REPUBLIC OF LIBERIA
SOLID WASTE MANAGEMENT IN MONROVIA

EMERGENCY MONROVIA URBAN SANITATION PROJECT

DEVELOPMENT OF FIAMAH TRANSFER STATION

ENVIRONMENTAL MANAGEMENT PLAN

MARCH 2010

prepared for:

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Table of Contents

1. INTRODUCTION 6
  1.1 Objectives of the Assignment 6
  1.1.1 Specific Objectives 6
  1.1.2 The Environmental Management Plan (EMP) 6
  1.2 Institutional arrangements 7
  1.3 Draft Environmental Policies and Laws 8

2. HISTORICAL AND PROJECT BACKGROUND 10
  2.1 Transfer Station development 10
  2.2 Scope of Works 10
  2.3 Operations philosophy 11

3. NATURE OF THE PROJECT WITH REASONABLE ALTERNATIVES 12
  3.1 Description of proposed actions and alternatives 12
  3.2 Location of Fiamah Site 12

4. CURRENT BASELINE CONDITIONS 16

5. MAIN ACTIVITIES DURING SITE PREPARATION AND CONSTRUCTION 18

6. GENERAL OPERATIONAL PROCEDURES OF THE SOLID WASTE TRANSFER STATION 19
  6.1 Description of the Transfer Station Facility 19
  6.2 Design Capacity 19
  6.3 Transfer Station Infrastructure 20
    6.3.1 Community Access Point 20
    6.3.2 Roof Structure 20
    6.3.3 Offloading Bay 20
    6.3.4 Loading Bay 20
    6.3.5 Drainage System 20
  6.4 Fencing and Gates 21
  6.5 Office Block 21
  6.6 Guard House 21
  6.7 Integrated Facilities 21
    6.7.1 Paving 21
    6.7.2 Water Tank 21
    6.7.3 Lighting System 21
    6.7.4 Sewage Disposal 22
6.7.5 Connecting Roads 22
6.7.6 Weigh bridge 22
6.7.7 Landscaping 22

7. INSTITUTIONAL, STAFFING AND TRAINING REQUIREMENTS 23

8. PUBLIC PARTICIPATION 24

9. EXPECTED EFFECTS ON THE BIO-DIVERSITY, LAND AND WATER. 25

10. ENVIRONMENTAL IMPACTS 26
10.1 Introduction 26
10.2 Positive impacts 28
10.3 Negative impacts 28

11. SOCIAL IMPACT ASSESSMENT 32
11.1 Introduction 32
11.2 Relevant human environment – public involvement 32
11.3 Identification of probable impacts (scoping) 32
11.4 Environmental impacts 33
11.4.1 Noise and stress by heavy truck traffic 33
11.4.2 Odors generation (Air emissions, odors and dust) 33
11.4.3 Storm water drainage 33
11.4.4 Health and safety risks 33
11.4.5 Impact on landscape and visual intrusion 34
11.4.6 Description of further Impacts 34
11.5 Investigation of probable impacts 35
11.6 Determination of probable response 35
11.7 Estimation of secondary and cumulative impacts 35
11.7.1 Recommendation of changes or alternatives 36
11.8 Social Management Plan (SMP) 36
11.8.1 Mitigation, remediation and enhancement plan 36
11.9 Development and implementation of a monitoring plan 36

12. ADVERSE MITIGATION MEASURES AND MONITORING 37
12.1 Introduction 37
12.1.1 Design and Preconstruction phase 37
12.1.2 Construction Phase 38
12.1.3 Operational phase 41

13. FACILITIES OPERATING PLAN 46
13.1 Introduction 46
13.2 General Operational Procedure 46
13.2.1 Introduction 46
13.2.2 Transfer Station Procedures 46
13.2.3 Site Operation 47

14. OPERATIONS MONITORING PLAN 50
14.1 Introduction 50

15. REPORTING PROCEDURES AND DOCUMENTATION 54
15.1 Reporting 55
15.2 Contingency Plan 57

16. CONCLUSIONS 59

Appendix 1.1: Water and Air Quality Monitoring At The SWTS
Appendix 1.2: List of Drawings
Appendix 1.3: Capacity of the transfer station
Appendix 1.4: Minutes of community consultation meeting with the Social Expert

List of Figures
Figure 1: Fiamah Transfer Station Location ................................................................. 13
Figure 2: General view of the construction site at Fiamah ........................................ 13
Figure 3: Access Road to Fiamah ............................................................................. 14

List of Tables
Table 1: Alternative Solution ...................................................................................... 15
Table 2: Baseline conditions at proposed transfer station site ................................ 17
Table 3: Environmental Impacts ................................................................................ 27
Table 4: Summary of Positive Impacts for the Construction Stage ....................... 28
Table 5: Summary of Positive Impacts for the Operation Stage ............................ 28
Table 6: Summary of Negative Impacts for the Construction Stage .................... 29
Table 7: Summary of Negative Impacts for the Operation Stage ........................... 30
Table 8: Table of persons met by Social Expert ......................................................... 32
Table 9: Potential local socio economic impacts at Fiamah and Stockton Creek transfer station ........................................................................................................ 34
Table 10: Mitigation Measures Required in the Design and Preconstruction Phase 37
Table 11: Mitigation Measures Required During the Construction Phase ............ 38
Table 12: Mitigation Measures to be audited during the Operational Stage ........... 41
Table 13: Mitigation Measures to be monitored during the Operational Phase of the TS ..................................................................................................................... 44
Table 14: Monitoring Plan ......................................................................................... 51
Table 15: Summary of Documentation to Be Produced .......................................... 54
Table 16: Estimated costs of EMP implementation and monitoring ...................... 58
Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BoQ</td>
<td>Bill of Quantities</td>
</tr>
<tr>
<td>CBO</td>
<td>Community Based Organisation</td>
</tr>
<tr>
<td>CLC</td>
<td>Community Liaison Committee</td>
</tr>
<tr>
<td>EMUS</td>
<td>Emergency Monrovia Urban Sanitation Project</td>
</tr>
<tr>
<td>FIND</td>
<td>Foundation for International Dignity</td>
</tr>
<tr>
<td>IAPSO</td>
<td>Inter-Agency Procurement Services Office</td>
</tr>
<tr>
<td>IIU</td>
<td>Infrastructure Implementation Unit</td>
</tr>
<tr>
<td>LISGIS</td>
<td>Liberian Institute for Statistics and Geo-Information Services</td>
</tr>
<tr>
<td>LWSC</td>
<td>Liberia Water and Sewer Corporation</td>
</tr>
<tr>
<td>MCC</td>
<td>Monrovia City Corporation</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>MPW</td>
<td>Ministry of Public Works (of Liberia)</td>
</tr>
<tr>
<td>MTEF</td>
<td>Medium Term Expenditure Framework</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Governmental Organisation</td>
</tr>
<tr>
<td>SoW</td>
<td>Scope of Works</td>
</tr>
<tr>
<td>SWTS</td>
<td>Solid Waste Transfer Station</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>WB</td>
<td>World Bank</td>
</tr>
<tr>
<td>WWTW</td>
<td>Waste Water Treatment Works</td>
</tr>
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</table>
1. **INTRODUCTION**

The Emergency Monrovia Urban Sanitation Project (EMUS), falls within the efforts of the World Bank to identify and implement the priority investment needs of the sanitation sector to restore the basic urban infrastructure services in Liberia. Part of it is the assessment and establishment of a waste management service and specifically a waste transfer station in Monrovia.

The Government of Liberia through its Infrastructure Implementation Unit at the MPW has requested assistance from the World Bank for the Monrovia Urban Sanitation Project (EMUS) to draft an EMP for the Solid Waste Transfer Stations (SWTS) at Fiamah and Stockton Creek. This document deals with the Fiamah SWTS.

The purpose of the EMP is for the project to ensure compliance with the Liberian Environment Laws and the World Bank Environment policies during the development and operational phase of the Fiamah SWTS facilities.

1.1 **OBJECTIVES OF THE ASSIGNMENT**

The objective of the overall assignment under EMUS is to design the Fiamah SWTS and to draft an Environmental Management Plan (EMP) to cover future operations of the facilities.

1.1.1 **Specific Objectives**

Specific objectives are to:

(i) Describe and assess the existing environmental and social setting that would be affected or impacted by developing and commissioning of the SWTS in Monrovia and its environs;

(ii) Identify and assess the types and magnitude of the likely potential environmental and social impacts of these activities; and

(iii) Provide an Environmental Management Plan (EMP) with the recommended measures to prevent or mitigate the potential impacts.

1.1.2 **The Environmental Management Plan (EMP)**

The objective is furthermore to produce an Environmental Management Plan (EMP) that includes mitigation measures for the assessment, development and commissioning of SWTS in Fiamah and its environs. The EMP should determine for the transfer station the types of potential impacts the development could cause, the elements of the social and natural environments that could be affected, and the recommended measures to avoid, minimize or mitigate the impacts and to monitor future impacts.

The purpose of the Environmental Management Plan, therefore, is to clearly state the scope and programme of mitigation measures to be implemented during the construction and operation stages of the project. The EMP must therefore be read in conjunction with the construction specification during the construction stage, and with the Operating and Maintenance manual during the operation of the lift stations.
The EMP is thus considered to be a dynamic document which is to be reviewed and continually updated based on actual site conditions. At this stage, it is recommended that the entire EMP be reviewed and/or revised after the first year of operation of the transfer stations.

1.2 INSTITUTIONAL ARRANGEMENTS

Several agencies are involved in water resources management in Liberia which are the following:

Government of Liberia

Ministry of Health and Social Welfare (MHSW): The Division of Environmental and Occupational Health of this Ministry handles matters relating to water, sanitation and periodic assessment of the status of food hygiene in public eating places, construction and/or supervision of water wells and pit latrines and the promotion of community health education. MHSW provides for capacity building and training of environmental health technicians and is mandated to conduct sanitary inspections, including drinking water surveillance and water quality monitoring, towards the evaluation of compliance with Public Health Laws and National Standards.

Ministry of Lands, Mines and Energy (MLME): The MLME among other things, supervises the development and management of water resources that are central to the water and sanitation sector, and conducts scientific and technical investigations required for environmental assessments. The implementation of water and sanitation activities is done through the Department of Mineral and Environmental Research of the Ministry, which houses both, the Liberian Geological Survey (LGS) and the Liberian Hydrological Service (LHS). They are responsible for collecting data on the quality, sources, and quantity of water resources in Liberia and are responsible for monitoring rainfall and stream flow in river basin as well as ground and surface water quality. Training of technicians of the Department of Rural Development for emergency disinfection (chlorination) of open wells has also been undertaken by MLME. The LHS mandate dictates that it be involved in the evaluation of urban sanitation, particularly the provision of guidance for geotechnical investigation of solid wastes SSLS disposal sites.

Ministry of Planning and Economic Affairs (MPEA): The MPEA is responsible for regional development planning and co-ordination. It is also responsible for identification, development and preparation of suitable development programs and projects: both for the public and private sectors development. The MPEA provides technical guidance to all governmental agencies in preparation for development programs and projects.

Environmental Protection Agency (EPA): The mandate of the EPA is to set environmental quality standards and ensure compliance for environmental pollution control. The Agency is responsible for the provision of guidelines for the preparation of Environment Impact Assessment and Audits, and the evaluation of environmental permits. These may include certification procedures for SSLS and other activities potentially damaging to the environment. The Agency is instrumental for the compliance of contractors to the ESMP recommendations.
Monrovia City Corporation (MCC): The MCC is responsible for the management of Monrovia including environmental sanitation primarily in the form of beautification, street cleaning, and solid waste collection and disposal. Several departments within the MCC are jointly responsible for planning, development, operation and maintenance of solid waste management system; these include the Departments of Waste, Environmental Health and Sanitation, General Services, Community Services and Commercial.

Liberia Water and Sewer Corporation (LWSC): The LWSC is a state owned enterprise with a commercial orientation and mandated to provide water supply and sewerage services to urban centres, including Monrovia and the capital cities of the various political subdivisions.

Ministry of Public Work (MPW): The MPW is responsible for the design, construction and maintenance of roads and highways, bridges, storm sewers, public buildings and other civil works in the country. Additionally, it has responsibility for the administration of urban and town planning, as well as provision of architectural and engineering services from all ministries and agencies of government. In principle, it is responsible for the installation of the entire infrastructures required for waste management delivery services including the construction of sanitary SSLS facilities. The Ministry of Rural Development is now merged with the Ministry of Public Works.

Department of Rural Development (DRD) of the Ministry of Public Works is mandated to ensure that safe drinking water and adequate sanitation facilities are provided in rural communities. It also ensures the provision of policy direction on the construction, utilization and maintenance of low cost facilities that are appropriate for rural communities, such as Roads and hand pumps. Environmental management in Liberia has been fragmented with each public agency governed by its own policies. The roles and responsibilities amongst the principle agencies waste management is ambiguous and overlap in some cases. For example, the mandate of MCC overlaps with that of the MHSW regarding environmental health inspection activities. These mandates will require further clarification, especially during the development of appropriate institutional framework for the management of solid waste and sanitation.

1.3 **Draft Environmental Policies and Laws**

The following draft environmental policies and laws govern the use of facilities to enable the protection of the environment:

- The National Environmental Policy of Liberia 1999
- Environment Protection Agency Act of the Republic of Liberia 1999

The Draft Environmental Policy of Liberia has a section on the conservation and management of water resources. The section recommends that water resources, both surface and ground should be managed and developed in a sustainable way. The river basins should be well studied and included in basic planning and development and in environmental impact assessment programmes. Priority
should be given to watershed management to control, conserve and regulate the balance in catchment areas and water courses, both the implementation of the mitigation measures and impacts that actually occur. The measures should as much as possible be formulated in terms that can be incorporated in the contracts. The Institutional responsibilities for implementing and overseeing the EMP and the estimated costs of its component activities should be included.

As new solid waste transfer station facilities are being constructed it is determined that only World Bank Policy OP 4.01 is triggered by the SWTS assessment, development and operations. In summary therefore:

<table>
<thead>
<tr>
<th>Safeguard Policies Triggered</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Assessment (OP/BP 4.01)</td>
<td>X</td>
<td></td>
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<tr>
<td>Natural Habitats (OP/BP 4.04)</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Forests (OP/BP 4.36)</td>
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<td>X</td>
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<tr>
<td>Pest Management (OP 4.09)</td>
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<tr>
<td>Physical Cultural Resources (OP/BP 4.11)</td>
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<td>Indigenous Peoples (OP/BP 4.10)</td>
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<tr>
<td>Involuntary Resettlement (OP/BP 4.12)</td>
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<td>Safety of Dams (OP/BP 4.37)</td>
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<tr>
<td>Projects on International Waterways (OP/BP 7.50)</td>
<td></td>
<td>X</td>
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<tr>
<td>Projects in Disputed Areas (OP/BP 7.60)</td>
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The Environmental Project Brief (EPB) is covered in the following chapters:

- Description of the project
- Objective and nature of the project with reasonable alternatives
- Current baseline conditions
- Main activities during site preparation and construction
- General operational procedure
- Institutional, staffing and training requirements
- Public participation
- Expected effects on biodiversity, land, water and geographical resources
- Environmental impacts
- Socio-economic impacts and resettlement/employment programme
2. **HISTORICAL AND PROJECT BACKGROUND**

In October 2006, the World Bank (WB) committed itself to address some of the most urgent infrastructure rehabilitation needs in Liberia including: (i) upgrade of the Fiamah (and now the Whein Town) waste disposal sites; (ii) clean-up of all accumulated trash in the city; and (iii) start-up of a solid waste collection service.

Rehabilitation and covering of the Fiamah site has recently been completed. To date the city has been rid of large volumes of waste with a regular waste collection service slowly being established.

As part of the WB commitment, 8 skip loading trucks and 120 skip waste containers were procured under the Emergency Rehabilitation Project for the city to assist in collecting and transporting household waste to the waste disposal sites. More than 120,000 tonnes of waste has been removed from the city which has been transported daily over long distances. This volume is steadily growing.

Due to the long travelling distances to the landfill a need for transfer stations has been identified. This will allow the collection vehicles to travel short distances to allow them to return to the collection points while the bulk of the waste can be transported in large volumes to the landfill using long haul vehicles.

**2.1 TRANSFER STATION DEVELOPMENT**

Although 120 skip collection points have been created throughout the city these are not sufficient to deal with the rising amount of waste generated in Monrovia. Waste management strategies performed by consultants indicate the need for the construction of waste transfer facilities to assist with the waste collection logistical requirements. One such logistical option is to introduce a transfer station which has the ultimate objective of minimizing overall transportation cost associated with the disposal of waste at the distant Whein Town Waste Disposal or Landfill facility. Transportation costs of waste in a city are known to be typically in the order of 75% of the total waste management bill.

The transfer station will be constructed with features such as fencing/walling, access road, land clearing, and construction of retaining walls, roofing structures, raised loading platforms, storm water drainage systems and site amenities (administrative building and ablution facilities).

Final detailed engineering plans and drawings, standard technical specifications, and construction schedules shall be finalized after EPA approval of this report.

**2.2 SCOPE OF WORKS**

As part of the World Bank EMUS programme a limited budget has been provided for the construction of two transfer stations on the sites at Fiamah and Stockton Creek.

The Construction Contractor’s main scope of works under this contract at each of the two sites include for the construction of the two transfer station buildings with reinforced walls, columns and roofing and the construction of the concrete
reinforcement driveways and curbs, plus ancillary electrical and mechanical and building works.

2.3 OPERATIONS PHILOSOPHY

A waste transfer station is seen as an interface between (short haul) specialized waste collection vehicles and economical (long haul) disposal vehicles, to ultimately assist in collection and disposal of waste economically. The purpose is to reduce, not only the transported unit cost of the collected waste, and thus more cost-effective payloads, but also to allow quicker turnaround times of collection vehicles such as the skip trucks and free them to continue with their collection process leading to increased productivity within the system.

Waste will be brought to the transfer station where the skip truck or other smaller vehicles will discharge their waste into a large container or truck parked at the bottom of constructed retaining walls. Once the containers are full they or the large truck will be moved and transported to the landfill. An empty container or truck will then be placed in the open bay ready to receive more waste. In general therefore the task of the transfer station operator would be to keep the facility tidy at all times, to ensure that waste that comes to the station is offloaded in an orderly way and transported away from the station to the landfill on a regular basis.

Transfer stations can be considered the final disposal point for the community, particularly where communal collection services are being provided. Communal disposal facilities, where open bulk containers are utilized, therefore need to be managed and controlled with the same care and responsibility as that required for a landfill site. At present the skips are basic “transfer” points and not a “transfer station” per sé.

Regardless of their degree of sophistication, transfer stations can thus

- Assist in the reduction of haulage costs;
- Reduce the congestion of traffic on the road to and at the landfill;
- Provide opportunities for recycling; and
- Allow easier collection and disposal by small entrepreneurs and household

The facilities will be operated on a daily basis by a dedicated operator through medium term contracts with private waste management companies on behalf of the MCC to ensure that the incoming waste is “moved along” so that waste is not stockpiled. The operations of the facility will also entail high quality housekeeping (cleanliness of the facility, continuous operational mechanical systems and open drainage systems) along with the available water, sanitation and electricity services. Attending to and ensuring security of the facility/site will also form an important part of the daily operations.
3. NATURE OF THE PROJECT WITH REASONABLE ALTERNATIVES

3.1 DESCRIPTION OF PROPOSED ACTIONS AND ALTERNATIVES

A part of the EMUS project refers to the municipal waste disposal system. Waste is planned to be collected at decentralized collection points and then transferred to two transfer stations from where the waste is transported by larger trucks to a centralized landfill (at the moment Whein Town landfill and in future Mt. Barclay as a potential permanent landfill).

The idea of the transfer stations is to receive the waste brought in by skip trucks or public containers or a variety of small vehicles, even carts and wheelbarrows, and dispose the waste into large containers or trucks parked inside the transfer station building. These large containers will be say 5 times larger than the skips so that the waste is being transported to the distant landfill in a more economic way (waste disposal site) and will cost less/unit of waste to operate than each small skips being transported individually to the landfill. After the waste collection skips are emptied at the transfer stations the skip trucks can return to the collection points in the city and continue with the daily collection task and collecting more waste per hour and day of operation.

These transfer stations will have a roof to prevent the operations from taking place in the rain. The sides of the building will consist of built up walls or steel sheets. It will also have an ablution block, a small office and security wall with entrance gates. The floor on the lower level and upper levels will be concrete with concrete. The station will be operated and kept clean by a contractor and the waste will be cleared from the transfer station of a daily basis.

On the recommendation of the Presidency, the Ministry of Lands, Mines and Energy (MLME) has been facilitating the process of designating land for the construction of two transfer stations envisaged under the project. Alternative sites in the city have been studied but excluded due to various reasons.

3.2 LOCATION OF FIAMAH SITE

The proposed site of the transfer station is located along Barclay Avenue next to the LWSC waste water treatment plant. The site was a solid waste dump site and has recently been capped and closed. It is part of this land that will act as the loading bay. The site is located between:

6°18.989’ N and 10° 46.825’ W,
6°19.036’ N and 10° 46.763’ W,
6°18.983’ N and 10° 46.750’ W and
6°18.979’ N and 10° 46.810’ W. (see drg No FIA-CIV-01-LIB).

The site is located within a residential area and managed by MCC. The proposed site is ideally located relative to the southern and western areas for effective solid waste transiting especially as all waste had in the past been transported to this site for final disposal.
Republic of Liberia  
Emergency Monrovia Urban Sanitation Project  
Development of Fiamah Waste Transfer Station  
Enviromental Management Plan (EMP)

Figure 1: Fiamah Transfer Station Location

Under the auspices of the MLME, the MCC and the Liberia Water and Sewer Corporation (LWSC) have agreed that a small area located on the premises of the LWSC and bordering the Fiamah lot (owned by MCC) will be provided for the construction and operations of a transfer station. The Government intends to formalize the agreement with a Memorandum of Understanding (MOU) between MCC and LWSC.

Figure 2: General view of the construction site at Fiamah
Figure 3 shows the access road which leads to the future transfer station at Fiamah. Road construction will require that a few illegal lean-to stalls and buildings at the road boundary be cleared.

**Figure 3: Access Road to Fiamah**

The nature of the development of a transfer station project and the operation of such a transfer station is the following:

a. To assess the site of the SWTS in terms of its structural stability (foundations), access possibilities, mechanical and electrical requirements, building functionality, operational safety and, operational and maintenance requirements.

b. Once the assessment is complete, to design the facility such as:
   i. Structure engineering interventions – such as walls, columns and roofing
   ii. Mechanical engineering replacements - such as piping and railings,
   iii. Electrical engineering such as switch gear, stand-by power supply, lighting and control
   iv. Architectural features - such as door, windows, roofing (if necessary), fencing and painting
   v. Civil works – such as earthworks, access roadways, paving and storm water drainage

c. Based on the assessment, bids will be called for through an open bidding process on order to undertake the construction process on behalf of the MPW/MCC
d. Once the contracts have been approved and awarded by the IIU the development of the SWTS will commence and, once complete, will be commissioned.

e. Commissioning will however be linked closely to existing and new waste collection contracts. The intension is also to accommodate small collection contractors to offload waste at the facility.

f. A separate but most important issue is the successful operations of the Whein Town disposal site as all existing pollution problems will only be displaced elsewhere is the two facilities, transfer station and landfill aren’t operated in harmony.

Due to the nature of the project i.e. collection of waste in and around the centre of the waste generation area, reasonable alternatives are limited to:

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Constitute</th>
<th>Implications</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintain status quo</td>
<td>Do nothing</td>
<td>Collected waste will have to be transported from the community collection point to the distant Whein Town landfill</td>
<td>Process will result in an expensive waste collection and disposal service</td>
</tr>
<tr>
<td>Establish transfer station at optimized locations</td>
<td>Minimise the collection route before disposal of waste</td>
<td>Eliminate waste collection vehicle traveling unnecessary routes and distances</td>
<td>Transportation constitute approximately 70% of waste management costs.</td>
</tr>
<tr>
<td>TS facilities throughout city</td>
<td>Developing a number of transfer stations</td>
<td>Double handing of waste could lead to higher waste management cost</td>
<td>Optimised number of facilities to be determined</td>
</tr>
<tr>
<td>Attend only to the large waste generation area</td>
<td>Only the large stations will be developed with no station in other parts of the city</td>
<td>Waste from a large portion of the city will have to be transported directly to the landfill increasing costs</td>
<td>This option is not recommended as a large portion of the City’s population is spread over large areas</td>
</tr>
</tbody>
</table>

The Fiamah transfer station is one of two to be developed.

Based on the terms of reference, the Consultancy services for construction of two solid waste transfer stations are phased. These phases being:

- Site inspection, assessment, site investigations
- Engineering designs and drawings
- Environmental Impact Statements and Action Plans
- Social Impact Statements and Action Plans
- Confidential Cost Estimates
- Preparation of Bid Documents
- Assistance in Bidding and Evaluation
- Supervision of Construction
- Commissioning of the Facility
4. CURRENT BASELINE CONDITIONS

A number of informal waste dumps are present throughout the city. Attempts have been made to clear the city of these dumps. The main dump at Fiamah has been closed and capped during recent years.
### Table 2: Baseline conditions at proposed transfer station site

<table>
<thead>
<tr>
<th>Station</th>
<th>Size</th>
<th>Air</th>
<th>Surface water</th>
<th>Soil</th>
<th>Subsurface water</th>
<th>Noise</th>
<th>Safety</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiamah</td>
<td>120 t/d</td>
<td>i) Limited to no odors</td>
<td>i) Away from standing water</td>
<td>i) Sandy clayey soils – partly contaminated by old disposed waste ii) Soil test indicated good foundation conditions</td>
<td>i) Assumed not to come from the SSLS as concrete structures do not show any leakage or damage</td>
<td>i) No ambient noise other than the nearby residential noise</td>
<td>i) Area partly WWTW and old dumpsite is fenced in and undulated with stormwater channel traversing site ii) No obvious unsafe environment</td>
<td>i) Site is largely undeveloped</td>
</tr>
<tr>
<td>Stockton Creek</td>
<td>200 t/d</td>
<td>i) Limited to no odors</td>
<td>i) Standing water visible</td>
<td>i) Saturated soils ii) Foundation conditions unknown – soil tests being awaited</td>
<td>i) Subsurface water from Mesuradu river lake</td>
<td>i) Audible traffic noise from the nearby Somali drive and informal auto workshops</td>
<td>i) Site at present open and not fenced. ii) Site located close to very busy main road iii) No direct and obvious unsafe environment</td>
<td>i) Site is undeveloped ii) Site is next to main road iv) Site located in industrial area.</td>
</tr>
</tbody>
</table>
5. **MAIN ACTIVITIES DURING SITE PREPARATION AND CONSTRUCTION**

The main activities that will be undertaken during the site preparation and construction are as follows:

a. Ensure through survey the exact site boundaries
b. After setting out, site will be shaped through earthworks (excavate and fill) to form embankments and platforms
c. The SWTS will be linked to the LEC electricity network system where available. Switch gear will be provided inside the SWTS. The switch gear will be configured such that the power supply could switch automatically from the local grid to the silent emergency generator provided and vice versa. Lighting will be provided along with the switchgear.
d. A generator will be purchased and housed in a new shelter (attachment to the SWTS building) which will be constructed as per requirement.
e. Elevated fuel storage tanks mounted to the wall with the exhaust system leading outwards will be located in the generator shelter.
f. The SWTS super structure will be constructed with concrete and block walls, sheet cladding, block windows and doors where required
g. The structure will be painted and fitted with electrical light fittings and forced air ventilation.
h. The site will be secured with security wall fencing and access gates.
i. The site will also be paved and surface drainage channels provided where necessary
j. Signage containing contact information will be provided outside the station in the event of emergency situations involving the station
k. Water supply tanks will be supplied on the roof of the station with taps to aid in washing of personnel after operations and servicing of the SWTS or general washing down of the station facilities during routine maintenance.
l. All wet wells will be provided with open grid covers to aid in ventilation of the wells as well as drainage of water.
m. The transfer station will be provided with ablution facilities to be connected to the sewer intake structure.
6. GENERAL OPERATIONAL PROCEDURES OF THE SOLID WASTE TRANSFER STATION

6.1 DESCRIPTION OF THE TRANSFER STATION FACILITY

The transfer station will act as a interface between the waste collection vehicles and the sanitary landfill. Presently there is no solid waste transfer station in Monrovia.

The existing skip trucks with capacity 6m$^3$ ferry waste directly to the landfill site. Approximately 6-8 trucks dispose of waste at the landfill per day along with waste collected by the private sector in either small trailers or trucks. The development of a waste transit area will increase the efficiency of waste collection and disposal as large longhaul vehicles will be used to ferry waste to the landfill.

The facility will be managed from an facilities building containing and office, ablution facilities and a store room. Control of the site will be done from the same office facilities and by means of a security gate and fencing. Access to the collection part of the site will be controlled via a guardhouse.

Waste will be brought to site on the receiving side where trucks will be able to manuevre and back up to the off loading bays. The waste will be offloaded in the bay area either into large containers or trucks directly or onto the storage floor area. Where waste is offloaded into the containers/trucks these will be lifted and removed from site as soon as they are filled. Where waste is dumped on the floor it will be collected with a front-end-loader and loaded into a long haul truck ready to be transported to the landfill for disposal.

Stringent operations and maintenance requirements will form part of the daily operational practices to ensure environmental acceptability.

6.2 DESIGN CAPACITY

The mass of municipal solid waste collected in the Greater City of Monrovia in the year 2025 is estimated to be 975 tons/day (Concepts Development Report, Poyry Environment GmbH, March 2008), was divided into two, the number of transfer stations to be built. Fiamah transfer station will be able to handle the waste generated. It has a handling capacity of approximately 415 tons per day, considering the assumptions made in Appendix Table 1-3 for the 6m$^3$ skip trucks and 25m$^3$ longhaul vehicles per day.

Considering the above the waste transfer station will ideally consist of the following:

- A raised platform with three container bays for the disposal of domestic waste.
- A concrete paved area for the driveway.
- An office block with a toilet, shower and generator room.
- Guard House
- Storm water drainage and other services (water, sanitation and electricity)
- Landscaping
- A security wall/fence around the entire site with two lockable gates, entry and exit points.

In sizing the waste transfer facility, cognisance was taken of the vehicular movements to ensure that all intended vehicles will be able to approach the areas where required with ease.

The site location and side view plans are shown in drawings No. FIA-CIV-02a-LIB and FIA-CIV-02b-LIB respectively. See Appendix 2.0

6.3 **TRANSFER STATION INFRASTRUCTURE**

The facility will incorporate the following which should be viewed in conjunction with the attached drawings in Appendix 2.0.

6.3.1 **Community Access Point**

A chute / opening will be constructed to accommodate the public when dumping their waste at the transfer station using any type of device, e.g., wheel burrows. The window will remain open through-out the day, 24 hours daily.

6.3.2 **Roof Structure**

The roof structure will be sheltering the footprint of the transfer building. The roof covers about 10-15% of the total area with transparent roofing material for natural lighting system. The clear vertical of the design is about 9m on the high side and 11.5m on the lower side. The roof is pitched type.

6.3.3 **Offloading Bay**

A raised, reinforced concrete platform, supported by reinforced concrete retaining walls under a shelter will be constructed. This is about 2.5m high. The public will have access onto the chute / window on the side platform via a ramp to offload waste down into the infrastructure / containers which will be stationed along the width of the first portion of the platform. (see drg No. FIA-CIV-03-LIB).

The platform has been designed to accommodate three containers (provisional) of each 25m$^3$ capacity.

6.3.4 **Loading Bay**

A Front End Loader will be used for loading of solid waste (mostly organics once the bulk of the waste has been sorted and collected for recycling) from the ground onto the long hauling vehicles. The space is adequate for front end loader turnaround maneuverings. The concrete base is lined with a metallic concrete hardener to protect the wear and tear of the concrete due to front end loader works. (see drg No. FIA-CIV-03-LIB).

6.3.5 **Drainage System**

To ensure that contaminated water or liquids from the waste is controlled, a sump grate will be constructed within the works area and be connected to the sewer system which will be discharged into the existing nearby sewer intake structure. The surface beds (concrete paving) on site will also be sloped so as to control rainwater away from the waste body into stormwater drainage channels.
Subsurface systems consisting of uPVC and HDPE pipes varying between 110 mm and 160 mm diam. will be used to collect the sewage and stormwater on site. The intention would be to remove and/or divert water away from the facility as fast and effectively as possible without any negative impact on the surrounding area (specifically the waste) (see drg No. FIA-CIV-06-LIB). The drainage of the site will as far as possible be overland/surface flow.

6.4 FENCING AND GATES

Approximately 0.23 ha of land will be fully fenced with a 2.5m wall and wire fencing, with concrete pillars at 20m intervals.

The vehicle entrance and exit points will be closed with two lockable 2.5m mesh wire gates. (see drg No. FIA-CIV-07-LIB).

6.5 OFFICE BLOCK

An office block will be built within the premises. It will contain a toilet and shower and generator room. The office block will be connected to the water reticulation system. (refer drg No. FIA-CIV-04a,b-LIB).

6.6 GUARD HOUSE

A guard house will be located at the outlet of the long haul collection trucks entry and exit point. (refer drg No. FIA-CIV-05-LIB).

6.7 INTEGRATED FACILITIES

The following sections explain in details the various components of the transfer station facilities.

6.7.1 Paving

Surfacing of the access to the site and internal roads will be constructed as follows:

- Access off the Barcaldy Avenue to the entrance and exit of the site: Asphalt
- All internal roads: 170mm thick concrete pavings
- Additional parking areas for trucks on the old landfill: Gravel

6.7.2 Water Tank

An elevated storage water tank of capacity 10 000 litres will be constructed at the transfer station (refer drg No. FIA-CIV-08-LIB). Water will be pumped into the tank by water bowsers from the LWSC. The reticulation system will run from the tank into the office block and the transfer station building. The high tower structure supporting the elevated tank will allow for sufficient water pressure for cleaning purposes.

6.7.3 Lighting System

As part of the safety features high mast lighting will also be provided. The area will be electrified by means of a generator which will be located within the office block building.
6.7.4 Sewage Disposal

The sewer lines together with the polluted water drainage pipes will lead to the existing sewer system. The pipes are located on the northern side as shown on drg No. FIA-CIV-03-LIB.

6.7.5 Connecting Roads

The site is located at the end of Barclay Avenue at the old Fiamah dump site and the Liberia Water and Sewer Corporation waste water treatment plant. A section of Barclay Ave feeding the SWTS is earmarked for rehabilitation.

6.7.6 Weigh bridge

Provision for a weighbridge through separate contracts has been allowed for at the entrance of short hauling vehicles.

6.7.7 Landscaping

Proper landscaping will where possible also be part of the development to improve the visual aesthetics of the facility. If not done during the contract, landscaping is often neglected.
7. INSTITUTIONAL, STAFFING AND TRAINING REQUIREMENTS

To ensure the successful implementation of the EMP for the MPW/MCC SWTS, in accordance with the requirements of the Environmental Act, resources (both human and financial) and commitment from various bodies will be required.

The EPA is responsible for enforcing the aforementioned regulations in terms of the Liberia Environment Act. The EPA will therefore have to accept and timely review all the requisite reports submitted to it by the Monrovia City Corporation. The EPA must therefore have suitably qualified people available for carrying out this function.

The Monrovia City Corporation, as the Implementing Agency (IA) for the new SWTS, is responsible for implementing the EMP. This requires inspection, auditing and monitoring of the site and the submission of Project Compliance Reports. As the Monrovia City Corporation does not currently have the necessary trained personnel to carry out these functions, environmental staff from Pöyry is proposed to fulfill this role, at least up to the end of the first year of operation (the end of the Defects Liability Period) if their consultancy agreement is extended. During this period, it is proposed that the Monrovia City Corporation identify appropriate personnel for training in these skills, with a view to taking over the auditing and monitoring functions eventually. If these people work with the consultants from Pöyry on the different audits, it will facilitate a transfer of skills.

In addition to provision for training of personnel, financial provision must be made by the City Council for the costs of all the water quality analyses required.

Regarding the operation of the SWTS, it is strongly recommended that the MCC consider privatising or contracting out the operation to a specialist SWTS contractor. This is due to the MCC staff, currently employed, not trained and thus insufficiently skilled in the operation and maintenance of a modern SWTS facility. If a specialist contractor is appointed for a set period of say 3 years, with the proviso that the current council employees and other local people are employed, a transfer of skills and training will result. This would then facilitate the operation of the site to a high standard by the MPW/MCC employees in the future.
8. PUBLIC PARTICIPATION

To ensure that the public is properly informed about the project, and to enable any interested and affected parties (IAPs) to raise concerns about the project, a public participation exercise should be maintained by the Monrovia City Corporation. During the planning phase the public was consulted regarding the establishing of a transfer station in the proposed location (further described in Section 11).

An initial public information meeting should be held at which the SWTS project is presented and discussed. In addition to advertising the meeting in the local press, invitations must be sent to residents in the area and to the EPA and other relevant officials. At this meeting, the IAPs would have the opportunity to raise any concerns they may have regarding the project. Where necessary, the concerns of the IAPs would be added to the compliance monitoring plan (CMP) for regular monitoring.

At the public meeting, it is recommended that a Community Liaison Committee (CLC) be elected to represent the community in issues relating to the SWTS. This committee could then delegate one or more representatives to participate in the scheduled environmental inspections and audits of the SWTS. Any issues or concerns of the community could be raised by the representative, and could be addressed by the consultants and operator in the inspection report. Copies of the inspection reports are to be given to the CLC.

In addition to the scheduled inspections, the CLC would be given clear lines of communication and contact persons with telephone numbers should the need arise to discuss problems, complaints etc.

The CLC would be responsible for reporting back to the community on how problems with the SWTS are being resolved.
9. **EXPECTED EFFECTS ON THE BIO-DIVERSITY, LAND AND WATER.**

The bio-diversity in the specific location of the proposed SWTS had been changed many years earlier and no further change to the environmental is bound to take place apart from potential improvement and control. Where effluent is not discharged in the open the earlier bio-diversity such as fauna and flora in many areas could return or be reinstated. The land in the vicinity of the SWTS will be improved through the rehabilitation process by removal of the pollutants. Issues such as surfacing and improved drainage will be added to curb erosion. Geographical resources such as layout maps of the sewer system and satellite image of the area are available as management tools.

Although very few, the expected environmental impacts brought about by the project are indicated in the tables below. Impacts on soil, water, air, fauna, flora biodiversity and safety during planning, construction and operations were considered. Impacts are shown in relation to the necessary mitigation measures. In general very few negative impacts and more positive impacts will be brought about by the project.

However in the event that the transfer station fails, conditions will revert back to the status quo where waste is dumped indiscriminately with irregularity in collection due to long distance traveling to offload the waste.

In the event of a breakdown or blockage at the SWTS, which is expected to be for a short period only, all incoming waste can be diverted directly to the landfill.
10. ENVIRONMENTAL IMPACTS

10.1 INTRODUCTION

Each individual transfer station project has both short and long term positive and negative impacts which must be addressed through the implementation of appropriate mitigation measures. The objective of mitigating the negative impacts is to eliminate or minimise the effect of each impact. On the other hand, the objective of enhancing the positive impacts is to gain the maximum benefit there from.

Since the impacts for the Construction and Operation stages of the project differ significantly in type and duration, they are to be considered separately. Significant impacts (both positive and negative) are highlighted in the generic table below.

In May 2009 Pöyry visited the two transfer station sites with the view to assess them from an environmental perspective. Upon application the EPA have requested that an EMP to be compiled for the SWTS. Basic environmental assessments of the sites were thus carried out to enabled the consultants to compile the EMPs for the transfer station.

The expected environmental impacts brought about by the project are thus indicated in the table below. Impacts on soil, water, air, fauna, flora biodiversity and safety during planning, construction and operations were considered. Impacts are shown in relation to the necessary mitigation measures. In general very few negative impacts and more positive impacts will be brought about by the project.
Table 3: Environmental Impacts

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<tr>
<td>consumption</td>
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</tbody>
</table>

Key: *** Potential major positive effect          --- Potential major negative negative effect
* Potential minor positive effect        - Potential minor negative effect
10.2 **POSITIVE IMPACTS**

The positive impacts to be enhanced by the project are summarized in Tables 2 and 3.

**Table 4: Summary of Positive Impacts for the Construction Stage**

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment opportunities</td>
<td>• Limited employment for local community, for duration of construction period (5 months).</td>
</tr>
<tr>
<td></td>
<td>• Possible continued employment with contractor on further contracts.</td>
</tr>
<tr>
<td>Skills enhancement</td>
<td>• Development of skills such as machine operator, site management, security guard, etc.</td>
</tr>
</tbody>
</table>

**Table 5: Summary of Positive Impacts for the Operation Stage**

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of new facility – land-use formalization</td>
<td>• Waste management in city to be enhanced by ensuring more rapid collection and increased volumes - increased efficiencies</td>
</tr>
<tr>
<td></td>
<td>• Enhance sustainability of the waste management system</td>
</tr>
<tr>
<td></td>
<td>• Although not a direct benefit of the facilities, the provision of surfaced access roads to the sites will enhance vehicle access for local residents and reduce dust.</td>
</tr>
<tr>
<td></td>
<td>• Facility to offer opportunity and place to recycle materials.</td>
</tr>
<tr>
<td></td>
<td>• New development could establish a base or kick start the process for a structured town planning layout in the area</td>
</tr>
<tr>
<td>Employment opportunities</td>
<td>• Employment opportunities for local community as operators and clerks.</td>
</tr>
<tr>
<td></td>
<td>• Although limited in number (approximately 5), these employment positions would be long term.</td>
</tr>
<tr>
<td>Health improvement through available facilities</td>
<td>• Communities less exposed to uncollected waste.</td>
</tr>
<tr>
<td>Safety through organized waste managing</td>
<td>• Communities in close proximity not exposed to uncollected waste.</td>
</tr>
<tr>
<td>Skills enhancement</td>
<td>• Development of skills such as machine operator, security guard, etc.</td>
</tr>
</tbody>
</table>

10.3 **NEGATIVE IMPACTS**

The majority of the permanent negative impacts identified in the Table 1 will be addressed and mitigated through appropriate design measures.
Most of the temporary negative impacts occur during the construction stage of the project. Temporary impacts which occur during the operation of the SWTS are addressed through appropriate design and operating methods.

The temporary negative impacts to be addressed during the construction stage of the project are listed in Table 4. The negative impacts to be addressed during the operation of the SWTS are listed in Table 5.

### Table 6: Summary of Negative Impacts for the Construction Stage

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
</table>
| Siting of contractor’s temporary facilities | • Visual impact for duration of contract for passersby.  
• Ground disturbance through clearance and leveling of area.  
• Limited significance for duration of contract. |
| Water supply to contractor’s facilities     | • Temporary impact on water supply for duration of contract to be used in the production of concrete.  
• Limited significance as it is only potable water for contractor’s staff and limited volumes of concrete. |
| Contractor’s temporary sanitation facilities| • As no sewer line to the site exists the contractors would need to provide own chemical toilet facilities.  
• Limited significance for duration of contract. |
| Fuel spillage from contractor’s fuel tanks  | • Fuel spillage could pollute soil and ground water in immediate vicinity of contractor’s establishment if not properly managed.  
• Limited significance for duration of contract. |
| Contractor’s waste oil and other waste disposal and litter | • If not properly disposed of, waste oil could pollute soil, surface and ground water.  
• Other waste could have an aesthetic and health impact if not suitably disposed of.  
• If not properly controlled, pollutants such as oil and paint could pollute the nearby water courses.  
• Limited significance for duration of contract. |
| Workers’ safety                             | • Risk of construction related accidents to workers.  
• Significant risk for duration of contract. |
| Employment from outside                     | • Employment of workers from outside the area could cause friction with the local labour force.  
• Unrealistic expectations of employment from local people.  
• Limited significance for early stages of contract. |
| Flora conservation                          | • Permanent loss of flora in areas of permanent works.  
• Temporary loss and disturbance of original flora on site, beyond permanent works, as a result of construction activities. |
| Construction noise                          | • Nuisance factor from noise of construction equipment.  
• Limited significance to workers and nearby residents for contract period during normal working hours. |
| Construction                                | • Nuisance factor from vibrations of construction equipment. |
vibration

- Limited significance to workers and nearby residents for contract period during normal working hours.

Construction dust

- Nuisance/health risk to workers and nearby residents from dust generated by building works and clean-out operations.
- Limited significance for contract period during normal working hours.

Public safety

- Safety risk to members of public who may come onto the site, posed by construction machinery.
- Low significance for construction period as work is more concentrated in-doors.

Traffic disruption

- Limited disruption to traffic away from main roads
- Limited significance as traffic volumes are not great.

Trespassing/infringement on adjacent properties

- Possible trespassing on adjacent private properties.
- Limited significance until permanent site fence is erected.

### Table 7: Summary of Negative Impacts for the Operation Stage

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground water contamination</td>
<td>Leakage of polluted liquids from the station or sewer systems could contaminate ground water supplies in the area. This impact could have severe long term consequences for users of both ground water and surface water in the area.</td>
</tr>
<tr>
<td>Surface water contamination</td>
<td>Blockage or malfunctioning of the station drainage and all oil and litter traps could lead to surface water contamination. This impact could have serious health consequences for downstream users throughout the life of the station.</td>
</tr>
<tr>
<td>Soil contamination</td>
<td>All waste to be handled could lead to contamination of the surrounding areas if not cleared on a daily basis. Low significance provided it is removed and managed daily especially as the waste is contained or placed on a concrete floor.</td>
</tr>
<tr>
<td>Visual impact of transfer station operation</td>
<td>Visual impact of waste disposal operation for surrounding residents. Low significance due to operations concentrated inside an enclosed structure with a few inhabitants surrounding the site.</td>
</tr>
<tr>
<td>Increased road traffic to site and vicinity</td>
<td>Increased road traffic (trucks) to new site will create noise, air pollution and safety impacts. This is a significant long term impact for road users and residents along the road to the site.</td>
</tr>
</tbody>
</table>
| Noise from operation                        | Noise from plant and trucks on site represents a nuisance. Limited long term significance for on-site workers and
| Dust from operation     | Dust from vehicles on site represents a nuisance/health risk.  
|                         | Very limited long term significance for site workers and users, as well as nearby residents, during normal working hours. |
| Dust on access road     | Dust from collection and haul vehicles on the access road represents a health impact.  
|                         | Serious long term significance throughout the life of the station. |
| Odours from operations  | Odours from collected and handled waste stockpiled.  
|                         | Serious long term significance throughout the life of the station. |
11. SOCIAL IMPACT ASSESSMENT

11.1 INTRODUCTION

A social expert mission was carried out for the Emergency Monrovia Urban Sanitation (EMUS) project from June 3-18, 2009 for the Social impact Assessment (SIA) and associated Social Management Plan (SMP) for two (2) Transfer Stations in Monrovia.

This section describes key issues discussed and agreed with the respective communities with regards to the proposed construction of two (2) transfer stations of the waste disposal system.

The list of key persons met by the Social Expert is tabled as below.

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bill Warner</td>
<td>LWSC</td>
<td>Deputy Managing Director</td>
</tr>
<tr>
<td>Abraham Garneo</td>
<td>MCC</td>
<td>Director Solid Waste Dept. and Urban Works Focal Point</td>
</tr>
<tr>
<td>Marie E. Norma</td>
<td>MCC</td>
<td>Director Squatter Resettlement and Rehabilitation</td>
</tr>
<tr>
<td>Manfred Bussler</td>
<td>Pöyry Environment GmbH</td>
<td>Team Leader</td>
</tr>
<tr>
<td>Pieter Smuts</td>
<td>Pöyry Environment GmbH</td>
<td>Solid Waste Expert</td>
</tr>
<tr>
<td>Paul Howell</td>
<td></td>
<td>Resident Engineer</td>
</tr>
<tr>
<td>Eugene Caine</td>
<td></td>
<td>Engineer (Liquid Waste)</td>
</tr>
<tr>
<td>Alfred Collins</td>
<td></td>
<td>Engineer (Liquid Waste)</td>
</tr>
<tr>
<td>Udo Stumpf</td>
<td></td>
<td>Mechanical engineer</td>
</tr>
</tbody>
</table>

11.2 RELEVANT HUMAN ENVIRONMENT – PUBLIC INVOLVEMENT

Besides the general public of Monrovia which is benefitting from the waste disposal system, primary stakeholders, those people living in the vicinity of the site that would be directly affected by or displaced by the proposed transfer station were consulted through a community meeting. Both the landfill operator and the supervising engineer for urban works have established ongoing communications with the community at Fiamah. The proposed transfer station site is located adjacent to the old dumpsite that was replaced by Whein Town. Consultation with the affected communities is essential, so that communities can have inputs into design, operating procedures, and environmental and social impact management measures. An NGO, FIND, has been implementing an awareness campaign in Monrovia with World Bank support and has also directly assisted MCC by facilitating consultations at Fiamah. Neighborhood consultations were and will be part of both the transfer station site selection process and the preparation of EMPs for the transfer stations.

11.3 IDENTIFICATION OF PROBABLE IMPACTS (SCOPING)

The two simple transfer stations for domestic and commercial solid waste that will be constructed and placed into operation under EMUS will not have impacts that are complex or significant (minor local impacts). They can normally be managed through application of proper operating procedures. However, it is important to
ensure that the design of the facilities, the planning of hauls routes, and the operating procedures including hours of operation are appropriate in the environmental and social settings of the stations. The construction and operation of two solid waste transfer stations will make transport to the landfill more efficient and thereby allow collection to expand which has positive social impact for the majority of the key stakeholders representing the people of Monrovia.

11.4 ENVIRONMENTAL IMPACTS

The community living in the vicinity of a transfer station is confronted during operation with the following environmental nuisances of the transfer station, which is subject to the preparation of an EMP:

11.4.1 Noise and stress by heavy truck traffic

The operational phase is associated with noise generation from the operations as well as loading and unloading activities that may have impact on nearby residential communities.

During the operational phase, the facility will result in significant impacts on the traffic flow along the Monrovia Tubman Boulevard as well as other road networks leading to this highway where the majority of the waste transportation vehicles will converge. The site is currently accessible by one main secondary road branching from the Monrovia Tubman Boulevard; the access road is 0.5 km, it is asphalted and appears to be in good condition. In addition, traffic impacts are expected along secondary and tertiary roads, depending on the collection schedule and routing. These impacts include a marked increase in congestion, noise, and air pollution.

11.4.2 Odors generation (Air emissions, odors and dust)

Odors are by far the most common cause of public complaint against waste management operations. During the construction phase, no odors will be generated from the facility; however, the operation phase may be associated with odor impacts. During the operation phase, odor generation should not be a major concern under normal and proper facility operation. However improper handling of waste, facility mal operation may result in significant odor impacts.

11.4.3 Storm water drainage

In the rainy season, the waste temporarily stored at the transfer stations will be delivered wet, which requires a good and controlled drainage. Further inundation will be minimized due to the roofing of the entire dump and loading area. The waste storage area will be protected by adequate drainage designs for the roofing and the surrounding ground from flooding by unpolluted rain water. All drainage water generated and collected within the covered dumping and loading area will be treated in an on-site treatment facility and therefore will not contribute to additional pollution of the nearby small waters and rivers.

11.4.4 Health and safety risks

There is no direct negative health impact for the community if the facility is managed correctly. Hazardous and special wastes are being excluded from the collection and temporary dumping at the transfer stations. Nevertheless some members of the local community fear such negative impact. Information should be communicated on proper handling of the waste transfer, health hazards by not
observing proper management instructions e.g. concerning cleanliness of the facility and potential health risks.

11.4.5 Impact on landscape and visual intrusion

As the facility in Fiamah will be erected on a former now closed landfill site, which has been closed and covered recently, a negative impact on the landscape and visual intrusion can be denied.

11.4.6 Description of further Impacts

The main local impacts at Fiamah or Stockton Creek are composed of environmental impacts. A minor role refers to socio economic impacts.

Very limited positive local socio economic impacts are associated with the construction phase of the facility including temporary job opportunities in facility construction and associated activities.

During the operation phase, the facility will have only indirect positive socio economic benefits to the local community. However, possible negative impacts include a drop in the land value in the area particularly during the operation phase, limitation of agricultural and recreational activities in the direct vicinity of the facility as well as the perception of being exposed to health risks, which may lead to psychological stress.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Beneficial</th>
<th>Adverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>Employment generation</td>
<td>Decrease in property value</td>
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<tr>
<td></td>
<td>Expenditure of wages in local area</td>
<td>Perception of pollution sensitive</td>
</tr>
<tr>
<td></td>
<td>Local authority business tax/rates revenue</td>
<td>Individuals leading to out migration</td>
</tr>
<tr>
<td></td>
<td>Reduction in waste transport costs to local communities</td>
<td>Deterrent to inward investment</td>
</tr>
<tr>
<td>Social</td>
<td>Indirect beneficial community impacts from employment and provision of skilled workforce</td>
<td>Decreased level of resident satisfaction with character and amenity of area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perception of health risk leading stress</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Out migration leading to reduced social cohesion in small communities</td>
</tr>
</tbody>
</table>

Local socio economic impacts have to be embedded into the assessment of general socio economic impacts. In this context the general assessment shows clear common advantages for the whole citizenship of Monrovia as the waste disposal systems will combat the existing waste generation within city limits and negative practices of waste dumping and burning within the city.
11.5 INVESTIGATION OF PROBABLE IMPACTS
Potential negative impacts can result from construction and operation of the two transfer stations but are locally restricted and readily manageable by good construction and operating practice, coupled with effective community liaison. The possible use of larger solid waste trucks will require the rehabilitation of the access road (about 200 meters) to the entrance of the Fiamah transfer station. There may be 5 or 6 structure that will be affected by the development and improvement to the road. Individuals will not need to be resettled, per se, but a RAP is required and under preparation by IIU.

11.6 DETERMINATION OF PROBABLE RESPONSE
(Results of Community liaison meeting during the Social Impact assessment)
During a meeting with the Fiamah Community their representatives expressed the following concerns but also consent:

- There are concerns about air pollution and health risks (e.g. diarrhea) caused by the transfer station operations and the trucks transporting the wastes. They suggested covering the transfer station and the trucks in order to prevent the spread of diseases and odors.

- In order to protect children on their way to school (elementary and high schools are in the vicinity) they suggest slowing down the speed of the skip trucks heading for or coming from the transfer station.

- A major problem of the community residents concerns the lack of public toilets at Fiamah. The community residents asked for the provision of such facilities.

- There are no general objections against the construction of the transfer station. Even opening hours early in the morning (e.g. starting at 6h00 a.m.) and late in the evening (until 11h00 p.m.) are no concern and problem.

Upon direct questioning the residents did not await any relocation necessary for the construction and operation of the Fiamah transfer station. Same applies to the opening of access roads.

It was welcomed that neighbors could bring their waste directly to the transfer station to dump it.

The residents are ready to participate in a monitoring team which could supervise any agreement between owners/operators and neighbors during implementation and operation of the transfer station.

11.7 ESTIMATION OF SECONDARY AND CUMULATIVE IMPACTS
It is not to be expected that secondary or cumulative impacts will appear in the middle or long run of the transfer station operations.
11.7.1 Recommendation of changes or alternatives

It is not necessary to change the current planning of the two transfer stations. Alternatives will always have the same kind of social impacts when situated within the city limits.

11.8 Social Management Plan (SMP)

11.8.1 Mitigation, remediation and enhancement plan

In order to maximize the positive socio economic impact, it is recommended that qualified local residents be given the priority to employment opportunities generated by the construction and operation of the transfer stations. It should not only be restricted to qualified people but also people from the surrounding communities should be trained to become qualified and allow them work especially as drivers. So, there should be a specific quota from local communities that should work in the transfer station and this will help improve their economic level and generate revenue for them.

Facilitating good relations between the owner/operators of the transfer station and the Fiamah Community it would be of help to integrate in the overall operations concept their proposition to control the speed of trucks in the vicinity of the transfer station, in the design of the facility it would be of help to integrate a possibility for the community to directly dump their household waste and if possible to offer public toilet facilities run and managed by the community itself.

Close relations can be fostered additionally by integrating some representatives of the community in a supervision team with a clear task description (Truck speed control, cleanliness of public toilet and individual waste dumping practices, health impact monitoring in the vicinity).

Last but not least more intense information on health risk impact of transfer stations should be organized to raise the information level of Fiamah community.

11.9 Development and implementation of a monitoring plan

As the above described mitigation tasks concerning the environmental mitigation, they are fully described in the EMP. No further monitoring task planning has to be developed in the social context of the transfer stations.
12. ADVERSE MITIGATION MEASURES AND MONITORING

12.1 INTRODUCTION
The proposed mitigation plan is broken down into three phases, viz

- Design and preconstruction phase
- Construction phase
- Operational phase

12.1.1 Design and Preconstruction phase
To mitigate the permanent environmental impacts the following measures would have to be addressed in the design of the TS, as shown in Table 9. An audit should be carried out on the design before commencement of construction to ensure that the mitigation measures have been incorporated in the design.

Table 10: Mitigation Measures Required in the Design and Preconstruction Phase

| Protection of ground water | Objective | • To minimise the risk of ground water pollution resulting from the TS.  
| Protection of surface water quality | Objective | • To minimise the risk of pollution to surface water bodies resulting from the TS.  
| Dust and traffic control | Objective | • To minimise the impact of dust on health of workers and nearby residents.  
| | Target | • No pollution of ground water from the TS.  
| | Target | • No pollution of nearby surface water bodies from the TS.  
| | Actions | • Design to include ground water monitoring wells (Design Consultant).  
| | | • A monitoring well to be installed according to specification, under supervision of the construction consultant, at the commencement of the construction period (Contractor).  
| | | • Monitoring well to be sampled and analyses at commencement of construction to establish background ground water quality (Consultants) (see Annexure A for water quality parameters to be analysed).  
| | Actions | • Drains to be designed to contain surface run-off from the TS into sewer system (Design Consultant).  
| | | • Existing stream to be sampled and analysed at commencement of construction to establish background water quality (Design Consultant) (see Annexure A for water quality parameters to be analysed for).  
| | Actions | • To minimise the impact of dust on health of workers and nearby residents.  
| | | • To mitigate the effect of traffic to the site.  

Pöyry Environment GmbH
March 2010
12.1.2 Construction Phase

To mitigate the temporary adverse impacts during the construction phase of the project, the following mitigation measures must be implemented as shown in Table 10. These measures should have been included in the relevant construction specifications.

### Table 11: Mitigation Measures Required During the Construction Phase

<table>
<thead>
<tr>
<th>Contractor’s establishment</th>
<th>Objective</th>
<th>Action</th>
</tr>
</thead>
</table>
|                           | • To reduce the visual and environmental impact of the Contractor’s temporary facilities.  
• To ensure hygienic facilities for Contractor’s workers.  
• To minimise the risk of pollution by contractor's temporary facilities. | Contractor’s establishment and siting to be to approval of the Construction Consultant (Contractor/Construction Consultant).  
• Contractor to provide potable water and approved sanitation facilities for workers (Contractor).  
• Contractor to construct fuel spill containment bund around temporary fuel storage tanks (Contractor).  
• Waste oil and other waste to be disposed of at approved disposal facilities (Contractor). |

<table>
<thead>
<tr>
<th>Safety awareness</th>
<th>Objective</th>
<th>Action</th>
</tr>
</thead>
</table>
|                  | • To reduce the risk of accident/injury to workers.  
• To reduce the risk of damage to equipment/plant resulting from construction accidents.  
• To prevent injury to members of the public. | Contractor to provide appropriate safety equipment to workers (Contractor).  
• Safety training programme for all workers to be implemented (Contractor).  
• Statutory safety regulations to be enforced on site (Contractor/Construction Consultant).  
• Contractor to prevent unauthorised access to the site by members of the public. Fences and signs to be erected (Contractor). |
<table>
<thead>
<tr>
<th>Emergency procedures and response</th>
<th>Objective</th>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• To ensure that the Contractor is prepared to respond to any foreseeable emergency in an ordered and rational manner.</td>
<td>• Emergency plans to be in place at commencement of construction.</td>
<td>• Site Agent, with input from Group Safety Office, to draw up emergency plans which allocate specific responsibilities to respond appropriately to any foreseeable emergency situation such as fire, explosion, accident, fuel/oil spillage, outbreak of infectious diseases (Contractor). • Information on local emergency services (Police, Fire, Ambulance) to be clearly displayed at site office and all workers advised accordingly (Site Agent/Contractor) • Fire extinguishers to be provided at site offices and fuel tanks (Contractor). • Regular &quot;tool box&quot; discussions be held with workers as part of the safety training programme, to keep all staff and workers aware of the emergency plans (Contractor). • Basic first aid courses be held for all supervisors and selected workers (Contractor).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Local employment</th>
<th>Objective</th>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• To employ as many local workers as possible. • To minimise the risk of friction between the contractor and the local labour force. • To improve local skills.</td>
<td>• To make a tangible improvement to local employment and skills.</td>
<td>• All unskilled positions on site to be filled with local labour (Contractor). • Semi-skilled/skilled positions to be filled by locals as far as practically possible (Contractor). • Programme of skills training within the scope and schedule of the project to be implemented (Contractor).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site clearance activities</th>
<th>Objective</th>
<th>Target</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• To minimise the biophysical impact of vegetation and topsoil removal.</td>
<td>• Avoid disturbance of flora and topsoil beyond limits of permanent works.</td>
<td>• Areas for vegetation and topsoil removal to be clearly specified and demarcated before commencement of operations (Construction Consultant/Contractor). • Areas for topsoil stockpiles to be clearly demarcated and kept to a minimum (Contractor). • Cleared trees to be stockpiled for fuel wood uses by local residents.</td>
</tr>
<tr>
<td>Noise control</td>
<td>Objective</td>
<td>• To minimise the impact of construction noise on workers and the nearby community.</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Target</td>
<td>Control noise below 75dB(A) at site boundary.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actions</td>
<td>Contractor's equipment to be silenced within limits (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction operations to be restricted to normal working hours (No Sunday or night working) (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operators and workers close to noisy equipment to be provided with ear muffs or plugs (Contractors).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dust control</td>
<td>Objective</td>
<td>• To minimise the impact of dust on health of workers and nearby residents.</td>
<td></td>
</tr>
<tr>
<td>Target</td>
<td>Dust levels below 300μgm-3 at closest residences.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actions</td>
<td>Contractor to control dust through regular wetting of roads and earthwork activities (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operators and workers to be provided with dust masks (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Topsoil stockpiles and completed earthworks to be vegetated as soon as possible after completion (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion/pollution of streams</td>
<td>Objective</td>
<td>• To prevent erosion of cleared areas, soil stockpiles and completed earthworks.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• To minimise pollution of streams through soil erosion.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target</td>
<td>No significant turbidity in the adjacent streams.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actions</td>
<td>Completed earthworks and soil stockpiles to be vegetated as soon as possible after completion (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temporary drainage to be provided.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Site to be inspected and monitored after heavy rains to identify and remedy areas of soil erosion (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Filter fences to be erected as appropriate to prevent silt from entering streams (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site aesthetics</td>
<td>Objective</td>
<td>• To minimise the visual impact of construction activities.</td>
<td></td>
</tr>
<tr>
<td>Target</td>
<td>Public acceptability of construction activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actions</td>
<td>Site to be hoarded off from the public eye during construction (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cleared material (vegetation, rock etc) to be disposed of in designated areas and kept neat and tidy (Contractor).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction waste and litter to be disposed of at the current waste site (Contractor).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|               | Programme to accept and address complaints by the
Traffic control

<table>
<thead>
<tr>
<th>Objective</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>To minimise the risk of accidents on route and in close proximity to the TS.</td>
<td>Temporary road traffic signs to be erected at the intersection, in accordance with the republic of Liberia traffic regulations (Contractor).</td>
</tr>
</tbody>
</table>

Target

| No accidents. |

Protection of adjacent properties

<table>
<thead>
<tr>
<th>Objective</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>To minimise the risk of trespassing on adjacent properties.</td>
<td>Contractor’s workers to be instructed not to trespass (Contractor). Site boundary fence to be erected as early as possible in the contract (Contractor).</td>
</tr>
</tbody>
</table>

Target

| No complaints from adjacent landowners. |

Actions

| • To prevent unauthorized persons from entering the site. • To ensure that the entire operation of the TS is controlled in an orderly manner. |

| Control system to be in place at commencement of operation. • Public and Environmental Authorities acceptance of the operation. |

| All access to the site to be controlled through a security fence and gate (Operator/Gate Controller). • Gate controllers to be trained in identifying unauthorised visitors if manned throughout the day (Operator). • Site reporting structure and lines of authority to be clearly defined (Operator). |

12.1.3 Operational phase

Initially, the environmental monitoring during the operational phase of the projects is to be carried out only during the 12 months Defects Liability Stage by Pöyry. However, it is motivated that the environmental monitoring be continued throughout the operational life of the TS.

As the impact of the TS on the environment is very much dependent on the standard of operation, the monitoring of environmental issues during the operational phase will take the form of operational auditing and environmental monitoring. The mitigation measures to be audited and monitored during the operation of the TS are summarized in Tables 11 and 12.

Table 12: Mitigation Measures to be audited during the Operational Stage

<table>
<thead>
<tr>
<th>Access Control</th>
<th>Objective</th>
<th>Target</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>To prevent unauthorized persons from entering the site. • To ensure that the entire operation of the TS is controlled in an orderly manner.</td>
<td>Control system to be in place at commencement of operation. • Public and Environmental Authorities acceptance of the operation.</td>
<td>All access to the site to be controlled through a security fence and gate (Operator/Gate Controller). • Gate controllers to be trained in identifying unauthorised visitors if manned throughout the day (Operator). • Site reporting structure and lines of authority to be clearly defined (Operator).</td>
</tr>
</tbody>
</table>
### Access/Traffic

**Objective**
- To prevent traffic congestion on/at site.
- To prevent vehicle accidents on/at site.
- To reduce vehicle wear and tear.
- To reduce waste spillage from vehicles.

**Target**
- Traffic control system to be in place at commencement of operation.
- No vehicle accidents on site.

**Actions**
- Roads on site and in TS area to be maintained in trafficable condition at all times, including wet weather (Operator).
- Direction signs to be placed to direct traffic to and from the site (Operator).

### TS operation

**Objective**
- To prevent nuisances such as odours, flies, vermin and fires, resulting from dirty environment such as screening material.
- To minimise dust resulting from the TS operation.
- To minimise noise resulting from the TS operation.
- To minimise generation of pollutants as a result of exposed screening material.

**Target**
- Public and Environmental Authorities acceptance of the operation.
- Compliance with Liberian Legislation.

**Actions**
- Ensure proper TS daily (Operator).
- Ensure TS equipment is properly maintained in good working order (Operator).
- Ensure adequate dust control by wetting on-site roads (Operator).
- Ensure silencing of TS equipment is within limits such as power generators and vehicles carting the screenings to the landfill (Operator).
- Public and Environmental Authorities to be involved in auditing of operation (Monitoring Consultant).

### Aesthetics

**Objective**
- To ensure that the TS operation remains aesthetically acceptable to nearby residents, the general public and the Environmental Authorities.

**Target**
- Complete public acceptability

**Actions**
- Ensure that all broken or damaged building parts are repaired without delay when observed and noted. (Operator).
- Ensure that damaged security fencing is repaired without delay when observed and noted. (Operator).

### Drainage Controls

**Objective**
- To ensure that the designed rainwater drainage systems function correctly, thereby minimising any ponding and erosion or flooding.
| Republic of Liberia | Development of Fiamah Waste Transfer Station
| Emergency Monrovia Urban Sanitation Project | Enviromental Management Plan (EMP) |

| • To ensure that no waste ends up on the surface outside the TS and is operated correctly, thereby minimising the potential for water pollution.  
• To ensure that all liquids inside the facility end up in the sewer system drainage system. | **Target**  
• No pollution of ground water or adjacent streams that would render the water unsafe for domestic use. |

| **Actions**  
• Ensure that upslope cut-off drains and drainage paths are maintained (vegetation/erosion) and functioning correctly ([Operator](#)).  
• Ensure that subsurface drains on the downstream site of the TS are functioning correctly ([Operator](#)).  
• Ensure that all road side drains are maintained (cleaned and free of litter, silt etc) and functioning correctly ([Operator](#)). |  

| **Safety and Health Objective**  
• To prevent accidents and injury to workers and visitors to the TS.  
• To prevent damage to equipment, vehicles and site facilities resulting from accidents.  
• To prevent the risk of illness or disease to workers and members of the public as a result of the TS operation. | **Target**  
• No accidents on site  
• No injury or loss of life as a result of accidents on site.  
• No damage to equipment, vehicles or facilities resulting from accidents.  
• No illness or disease from the TS operation. |

| **Actions**  
• A safety officer responsible for all aspects of safety and health on site to be appointed ([Operator](#)).  
• Safety procedures to be enforced by the Safety Officer ([Operator](#)).  
• A detailed safety plan as outlined in the Operation and Maintenance Guidelines must be implemented from commencement of operations ([Operator](#)).  
• An emergency response plan to be in place from commencement of operations ([Operator](#)).  
• Safety training commensurate with the different levels of responsibility to be provided for all TS staff ([Operator](#)).  
• Appropriate safety awareness signs to be prominently displayed on the site ([Operator](#)).  
• All workers to be provided with appropriate protective clothing as recommended in the Operation and Maintenance Guidelines ([Operator](#)).  
• First aid facilities to be provided on site. Key personnel to be trained in first aid and emergency procedures ([Operator](#)).  
• Serviceable fire extinguishers to be provided on site ([Operator](#)).  
• Site staff to be trained in fire drills |
Ablution and eating facilities to be maintained in a clean condition at all times (Operator/Safety officer).

Table 13: Mitigation Measures to be monitored during the Operational Phase of the TS

<table>
<thead>
<tr>
<th>Surface water monitoring</th>
<th>Objective</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To detect any contamination of the adjacent streams or rivers as a result of the TS operation.</td>
<td>Streams or rivers to be sampled upstream and downstream of the TS on a 6 monthly basis, and analysed for the water quality parameters listed in Annexure A, Table A2 (Operator/Monitoring Consultant).</td>
</tr>
<tr>
<td></td>
<td>To provide an early warning system to downstream users of possible water contamination.</td>
<td>Results of water quality analyses to be compared with the background values as well as the WHO/LWSC Specification for Water for Domestic Supplies, to evaluate water quality changes resulting from the TS operation (Operator/Monitoring Consultant).</td>
</tr>
<tr>
<td></td>
<td>To facilitate timeous implementation of remedial measures in the event of surface water contamination.</td>
<td>Should surface water quality deteriorate as a result of the TS operation to the extent that it is no longer fit for domestic use, steps shall be taken to prevent its human consumption by downstream users. Alternative supplies of drinking water shall immediately be provided to downstream users by means of tanker and possibly piped water (Operator).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Investigations to be initiated to determine the cause of surface water contamination, and remedial measures to be implemented (Operator/Monitoring Consultant).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>No contamination of adjacent streams or rivers.</td>
</tr>
<tr>
<td>No consumption of contaminated water from the streams which is unfit for human consumption.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ground water monitoring</th>
<th>Objective</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To detect any contamination of ground water beneath the site resulting from the TS operation.</td>
<td>Monitoring boreholes to be sampled every 12 months, and analysed for the water quality parameters listed in Annexure A, Table A2 (Operator/Monitoring Consultant).</td>
</tr>
<tr>
<td></td>
<td>To provide an early warning system to ground water users in the area of potential ground water contamination.</td>
<td>Ground water quality results to be compared with the</td>
</tr>
<tr>
<td></td>
<td>background values, as well as WHO/LWSC specification, to evaluate ground water quality changes resulting from the TS operation (Operator/Monitoring Consultant).</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Should ground water quality deteriorate to the extent that it is no longer fit for domestic use, steps shall be taken to prevent its further consumption. Alternative supplies of drinking water shall be provided to affected users (Operator).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Investigations to be initiated to determine the cause of ground water contamination and remedial measures to be implemented (Operator/Monitoring Consultant).</td>
<td></td>
</tr>
</tbody>
</table>
13. FACILITIES OPERATING PLAN

This section describes the general operation and maintenance procedures of the TS, part of the overall waste management system for the City of Monrovia. For special equipment that is supplied through suppliers and the operations contractor, the manufacturer’s instructions should be consulted. These instructions will be handed over as part of the project documentation. Unless otherwise stated, particular equipment specifications should take precedence over this document.

13.1 INTRODUCTION

This document describes the general operation and maintenance procedures for the Fiamah Waste Transfer Stations in Monrovia. For special equipment that is supplied, the manufacturer’s instructions should be consulted. These instructions will be handed over as part of the project documentation. Unless otherwise stated, particular equipment specifications should take precedence over this document.

13.2 GENERAL OPERATIONAL PROCEDURE

13.2.1 Introduction

The Fiamah TS will receive waste from the City of Monrovia, as well as from proposed future residential and industrial areas in the Monrovia region. Once waste is collected, it will be transferred to the Whein Town landfill site or other landfill designated by the council.

The Council will collect waste with the Skip Truck system as utilized by Monrovia City Corporation and the full skip bins will be off-loaded at the transfer station. Waste will also be collected with other smaller collection trucks as well as vehicles and carts utilized by the SMMEs, which will discharge their waste in long haul waste containers. The waste will for the time being not be compacted into purposely-built containers normally stationed at the transfer station but the process will rely on bulk volume transportation. Stationary open bins will also be in use at the transfer station for offloading of waste by the public.

13.2.2 Transfer Station Procedures

The following operational procedures should be adopted for the transfer station:

- Incoming vehicles will be directed to the appropriate loading spaces
- All open containers have to be covered with a suitable type of material (e.g. netting, tarpaulin etc.) when not in use, so as to prevent the ingress of moisture into stored waste and waste being blown out by the wind.
- All areas of the transfer station have to be kept free of litter. The site shall be cleaned and hosed down if necessary (e.g. sewer, stormwater and contaminated stormwater runoff) on a daily basis, and shall be kept tidy at all times.
- Every deposit of waste must be controlled and also be tidy
- All drainage pipes shall be kept in working order
- The on-site security personnel shall inspect the site fencing/walling on a regular basis. Should there be any damage to the fence, it must be repaired as soon as possible.
Members of the public should not be allowed onto the site except where specifically allowed.

A safety code of practice has to be prepared and one member of each working shift should be trained in first aid. Safety apparatus such as ear, hand and head as well as face and eye protection shall be available on site. Safety clothing and shoes or boots (PPE) are required.

The operating procedures for any mechanical equipment brought onto site have to be adhered to at all times.

13.2.3 Site Operation

The items for the operation and maintenance of the Fiamah TS are inter alia the following:

Security Gates
Vehicles will enter and exit the transfer station along the built access routes. Two different security gates will be situated at the entrance to the facility for the off loading vehicles as well as the long haul waste disposal vehicles. The gate will open in the mornings and will be locked after hours. It must be ensured that the security gates are operational and working at all times, and the necessary maintenance such as repairs, greasing and cleaning shall be taken care of. The gate must be fitted with an approved padlock and the site security personnel must keep the key.

Waste Picking
The following approach will be followed in terms of informal waste pickers on site:

- the value of waste picking is recognized, both as a source of revenue to community members and a means of reducing the volume of waste to be landfilled, but there are countervailing concerns about risks to health and safety of pickers and interference with efficient operations
- waste picking will be allowed on site, initially on a trial basis to become permanent if successful, provided that
- pickers are organized into a group with an overall manager,
- pickers wear protective clothing and equipment to be provided by MCC
- pickers will be restricted to one area of the facility
- the time available to the pickers to collect recyclable materials from the waste will be limited and will be dictated by the operational requirements to maintain space on the floor area for incoming loads and to efficiently fill long-haul containers so that they can move to the landfill on schedule.

Gatehouse
The gatehouse is located close to the security gate. A gatehouse controller and a boom operator who operates the double boom system at the facility entrance will man the gatehouse. The gate control officer will be in charge of directing vehicles unfamiliar with the transfer station to the appropriate off loading areas, and thorough records shall be kept of incoming vehicles and their load. As a weighbridge will be introduced on site record keeping will form part of the weighbridge system operations. The gatehouse controller shall see to it that everything operates optimally on the facility, and should notify the relevant contractor/his manager when problems arise.
Elevated Area
The public as well as private companies will use the elevated area (first entrance towards the TS). A vehicle on the elevated area will have access to four different disposal methods i.e. open bins, bottles and paper banks, yard trimmings and mixed compactable waste. One person will act as a spotter to direct incoming vehicles to a specific section.

Loading Bays
Loading bays consist of three bays, which can be used to separate different types of waste in bulk for disposal or recycling purposes. The elevated vehicles will have easy access to the bins for easy offloading of waste down into the bins or disposal floor. The open bins located in the loading bays must be covered with netting or tarpaulins to keep moisture from entering the bins or litter being blown out by the wind when not under cover or on the open road.

Long haul loading bins
Empty bins are offloaded onto the collection bays. Waste will now be loaded into the bins via the elevated loading bays. Once a bin is full it is ready for transfer to the landfill. A schedule shall be devised to ensure that the full bins are being emptied on a regular basis.

The operator shall use safety clothing at all times. Safety gear such as hand and head protection is a prerequisite. The area around the loading bays shall be kept clean of spilt waste at all times.

Necessary warning signs shall be erected at the loading side of the bin.

Yards trimmings (Green/organic waste)
Should large volumes of yard trimmings be received vehicles entering the transfer station carrying wood type waste will be directed to the elevated area. From here the spotter will direct the vehicle to an appropriate offloading position. In time a wood chipper should be introduced to minimise volume should large volumes be received at the station.

It is important that safety gear be worn around the chipper at all times, especially hand, head, ear and eye protection. The operator shall adhere to the operating methods set by the manufacturer.

Recycling Bins
Recycling bins will be provided on the elevated area by recycling companies. These bins or igloos will mostly accommodate paper and glass type refuse. There must be an arrangement with the recycling company to remove and replace these bins on a regular basis. It must be taken into account that other recycling types might be added in the future, and that these should be introduced to the facility. The area around the bins or igloos must be kept clean and tidy at all times, and any paper or glass lying around the bins must be disposed of.

Ablution Facilities and Mess
The ablution facilities on the site of the transfer station will house public and staff restrooms, shower, and a mess room for the staff as well as a small storeroom.
This facility must be cleaned daily and the mess room kept clean and hygienic. Proper signs are placed to direct non-staff members to the public toilets.

**Grease, Water and Sand Traps**
All grease and oil must be cleared from concrete paved surfaces at all time. The site has been equipped with grease, water and sand traps or sumps. This system serves the purpose of removing unwanted and harmful liquids from the working areas, and must thus be managed to such an extent as to always function at optimum efficiency. All trapped liquids will be captured in a sump, which must be emptied on a regular basis. Any problems experienced with the system must receive immediate attention, and should be kept operational at all times.

**Monitoring and Record Keeping**
To monitor the effectiveness of the transfer site, a thorough record keeping system must be implemented. As a vehicle enters the transfer station, the gate control officer must gather the necessary details. Proper records shall also be kept on the following items:

- Skip bins entering and leaving the transfer station
- Other vehicles and systems entering and disposing of waste in the compactor
- Public and private vehicles entering the site
- Status of all the containers
- Service records of all equipment at the transfer station
- Maintenance of the transfer station and equipment
- Amount of waste separated for recycling
- Amount of waste cycled through the wood type waste separation
- Utilization of the transfer station by the public and private companies
- Amount of rain recorded at the transfer station
- Amount of grease/oil and sand removed from the sump, and the effectiveness of the system

**Facility Maintenance**
The site must be kept in a clean and tidy state at all times. A gardener must see that all plants and trees are looked after, and water them on a regular basis. Any refuse generated by the trees and plants or grass on the transfer facility can be disposed with the other waste on the facility. The surfaced roads within the transfer station must be maintained, and immediate repair must be done in the case of damage or wear. Notice boards guiding traffic on the facility must also be properly maintained and to be legible at all times.

**Facility Security**
The transfer station must be protected by security personnel 24 hours of the day, 7 days a week. The security gate at the transfer station entrance will be closed and locked after hours. Any unauthorised persons must be kept from the facility, including unauthorised scavenging, and vandalism must be prevented.
14. OPERATIONS MONITORING PLAN

This section describes the environmental monitoring of the operation and maintenance procedures of the TS for the city of Monrovia.

14.1 INTRODUCTION

The monitoring plan for the proposed TS identify measures to monitor implementation effectiveness of mitigation measures, and specifies the responsible party(ies). The monitoring plan outlines monitoring procedures and indicator parameters.

The objective of the monitoring is to provide information on impact in terms of:

- Nature
- Magnitude
- Geographical extent
- Timescale
- Probability of occurrence
- Significance
- Confidence in prediction

The effectiveness of the monitoring programmes will be determined by and has to:

- Have realistic sampling programmes
- Use relevant sampling methods
- Collect quality data
- Have compatibility of old and new data
- Have cost-effective data collection
- Are innovative
- Use appropriate databases
- Use multi-disciplinary interpretation
- Report internally and have external checks
- Respond to third party input
- Present data to the public

The proposed monitoring plan for the transfer station is as shown in Table 12.
### Table 14: Monitoring Plan

<table>
<thead>
<tr>
<th>Impact</th>
<th>Monitoring means</th>
<th>Parameter</th>
<th>Phase</th>
<th>Location</th>
<th>Frequency</th>
<th>Approximate cost</th>
</tr>
</thead>
</table>
| Local climatic conditions       | Permanent weather monitoring station | • Temperature, humidity, rainfall and wind speed and direction  
 • Volume of precipitation  
 • Evaporation (lysimeter)  
 • Atmospheric humidity | • Pre-works  
 • Facility construction & site preparation  
 • Operation  
 • Post-closure | • Facility site   | • Daily                  | • $4,000/weather station |
| Ambient Air Quality             | Portable sampling      | • Total suspended particulates (TSP)  
 • Particulates < 10 microns (PM10) | • Facility construction & site preparation | • Facility site  
 • Nearby receptors | • Once                   | • $7,000/portable sampling device |
| Noise levels                    | Noise levels           | • Leq (dBA)                                                              | • Facility construction & site Preparation  
 • Operation | • Facility site  
 • 3 monitoring locations around the perimeter of the site | • Monthly  
 • Upon Complaints | • $5,000/portable sampling device |
| Surface water quality           | Sampling               | • Conductivity (EC)  
 • Ammonia, Nitrate, Manganese, Total  
 • Phosphorous, Total  
 • Suspended | • Pre-works  
 • Operation  
 • Post Closure | • At least two sample locations should be conducted one upstream and Surface drainage recuperation canal | • Bi-Annually for 10 years | • $400/sample |
| Waste generation | • Generated waste checklist | • Quantity and Composition | • Facility construction & site Preparation | • Facility site | • Quarterly |
| | • Incoming waste assessment | • Quantity | • Operation | • Incoming wastes | • Daily |
| | • Incoming waste assessment (upon need) | • Categorization: quantity and percent composition by weight and volume of organic waste, paper, cardboard, plastic products, glass, fabrics/textiles, metals | • Operation | • (Weighbridge) | • Quarterly |
| | | | • Operation | • Uploading area | |

| Odour emissions | Olfactory test | • Unpleasant/noxious smells | • Operation | • Facility site Sensitive receivers | • Daily |
| | | | | | Upon complaints |

| Health and safety | Health and safety surveys, | • Proper use of PPE, | • Facility construction & site Preparation | • Facility site | • Continuous |
| | | | | | |

- Solids: (TSS), Biochemical oxygen demand (BOD) / Dissolved oxygen (DO), Total Organic Carbon (TOC), Total Coliform, Salmonellae, Metals (Chromium, Cadmium, Copper, Zinc, Nickel, Mercury, Lead)
- Exact location should be determined prior to work initiation by the contractor in collaboration with local authorities
- Facility site
- Operation
- Sensitive receivers
- Continuous
- Daily
- Upon complaints
- Quarterly
- Priced within construction

Odour emissions: Unpleasant/noxious smells
Health and safety: Proper use of PPE, Facility site
| Documentation of injuries and accidents | Presence of signs, first aid kit, and fire fighting devices | Site preparation | Operation | Pre-works | Facility construction & site Preparation | Operation | Post-closure | Region of influence | Once | Once | Annually | Annually for 5 years | $500/visit |
| Socio-economics | Field Questionnaires and interviews | Population perception | Employment record | Reported cases of affected psychological stresses | Facility construction & site Preparation | Operation | | Region of influence | Once | | Annually | Annually for 5 years | $500/visit |
15. REPORTING PROCEDURES AND DOCUMENTATION

On the basis of this EMP, a review of the detailed construction drawings for the TS has been carried out to confirm that the necessary mitigation measures have been adequately addressed in the design. Where deemed necessary, a number of design changes were made, the most important of which are:

- Oil and sand traps inside the facility
- Weighbridge for proper recording of waste generation and disposal information.
- Polluted water drainage point.
- Noise dissipation through wall cladding or block wall construction

During the construction of the SWTS, Pöyry will have had a full time Resident Engineer on site to supervise construction and ensure that the works are constructed in accordance with the design, and that all the mitigation measures tabled in the EMP are implemented. In addition, Pöyry's environmental consultant has visited the site regularly to check on the implementation of the EMP, particularly regarding environmental issues. Ground water and surface water samples will be taken and analysed for background data.

At the monthly construction progress meeting with the Contractor, a separate item relating to Environmental Issues will be discussed on the agenda. Non-compliances with the EMP have been brought to the attention of the Contractor for rectification, and additional environmental impacts identified have been addressed. At the end of construction, Pöyry will, should the work comply, issue a "Certificate of Completion of the Works", to certify that the TS has been satisfactorily constructed in accordance with the design and specifications. This certificate would therefore serve as the Project Compliance Report (PCR) for the construction stage.

Once the TS is commissioned, the operation is to be audited and environmental monitoring carried out every six months.

After each audit, a report is to be submitted giving the results of the audit, comments on the status quo and recommendations for improvement of the operation. The results of each monitoring exercise, as well as an interpretation of the results, are to be included in the report. This report would constitute the PCR for the operation of the TS.

Where more regular monitoring is required as stated in the EMP, this is to be carried out by the site operator and recorded in the weekly/monthly site report.

Table 15 gives a summary of the documentation to be produced.

<table>
<thead>
<tr>
<th>Document/report</th>
<th>Frequency</th>
<th>Responsibility</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certificate of Completion of the Works</td>
<td>At completion of construction and handover of the facility.</td>
<td>Pöyry</td>
<td>Certification that TS was constructed to design and specifications.</td>
</tr>
<tr>
<td>Emergency Response</td>
<td>At start of</td>
<td>Site Operator</td>
<td>Details of all emergency</td>
</tr>
<tr>
<td>Document/report</td>
<td>Frequency</td>
<td>Responsibility</td>
<td>Details</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------</td>
<td>----------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Plans</td>
<td>operation, to be reviewed and updated every six months.</td>
<td></td>
<td>procedures for accidents, fires, fuel spillages, gas explosions, hazardous waste dumping etc.</td>
</tr>
<tr>
<td>Minutes of Public/Community meetings</td>
<td>As required. Probably every six months.</td>
<td>LWSC/MCC</td>
<td>Meetings with public/community liaison Committee to discuss issues relating to the operation of the TS, and address concerns.</td>
</tr>
<tr>
<td>Operational Audit and Monitoring Report</td>
<td>Every six months</td>
<td>Pöyry/MCC</td>
<td>Results of audit of operation and water quality monitoring including non-compliances and recommendations for improvement.</td>
</tr>
<tr>
<td>TS Operation Reports</td>
<td>Monthly</td>
<td>Site Operator</td>
<td>Cumulative details of hours pumped, sewage levels, fuel usage, maintenance inspection carried out, accident/incident reports.</td>
</tr>
<tr>
<td>Accident/Incident Report</td>
<td>As required after every accident/incident.</td>
<td>Site Operator</td>
<td>Details of all accidents/incidents as required in terms of the Occupational Health and Safety Regulation.</td>
</tr>
<tr>
<td>Gate Register</td>
<td>Daily</td>
<td>Site Operator</td>
<td>Record of all persons entering and leaving the site.</td>
</tr>
<tr>
<td>Updating of EMP</td>
<td>Annually</td>
<td>LWSC/MCC</td>
<td>New issues to be captures for future monitoring</td>
</tr>
</tbody>
</table>

To implement such an EMP would require the involvement of ideally an environmental practitioner (independent body) and representatives from the government departments. The only financial requirements would be that for the private sector involvement as it is accepted that the monitoring process would form part of the normal activities of the personnel from the government departments.

### 15.1 Reporting

The shift leaders in charge of operation during the 24 hour day should prepare a daily facility monitoring report during both the facility construction and site preparation phase and operation phase containing the following information:

- Personal log
- Incoming waste (total daily quantity). Ideally a waste composition analysis must be done every 6 months.
- Waste transportation truck information (truck number, truck type, arrival time, departure point, total weight, nett waste weight)
- Staff accidents and failure during operation
- Equipment and machinery monitoring data
Monitoring reports should be submitted quarterly during both the construction and operation phases. In addition, yearly comprehensive reports should be generated to present results of the monitoring activities and assess the adequacy of environmental control measures.

Monitoring reports should be submitted to the EPA, and the respective local authority for feedback on the overall monitoring program. These reports should summarize monitoring data with full interpretation illustrating the acceptability or otherwise of environmental impacts and identification or assessment of the implementation status of agreed mitigation measures. The annual monitoring reports should include at least the following sections/information:

- a. Executive summary
- b. Transportation vehicles
  - Days used/not used
  - Reasons for non-usage of vehicles
  - Average payloads
  - Incoming vehicle IDs, weights (with incoming wastes, empty, with outgoing wastes or products)
  - Distance driven
  - Replacement of vehicles, containers or staff
  - Log of problems, outages, breakdowns, etc.
- c. Sorting facility
  - Received waste types and quantities
  - Material types separated and products produced and their qualities
  - Replacement of vehicles, machinery or staff
  - Report on marketing activities
  - Log of problems, outages, breakdowns, etc.
- d. Transfer station operation
  - Processed waste types and qualities
  - Results on annual survey
  - Replacements of vehicles, machinery or staff
  - Log of problems, outages, breakdowns, etc.
- e. Environmental parameters
  - Location of sensitive receivers and monitoring stations
  - Implementation of status of environmental mitigation measures as recommended in the EIA
  - Monitoring results
  - Monitoring methodology
  - Parameters monitored
  - Monitoring date, time frequency, and duration
  - Weather conditions during the period
  - Monitoring results tabulated with maximum and minimum values
- f. TS construction and site preparation
  - Implementation schedule and achieved position
  - Achievements in construction
  - Construction materials used
  - Log on problems and solutions
  - Status of complete landfill
- g. Mass balance and ratios
  - Mass balance, showing all mass flows within the disposal services
i. Other parameters
  o Daily consumption figures of electricity and chemicals
  o Statistics of staff members and labour utilization
  o Report of all non compliance or exceeding of the environmental standards
  o Record of all complaints received including location, nature, actions, and
  o Follow-up procedures
  o Records of health and safety accidents on-site

15.2 Contingency Plan

The design and environmental management plan for the proposed TS has been developed in order to minimize and mitigate the effects of potential impacts that might arise during the preparation, operation and post closure phases. However, unexpected accidents and emergencies might occur that require additional measures during transportation, handling and landfilling of the solid waste. In this case, a contingency plan should be developed.

The contingency plan includes the identification of likely accidents and emergencies, outlining response scenarios, delegating responsibilities, and co-ordination with the proper authorities. Furthermore, the plan would serve as a reference for risk assessment and employee training.

The following are potential emergencies that may occur thereby requiring effective contingency planning:

- Accidental leakage and/or spillage of the solid waste, liquid waste and leachate
- Sorting line breakdown
- Power failure
- Vehicle/truck breakdown
- Fire events
- Staff absence

In the case of any accidents and emergencies, the required response should be implemented in a timely fashion in order to minimize the impacts of the accident and it must be undertaken by qualified individuals, experienced in emergency response actions.
### Table 16: Estimated costs of EMP implementation and monitoring

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>FREQUENCY</th>
<th>INVOLVEMENT</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMP implementation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction stage</td>
<td>Ongoing during construction stage</td>
<td>Contractor</td>
<td>No cost - Part of contractual obligation and specifications</td>
</tr>
<tr>
<td>Water sampling from surface and ground water</td>
<td>Once as background sample before construction commences</td>
<td>Laboratory</td>
<td>US$ 100,000</td>
</tr>
<tr>
<td>Monitoring</td>
<td></td>
<td>Environmental Practitioner/LWSC/EPA/MCC</td>
<td>Travel and time cost covering all 2 stations: US$ 45,000/a</td>
</tr>
<tr>
<td>Operational stage</td>
<td>Ongoing during construction stage</td>
<td>Operator – requirements built into the operational procedures</td>
<td>No cost – Part of contractual obligation and specifications for the operations</td>
</tr>
<tr>
<td><strong>Long term monitoring</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meet with the local communities through their representatives</td>
<td>Every 6 months</td>
<td>LWSC/MCC Managers, Environmental Practitioner, Operators, Co-opted Member</td>
<td>Travel and time cost covering both stations: US$ 25,000/a</td>
</tr>
<tr>
<td>Recording and documentation</td>
<td>(See Table 13)</td>
<td>Site Operator/LWSC/MCC</td>
<td>No Charge – part of normal activities</td>
</tr>
<tr>
<td>Updating of EMP</td>
<td>Annually</td>
<td>Environmental Practitioner</td>
<td>US$ 15,000/a</td>
</tr>
<tr>
<td>Annual water sampling from ground water and surface water</td>
<td>Annually</td>
<td>Laboratory</td>
<td>US$ 100,000/a</td>
</tr>
</tbody>
</table>
16. CONCLUSIONS

Having identified the potential impacts posed by the rehabilitation of the existing SWTS, it is concluded that all impacts can be adequately addressed through the implementation of appropriate mitigation measures. Regular inspection of the works and operation would confirm compliance with the required mitigation measures, and would be recorded in appropriate Project Compliance Reports.
### WATER QUALITY MONITORING AT THE SWTs

**Water Quality Parameters To Be Analysed**

**A.1 Parameters For Background Monitoring**

*At start of construction*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Analyte</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Faecal Coliforms</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>Ammonia</td>
</tr>
<tr>
<td>Chemical Oxygen Demand (COD)</td>
<td>Nitrates</td>
</tr>
<tr>
<td>Electrical Conductivity (EC)</td>
<td>Phosphates</td>
</tr>
<tr>
<td>Chlorides</td>
<td>Sulphates</td>
</tr>
<tr>
<td>Sodium</td>
<td>Nickel</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Zinc</td>
</tr>
<tr>
<td>Chromium (Cr6+ and total Cr)</td>
<td>Lead</td>
</tr>
<tr>
<td>Iron</td>
<td>Arsenic</td>
</tr>
<tr>
<td>Copper</td>
<td>Mercury</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Fluoride</td>
</tr>
<tr>
<td>Potassium</td>
<td>Boron</td>
</tr>
<tr>
<td>Manganese</td>
<td>Calcium</td>
</tr>
<tr>
<td>Total dissolved solids (TDS)</td>
<td></td>
</tr>
</tbody>
</table>

**A.2 Parameters For Routine Detection Monitoring**

*Every 12 months*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Analyte</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Sulphates</td>
<td></td>
</tr>
<tr>
<td>Alkalinity (Total)</td>
<td>Sodium</td>
<td></td>
</tr>
<tr>
<td>Chemical Oxygen Demand (COD)</td>
<td>Magnesium</td>
<td></td>
</tr>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td>Calcium</td>
<td></td>
</tr>
<tr>
<td>Electrical Conductivity (EC)</td>
<td>Nitrates</td>
<td></td>
</tr>
<tr>
<td>Chlorides</td>
<td>Fluorides</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ammonia</td>
<td></td>
</tr>
</tbody>
</table>
AIR QUALITY MONITORING AT THE SWTS
Air Quality Parameters to be Monitored

A.3 Parameters for Background Monitoring
(At start of construction)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide concentration (ppm)</td>
<td></td>
</tr>
<tr>
<td>Humidity (%)</td>
<td></td>
</tr>
<tr>
<td>Nitrogen dioxide concentration (ppb)</td>
<td></td>
</tr>
<tr>
<td>Nitrogen oxide concentration (ppb)</td>
<td></td>
</tr>
<tr>
<td>Oxides of nitrogen (NOX) (ppb)</td>
<td></td>
</tr>
<tr>
<td>Ozone concentration (ppb)</td>
<td></td>
</tr>
<tr>
<td>PM10 concentration (ug/m³)</td>
<td></td>
</tr>
<tr>
<td>Pressure (mB)</td>
<td></td>
</tr>
<tr>
<td>Rainfall (mm)</td>
<td></td>
</tr>
<tr>
<td>Sulphur dioxide concentration (ppb)</td>
<td></td>
</tr>
<tr>
<td>Temperature (Ambient) (degree C)</td>
<td></td>
</tr>
<tr>
<td>Wind direction (degree)</td>
<td></td>
</tr>
<tr>
<td>Wind speed (m/s)</td>
<td></td>
</tr>
</tbody>
</table>

A.3 Parameters for Routine Detection Monitoring
(frequency as per table)

Parameters measured on quarterly basis can be relax to bi-annually and annually if no change detected.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide concentration (ppm)</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Humidity (%)</td>
<td>Daily</td>
</tr>
<tr>
<td>Nitrogen dioxide concentration (ppb)</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Nitrogen oxide concentration (ppb)</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Oxides of nitrogen (NOX) (ppb)</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Ozone concentration (ppb)</td>
<td>Quarterly</td>
</tr>
<tr>
<td>PM10 concentration (ug/m³)</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Pressure (mB)</td>
<td>Daily</td>
</tr>
<tr>
<td>Rainfall (mm)</td>
<td>Daily</td>
</tr>
<tr>
<td>Sulphur dioxide concentration (ppb)</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Temperature (Ambient) (degree C)</td>
<td>Daily</td>
</tr>
<tr>
<td>Wind direction (degree)</td>
<td>Daily</td>
</tr>
<tr>
<td>Wind speed (m/s)</td>
<td>Daily</td>
</tr>
</tbody>
</table>
## List of Drawings

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>Fiamah Transfer Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIA-CIV-01-LIB</td>
<td>Location Plan</td>
</tr>
<tr>
<td>FIA-CIV-02a-LIB</td>
<td>Site Layout Plan</td>
</tr>
<tr>
<td>FIA-CIV-02b-LIB</td>
<td>Elevations</td>
</tr>
<tr>
<td>FIA-CIV-03-LIB</td>
<td>Offloading and Loading Bay</td>
</tr>
<tr>
<td>FIA-CIV-04a-LIB</td>
<td>Office Building, Plan, Section and Schedule</td>
</tr>
<tr>
<td>FIA-CIV-04b-LIB</td>
<td>Office Building, Elevations</td>
</tr>
<tr>
<td>FIA-CIV-05-LIB</td>
<td>Guard House</td>
</tr>
<tr>
<td>FIA-CIV-06-LIB</td>
<td>Manhole Details</td>
</tr>
<tr>
<td>FIA-CIV-07-LIB</td>
<td>Fence and Gate Details</td>
</tr>
<tr>
<td>FIA-CIV-08-LIB</td>
<td>Water Tank Stand Details</td>
</tr>
</tbody>
</table>
Appendix 1.3

Capacity of the transfer station

Daily hours = 10 hrs (input)

Incoming area - vehicles turning
Yard area $A_i =$ 484 m² (calc)
Yard length $L_i =$ 22 m (input)
Yard width $W_i =$ 22 m (input)
Turning radii offered $R_i =$ 11 m (calc)
Turnaround time of incoming vehicles = 10 min (input)
Number vehicles at the same time = 6 nr (input)
Volume of container = 6 m³ (input)
Volume brought to site per day = 2160 m³/d (calc)
Density of waste in truck = 250 kg/m³ (input)
Potential equivalent tonnages = 540 tonne (calc)

Offloading area - bays
Bay area $A_o =$ 108 m² (calc)
Bay length $L_o =$ 6 m (input)
Bay width $W_o =$ 3 m (input)
Number of bays = 6 nr (input)
Offloading time of vehicle = 5 min (input)
Number of offloading vehicles = 6 nr (input)
Volume of container = 6 m³ (input)
Volume offloaded = 4320 m³/d (calc)
Density of waste in truck = 250 kg/m³ (input)
Potential equivalent tonnages = 1080 tonne (calc)

Storage area - collection floor
Storage floor area $A_c =$ 3000 m² (calc)
Storage floor length $L_c =$ 20 m (input)
Storage floor width $W_c =$ 150 m (input)
Storage height $h_c =$ 2 m (input)
Max volume stored on floor = $V_c = 4000$ m³ (calc)
Density of waste on floor = 150 kg/m³ (input)
Potential equivalent tonnages = 600 tonne (calc)

Storage capacity on incoming waste = 1.1 days (calc)

Outgoing area - removal
Yard area $A_o =$ 875 m² (calc)
Yard length $L_o =$ 35 m (input)
Yard width $W_o =$ 25 m (input)
Turning radii offered \( R_i = \) 12.5 m \((\text{calc})\)
Turnaround time of incoming vehicles = 30 min \((\text{input})\)
Number vehicles at the same time = 3 nr \((\text{input})\)
Volume of container/truck = 15 m\(^3\) \((\text{input})\)
Volume removed from site per day = 900 m\(^3\)/d \((\text{calc})\)
Density of waste in truck = 450 kg/m\(^3\) \((\text{input})\)
Potential equivalent tonnages = 405 tonne \((\text{calc})\)

**Requirement:**

<table>
<thead>
<tr>
<th>Location</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiamah</td>
<td>80 t/d</td>
</tr>
<tr>
<td>Stockton Creek</td>
<td>120 - 150 t/d</td>
</tr>
</tbody>
</table>
Minutes of community consultation meeting with the Social Expert

Meeting with Fiamah community residents on Tuesday 16. June 2009 16h00 to 17h00

Table 17: Attendance Record

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Organization / Address, / Mobile Phone No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kpoto, Janah</td>
<td>Community Fiamah, no phone</td>
</tr>
<tr>
<td>2</td>
<td>Mark Suah</td>
<td>Community Fiamah, no phone</td>
</tr>
<tr>
<td>3</td>
<td>Laurence A. Flomo</td>
<td>Community Fiamah, 06-422492</td>
</tr>
<tr>
<td>4</td>
<td>D. Nelson Berengah</td>
<td>Community Fiamah, 06-616 933</td>
</tr>
<tr>
<td>5</td>
<td>Daniel D. Wilson</td>
<td>Community Fiamah, 06-590749</td>
</tr>
<tr>
<td>6</td>
<td>James S. Mussaquoi</td>
<td>Community Fiamah, 077085891</td>
</tr>
<tr>
<td>7</td>
<td>Jeremy G. Pdrenah</td>
<td>NGO FIND, 06-872055</td>
</tr>
<tr>
<td>8</td>
<td>Eugene S. Caine</td>
<td>Pöyry, Asst. Res. Engineer, 06-578 557</td>
</tr>
<tr>
<td>9</td>
<td>Klaus H. Schmidt</td>
<td>Pöyry, Social Expert, 06-535 248</td>
</tr>
</tbody>
</table>

At the beginning the question was raised why no women are participating in the meeting. The answer was that women are occupied by work at the time of the meeting. (The venue place and time instead was arranged by the Fiamah community residents themselves).

After self presentations of all present, the Asst. Res. Engineer of Pöyry Mr. Caine gave an introduction to the current technical planning of the transfer station at Fiamah. A handout with explanations (see Annex III) together with visual design sketches was given to the participating citizen and explained. Some additional explanations were given to questions of the audience.

After some introductory remarks the social expert Mr. Schmidt raised one simple question: “At the end of this meeting, what result do you think this meeting should have to satisfy you?”

The following answers were given: “There are concerns about air pollution and health risks (e.g. diarrhea) caused by the transfer station and the trucks transporting the wastes. It would be fine to obtain an agreement that the transfer station but also the trucks are covered to prevent the spread of diseases and odors. It was welcomed that neighbors could bring their waste directly to the transfer station and dumps it. In order to protect children on their way to school (elementary and high schools are in the vicinity) it would be necessary to slow down the speed of the skip trucks heading for or coming from the transfer station. The residents are ready to participate in a monitoring team which could supervise such an agreement during implementation.”

There are no objections in general against the construction of the transfer station. Even opening hours early in the morning (e.g. starting at 6h00 a.m.) and late in the evening (until 11h00 p.m.) are no concern and problem. Upon
questioning the residents did not await any relocation necessary for the construction and operation of the Fiamah transfer station. Same applies to the opening of access roads.

A major problem of the community residents concerns the lack of public toilets at Fiamah. The community residents asked for such facilities.
Drawings separately stacked.