | | | | | | | | | | | | | | |
| **Programme 7: Institutional Strengthening and Organizational Plan** | | | | | | | | | | | | | | | | | |
| 7-1 Improvement of Organisational Restructuring of GWMC | | 346,709 | | | | | | | | | | | | | | | |
| 7-2 Capacity Development of GWMC Staff | | 76,894 | | | | | | | | | | | | | | | |
| 7-3 Establishment of Gujuranwala Solid Waste Management By-Law | | 844 | | | | | | | | | | | | | | | |
| **Sub-Total of Programme 7** | **0** | **424,447** | | | | | | | | | | | | | | | |
| **Total of Programme 4 to 7** | **0** | **568,847** | | | | | | | | | | | | | | | |
| **Grand Total** | **0** | **20,497,110** | | | | | | | | | | | | | | | |

To be conducted by local fund
To be conducted by Special Purpose Vehicle (SPV)
To be conducted by the GWMC's own resources

**Figure S.6.2 Summary of Implementation Schedule and Cost of the Master Plan (2)**

## 6.7 Selection of Priority Projects

The priority projects are defined as projects for the short-term period of the Master Plan which will be developed to the action plans in the next stage. The following projects are thus selected as the priority projects:

**1. Waste Collection and Transportation Plan**

1-1 Introduction of Separate Collection and Alternate day Collection through Implementation of Pilot Project

1-2 Increase of Waste Collection Rate in 64 UCs up to 100% in 2018

1-3 Conducting Street Cleaning in 64 UCs

1-4 Collection of Bulky Waste

1-5 Cleaning Up of Illegal Dumping sites in 64 UCs

1-6 Construction and Demolition Waste Collection

1-7 Construction of Parking Area

**2. Final Disposal Plan**

2-1 Procurement of Sanitary Landfill Site

2-2 Engineering Service for Sanitary Landfill Facilities (Stage 1)

2-3 Construction of Sanitary Landfill Facilities (Stage 1) in Bhakhraywali

2-4 Procurement of Landfill Machinery

2-5 Operation and Maintenance of Landfill Facilities

2-6 Improvement Work of the Existing Landfill in Gondlanwala

2-7 Safe Closure of the Landfill Site in Gondlanwala

2-8 Safe Closure of the Landfill Site in Chianwali

2-9 Monitoring of Final Disposal in Bhakhraywali

2-10 Post-Closure Monitoring of Gondlanwala and Chianwali Landfill Sites

**3. Intermediate Treatment and 3R Promotion Plan**

3-1 Awareness and IEC (Information, Education and Communication) Campaign on Resource Recovery

3-2 Implementation of Simplified WACS

3-3 Preparation for PPP and Formation of a Committee of the BOD of GWMC

3-4 Implementation of Land Preparation by GWMC

3-5 Engineering Service for Detailed Design of a Compost Plant by SPV

**4. Environmental Education and Public Awareness Raising Plan**

4-1 Capacity Development of Communication Unit to Strengthen Coordination among Relevant Bodies

4-2 Development and Implementation of Educational Programmes Targeting Primary School Teachers and Students to Enhance Knowledge/Awareness on SWM and 3R Promotion

4-3 Development and Implementation of Educational Programmes Targeting General Public to Enhance Knowledge/Awareness on SWM and 3R Promotion

4-4 Development of Environmental Education Facility and its Utilisation Plan including the Content of Educational Programmes

**5. Economic and Financial Plan**

5-1 Establishment of Sustainable Cost Recovery

5-2 Implementation of Accurate Total Costing

5-3 Introduction of Proper Tariff Charging System

5-4 Implementation of Financially Efficient Private Sector Involvement

**6. Environmental Monitoring Plan**

6-1 Environmental Monitoring for the Collection and Transportation Work

6-2 Environmental Monitoring for the Final Disposal Site in Bhakhraywali

6-3 Environmental Monitoring for the Safe Post-Closure of Final Disposal Sites in Gondlanwala and Chianwali

**7. Institutional Strengthening and Organizational Plan**

7-1 Organizational Restructuring of GWMC

7-2 Capacity Development of GWMC Staff

7-3 Establishment of Gujranwala Solid Waste Management By-Law

# 7. ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

## 7.1 Planning Procedures and Selection of Optimum Master Plan

### (1) Planning Procedures for Development of the Master Plan

The SEA principle is 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 the tools for 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 S.7.1** 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.

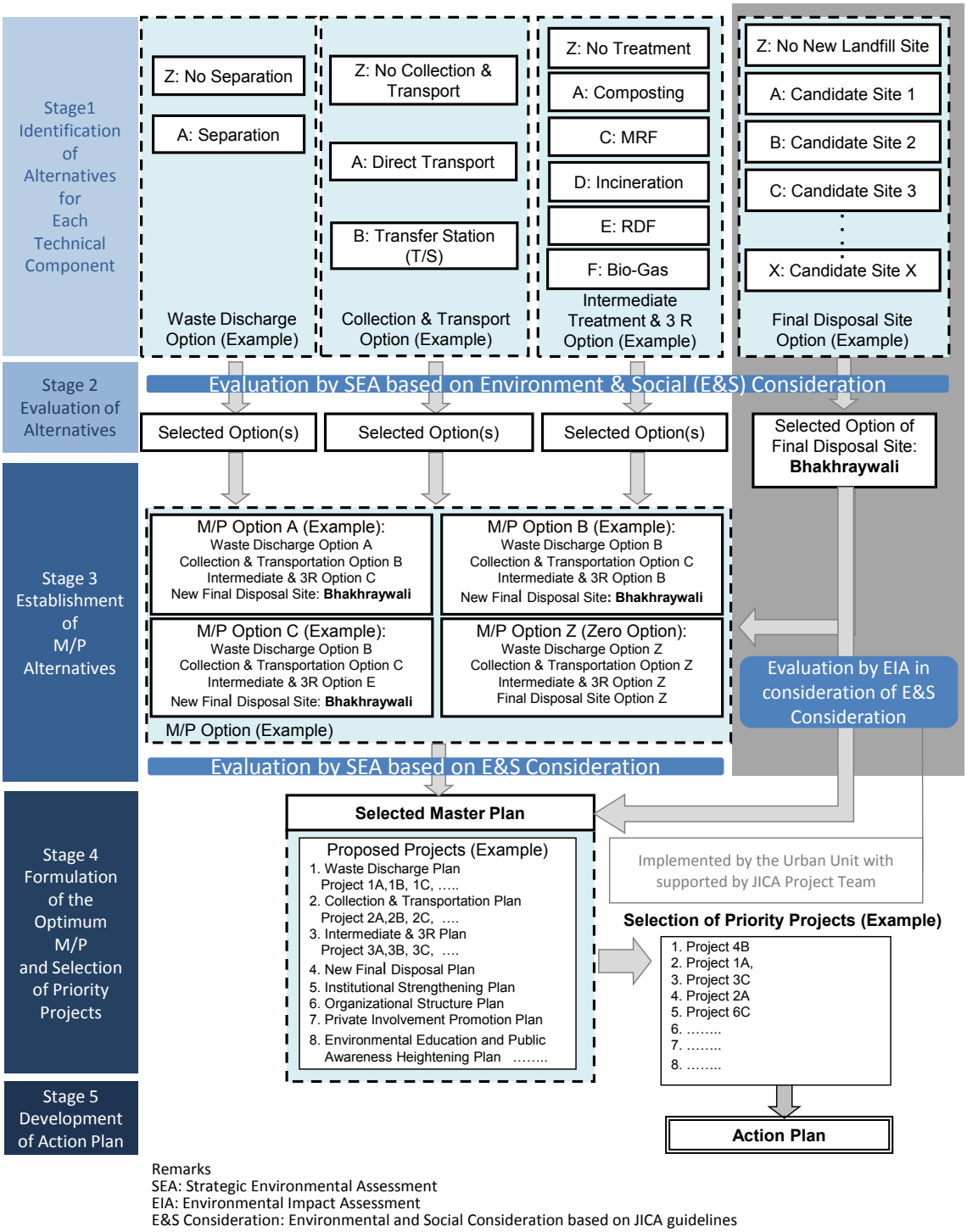



**Figure S.7.1 Planning Procedure of the Master Plan with Environmental and Social Considerations**

## (2) Selection of Optimum Master Plan

The master plan study options including the selection of Option B as the optimum combination from the technical, environmental, social, financial, institutional and organizational viewpoints have been discussed in the preceding **Chapter 6**. This Option B consists of the following technical options to achieve the targets for setting the master plan:

- 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 a RDF plant.

## 7.2 Baseline of Environmental and Social Condition

It is essentially required to consider the utmost mitigation of probable impacts to the environmental and social aspects in practicing the projects of the selected technical option, and 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 the submission, the Public Hearing and Review was carried out on 17 August 2015, and Decision will be made by the Federal Agency.

### (1) Natural Condition

**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, and 4 degrees Celsius in the months of December and January. The summer season starts from April and continues until the end of September, the winter season starts from November and continues until February, and Monsoon starts from the later part of June and lasts over the period of two-and-a-half months.

**Water**

**Surface water:** The *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 *nullahs* (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 mainly used 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 population use drinking water from the piped water supply scheme.

**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.

**Flora:** The project area, which is an agricultural land, is the habitat of several flora species. Common floral species with rooted vegetation are also present near most of the water bodies of the area.

**Land-use**

The project site of the proposed landfill is an agricultural land with 10-15% uneven land left after the excavation activities.

**Air and Noise**

During the survey at the site, no air pollution or generation of noise was noted.

### (2) Socio-economic Condition

**Population**

The total population of Gujranwala District is 3,400,940 as estimated in March 1998. The 1998 Census shows that the population of the district consists of Muslims (95%), Christians (4%), and Hindu and others (less than 1%).

**Economic Activities**

Gujranwala is a vibrant economic city of the Punjab with palpable contribution in agriculture and the industrial sector. It is one of the major wheat and rice producers in the Punjab. In terms of industrial sector, Gujranwala is one of the important commercial and industrial nerve centres of Pakistan. Production of good quality ceramics is also one of the most important sectors in Gujranwala.

**Sanitation**

Thirty-five point three percent (35.3%) of households have no sanitation facility, and 42.8% have flush toilet in dwelling while 21.9% have flush toilet in premises. Infant morbidity rate is 67/1,000 live births.

**Health Condition**

Acute respiratory infection is the frequent health problem.

### (3) Public Consultation

As a component of public consultation, 74 stakeholders were interviewed. As many as 11 stakeholders selected from public institutions, such as the Irrigation Department, Agriculture Department, Environment Protection Department, City District Government Gujranwala, Gujranwala Environmental Organization, and Chaon Foundation, were interviewed, and the remaining 63 residents/landowners were interviewed as well.

**Positive Perceptions:** Stakeholders showed affirmative standpoint for the sanitary landfill in Bhakhraywali in terms of public health and environmental benefit.

**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.

## 7.3 Scoping for Consideration of EIA or IEE Study

The environmental and social impact elements and the degree for the projects are clarified in advance, and the results are summarised as scoping for consideration to carry out the projects requiring EIA or IEE.

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 the scoping tables shown below are made as reference as the EIA/IEE of the respective project is carried out to ensure the appropriateness of Option B projects in terms of environmental and social aspects.

### (1) Scoping of EIA or IEE for Composting and RDF Projects

**Table S.7.1** indicates the results of preliminary evaluation of probable environmental and social impacts of composting and RDF projects, which are used as the basic scoping to carry out the EIA or IEE for the project concerned.

**Table S.7.1 Scoping of 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<br>Operation Phase: Dust in workplace |
| | (2) Water Quality | B | B | B | B | Construction Phase: Wastewater from construction staff quarters<br>Operation Phase: Wastewater from plant office |
| | (3) Wastes | C | C | C | C | Construction Phase: Construction waste and garbage<br>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 machinery<br>Operation Phase: Noise of plant machinery and incoming vehicles |
| | (6) Odour | C | A | C | B | Construction Phase: Not applicable<br>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<br>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 residents in the site |
| | (2) Living and Livelihood | C | C | C | C | No residents 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<br>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) Scoping of EIA or IEE for Waste Disposal Projects

**Table S.7.2** shows the results of preliminary evaluation of probable environmental and social impacts of the final disposal projects at Bhakhraywali, Gondlanwala and Chianwali, which are used for the basic scoping to carry out the EIA or IEE of the project concerned.

**Table S.7.2 Scoping of Bhakhraywali, Gondlanwala and Chianwali Landfill Projects**

| Category | Environmental Items | Bhakhraywali Sanitary Landfill | | Gondlanwala Improvement of Existing Landfill | | Chianwali Closure of Former Landfill | | Check Items |
|---|---|---|---|---|---|---|---|---|
| | | 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<br>Operation Phase: Generation of dust in landfill work. Generation of landfill gases. |
| | (2) Water Quality | B | A | B | A | B | B | Construction Phase:<br>Wastewater from construction staff quarters<br>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<br>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 machinery<br>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<br>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<br>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 residents 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 passersby. |
| | (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<br>Operation Phase: Accidents and insanitation to landfill operation staff |
| | (7) Waste Pickers in Landfill Site | - | A | B | A | - | - | Construction Phase: Accidents in construction work<br>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

## 7.4 Impact Assessment of Each Project

Impact from the project in the construction phase and the operation phase is evaluated. Impact in the current situation as well as in the situation that possible measures are implemented is also considered. Major residual impacts of negative and positive aspects are summarised below.

### (1) Construction and Operation of Central Compost Plant

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

**Operational Phase:** Odour, noise and vibration problem due to incoming vehicles to the plant will also be the cause of environmental impacts of 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 the construction workers will also be cause of impacts of the project. On the other hand, the increase of employment opportunity and community development will be counted as positive impact.

**Operational Phase:** Odour problem due to handling of organic waste is the most negative impact. In addition, noise and vibration problem due to incoming vehicles to the plant will

also be the cause of environmental impacts of 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 is the dust problem. In addition, surface water contamination by staff quarters, noise and vibration by construction machinery, and working condition of workers will become cause of environmental and social problems. On the other hand, the increase of employment opportunity and community development are counted as positive impact.

**Operational Phase:** Leachate and odour will become the most concerned environmental impact elements for taking appropriate measures. Working at the disposal site increases risks 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 Work of the 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 working condition of the construction workers. On the other hand, the increase of employment opportunity and community development are counted as positive impact.

**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 the Former Landfill Site in Chianwali

**Construction Phase:** The most negative impacts are the dust problem. In addition, surface water contamination, noise and vibration, working condition of the construction workers will also become impacts to the environment and to human beings. On the other hand, the increase of employment opportunity is counted as 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 elements. On the other hand, safe closure with final earth cover and fencing will be the positive impact.

## 7.5 Overall Evaluation of Selected Master Plan Option B

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

### (1) Expected Positive Impact

- The technical process mutually contributes to each other in 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 reduce the 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 reduce environmental load compared to chemical fertilizers; and
- 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 are to be controlled before the implementation of RDF in Gujranwala.

# 8. PROPOSAL FOR THE ACTION PLAN

## 8.1 Action Plan for Waste Collection and Transportation

### (1) Project for Introduction of Separate Collection and Alternate-Day Collection through Implementation of a Pilot Project

#### (a) Formulation of Detailed Plan for the Pilot Project Area

Separate waste collection and alternate-day collection are to be applied as the pilot project. One of the eight zones in the 64 UCs has been selected as the pilot project area and a detailed plan is formulated for the implementation. Separation at source and alternate-day collection are to be introduced for the first time in the city and it takes some time for the residents to acknowledge the conduct of these new activities. GWMC needs to establish an optimum promotion method through operation in the pilot project area. The detailed plan should thus include a) the necessary number of collection vehicles and containers, b) the allocation of vehicles and containers, c) specifications of required vehicles and containers, d) organization for operation and management, and e) method of monitoring and feedback of the operations.

Commencement of separate collection and alternate-day collection all over the city, i.e., in 98 UCs, are planned to start in 2019 in order to prepare for operation of the composting facility that has to be started in 2020. Based on the lessons learned from the result of the pilot project, the method of promoting the new activities in the pilot project zone shall be disseminated to the other zones in order to spread the practice of separation at source and alternate-day collection throughout the whole city.

**Selection of Pilot Project Area**

Zone 6 is selected as a pilot project zone because this zone is congested with both residential and vacant areas such as farmland, i.e., several land use types can be seen in the zone.

**Method of Separate Collection and Alternate-Day Collection**

Several units of waste containers are to be placed in each container location to conduct the separate collection of waste. If a total of four containers are required to be placed at one site, two containers shall be utilised for organic waste and the other two for the other wastes such as paper or plastic waste etc. These two types of containers should be painted with different colours to distinguish the type of waste to be discharged; for instance, a container for organic waste is painted green and the other is painted yellow.

Simultaneously, alternate-day waste collection is also proposed in the waste collection and transportation action plan. The alternate-day collection starts in Zone 6 as a pilot case in 2016 for establishing a good practice model. After establishing a good practice model by the operation in Zone 6, this model will be duplicated in other waste collection zones from year of 2019.

Public announcements and public awareness campaigns on the new system are crucial to promote acknowledgement of all the waste generators including residents and commercial establishments.

**Placement of Waste Collection Containers in the Pilot Project**

Two sizes of waste containers, i.e., $5m^3$ and $0.8m^3$ containers, are to be used in the pilot project. Each container is set to have the optimum waste collected from the source. Since the purpose of posting the $5m^3$ container is to collect a large amount of waste from the source, they are placed in a large waste discharge point such as a shopping mall, shopping centre, school, public office and market. The purpose of the $0.8m^3$ container, on the other hand, is to collect waste from households.

Zone 6 consists of farmland and residential areas and it is difficult to find an open space for the installation of containers. Therefore, it is recommended that a large number of containers shall be allocated at each site. In consideration of accessibility to the containers and the required area for their placement, four units are to be installed at each site in the plan. **Table S.8.1** shows the necessary number of waste collection vehicles and containers; that is, 240 units of containers are necessary for Zone 6 in 2018.

**Table S.8.1 Necessary Number of Waste Collection Containers in Zone 6**

| Item | 2016 | 2017 | 2018 |
|---|---|---|---|
| $5m^3$ Container | 24 | 24 | 24 |
| $0.8m^3$ Container | 110 | 170 | 240 |

**Waste Collection Vehicle Fleet Allocation in the Pilot Project**

For secondary collection, a combination of $13m^3$ compactor, $7m^3$ compactor and $4m^3$ compactor are to be utilised to support a $1m^3$ mini-dumper. The area for each collection vehicle is defined as follows:

- $13m^3$ compactor: these vehicles are dispatched for large streets such as Bypass Road and other major streets.
- $7m^3$ compactor: these vehicles are dispatched for wide streets and major streets except the above.
- $4m^3$ compactor: these vehicles are dispatched for narrow streets.
- $1m^3$ mini-dumper: these vehicles are dispatched for narrow streets to assist in the secondary collection.
- $5m^3$ arm-roll truck: these vehicles are dispatched for collecting waste from markets and shopping centres.
- Tractor trolley: these vehicles are dispatched for narrow streets.

Zone 6 consists of main streets such as Bypass Road, wide streets and narrow streets. Considering these street conditions, adequate type of vehicles has to be dispatched to the zone. **Table S.8.2** shows the necessary number of waste collection vehicles for Zone 6. As many as 37 units of waste collection vehicles are required in 2018.

**Table S.8.2 Necessary Number of Waste Collection Vehicles in Zone 6**

| Item | 2016 | 2017 | 2018 |
|---|---|---|---|
| $5m^3$ Arm-Roll Truck | 3 | 3 | 3 |
| Tractor Trolley | 4 | 4 | 4 |
| $13m^3$ Compactor | 2 | 2 | 10 |
| $7m^3$ Compactor | 5 | 8 | 10 |
| $4m^3$ Compactor | - | - | 5 |
| $1m^3$ Mini-Dumper | 5 | 5 | 5 |
| Total | 19 | 22 | 37 |

## (b) Procurement of Waste Collection Vehicles and Containers for the Pilot Project

Based on the detailed waste collection and transportation plan formulated in **Item (a)**, the necessary number of waste collection vehicles and containers needs to be procured by GWMC. Some $13m^3$ compactors, $7m^3$ compactors, $4m^3$ compactors are utilised for waste collection and mini-dumpers are utilised to assist in the primary collection. Additionally, $5m^3$ containers and $8m^3$ containers are utilised for waste collection.

GWMC shall procure the equipment from 2016 up to 2018 based on the plan. For this purpose, GWMC has to prepare documents and submit them to the Provincial Government for the annual budgetary arrangement for procurement of waste collection vehicles and waste containers.

## (c) Operation of Waste Collection and Transportation Services in the Pilot Project

For implementing the waste collection and transportation work in the pilot project, the task of General Manager Operations, Senior Manager, Assistant Manager, Inspector must be defined clearly.

An operation manual of waste collection and transportation should be prepared by a task force organized by the representative staff of GWMC. The manual must be completed by the beginning of 2016. The manual may be revised as necessary to meet the actual condition in consideration of effectiveness and efficiency of the work.

The manual has to be compiled in a booklet form and copies of the manual provided to all waste collection workers. All waste collection workers have to follow the work procedures stated in the manual to carry out the services more efficiently. In addition, regular training sessions for workers must be conducted for assuring/enhancing the knowledge on waste collection operation under the Comprehensive Capacity Development Programme (CCDP) proposed in the Institutional Strengthening and Organizational Plan.

## (d) Monitoring and Feedback of Pilot Project Operation

Regular monitoring of waste collection amount and waste collection rate must be carried out by GWMC for evaluating performance of the waste collection and transportation service in the pilot project. The monitoring of waste collection vehicles and waste containers is not only to check the operation status of daily waste collection work, but also to improve the waste collection efficiency and effectiveness by feedback from the information on the daily work. Especially, the allocation of waste collection vehicles and waste collection containers should be monitored carefully since it is linked with the waste collection efficiency and effectiveness.

Monitoring items are stipulated in the operation manual prepared under the activities of the above **Item (c)**, and the monitoring items and method must be established in the

beginning of 2016. The required minimum monitoring items for waste collection and transportation are proposed as follows:

- Weighbridge record for analysis of waste collection amount and collection service rate;
- Sanitation condition around the waste containers;
- Status of operation condition of separate collection;
- Status of operation condition of regular time collection and alternate-day collection;
- Working status of waste collection vehicles and waste containers; and
- Allocation of waste collection vehicles and waste collection containers.

## (2) Project for Increase of Waste Collection Rate in 64 UCs up to 100% in 2018

### (a) Formulation of Detailed Waste Collection and Transportation Plan for Waste Collection Rate in 64 UCs up to 100% in 2018

Increasing the waste collection rate in 64 UCs up to 100% in 2018 is the ultimate target for the short-term period of the Master Plan. To achieve the target, it is necessary to formulate a detailed waste collection and transportation plan in the early part of 2016. The contents of the detailed plan should include an allocation plan for the adequate number of waste collection vehicles, waste containers and sanitary workers on each zone in 64 UCs. Once the waste collection vehicles, waste containers and sanitary workers are in operation on site based on the plan, GWMC needs to acquire feedback and update the allocation of equipment and human resources on each zone if something has to be improved. The optimum waste collection and transportation plan, therefore, shall be established during the operation phase.

### (b) Necessary Number of Waste Collection Vehicles and Containers in 64 UCs

For allocating the waste collection vehicles and waste collection containers, necessary number of waste collection vehicles and waste collection containers are distributed based on the waste generation amount in each zone and the total number of waste collection vehicles and waste collection containers except Zone 6. **Table S.8.3** shows the necessary number of waste collection vehicles and containers in other zones from 2016 to 2018. The actual number/type of waste collection vehicles and containers for the respective zones except Zone 6 shall be distributed and adjusted in consideration of the site conditions, such as road width and surrounding land use, etc.,

**Table S.8.3 Necessary Number of Waste Collection Vehicles and Containers in Other Zones (2016-2018)**

| Item | | 2016 | 2017 | 2018 |
|---|---|---|---|---|
| Vehicle | 10m$^3$ Arm-Roll Truck | 4 | 4 | 4 |
| | 5m$^3$ Arm-Roll Truck | 19 | 19 | 19 |
| | Tractor Trolley | 33 | 33 | 33 |
| | 13m$^3$ Compactor | 12 | 27 | 67 |
| | 7m$^3$ Compactor | 33 | 49 | 89 |
| | 4m$^3$ Compactor | 0 | 0 | 35 |
| | 1m$^3$ Mini-Dumper | 30 | 30 | 30 |
| Container | 10m$^3$ Container | 10 | 10 | 10 |
| | 5m$^3$ Container | 171 | 171 | 171 |
| | 0.8m$^3$ Container | 850 | 1,490 | 2,010 |

### (c) Procurement of Waste Collection Vehicles and Containers in 64 UCs

Based on the distribution of waste collection vehicles and containers shown in the above **Item (b)**, the necessary number of waste collection vehicles and containers needs to be procured by GWMC between 2016 and 2018.

### (d) Operation of Waste Collection and Transportation Services in 64 UCs

GWMC also requires commencement of the waste collection and transportation operation not only in Zone 6 but also in other zones in 2016. The operation and management of waste collection and transportation services are the same as those of Zone 6. However, separation at source starts in the other zones from 2019, so that items required for separation at source are not needed to be included during the operation in other zones until end of 2018.

### (e) Monitoring and Feedback of Operation in 64 UCs

Monitoring and feedback of the waste collection and transportation work are conducted in other zones. Regular monitoring of waste collection amount and waste collection rate is also necessary to be carried out by GWMC for evaluating performance of the waste collection and transportation service. The contents of monitoring items are the same as those of Zone 6; however, items required for separation at source are not needed to be monitored on site.

## (3) Project for Conducting Street Cleaning in 64 UCs

### (a) Plan for Conducting Street Cleaning

The necessary length for street cleaning is determined at 2,600 km based on the measurement by using a satellite map. Also, the street sweeper is applied for major roads like G.T. Road and Bypass Road in Zones 9 and 10 while the road washing machine is applied for roads in the other zones.

In consideration of the speed of the street sweeper, the street cleaning shall be conducted once a week in Zones 9 and 10. If GWMC covers Zones 9 and 10 with a total road length of 665 km for street cleaning, one vehicle shall be dispatched on each zone and two vehicles are necessary for the street cleaning in total. Additionally, the street cleaning shall be conducted once in two weeks in the other zones if GWMC dispatches four vehicles for street cleaning by road washers.

### (b) Necessary Number of Vehicles for Street Cleaning

GWMC is obliged to conduct street cleaning in all the 64 UCs within the short-term period. The necessary number of vehicles in this period is estimated at two street sweepers and four road washers.

### (c) Specifications of Street Cleaning Vehicles

The street sweeper is a truck of 8.8 gross tonnes with a $4m^3$ of waste storage tank and a 1,000 litre water tank. Brushes are equipped at both sides of the body for cleaning road surfaces and curbs by sprayed water. The road washer is larger than the street sweeper.

## (4) Project for Collection of Bulky Waste

### (a) Plan for Conducting Bulky Waste Collection

The purpose of the project for collection of bulky waste is the collection of green waste from parks in the city and old furniture from households. There are 36 public parks in Gujranwala and the total area is approximately 580,000 square metres ($m^2$). The largest park in the city is the Gulshan-e-Iqbal Park (106,000 $m^2$) abutted on G.T. Road. There

are also trees along the streets. Green waste is generated from the parks and the streets. The project is to start in 2016 and it continues until 2030.

Bulky waste is not occasionally generated from the source so that necessary vehicles and workers for these wastes are deployed separately from the regular collection by GWMC. GWMC needs to travel and collect green waste from parks in the city on regular basis starting from 2016. However, old furniture is collected by GWMC when a concerned resident calls up for the waste collection. GWMC should set the price schedule for bulky waste collection such as old furniture, etc.

GWMC operates 6 days in a week, so that 36 parks/ 6 days = 6 parks/day. GWMC is able to collect green waste from 6 parks in a day. If a resident needs to dispose bulky waste, GWMC also collects the waste during the operation.

### (b) Necessary Number of Vehicles for Bulky Waste

Two units of 5-ton trucks and one wheel loader are deployed for the collection of bulky wastes. The workers are deployed as one team comprised of one driver and one sanitary worker per 5-ton truck and one driver for a wheel loader. The team works in 6 days from Monday to Saturday.

### (c) Specifications of the Bulky Waste Collection Vehicles

The maximum lifting capacity of 8 to 10 ton and 2,800 to 3,000 kg is required for a 5-ton truck and a wheel loader for the bulky waste collection and transportation, respectively.

## (5) Project for Cleaning Up of Illegal Dumping Sites in 64 UCs

### (a) Plan for Cleaning Up the Illegal Dumping Sites

GWMC needs to eliminate all illegal dumping sites in the city between 2016 and 2018. To achieve this goal, GWMC should firstly examine all locations of illegal dumping sites in the city.

**Planning the Clean-Up Schedule and Formation of Clean-Up Team**

The number of illegal dumping sites is estimated at 799 locations as of August 2014 based on the survey conducted by GWMC Waste Managers. GWMC has to provide ordinary waste collection services for households and commercial establishments on a daily basis so that a clean-up team is to be established exclusively for cleaning the illegal dumping sites in this action plan.

799 locations / 6 days /4 weeks /12 months / 3years = 0.9 location/day; that is, GWMC has to clean one illegal dumping site per day if GWMC considers to eliminate all the illegal dumping sites in the city in three years. If the clean-up vehicles are composed of two 5-ton trucks and one wheel loader, the loading capacity will be 5 tons × 5 trips/day × 2 vehicles = 50 ton/day = 1,200 ton/month (6 working days, 4 weeks). In this case, the duration of clean-up is 21,739 (ton) /1,200 (ton/month) = 18 months. The clean-up work is finished in around one-and-a-half year.

**Monitoring the Cleaned Sites after Conducting the Activity**

Once the cleaning activity is conducted on a site, GWMC should monitor the site consistently through patrol by an inspector and/or a sanitation supervisor. If illegal dumping activity is seen on site, they have to stop the activity.

### (b) Conducting Public Awareness Campaign and Posting of Signboard

Not only patrol of the site but also public awareness campaign is indispensable for keeping cleanliness at the site. For instance, a signboard is installed to warn that illegal dumping of waste is prohibited at the site.

### (c) Necessary Number of Vehicles for the Clean-Up of Illegal Dumping Sites

Two units of 5-ton trucks, one wheel loader and two workers are required for the work. The assigned vehicles and workers conduct only the cleaning work and are excluded from the regular waste collection work.

### (d) Specifications of Vehicles for Clean-Up of Illegal Dumping Sites

The specifications of 5-ton truck and wheel loader are the same as those in the preceding **Item (4), (c)**.

## (6) Project for Construction and Demolition Waste Collection

### (a) Plan for C&D Waste Collection

The collection and disposal of construction and demolition waste (C&D waste) is a part of GWMC's obligation according to the survey conducted by the JICA Project Team, while disposal is the responsibility of generators of C&D waste. Necessary number of C&D waste collection vehicles is taken into account for the action plan starting from 2016 and it continues until 2030 in the master plan. Since C&D waste is consisted of construction materials such as rocks, sand, concrete, reinforcement bar, brick, etc., a waste compactor is not suitable for the collection work and the work is to be carried out separately from the ordinary waste collection services.

In addition, C&D waste is generated from commercial activity and its collection should be conducted primarily by private waste collection companies with GWMC's supervision, if necessary. However, the current situation demands that GWMC has to conduct the work immediately. Thus, the schedules of collection charges by GWMC should be determined based on the estimation of costs of operating and maintaining the vehicles and manpower.

### (b) Necessary Number of Vehicles for C&D Waste Collection

Target waste is so heavy that it is difficult for a sanitary worker to load the waste. Thus, one unit of wheel loader is deployed for C&D waste loading and three units of 5-ton trucks are also deployed for the transportation of waste.

### (c) Specifications of Vehicles for C&D Waste Collection

The specifications of the 5-ton truck and wheel loader are the same as those of the preceding **Item (4), (c)**.

## (7) Project for Construction of Parking Area

### (a) Plan for Construction of Parking Area

The function of a parking area is to store collection vehicles at night after waste collection and transportation work. The number of collection vehicles has been increasing and the collection rate has improved, so that additional parking areas for procured vehicles are necessary in the future. The project starts in 2016 and it continues until 2030.

The parking area does not have the minimum function of repair work because the garage has the capability of repair work and it is centralised for efficiency.

### (b) Necessary Number of Parking Areas

In 2030, the total number of vehicles becomes 612 vehicles. However, the existing garage could accommodate only approximately 100 vehicles. Hence, the designated number of vehicles in one parking area is set as 100 vehicles. This number has the same capacity as the existing parking area. The average parking area is set as 6,000 sq. metres. However, the total area varies depending on the acquisition and/or location of the area. Necessary number of parking areas is calculated at 6; that is, total number of vehicles 612 / 100 vehicles per parking area = 6 parking areas. **Table S.8.4** shows the annual number of vehicles (for years 2016 to 2018).

**Table S.8.4 Annual Number of Vehicles (Year 2016-2018)**

| Year | 2016 | 2017 | 2018 |
|---|---|---|---|
| Number of Waste Collection Vehicles | 161 | 196 | 316 |
| Number of Parking Area | 2 | 2 | 4 |

### (c) Specifications of the Parking Area

Based on the following specifications of the new parking, GWMC needs to build new parking areas for waste collection vehicles:

- Size of the area: 6,000m$^2$
- Parking area: The area could accommodate 102 vehicles.
- Roofing: Steel skeleton structure
- Pavement: Asphalt-paved, 30mm thick
- Security system: 1 unit of guardhouse; fencing around the parking area
- For security reasons, one guardhouse is built and steel fence is installed around the facility. The place where vehicles are parked is covered with a steel skeleton building for protection against rain. The existing garage has no pavement and no roofing in parking area. The cost for improvement of the garage is included in the plan.
- Necessary pavement area on existing garage: 30mm thick, 3,735m$^2$
- Necessary roofing area on existing garage: steel skeleton structure, 1,344m$^2$

## (8) Cost of the Action Plan

The total cost for implementation of the Action Plan is estimated at Rs. 2,476 million and the annual cost of each project is presented in **Table S.8.5** below.

**Table S.8.5 Cost of the Action Plan for Waste Collection and Transportation**

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| Introduction of Separate Collection and Alternate-Day Collection through Implementation of a Pilot Project | 52,343 | 40,523 | 50,659 | 143,525 |
| Increase of Waste Collection Rate in 64 UCs up to 100% in 2018 | 288,028 | 394,639 | 966,732 | 1,649,399 |
| Conducting Street Cleaning in 64 UCs | 67,328 | 6,528 | 6,528 | 80,384 |
| Collection of Bulky Waste | 23,730 | 4,130 | 4,130 | 31,990 |
| Cleaning Up of Illegal Dumping Sites in 64 UCs | 22,382 | 1,391 | 0 | 23,773 |
| Construction and Demolition Waste Collection | 7,690 | 7,690 | 7,690 | 23,070 |
| Construction of Parking Area | 126,424 | 3,546 | 393,510 | 523,480 |
| Total | 587,925 | 458,447 | 1,429,249 | 2,475,621 |

## 8.2 Action Plan for Final Disposal

### (1) Project for Procurement of Sanitary Landfill Site

Negotiation for the acquisition of construction site has been made and agreement has almost been reached. However, the boundary line of the site is suspected to lack credibility because there is a part that is not along the existing farmland. Confirmation of the boundary line shall thus be carried out again in the presence of the landlords, because acceptance of the site boundary is necessary as advance preparation before proceeding with the signing of acquisition contract and payment immediately after approval of the 2015/2016 budget.

The road at both side banks along the irrigation canal (canal bank road) from Ali-Pur Chatha Road is used for access road. One-way traffic will be imposed, using the south-side road for access and the north-side road for exit. Since the width of the existing bridge over the irrigation canal is narrow and not suitable for passage of large vehicles, a new bridge with a minimum 40-ton traffic load is constructed across the irrigation canal. In addition, since several sections of the north-side road are narrow, a field survey shall be carried out carefully to determine the boundary for the road improvement work. Approval of the Irrigation Department is a must for the road improvement work, including the construction of bridge and use of the road for the purpose of waste management services. By the end of July 2015, an application has been submitted to obtain the approval. All the processes for the approval and/or agreement have to be completed as the requirement for allocation of the project budget.

### (2) Project for Engineering Service for Sanitary Landfill Facilities (Stage 1)

GWMC shall organize a project management unit (PMU) with the deployment of one chief engineer, two assistant engineers and two office clerks. The PMU shall firstly enter into a consulting service contract with an engineering service company for performing the role of project consultant which will conduct on behalf of the project proponent a series of step-wise works required for implementation and management of the construction project of Bhakhraywali sanitary landfill (SLF) facilities. The consultant will also advice, assist and support the project proponent to make timely and appropriate approval required from time to time in the course of implementation of the project. The construction project of Bhakhraywali will be implemented mainly by three parties: GWMC, consultants and contractors.

#### (a) Preliminary and Detail Design Works

The consultant shall perform the preliminary design based on the conceptual design of the Action Plan. The preliminary design must be subject to approval by the project proponent, GWMC. Based on the approved preliminary design drawings, the consultant will prepare the detail design drawings that make up the tender document to facilitate accurate cost estimates for the construction contract tender. The detail design work shall include preparation of quantity take-off, unit cost analysis, priced bill of quantities, design criteria, report and calculation in addition to the tender drawings. The conceptual design drawings of Bhakhraywali SLF facilities are presented in **Figure S.8.1**.

#### (b) Preparation of Tender Document

The consultant is to prepare the document for competitive bidding of the construction of Bhakhraywali sanitary landfill facilities in the final stage of the design work. With regard to the preparation of contract documents and general conditions of contract, it is preferable to take into consideration the conditions of standard contract of GWMC as much as possible.

### (c) Preparation of Bill of Quantities

Calculation of the Bill of Quantities shall commence with the preparation of construction quantity take-off sheets of the facilities, equipment, devices and temporary works required to construct, install and procure for completing the construction work as intended in the design. Each item composing the Bill of Quantities shall be itemised to coincide with the regular payment items for the work done. The consultant will also prepare the unit cost analysis/estimates for each item of the Bill of Quantities with reference to the latest market price announced by the government and the quotation from the manufacturers.

### (d) Support for Tender Evaluation

The consultant shall support the tender evaluation in each process from pre-qualification of the interested bidders until signing of the construction work contract.

### (e) Construction Supervision

The consultant shall supervise the construction work in the construction stage and to assist/advice GWMC and the contractor to perform the construction work in accordance with the drawings, specifications and the construction time schedule.

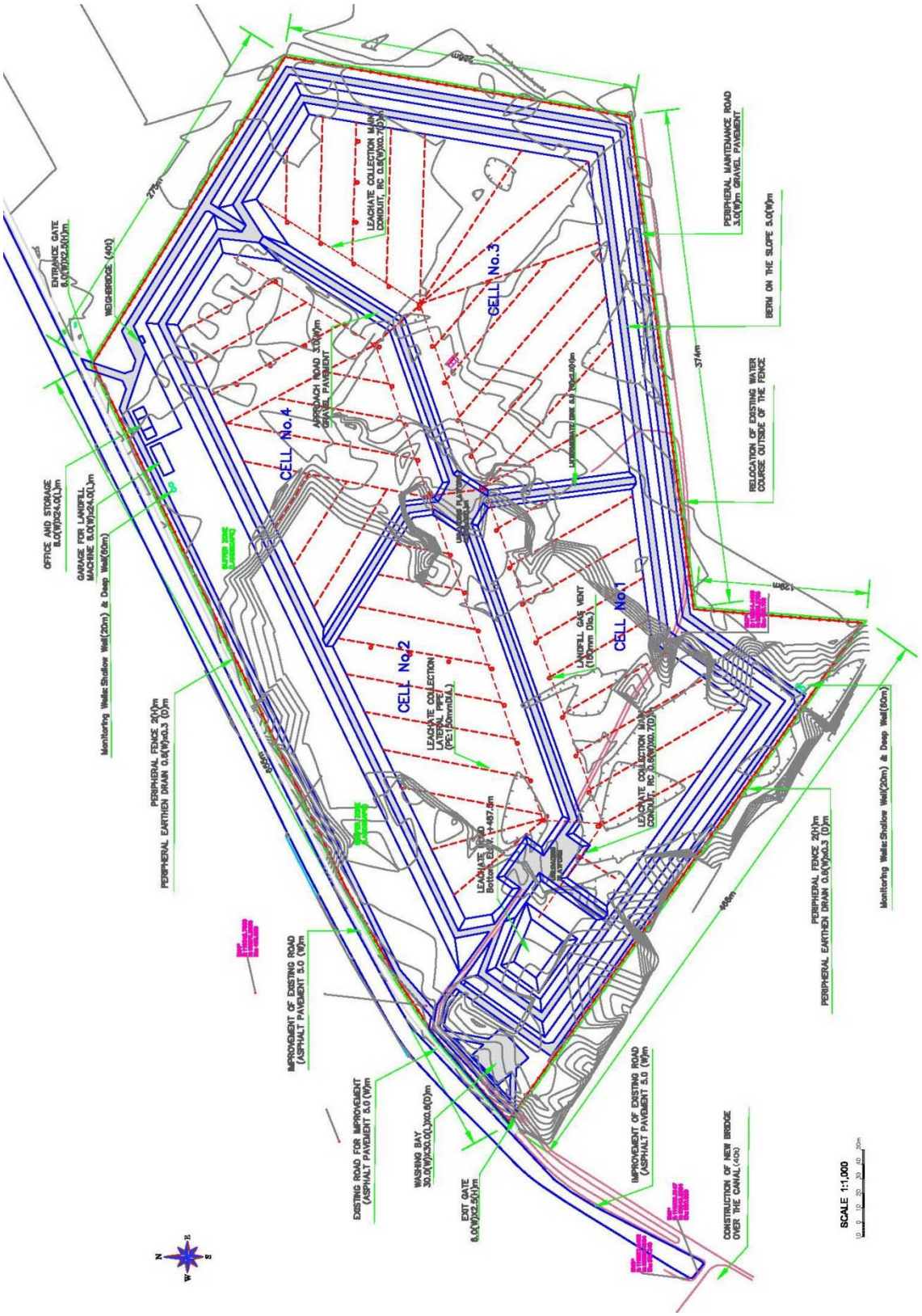



**Figure S.8.1 Layout Plan of Bhakhraywali SLF Facilities**

### (3) Project for Construction of Sanitary Landfill Facilities (Stage 1) in Bhakhraywali

Development of sanitary landfill facilities is divided into three (3) stages under the Master Plan period from 2016 to 2018. In the first stage of development or the action plan, the landfill containment of 20 hectares is constructed together with the associated facilities. In addition, improvement of the existing canal bank road on both sides of the main irrigation canal and construction of the new bridge are included in the first stage of development work. The construction work period will take 15 to 18 months and the contractor shall complete the construction work by the end of 2017 or at the latest in early 2018.

### (4) Project for Procurement of Landfill Machinery

#### (a) Preparation of Tender Document

In total, seven (7) units of landfill machine are required in 2018. Since three (3) units of bucket tractors exist as of May 2015, an additional of four (4) units shall be procured by 2018. Preparation of the tender documents will be carried out by the consultant hired for the procurement of landfill machine. The required tender document will be similar to the document prepared for the construction work of Bhakhraywali SLF facilities.

#### (b) Procurement and Inspection

During the short-term period from 2016 to 2018, the procurement of landfill machinery will be executed twice in 2016 and in 2017 as listed in **Table S.8.5**. The landfill machinery shall be inspected upon delivery at site and operation instructions shall be provided by the supplier/manufacturer.

**Table S.8.6 Landfill Machine Procured in the Short-Term Period**

| Landfill Machine | Procurement Year | | Specifications |
|---|---|---|---|
| | 2016 | 2017 | |
| Wheel Loader | 1 | | Bucket Size 3.3m$^3$, Output Capacity 149kW or 202hp |
| Excavator | 1 | | Bucket Size 1.5m$^3$, Output Capacity 200kW or 272hp |
| Bulldozer | | 2 | Chain Dozer, Blade Width 3.9m or wider, Output Capacity 165kW or 220hp |

### (5) Project for Operation and Maintenance of Landfill Facilities

#### (a) Preparation of Operation and Maintenance Manual

Landfill operation is scheduled to start in the beginning of 2018 at Bhakhraywali. Accordingly, a landfill plan and a landfill operation and maintenance manual shall be prepared in advance of the commencement of landfill operation. The manual shall be prepared based on the relevant rules, regulations and guidelines in consideration of the specific conditions of the Bhakhraywali landfill site.

#### (b) Operation and Maintenance of Landfill Facilities

In order to carry out appropriate landfill operation and maintenance of the landfill facilities, the key issues are input with capable human resources, sufficient number of staff and landfill machine/equipment and adequate financing for operation and management.

### (6) Project for Improvement Works of the Existing Landfill in Gondlanwala

#### (a) Design of Improvement Works

Improvement works are carried out to provide the required minimum functionality to the existing disposal site for upgrading the landfill work. The main purpose of the

improvement works is to change the existing open dumping method from the top of the landfill area to the method of unloading waste in the bottom of the landfill area and piling up of the waste layer. The improvement works will be carried out mainly by GWMC and partly by the hired contractor for some special works. Based on this concept, the consultant shall prepare the work drawings in accordance with the conceptual design of the Action Plan which is presented in **Figure S.8.2**.

### (b) Implementation of Improvement Works

The improvement works will be carried out mainly by GWMC staff responsible for landfill operation. The works will be carried out as free time or idling time and extra work of the staff. Some of the special works such as installation of leachate collection conduit, leachate pump well, piping, power supply, landfill gas venting system, etc. may be carried out by the construction contractor hired by GWMC as required. The improvement work to be conducted by the contractor(s) shall follow the requirements similar to the description in the above ***Item (3), Project for Construction of Sanitary Landfill Facilities (Stage 1) in Bhakhraywali***. Funding of this project shall be secured by the annual budget of GWMC or the project funding by the Government of the Punjab.

## (7) Project for Safe Closure of Landfill Site in Gondlanwala

### (a) Design of Safe Closure Work of Gondlanwala Disposal Site

Safe closure work of Gondlanwala is scheduled in 2018 after the Bhakhraywali SLF facilities become operational. If the proposed improvement work is carried out properly, it is not necessary to implement a special safe closure work except the requirement for final soil cover and extension of gas vent pipes. Accordingly, the design of safe closure work of Gondlanwala will be carried out by GWMC.

### (b) Implementation of Safe Closure Work of Gondlanwala Disposal Site

The safe closure work of Gondlanwala will be carried out mainly by the landfill operation staff of GWMC as free time or idling time and extra work. Some of the special works such as extension of gas vent pipes may be carried out by the construction contractor hired by GWMC as required. The closure work to be conducted by the contractor(s) shall follow the requirements similar to the description in the above ***Item (3), Project for Construction of Sanitary Landfill Facilities (Stage 1) in Bhakhraywali***. Funding of this project shall be secured under the annual budget of GWMC or the project funding by the Government of the Punjab.

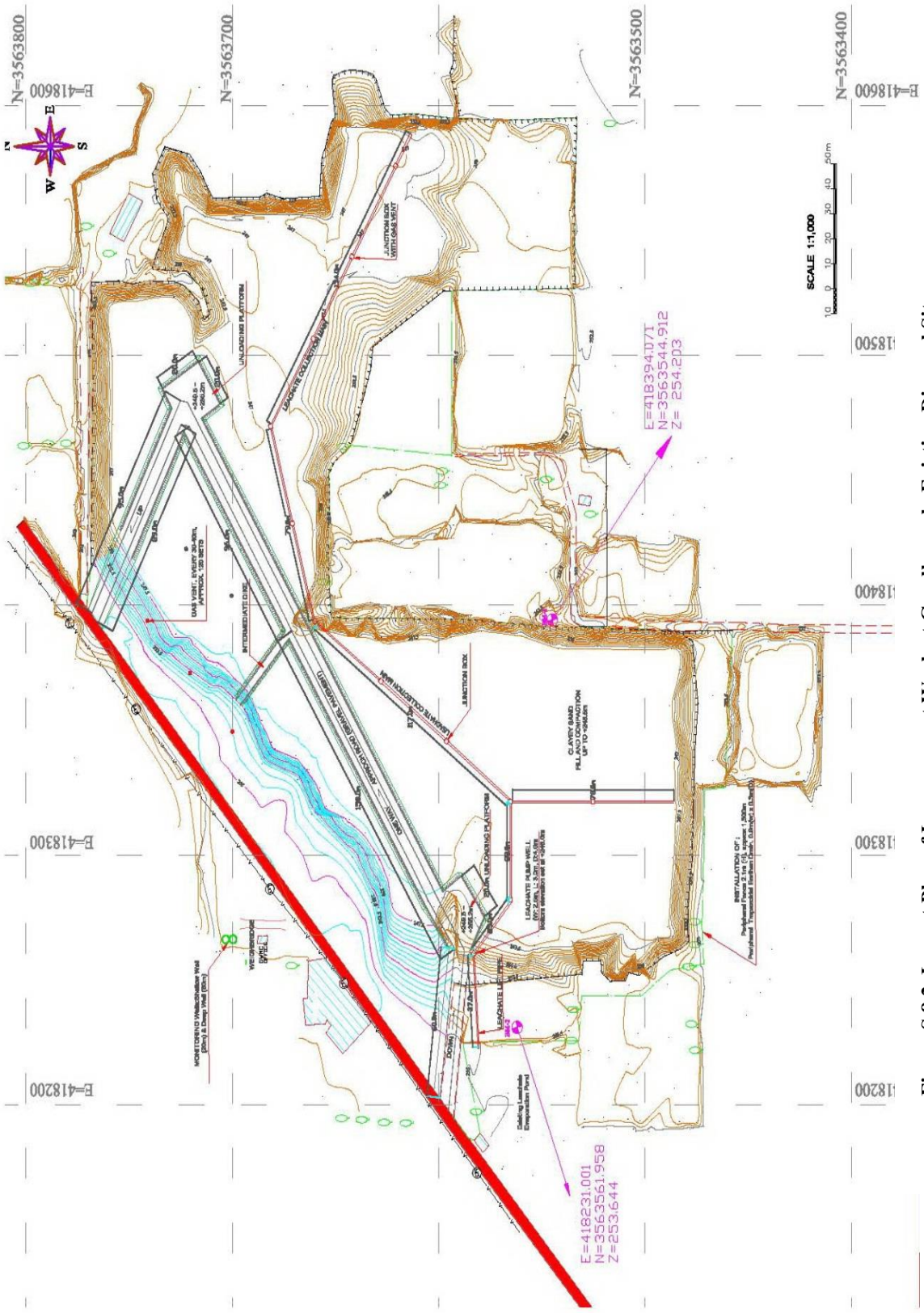



**Figure S.8.2 Layout Plan of Improvement Work at Gondlanwala Existing Disposal Site**

## (8) Project for Safe Closure of Landfill Site in Chianwali

### (a) Design of Safe Closure Work of Chianwali Disposal Site

Safe closure work is carried out to provide the required minimum facilities and work to the former Chianwali landfill site. The main purpose of this closure work is to facilitate safe closure of the former landfill site to mitigate the probable negative environmental impacts in the surrounding area. The closure work will be carried out mainly by GWMC and partly by the hired contractor for some special works. The consultant shall prepare the work drawings based on this conceptual design of the Action Plan which is presented in the following subsections together with the descriptions of required facilities, specifications and dimensions for safe closure of the former landfill site in Chianwali. The conceptual design drawings of safe closure work of the former Chianwali disposal site are presented in **Figure S.8.3**.

### (b) Implementation of Safe Closure Work of Chianwali Disposal Site

The closure work will be carried out mainly by GWMC staff responsible for landfill operation. The work will be carried out as free time or idling time and extra work of the staff. Some of the special works such as installation of leachate collection pipes, power supply, etc. shall be carried out by the construction contractor hired by GWMC as required. The closure work to be conducted by the contractor(s) shall follow the requirements similar to the description in the above ***Item (3), Project for Construction of Sanitary Landfill Facilities (Stage 1) in Bhakhraywali***. Funding of this project shall be secured under the annual budget of GWMC or the project funding by the Government of the Punjab.

## (9) Project for Monitoring of Final Disposal in Bhakhraywali

Monitoring of landfill work and waste disposal facilities is an integral part of operation and maintenance of final disposal activities. The series of activities for monitoring, inspection and restoration work plays an important role in practicing the sanitary landfill operation. The monitoring plan being proposed hereunder consists of monitoring of landfill facilities and the environmental elements closely related with conducting waste disposal operation and evaluating the stability of landfill layer.

### (a) Preparation of Monitoring Plan of Landfill Facilities

GWMC shall prepare a monitoring plan having items of regular monitoring and inspection for the main landfill facilities and associated facilities, such as access road, leachate collection and circulation system, weighbridge, power supply and so on. The actual monitoring/inspection plan of each facility stated above shall also be prepared. In addition, landfill status shall be monitored by the major parameters like incoming waste amount, rate of subsidence, leachate quality, and temperature of landfill layer.

### (b) Monitoring of Landfill Facilities and the Environment

Monitoring/Inspection of the landfill facilities, status of landfill and environmental monitoring will be carried out under the responsibilities of assistant landfill manager and landfill supervisors. Conducting facility monitoring and inspection is an essential part of maintaining the function of sanitary landfill facilities. All facilities and equipment comprising the waste disposal facility shall be monitored/inspected/checked regularly, daily, weekly or monthly depending on the facility, and measures evaluated repaired and/or restored to maintain the functionality of facilities and for preventive measures. Environmental and social impacts caused by the landfill facilities and landfill work will be monitored and evaluated separately.

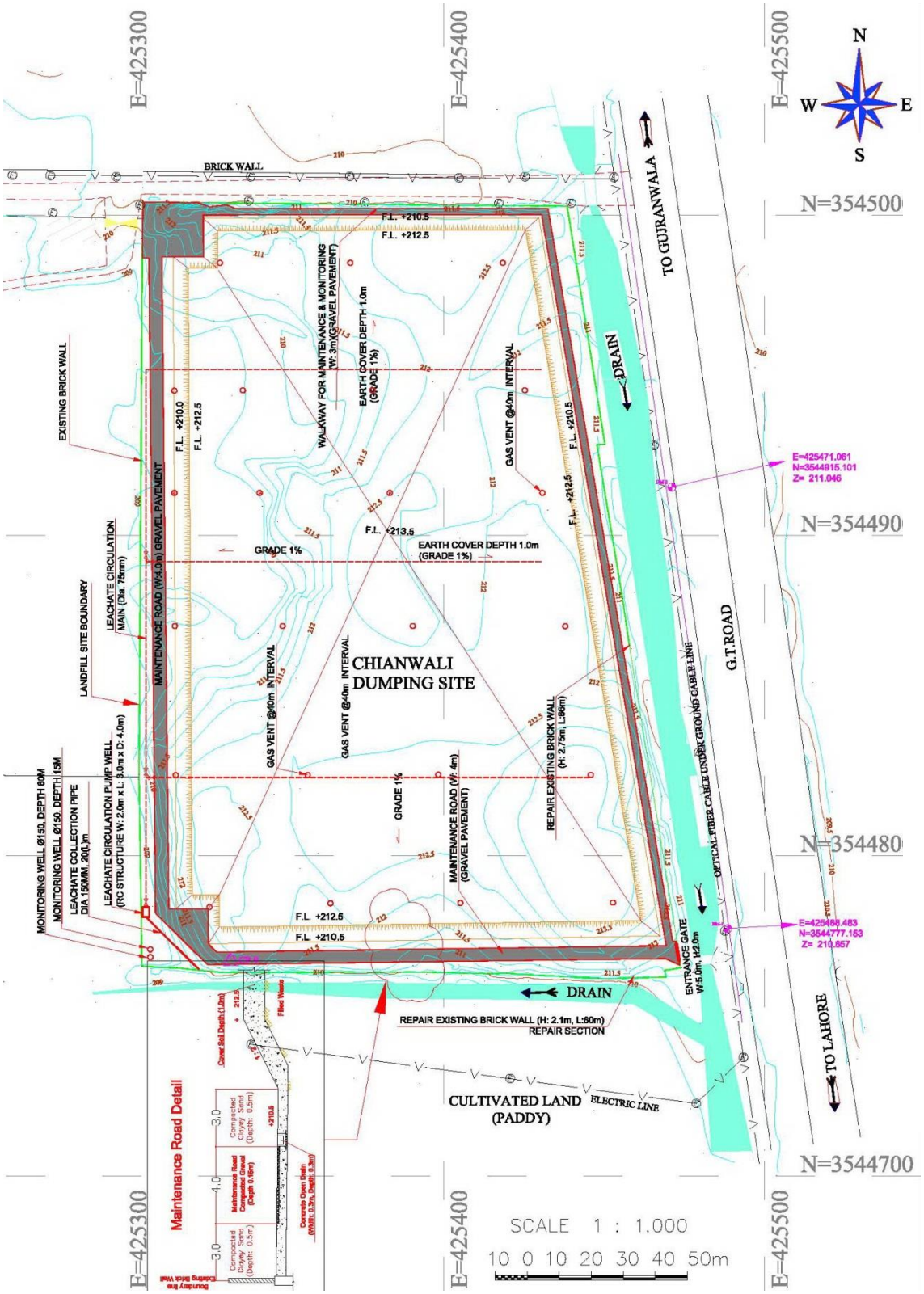



**Figure S.8.3 Layout Plan of Safe Closure Work at Chianwali Former Disposal Site**

## (10) Project for Post-Closure Monitoring of Gondlanwala and Chianwali Disposal Sites

After the completion of safe closure work, the assistant landfill manager and his team members will carry out the post closure monitoring based on the requirements stated in the Landfill Operation and Maintenance Manual. In addition, the post closure monitoring of environmental and social impacts will be carried out in accordance with the requirements proposed under the Environmental Monitoring Plan.

### (a) Overview of Management of Post Closure Landfill Site

Post closure monitoring is carried out for the purpose of avoiding the negative environmental impacts and risks attributed to the closed landfill site. Accordingly, the administrator of the site must ensure that public health and the environment are protected by instituting appropriate measures in monitoring, analysing problems and restoration work of the abandoned landfill site.

### (b) Control of Leachate and Landfill Gas

Generation of leachate and landfill gas will continue for a considerably long period after closure of the landfill site. Operation, maintenance, monitoring and restoration work will be required for the purpose of limiting and controlling the negative impacts of the closed site.

### (c) Control of Land Subsidence

Monitoring the status of the facility and final soil cover and the measures shall be taken against the influence of subsidence caused by decomposition of the waste layer.

### (d) Monitoring the State of Stabilisation of Landfill

Several parameters must be determined for evaluating the stabilisation status of the landfill site. Site abolition procedures will be made after ensuring the stabilisation of the landfill site.

### (e) Utilisation and Management of Safe Post-Closure of Landfill Site

Safe closure and maintenance plan is formulated in response to the purpose of utilisation of the disposal site in addition to closing the site safely against the probable pollution source. With regard to the post closure site use planning, as well as the maintenance work until ensuring the site stability, the management work during the period shall be carried out.

## (11) Cost of the Action Plan

The total cost for implementation of the Action Plan is estimated at Rs. 1,506 million and the annual cost of each project is presented in **Table S.8.7** below.

**Table S.8.7 Cost of the Action Plan for Final Disposal**

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| Procurement of Sanitary Landfill Site | 1,500,000 | 0 | 0 | 1,500,000 |
| Engineering Service for Sanitary Landfill Facilities (Stage 1) | 49,840 | 49,840 | 0 | 99,680 |
| Construction of Sanitary Landfill Facilities (Stage 1) in Bhakhraywali | 492,751 | 504,051 | 0 | 996,802 |
| Procurement of Landfill Machinery | 31,500 | 38,850 | 0 | 70,350 |
| Operation and Maintenance of Landfill Facilities | 18,669 | 21,859 | 31,623 | 72,151 |
| Improvement Work of the Existing Landfill in Gondlanwala | 55,902 | 0 | 0 | 55,902 |

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| Safe Closure of the Landfill Site in Gondlanwala | 0 | 0 | 26,196 | 26,196 |
| Safe Closure of the Landfill Site in Chianwali | 0 | 0 | 34,544 | 34,544 |
| Monitoring of Final Disposal in Bhakhraywali | - | - | - | GWMC |
| Post-Closure Monitoring of Gondlanwala and Chianwali Disposal Sites | - | - | - | GWMC |
| Total | 2,148,662 | 614,600 | 92,363 | 2,855,625 |

## 8.3 Action Plan for Intermediate Treatment and 3R Promotion

### (1) Project for Awareness and IEC Campaign on Resource Recovery

During the Short-Term Plan (2016-2018), awareness raising and IEC (Information, Education and Communication) campaign on 3R (Reduce, Reuse, Recycle) is to be conducted together with the action plan project for development and implementation of educational programmes to enhance knowledge/awareness on solid waste management (SWM) and 3R promotion. These programmes are to target primary school teachers, students, and the general public in Gujranwala under the Environmental Education and Public Awareness Raising Plan.

GWMC has the important role of 3R resource recovery during not only the Short-Term Plan (2016-2018), but also the Mid-Term Plan (2019-2024) and the Long-Term Plan (2025-2030). The Communication Unit will be the focal point of GWMC when it comes to public relations. This unit will serve as the information dissemination point and where the general public makes inquiries about SWM in GWMC.

Proposed activities are 1) development of manual for environmental education programmes at schools; 2) development of educational materials for school programmes; 3) selection of target schools; and 4) implementation of the environmental education programmes at schools.

### (2) Project for Implementation of Simplified WACS

The Solid Waste Amount and Composition Survey (WACS) was conducted in 2014 and 2015 as a part of the project to identify the amounts and composition of different types of waste generated in Gujranwala City. The results and analysis of the WACS are to be used for the basic data to formulate the waste collection, 3R, intermediate treatment and waste disposal plans for the review, updating and formulation of the SWM Master Plan.

The WACS is to be conducted once a year during the short-term period (2016-2018) by GWMC. GWMC has a number of experienced staff for WACS who worked with the JICA Project Team in 2014 and 2015; for instance, 5 waste managers and 3 research assistants have had experiences and possess the knowhow to conduct the survey and to compile the data. They will be the main members of the team to conduct the WACS three times during the short-term period. The survey items and contents are also basically the same as the WACS conducted during the JICA Study in 2014 and 2015.

### (3) Project for Preparation for PPP and Formation of a Committee of the BOD of GWMC

A new compost company which is tentatively called "Gujranwala Central Compost and RDF Plant" is proposed to start its operation in 2020 during the mid-term period (2019 to 2024). The new company which is under the PPP (Public-Private-Partnership) scheme, BOT (Build-Operate-Transfer) basis is recommended in the Master Plan.

According to the MD of GWMC, the whole process of the PPP scheme will take about 6 months and finished by the year 2017 before the preparation for procurement of the land (7 ha) for the compost plant and the engineering detailed design of the plant. The awarded

company will thus be the SPV during the contract period and hence the owner of the compost plant in the project. All the required terms for the awarded SPV are to be stipulated in the TOR (Terms of Reference) signed between GMWC and SPV.

### (4) Project for Implementation of Land Preparation by GWMC

The committee formulated by BOD (Board of Directors) of GWMC will prepare the plan for the procurement of the land for the compost plant project based on the TOR. The TOR shall specify that the required land is to be procured and provided for the SPV before the start of construction of the compost plant project in 2019 and the start for the detailed design engineering services in 2018. The land area of approximately 7 ha shall be located in flat fields and adjacent to the first phase compound of the final landfill site at Bhakhraywali in accordance with the master plan. So far, there has been no actual action taken by GWMC for the land yet, because preparation of the development plan of the final landfill site is still in progress.

### (5) Project for Engineering Services for the Detailed Design of a Compost Plant by SPV

#### (a) Assumed General Arrangement and Detailed Design of the SPV Project

The detailed design of the compost plant by SPV is to be started and completed within 2018. Effective performance monitoring requires that the SPV is responsible for the operation and management of the compost plant project and the BOD of GWMC may also be required to conduct joint monitoring, whether or not the service contract is actually and properly delivered financially. This matter has to be stipulated in the TOR.

Although the contents of the TOR are not available at this moment and no award has yet been made to the SPV, general requirements for preparation of the tender documents, bill of quantities, tender evaluation, and construction supervision are required for the SPV's project in general.

#### (b) Quality Control of SPV's Compost

The quality control of compost production of the SPV's project is not satisfactory for the farmers' requirement. In this context, compost production by the SPV should be satisfactory for the farmers' needs and the following should be described clearly in the contract and the technical specifications between the SPV and the committee of BOD of GWMC as mentioned in the TOR:

- Organic matters of compost from the SPV should be 35%~45% or more, and the bulk density of compost produced by Gujranwala Compost Company should be generally about 0.5~0.8 t/$m^3$;
- A mix of organic matters and cow-dung should be used for the SPV's mature compost and the SPV should search for a proper mix proportion of compost. Cow-dung is more available in Gujranwala City and its surrounding areas than in Lahore. It is therefore expected that better mature compost production with more organic contents in Gujranwala can be produced;
- It is also advised that the expected pilot farm in the complex of the SPV's plant area should be managed and be well-organized by SPV, and be open to the public for revealing the effective result of compost at the field;
- The SPV shall get a licence for compost production from the Agricultural Department Directorate of Soil Fertility, Lahore, Government of the Punjab. However, it is recommended that quality control of the SPV's compost should be maintained and improved effectively;
- Compost production should be recorded properly to measure how much

kilogramme of compost is sold or unsold daily, including searching for a good market of compost; and

- Besides being required for the quality control of SPV's compost, IEC programmes on effectiveness and safety of SPV's compost is further needed for the famers/residents.

### (6) Cost of the Action Plan

The total cost for implementation of the Action Plan is estimated at Rs. 40 million and the annual cost of each project is presented in **Table S.8.8** below.

**Table S.8.8 Cost of the Action Plan for Intermediate Treatment and 3R Promotion**

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| Awareness & IEC Campaign on Resource Recovery | - | - | - | GWMC |
| Implementation of Simplified WACS | - | - | - | GWMC |
| Preparation for PPP & Formulation of a Committee of the BOD of GWMC | - | - | - | BOD/GWMC |
| Implementation of Land Preparation by GWMC | - | - | - | BOD/GWMC |
| Engineering Service for Detailed Design of the Compost Plan by SPV | 0 | 0 | 40,000 | 40,000 |
| Total | 0 | 0 | 40,000 | 40,000 |

## 8.4 Action Plan for Environmental Education and Public Awareness Raising

### (1) Project for Capacity Development of Communication Unit to Strengthen the Coordination among Relevant Bodies

#### (a) Establishment of the Communication Unit

The Communication Unit will be the focal point of GWMC when it comes to public relations. This unit will serves as the information dissemination point and where the general public can make inquiries about solid waste management in GWMC. The Unit will work closely with the Waste Managers of GWMC.

The Communication Unit should be composed of eight (8) staff of GWMC; namely, one (1) Senior/Manager Communication; one (1) Assistant/Deputy Manager Public Relations; one (1) Assistant/Deputy Manager Environmental Education, and a team of five (5) officers for field operations with diploma as environmentalist, sociologist or public health. It should be noted, however, that the staff in this unit should not only have environmental/hygienic background but also have good people's skill. The team of field officers should be increased as activity areas expand in the future.

In the short-term period, the Unit will implement environmental education programmes in elementary schools targeting small children and their teachers, and environmental programmes targeting the general public in periodical events. In order to mobilise this, the Unit will need vehicles and subsequent drivers. **Table S.8.9** below shows the estimated salary cost for the Communication Unit for this period.

**Table S.8.9 Estimated Salary for Newly Recruited Staff of the Communication Unit in the Short-Term Period**

Unit: Rs./year

| Position | Number of Staff | 2016 | 2017 | 2018 |
|---|---|---|---|---|
| Field officers* | 4 | 960,000 | 1,036,800 | 1,113,600 |
| Drivers | 2 | 792,000 | 792,000 | 792,000 |
| Total | | 1,752,000 | 1,828,800 | 1,905,600 |

Note:* Initially, one of the current waste managers will lead the team due to their experience; therefore, the number of first recruits will be 4.

### (b) Strengthening of Coordination among Relevant Bodies

An important role of the Communication Unit is to coordinate the programme with relevant bodies. In the school programme, for example, the Unit needs to coordinate not only with target schools but also all the authorities concerned. Likewise, the coordination in implementing the environmental programmes targeting the general public requires careful coordination with community groups, labour union, NGOs for collaboration efforts, TV / radio stations or various advertising media on bus or street billboards, etc., for publicity purpose, and editors and printing companies for preparing these materials to be used in the programmes. In order to facilitate these, the Unit must develop a list of contact information and mechanisms to maintain and update the list.

## (2) Project for Development and Implementation of Educational Programmes Targeting Primary School Teachers and Students

### (a) Development of Manuals for Environmental Education Programme in Schools

It is proposed to develop manuals for the environmental education programme in schools. This manual will be used by the field personnel who go out and give lectures to the elementary students and teachers. The contents of the manual shall include a) purpose of the manual and objective of the programme, b) planning the programme, c) carrying out the programme, and d) reference data.

The manual should be written in a way that the Communication Unit staff can learn how to develop or modify an attractive programme for elementary schools and carry out lectures attractive to the students. It should also include background information on proper SWM practices or 3R, so that the staff can easily find the right information. The manual should be prepared by the Waste Managers led by the Communication Unit.

### (b) Development of Educational Materials for the School Programme

It is proposed to produce a short video clip, explaining the overall SWM and 3R efforts in Gujranwala. The production of the video should be entrusted to a production company specialising in PR material production under the supervision of the Communication Unit. The video should cover the current SWM in Gujranwala and the issues to be solved.

Besides the video clip, a printed material should be developed to be used and distributed during the programme. The contents of the printed material should include proper SWM practices and promotion of 3R. Topics should be dealt from the viewpoint of everyday life of target students/teachers. For the Short-Term Period, a total of 75,000 copies will be necessary.

### (c) Selection of Target Schools

The Communication Unit should select a target area or UC to implement the school environmental education programme. The area should preferably be coincided with other programmes, such as, the separate collection pilot project in Zone 6, to implement the programme effectively.

Firstly, all public and private elementary schools in the area should be listed, together with the number of students and contact information. Secondly, target schools should be selected in consideration of the number of students and the degree of cooperativeness of the schools. Then with careful coordination with school representatives, a schedule to visit is planned. The number of expected target schools and students for the short-term period is as shown below.

**Table S.8.10 Number of Schools and Students Targeted for the Environmental Education Programme in the Short-Term Period**

| Year | 2016 | 2017 | 2018 |
|---|---|---|---|
| No. of Schools | 70 | 80 | 100 |
| No. of Students | 2,100 | 2,400 | 3,000 |

### (d) Implementation of the Environmental Education Programme at Schools

Based on the list of schools and schedule of the programme developed in **Item (c)** above, coordination with the school principal or teacher in charge prior to implementation of the programme is indispensable to confirm how will be carried out, including, but not limited to, size of room, availability of power and lights, space to display materials, etc.

## (3) Project for Development and Implementation of Educational Programmes Targeting the General Public

### (a) Development of Guideline for Environmental Education Programmes for the General Public

A guideline for the environmental education programme for the general public is proposed to be developed. This guideline will be used by the field staff that go out and raise awareness among the public in periodical events like the Earth Day and Eid-ul-Fitr Day. The contents of the guideline shall include a) purpose of the guideline and objective of the programme, b) planning of the programme, c) carrying out of the programme, and d) references including data and contacts information about possible collaborating partners.

The programme should be written in a way that staff of the Communication Unit can plan how to develop or modify the programme to make it attractive to the general public. It should also include background information on proper SWM practices or 3R, so that the staff can easily find the right information. The target population is different from that of the school educational programme; therefore, broader viewpoints are necessary when developing this guideline. For instance, budget allocation and how they are used in GWMC operation is good information for adults who pay for his/her SWM. The manual should be prepared by the Waste Managers led by the Communication Unit.

### (b) Development of Educational Materials for the General Public

Some printed materials should be developed for use and distribution during implementation of the programme. Contents of the printed materials should include proper SWM practices and promotion of 3R, as well as information necessary to gain confidence among the general public on the GWMC's operation. Such information shall include budget allocation and how they are used in GWMC operations since it is vital information to gain confidence from the adults who pay for his/her SWM. For the short-term period, a total of 5,000 copies will be necessary.

Besides the printed materials, some displays which show waste flow in Gujranwala or items which can be recycled should be prepared, along with actual recyclable or recycled materials so that the general public can touch and easily understand them.

### (c) Implementation of Environmental Education Programmes in Periodical Events

In the implementation of the programme, close coordination should be made among the other relevant bodies listed in the guideline prepared in **Item (a)** above. Coordination may include co-hosting awareness raising programmes activities. It can be worth

considering to having support from local and influential leaders, such as religious leaders, head of labour union, and neighbourhood groups and alike. This gives the residents additional reasons why their cooperation in SWM makes sense.

### (4) Cost of the Action Plan

The total cost for implementation of the Action Plan is estimated at Rs. 9 million and the annual cost of each project is presented in **Table S.8.11** below.

**Table S.8.11 Cost of the Action Plan for Environmental Education and Public Awareness Raising**

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| Capacity Development of Communication Unit to Strengthen the Coordination among Relevant Bodies | 3,002 | 1,829 | 1,906 | 6,736 |
| Development and Implementation of Educational Programmes Targeting Primary School Teachers and Students | 965 | 349 | 416 | 1,730 |
| Development and Implementation of Educational Programmes Targeting General Public | 287 | 301 | 315 | 903 |
| Total | 4,254 | 2,479 | 2,637 | 9,370 |

## 8.5 Action Plan for Economic and Financial Aspect

### (1) Project for Establishment of Sustainable Cost Recovery

During the Short-Term Period from 2016 to 2018, in order to prepare for the establishment of the future sustainable cost recovery, a wide spectrum of below actions shall be carried out:

- To establish the long-term cost recovery strategies for the operation and maintenance costs to provide SWM services;
- To establish the financial monitoring system through a wide range of financial key performance indicators (KPI) related to cost recovery;
- To establish the standard procedure for monitoring the cost recovery;
- To prepare a manual for the management of cost recovery;
- To train GWMC's staff in charge of managing the cost recovery;
- To prepare a 3-year recurrent cost rolling plan to request CDGG for budgetary arrangement; and
- To prepare a 3-year capital investment cost rolling plan to request the provincial government for the budgetary arrangement.

The above preparatory actions for the establishment of sustainable cost recovery will start from the first quarter of 2016.

### (2) Project for Implementation of Accurate Total Costing

Although tariff will not be charged during the Short-Term Period from 2016 to 2018, it is absolutely necessary to grasp the total cost accurately based on the selected methodologies for the future monitoring of cost recovery after full-scale introduction of the tariff system from 2025. There is a wide range of actions to be taken for grasping the total cost as well as the cost structure of providing SWM services, as follows:

- To establish the cost centre inside the financial department of GWMC;
- To monitor and streamline the latest operating and maintenance costs for SWM services;
- To carry out the break-even point analysis as well as the breakdown of operation and maintenance costs by fixed costs and variable costs;

- To estimate the average cost and the marginal cost per unit amount of the disposed wastes;
- To prepare and start the cost minimisation plan for SWM services;
- To prepare the operation manual for standard procedures for the Cost Centre; and
- To train the staff of the Cost Centre in the estimation of various costs for SWM services.

The Cost Centre shall be established under the Financial Department of GWMC. It shall manage the GWMC under a convenient mechanism to determine the proper tariff level to recover the total operation and maintenance costs required for providing the SWM services.

Another important action to be taken is to minimise the cost of providing SWM services by the financially efficient manner under the cost minimisation plan of GWMC. The organizational assessment has been carried out in the master plan, and the most efficient organizational structure was proposed to achieve the best performance and SWM services and thus minimising the operating costs.

The cost minimisation plan being jointly prepared by the Financial Department and the Human Resources Development Department of GWMC will include a series of actions to significantly reduce operating costs and bring improvements in service delivery efficiency such as the operation of sanitary landfill, the operation of collection and transport, billing and collection, and fuel and repair of collection vehicles, the overhead cost of the headquarters, etc.

In addition, the preventive maintenance programme will help identify possible inefficiency in the operation of the sanitary landfill as well as the collection and transport of wastes with minimum expenses and thus saving major repairs and maintenance costs. The efficient collection route should be continuously reviewed in each service zone to bring more efficiency in the operations and thus reduce costs.

The above preparatory actions for the implementation of the accurate total costing will start from the first quarter of 2016.

### (3) Project for Introduction of Proper Tariff Charging System

During the Short-Term Period from 2016 to 2018, the tariff system will not be introduced. Therefore, cost recovery for the SWM services through introduction of the tariff system will not be actually started. However, there is a wide spectrum of activities in the field of preparatory activities for introduction of the tariff system as given below. The partial establishment of cost recovery through introduction of the optimum tariff system will be commenced from 2022 in high and middle income areas during the Mid-Term Period. For the time being, the absence of cost recovery will be replenished by the CDGG's financial support for the recurrent costs and the provincial government's subsidies for the investment and replacement of facilities and equipment required for the SWM services:

- To forecast the cost recovery rate and the optimum tariff level as well as the required amount to be covered by the provincial property tax;
- To roughly establish the tariff table in low-income, middle-income and high-income areas;
- To establish the standard procedure for the tariff setting;
- To carry out the survey on customers' willingness to pay by income group;
- To carry out the survey on customers' affordability to pay by income group;
- To train the staff in charge of establishing and operating the financial monitoring system; and
- To start the negotiation with the provincial government for exploring the required legal actions for introduction of the additional surcharge of the provincial property tax.

It is essential to set the SWM tariff at the level for which users can actually afford to pay. In this connection, the concept of ATP (Affordability to Pay) is frequently used. ATP is defined as the amount which beneficiaries can pay for certain public utility services, being calculated with reference to household income and composition of household expenditures in the service areas. There are various methodologies employed for estimating ATP. A typical methodology is to determine ATP as a certain share of a household's disposable income based on a household economy survey. The survey on the household economy for estimating ATP should be periodically carried out during the early stage of the short-term period.

WTP (Willingness to Pay) is another consideration factor of the demand side, which is the amount expressed by respondents on the monetary value on users' degree of payment willingness for SWM services. WTP can be measured through a questionnaire survey such as CVM (Contingent Valuation Method).

Based on the survey results of the updated level of ATP and WTP, the optimum level of tariff as well as the required revenue to be covered by the provincial property tax will be estimated.

Although the actual tariff charging system is introduced from 2022 which is the fourth year of the mid-term period, the above preparatory actions for introduction of the proper tariff charging system will start from the first quarter of 2016.

### (4) Project for Implementation of Financially Efficient Private Sector Involvement

During the Short-Term Period from 2016 to 2018, private sector involvement will not be started. However, there is a wide range of preparation activities for the future commencement of efficient private sector involvement for the collection and transport as below. The outline of the service contract to be outsourced including area, scope and criteria to select the private service providers will be clarified.

- To study the tender procedure for the service contract;
- To study the area and scope of the service contract; and
- To review the unit cost of outsourcing.

Although actual private sector involvement through the service contract will be introduced from 2025 which is the fourth year of the long-term period, the above preparatory actions for the implementation of financially efficient private sector involvement will start from the first quarter of 2018.

### (5) Cost of the Action Plan

The total cost for implementation of the Action Plan is estimated at Rs. 0.4 million but all the costs are covered by the Institutional Strengthening and Organizational Plan and the annual cost of each project is presented in **Table S.8.12** below.

**Table S.8.12 Cost of the Action Plan for Financial and Economic Aspect**

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| Establishment of Sustainable Cost Recovery (Preparatory Phase) | - | - | - | GWMC |
| Implementation of Accurate Total Costing (Preparatory Phase) | - | - | - | GWMC |
| Introduction of Proper Tariff Charging System (Preparatory Phase)* | 62 | 62 | 62 | 186 |
| Implementation of Financially Efficient Private Sector Involvement (Preparatory Phase)* | - | - | 196 | 196 |
| Total | 62 | 62 | 258 | 382 |

Note:* The cost required for these projects are covered by the GWMC staff training programmes proposed in the Institutional Strengthening and Organizational Plan.

## 8.6 Action Plan for Environmental Monitoring

### (1) Project for Environmental Monitoring for the Collection and Transportation Work

#### (a) Monitoring of Cleanness of Garbage Container

##### (i) Objectives of the Monitoring

This monitoring is 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.

##### (ii) Methodology of the Monitoring

**Location of Monitoring**

This monitoring is to be carried out all over Gujranwala City, but it is actually made at the locations of containers. For example, nearly 60 container locations have been identified in Zone 6 and they should be targeted for monitoring.

**Monitoring Items**

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

**Monitoring Data Collection System**

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

**Monitoring Feedback System**

Everyday sanitary supervisors shall monitor the area served by the sanitary workers. The supervisors shall check the garbage containers in their individual working areas and record the situation in the monitoring format. Inspectors will check the record, and the record will be submitted to the Assistant Manager 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 Manager Operations, and immediate measures should be implemented on a timely manner.

#### (b) Monitoring of Waste Separation at Household Level

##### (i) Objectives of the Monitoring

Waste separation at 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.

### (ii) Methodology of the Monitoring

**Location of Monitoring**

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

**Monitoring Items**

The situation of residents' waste separation at households shall be monitored. In the Short-Term Period, the monitoring shall focus on three items; namely, (1) Kitchen waste; (2) Paper and plastic bags; and (3) Recyclable waste (e.g. valuable metal).

**Monitoring Data Collection System**

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

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

**Monitoring Feedback System**

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

## (2) Project for Environmental Monitoring for Final Disposal Site in Bhakhraywali

### (a) Objectives of the Monitoring

The objectives of the monitoring are as follows:

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

### (b) Methodology of the Monitoring

Since GWMC does not have facility for the measurement and analysis of environmental quality, the actual monitoring will 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.

### (i) Location of Monitoring

Leachate in leachate pond shall be monitored. Two kinds of groundwater will be monitored: groundwater from shallow aquifer of about 20m in depth and from deep

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 will be set at the north side of the disposal site, around the office and storage, and another pair will be set at the south side of the site. In the north side, the sampling location will be set at 50m distance from the office and storage because human drainage water from the office will be mixed in shallow aquifer. Monitoring for vegetation and plantation will be carried out in the Bhakhraywali site and its vicinity, and monitoring for safety and traffic will be targeted to access roads into the Bhakhraywali site.

### (ii) Monitoring Items

The monitoring items together with their frequency and location in the project are summarised in **Table S.8.13** below.

**Table S.8.13 Monitoring Items with Their Frequency and Location for Final Disposal Site in Bhakhraywali**

| Type of Monitoring | Frequency of Monitoring | Location of Monitoring | Parameters (Monitoring Items) |
|---|---|---|---|
| Ambient Air Quality | 4 times in a year (January, April, July and October) | Four corners of the site | SPM, $PM_{10}$, $SO_2$, $NO_2$, CO, $CO_2$, Vapours |
| Groundwater Quality | | 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 | | Four corners of the site | dB(A) |
| Smelly Gas Quality (Landfill Gasses) | | At the pit in the pump station | $SO_2$, $H_2S$, $CH_4$ |
| Treated Wastewater Effluent (Leachate Pond Effluent) Quality | | At the exit of leachate pond | BOD, COD, TOC, TSS, DO, Chloride, Sulphate, Turbidity, Conductivity, Oil and Grease, Colour, TIN, Heavy metals |
| Leachate (Leachate Pond Influent) Quality | | At the pit in the pump station | BOD, COD, TOC, TSS, DO, Chloride, Sulphate, Turbidity, Conductivity, Oil and Grease, Colour, TKN, Heavy metals |
| Situation of Vegetation and Plantation | Once a year (April) | Vicinity of the site | Visual inspection of plant species survival rate and status of maintenance |
| Situation of Safety and Traffic | | Vicinity of the site | 1) Inspection of Signage<br>2) Faulty, overloaded and speeding of vehicles |

### (iii) Monitoring Data Collection System

Data will be collected by a private environmental laboratory, and the report is submitted to the Senior Manager Operations of GWMC. Frequency of the monitoring of data collection system is 4 times in a year (quarterly) except the "Situation of Vegetation and Plantation" and "Situation of Safety and Traffic". These two items will be carried out only once a year since these situations may not change drastically and therefore annual measurement 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.

### (iv) Monitoring Feedback System

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

## (3) Project for Environmental Monitoring for Safe Post-Closure Final Disposal Sites in Gondlanwala and Chianwali

### (a) Objectives of the 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.

### (b) Methodology of the Monitoring

As in the previous project, the monitoring will be outsourced to an environmental monitoring laboratory (private company) due to lack of measurement equipment in GWMC. GWMC shall supervise the monitoring, feedback and documentation.

#### (i) Location of Monitoring

Two kinds of groundwater will be monitored: groundwater from shallow aquifer of about 20m in depth and deep aquifer of about 60m in depth. Regarding landfill gas and leachate, construction of a pumping station with a man-hole is to be planned for the clearing purpose and landfill gases and leachate is collected from the man-hole. Therefore, the sampling point of landfill gases and leachate is the same as the location of pump station.

#### (ii) 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 S.8.14** shows the monitoring items of the project.

**Table S.8.14 Monitoring Items with Their Frequency and Location for Post-Closure Final Disposal Site 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/weight bridge | At the north-west corner of the site | pH, Temperature, TDS, Conductivity, Fluoride, Nitrate, DO, Hardness, Turbidity, Colour, Chloride, Arsenic, etc. |
| Smelly Gas Quality (Landfill Gasses) | | At the leachate pump station | At the leachate pump station | $SO_2$, $H_2S$, $CH_4$ |
| Leachate Quality | 4 times in a year (January, April, July and October) | 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 |

#### (iii) Monitoring Data Collection System

Data will be collected by a private environmental laboratory, and the report is submitted to the Senior Manager Operations of GWMC. The monitoring will be carried out in April since this month is between the dry season and the rainy season. This monitoring will start in April 2016.

#### (iv) Monitoring Feedback System

The monitoring feedback system follows the same procedures as the previous project (see **Item (2), (b), (iv)**).

### (4) Cost of the Action Plan

The total cost for implementation of the Action Plan is estimated at Rs. 2.6 million and the annual cost of each project is presented in **Table S.8.15** below.

**Table S.8.15 Cost of the Action Plan for Environmental Monitoring**

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| Monitoring of Collection and Transportation Work | - | - | - | GWMC |
| Monitoring of Final Disposal Site in Bhakhraywali | 435 | 870 | 1,150 | 2,455 |
| Environmental Monitoring of Post-Closure Final Disposal Sites in Gondlanwala and Chianwali | 0 | 0 | 140 | 140 |
| Total | 435 | 870 | 1,290 | 2,595 |

## 8.7 Action Plan for Institutional Strengthening and Organizational Restructuring

### (1) Project for Organizational Restructuring of GWMC

The organizational restructuring realises the creation of new departments and the reinforcement of personnel. The required actions are presented as follows:

- To strengthen the Operation (Field) Unit by allocating 7 additional Assistant Managers Operations until 2018;
- To establish the Manager Complaint Management post under GM Operations and allocate the manager until 2018;
- To establish the Intermediate Treatment Unit under the Operations Department and allocate an Assistant Manager Intermediate Treatment until 2018;
- To establish the Communication Unit under the GM Operations by shifting the Manager Communication and the Assistant Manager Communication from the Human Resources and Administration Department;
- To strengthen the Procurement and Contract Department for PPP Introduction of Collection and Transport; and
- To establish the Monitoring and Evaluation Department under the GM Operations and allocate the General Manager Monitoring and Evaluation and 3 Managers Monitoring and Evaluation (KPI, Finance and Environment) until 2018.

The required number of GWMC staff in the first three years of the short-term period is estimated at 66 or an increase of 20 personnel from the current number, 46.

GWMC should ensure the budget to cover the whole activities of recruitment, such as publicity, selection and employment, and shall carry out a series of adoption continuously. At the same time, it is necessary that GWMC shall plan the layout of office spaces and equipment with the increase in the number of staff. In addition, the compensation structure which depends on individual title, capacity and job tenure, and welfare should be reviewed from time to time.

### (2) Project for Capacity Development of GWMC Staff

Detail of eight (8) modules for capacity development programmes as the human resources development is to be carried out. In this project, it is recommended that all the modules should start from the beginning of the short-term period as the following activities for three years:

- Two (2) 2-day sessions of *Overall Management Capacity for SWM* programme (Module 1) for GWMC managerial staff in 2016;

- Four (4) 1-day sessions of *Capacities for Collection and Transport* programme (Module 2) for GWMC managerial staff from 2016 to 2017;
- One (1) 1-day session of *Seminar for Sanitary Worker* programme (Module 1&2) for sanitary workers in 2016;
- Two (2) 2-day sessions of *Capacity on Intermediate Treatment and 3R Promotion* programme (Module 3) for GWMC managerial staff in 2018;
- Twelve (12) 2-day sessions of *Sanitary Landfill Site Management* programme (Module 4) for GWMC managerial staff from 2016 to 2018;
- Four (4) 1-day sessions of *Public-Private Partnership* programme (Module 5) for GWMC managerial staff and personnel of private sector from 2017 to 2018;
- Four (4) 2-day sessions of *Financial Management* programme (Module 6) for GWMC managerial staff from 2017 to 2018;
- Two (2) 2-day sessions of *Organizational and Legal Improvement* programme (Module 7) for GWMC managerial staff in 2017; and
- Six (6) 2-day sessions of *Community Participation* programme (Module 8) for GWMC managerial staff, personnel of the private sector, personnel of CBO and personnel of NGO from 2016 to 2018.

GWMC is going to entrust a part of the business to the private sector; therefore, its participation in some training programmes is necessary. Additionally, some training programmes which will invite many participants and the training programme for managers should be scheduled not to disturb the daily operations.

### (3) Project for Establishment of Gujranwala Solid Waste Management By-Law

CDGG/GWMC had already embarked on drafting the by-law and shall continue the task towards its enactment. In the process of finalising of the by-law, a series of public hearings will be held in the 8 districts of Gujranwala City to exchange opinions about the contents to be included in the by-law. Since the current by-law is in English, it should be translated into Urdu language for easier understanding of Gujranwala citizens.

The approved by-law can be an important official document to support the implementation of the Master Plan. In the meantime and since it might take a long time to establish the by-law, GWMC has to manage all the related organizations, especially the CDGG side schedule towards the establishment. However approval of the by-law is not expected during the short-term. Therefore, the first three years of this project does not need a budget.

### (4) Cost of the Action Plan

The total cost for implementation of the Action Plan is estimated at Rs. 48 million and the annual cost of each project is presented in **Table S.8.16** below.

**Table S.8.16 Cost of the Action Plan for Institutional Strengthening and Organizational Restructuring**

| Project | Annual Cost (thousand Rs.) | | | Total (thousand Rs.) |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | |
| Improvement of Organizational Restructuring of GWMC | 8,180 | 13,234 | 17,443 | 38,858 |
| Capacity Development of GWMC Staff | 6,109 | 1,284 | 1,302 | 8,695 |
| Establishment of Gujranwala Solid Waste Management By-Law | - | - | - | GWMC |
| Total | 14,289 | 14,518 | 18,745 | 47,552 |

# 9. CONCLUSION

The Vision of solid waste management for Gujranwala City, i.e., *"Transformation of Gujranwala to the Cleanest City of Punjab"*, is the ultimate goal for all the residents of Gujranwala. To realise it, the target collection rate of 100% for the area of 64 urban UCs in year 2018 and for the area of 34 peri-urban UCs in addition to the 64 UCs in 2030 should firstly be achieved with dedication and dispatch. For pursuing this goal, the proposed projects in the Master Plan should be carried out as well since implementation of these projects will bring large benefits to the Gujranwala residents.

The total project cost of the Master Plan is Rs. 20,497 million for the period of 15 years from 2016 to 2030, summing up the investment cost of Rs. 10,848 million, the operation and maintenance cost of Rs. 8,490 million and the replacement cost of Rs. 1,158 million for all project components. Although the project cost seems to be huge, the total benefit of the Master Plan is estimated at Rs. 25,139 million for the 15 years, which is larger than the project cost, and the results of the economic evaluation show that implementation of the Master Plan is economically feasible and financially viable.

Introduction of the proposed waste collection and transportation system is based on the waste separation at source and requires the residents' understanding of the importance of 3R and their cooperation. Considering the low level of public awareness on integrated solid waste management (ISWM) of the residents in Gujranwala, public awareness raising and the implementation of environmental education are indispensable for the promotion of 3R even if the visible effects of the ISWM will take quite a long time to appear.

Since any kind of waste of whatever disposal method is adopted should finally go to a final disposal site, the new landfill site in Bhakhraywali shall be secured appropriately before the existing disposal site in Gondlanwala is filled up. In accordance with the increase of waste collection amount, however, the life of the Bhakhraywali site will be shortened; that is, construction of another new disposal site is additionally necessary by the end of 2023.

With regard to sustainability of the ISWM, the Master Plan proposes the introduction of an appropriate tariff charging system. Since there is currently no official tariff system for ISWM services in Punjab and this seems to be a political issue to some extent, it is suggested that tariff shall be partially charged in high-income and middle-income areas from 2022 and extended to the low-income areas from 2025. To enable the collection of user charges, the residents should fully understand the necessity of proper ISWM.

One of the integral parts of the ISWM in Gujranwala through the PPP scheme is to introduce the service contract system of waste collection and transportation from 2025 and establish and operate a central compost plant managed by the SPV (Special Purpose Vehicle) from 2020. As long as the outsourcing of waste collection and transportation services and operation of the compost plant in Lahore are properly observed, this private sector involvement option will be workable in Gujranwala.

Simultaneously, the Government of the Punjab, including the City District Government Gujranwala (CDGG) and the Gujranwala Waste Management Company (GWMC), should consider that some financial arrangements are indispensable for the implementation of the action plans. It should also be recognised that the implementation of proper ISWM requires a financial burden primarily from the government, but the responsibility should be shared equally by the government or public sector, the private collectors or private sector, and the residents or people. In this sense, the environmental education and public awareness raising on the ISWM is crucial to the success of the projects.

# 10. RECOMMENDATIONS

The JICA Project Team recommends that the Government of the Punjab (GOPb), the City District Government Gujranwala (CDGG) and the Gujranwala Waste Management Company (GWMC) should carry out the action plans in the ISWM Master Plan from year 2016. To achieve 100% waste collection firstly for the area of the 64 UCs, the required number of waste collection vehicles and containers shall be procured appropriately. Also, since the waste collection and transportation system is proposed based on the waste separation at source, the project for the introduction of separate collection through the implementation of a pilot project shall be carried out simultaneously.

The construction of a new final disposal site is inevitable by 2018, so that the land acquisition at Bhakhraywali should be completed immediately and the design and engineering works should be started accordingly. Safe post-closure work for the former landfill site in Chianwali and improvement work for the existing landfill site in Gondlanwala should also be conducted by using the Government and GWMC's own budget to mitigate the negative impacts on the surrounding environment.

In addition, the GOPb, the CDGG and the GWMC should commence the environmental education programmes and public awareness raising campaigns that are the bottom line of the ISWM in order to disseminate the waste separation at source and to proceed to the next stage of project implementation smoothly such as the construction of compost plant and the introduction of waste charges.

With regard to project implementation apart from the one mentioned above, a more detailed study including situation analysis should be carried out in terms of hospital, industrial, and construction and demolition waste management, since it is out of the scope of this project but closely related to the current operation by GWMC.