Project Implementation and Urban Management Improvement in the North Eastern Region – Package A

Draft Final DPR- Solid Waste Management Plan for Greater Shillong Planning Area

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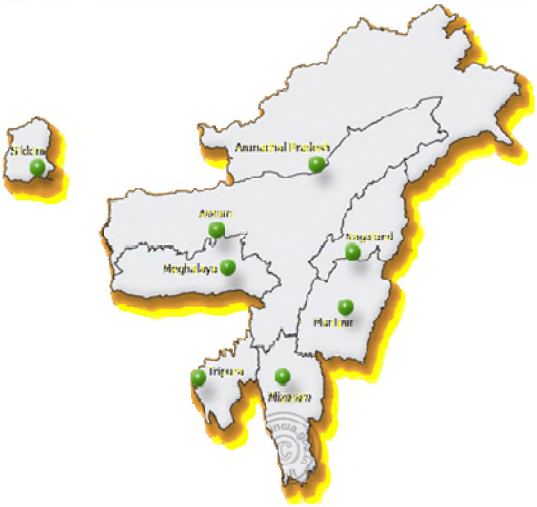

SMEC INDIA

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ACRONYMS

ADB	-	Asian Development Bank
ADC	-	Autonomous District Council
AE	-	Assistant Engineer
AusAID	-	Australian Aid
BPL	-	Below Poverty Line
CDP	-	City Development Plan
CBOs	-	Community Based Organizations
C & D	-	Construction and Demolition
CE	-	Chief Engineer
CEO	-	Chief Executive Officer
CPHEEO	-	Central Public Health and Environmental Engg. Organization
C/N Ratio	-	Carbon/Nitrogen Ratio
DPR	-	Detailed Project Report
Ex. Engr.	-	Executive Engineer
EO	-	Executive Officer
GI	-	Galvanized Iron
GoMe	-	Government of Meghalaya
GSPA	-	Greater Shillong Planning Area
GoI	-	Government of India
Hact	-	Hectare
HDPE	-	High Density Polyethylene
HIG	-	High Income Group
Hr	-	Hour
IEE	-	Initial Environmental Examination
INR	-	Indian Rupee
Kg	-	Kilogram
Km	-	Kilometer
LCV	-	Light Commercial Vehicle
LIG	-	Low Income Group
LLDP	-	Linear Low Density Polyethylene
MIG	-	Meddle Income Group
MLD	-	Million liters per day
Mm	-	Millimeter
Ml	-	Million liters
MIS	-	Management Information System
MoEF	-	Ministry of Environment and Forests
MoUD	-	Ministry of Urban Development
MS	-	Mild Steel
MSL	-	Mean Sea Level

MSW	-	Municipal Solid Waste
Mtpd	-	Metric Tons per Day
MSPCB	-	Meghalaya State Pollution Control Board
MUDA	-	Meghalaya Urban Development Authority
NGOs	-	Non-Governmental Organizations
NH	-	National Highway
O & M	-	Operation and Maintenance
P-P-P	-	Private-Public-Partnership
PPE	-	Personal Protection Equipment
PSC	-	Pre-Stressed Concrete
P-S-P	-	Private-Sector-Participation
PVC	-	Polyvinyl Chloride
RCC	-	Reinforce Cement Concrete
SCB	-	Shillong Cantonment Board
SE	-	Superintending Engineer
SIPMIU		State Investment Program Management & Implementation Unit
SMB	-	Shillong Municipal Board
SUA	-	Shillong Urban Agglomeration
SWM	-	Solid Waste Management
ULB	-	Urban Local Body

EXECUTIVE SUMMARY

Background

Solid Waste Management is one of the most essential services for maintaining the quality of life of the people in the urban areas and for ensuring better standard of health, sanitation and the environment. In India this service falls short of the desired level, as the systems adopted are out dated and inefficient. Institutional weakness, shortage of human and financial resources, improper choice of technology, inadequate coverage and lack of short and long term planning are responsible for the inadequacy of service. The Shillong Urban Agglomeration population is 0.27 million, of which Shillong Municipal Board (SMB) area consists of 0.13 million and is the major urban center. The Greater Shillong Planning Area (GSPA) consists, besides SMB and Shillong Cantonment Board (SMB), five urban centers and 32 villages covering an area of 174 sq km with a population of 0.33 million as per 2001 Census. The Shillong Urban Agglomeration (SUA) comprises of SMB, SCB, and 5 small urban centers with a population of 267662 as per 2001 Census. The density of population in SMB is the highest with 12825 per sq.km while the figure for the GSPA is 1904 per sq.km. The city of Shillong determined to improve and modernize Solid Waste Management activities in the city and its adjoining areas in GSPA.

For maximizing efficiency and effectiveness of the Solid Waste Management Service, it is necessary to tackle this problem systematically by examining all aspects of 'Solid Waste Management' (SWM) and devise cost effective system which may ensure adequate level of SWM services to all sections of the society, and collection, transportation and disposal of waste in an environmentally acceptable manner in the lines of Supreme Court Committee recommendations as well as Municipal Solid Waste (Management & Handling) Rules 2000 of Ministry of Environment & Forests, Government of India **(Annexure-1)**

With a view to improve the efficiency of SWM system in the GSPA, the Detailed Project Report (DPR) on Solid Waste Management has been prepared under the Project Implementation and Urban Management Improvement in The North Eastern Region, ADB-TA-4779-India, Project (Tranche-I). The report envisages modernization of SWM system, improvement of services and practices in the GSPA so as to achieve 100% coverage once the SWM project is translated on the ground (by 2041) complying with Municipal Solid Waste (Management & Handling) Rules 2000.

Problems being faced by urban local bodies

Except for a few progressive Municipal Corporations in the country, all other Urban Local Bodies lack in managerial, administrative, financial and institutional management as also the technical knowhow in management of urban solid waste. It is, therefore, very essential to provide proper guidance and training to the personnel in the urban local bodies including all the stakeholders to make them efficient in managing the solid waste generated, as per the guidelines of MSWMH, Rules 2000 in their respective areas/towns/cities.

Solid waste management policy guidelines

According to the Constitution of India, Solid Waste Management is a part of public health and sanitation and falls within the purview of the State list. It is the primary responsibility of the respective State Governments and Urban Local Bodies to ensure that appropriate Solid Waste Management practices are introduced and practiced in all cities and towns in the state. The role of the Ministry of Urban Development, Government of India is broadly to formulate and prepare policy guidelines and provide technical assistance to the states and urban local bodies whenever needed. It also assists the state governments and urban local bodies in human resource

development and also acts as a facilitator in mobilizing external assistance for implementation of Solid Waste Management projects.

Solid Waste Management is an obligatory function of the Urban Local Bodies as envisaged by the 74th Amendment of the Constitution of India. However, this service is poorly performed by most of the ULBs resulting in problems of public health, sanitation and environmental degradation. With rapid pace of urbanization the situation becomes more and more critical day-by-day. Infrastructure development is not in position to keep pace with population growth owing to poor financial health management of most of the ULBs. Lack of financial resources, institutional weakness, improper choice of technology, lack of public participation in SWM, non-involvement of private sector etc., have made the SWM service far from satisfactory. Therefore, there is a need to handle this problem in a concerted manner and adopt suitable strategies to tackle all aspects of solid waste management scientifically and economically involving private sector wherever necessary and possible. A policy framework is, therefore, necessary to guide and support the ULBs in the country for managing the solid waste more economically in a scientific manner.

The Ministry of Environment and Forests, Government of India has issued vide their Notification during September 2000 for "Municipal Solid Waste (Management and Handling) Rules 2000" **(Annexure-I)** making the same effective from the date of its publication in the Gazette of India. These rules are applicable throughout the country and the state policies on SWM will have to be shaped accordingly.

Approach adopted

The Municipal Solid Waste (Management & Handling) Rules 2000 describes the compliance criteria to be met for collection, segregation, storage, transportation, processing and ultimate disposal of Municipal Solid Waste. These rules entrust the responsibility of Solid Waste Management to the ULBs towards:

i. Implementation of the provisions of the Rules, and

ii. Infrastructure development for collection, storage, segregation, transportation, processing and disposal of solid wastes.

Shillong town, the capital of Meghalaya, faces many problems in managing solid waste in the town. These problems related to various factors such as financial health of the Shillong Municipal Board (SMB) - nodal agency for SWM in Shillong town, lack of institutional and administrative initiatives, lack of community awareness towards SWM, etc. compound the problems. In view of the importance of the town in Northeastern Region, the government of India and the government of Meghalaya have accorded high priority to development of infrastructure facilities including solid waste management in Greater Shillong Planning Area (GSPA). In view of the high priority attached to SWM in GSPA, a project on the preparation of Detailed Project Report (DPR) for SWM in GSPA has been taken up under Project Implementation in the North Eastern Region-Project ADB-TA-4779-India (Tranche-I).

In view of the objective of keeping the city neat and clean by adopting appropriate technologies which are techno-economically viable, methods for collection, transportation, processing and disposal of solid waste generated in GSPA have been suggested. It is proposed to provide SWM services to 100% population in SUA area under the project and thereafter (say after 2031) other areas covering 32 villages in GSPA will be taken up under Phase –II of the project. The DPR addresses all the above issues in detail including other relevant issues in their totality to be followed and implemented.

Action plan adopted

Following approaches have been adopted keeping in view the activities involved in achieving 100% coverage in Solid Waste Management in Shillong Urban Agglomeration Area in line with Solid Waste (Management & Handling) Rules 2000 of Ministry of Environment & Forests, Government of India **(Annexure-I)** and also considering the activities highlighted in the ADB Admemoire for solving solid waste problems outside SUA area and inside GSPA.

The improvement of SWM services in GSPA requires a carefully planned program incorporating all the major activities including minor details such as collection and segregation of solid waste form all the waste generating sources in GSPA, its transportation and safe disposal, management and the institutions responsible for providing SWM services. Economic viability of all the activities in SWM system play a very important role and in order to have a long term sustainability of the SWM project it is essential to generate adequate revenue from the beneficiaries depending upon their capacity and willingness to pay.

Following considerations are made in respect of improving SWM activities within GSPA;

Primary collection

House to House collection and segregation of waste at source,

i. In all 125000 LLDP bins will be provided to 62500 households. Each household will be given 2 nos. of LLDP bins-green for bio-degradable waste and blue for non-biodegradable waste.

ii. A set of 30 PVC bags will be given to each household for collection and storage of segregated waste, and its disposal accordingly.

iii. Segregation and collection of wastes from as commercial, institutional, market and other sources,

iv. Wastes which are hazardous in nature mixed with municipal waste stream have to be taken care of with proper precaution while selecting the disposal methods.

Secondary collection

i. Collection of domestic, commercial, institutional and other wastes and transporting to the community movable bins placed at convenient locations.

ii. Collection of Street sweepings, horticulture waste etc. or transferring to the appropriate locations/bins meant for the purpose for onward transportation to the disposal site.

iii. 30 numbers of TATA-ACE mini-trucks with 1.50 cum capacity will be procured and put into operation for collection of domestic, commercial, market and other wastes for transporting the same for unloading to 4.5 cum capacity tipper trucks for onwards transportation to sanitary landfill site at Mawiong.

iv. Transportation of garbage to the landfill site would be around 88 mtpd. This will be in addition to the 50 mtpd transported by SMB. Thus the total waste generated about 138 mtpd will be taken care of as 100% coverage has been proposed in DPR.

v. Waste will be collected from the households, market and commercial places, street sweepings, through mechanized system mounted on a 4-wheeler (Hydraulic system) 17 number of Tipper-trucks. The waste collected will be taken to transfer points and from transfer points waste will be transferred 17 in higher capacity vehicles and directly taken to treatment and disposal site.

vi. Bio-medical and such wastes from other sources to be collected using special types of waste collecting mechanized systems and disposed of as per the Bio-Medical (Management & Handling) Rules 1998 of Government of India.

Transportation

i. Transportation of waste collected from various primary and secondary collection vehicles at strategic locations and transported by proper designed vehicles to the disposal site and unloaded without much of manual handling.

ii. Wastes that need special care have to be transported by suitably designed vehicles to the disposal site fulfilling all the compliance brought out in the Municipal Solid Waste (Management & Handling) Rules, 2000 of Government of India.

iii. Approach adopted for achieving 100% coverage by collection and transportation of 138 mtpd of solid waste generated in SUA from 2011, with incremental coverage of 100% by 2014 in the entire GSPA.

Disposal of solid waste

i. Sanitary Landfill has been proposed as the only alternative at present for the safe disposal of solid waste generated in GSPA.

ii. All the precautions have been taken into account while recommending the disposal of solid waste in developed sanitary landfill as per the terms and conditions of the Ministry of Environment & Forests, Government of India have been stipulated in **Annexure-I.**

iii. Proper methodology has been proposed for Leachate treatment so as to abate the pollution of ground water and Umiam Lake.

iv. A detailed approach has been mentioned in the following chapter on '**The Design of Sanitary Landfill'**, covering all the aspects of a safe sanitary landfill in operation for solid waste disposal from GSPA.

V. The soil used as base with a thickness of 0.95 m for landfill site will be amended with 10% Bantonite. the soil used for preparing base for landfill is available within 5 km radius of the landfill site at Mawiong as per the Soil Investigation Report at **Annexue-7.**

Financial summary

With the proposed capital investment of INR 76.60 million and estimated annual O & M cost of INR 27.25 million, the project is expected to benefit about 0.16 million persons and about 0.032 million households in Shillong Municipal Board (SMB) area directly and about 0.31 persons in SUA area. The project will be constructed and installed in 18 months period and will be handed over to SMB for O & M which will be the implementing agency
Three economic benefits are assumed for economic analysis and the estimated value of EIRR is arrived as 17.64% with the ENPV of INR 23.91 million.

Four financial benefits are assumed due to the investment and the estimated FIRR is 10.88% with FNPV of INR 42.09 million.

The result of economic and financial analyses and related NPV values indicate that the investment on the SWM project is viable and feasible

1. INTRODUCTION

1.1 BACKGROUND

1. Solid Waste Management is one of the most essential services for maintaining the quality of life of the people in the urban areas and for ensuring better standard of health, sanitation and the environment. In India this service falls short of the desired level, as the systems adopted are out dated and inefficient. Institutional weakness, shortage of human and financial resources, improper choice of technology, inadequate coverage and lack of short and long term planning are responsible for the inadequacy of service. The Shillong Urban Agglomeration population is 0.27 Million of which Shillong Municipal Board (SMB) area consists of 0.13 Million and is the major urban center. The Greater Shillong Planning Area (GSPA) consists, besides SMB and Shillong Cantonment Board (SMB), five urban centers and 32 villages covering an area of 174 sq km with a population of 0.33 Million as per 2001 Census. The Shillong Urban Agglomeration (SUA) comprises of SMB, SCB, and 5 small centers with a population of 267662 as per 2001 Census. The density of population in SMB is the highest with 12825 per sq.km while the figure for the GSPA is 1904 per sq.km. The city of Shillong determined to improve and modernize Solid Waste Management activities in the city and its adjoining areas in GSPA. A map of North-Eastern Region is shown in **Figure 1.1**.

2. For maximizing efficiency and effectiveness of the Solid Waste Management Service, it is necessary to tackle this problem systematically by examining all aspects of 'Solid Waste Management' (SWM) and devise cost effective system which may ensure adequate level of SWM services to all sections of the society, and collection, transportation and disposal of waste in an environmentally acceptable manner in the lines of Supreme Court Committee recommendations as well as Municipal Solid Waste (Management & Handling) Rules 2000 of Ministry of Environment & Forests, Government of India **(Annexure-1)**

3. With a view to improve the efficiency of SWM system in the GSPA, the Detailed Project Report (DPR) on Solid Waste Management has been prepared under the Project Implementation and Urban Management Improvement in The North Eastern Region, ADB-TA-4779-India, Project (Tranche-I). The report envisages modernization of SWM system, improvement of services and practices in the GSPA so as to achieve 100% coverage once the SWM project is translated on the ground (by 2041) complying with Municipal Solid Waste (Management & Handling) Rules 2000.

1.2 PROBLEMS BEING FACED BY URBAN LOCAL BODIES

4. Except for a few progressive Municipal Corporations in the country, all other Urban Local Bodies lack in managerial, administrative, financial and institutional management as also the technical knowhow in management of urban solid waste. It is, therefore, very essential to provide proper guidance and training to the personnel in the urban local bodies including all the stakeholders to make them efficient in managing the solid waste generated, as per the guidelines of MSWMH, Rules 2000 in their respective areas/towns/cities.

1.3 SOLID WASTE MANAGEMENT POLICY GUIDELINES

5. According to the Constitution of India, Solid Waste Management is a part of public health and sanitation and falls within the purview of the State list. It is the primary responsibility of the respective State Governments and Urban Local Bodies to ensure that appropriate Solid Waste Management practices are introduced and practiced in all cities and towns in the state. The role of the Ministry of Urban Development, Government of India is broadly to formulate and prepare policy guidelines and provide technical assistance to the states and urban local bodies whenever needed. It also assists the state governments and urban local bodies in human resource development and also acts as a facilitator in mobilizing external assistance for implementation of Solid Waste Management projects.

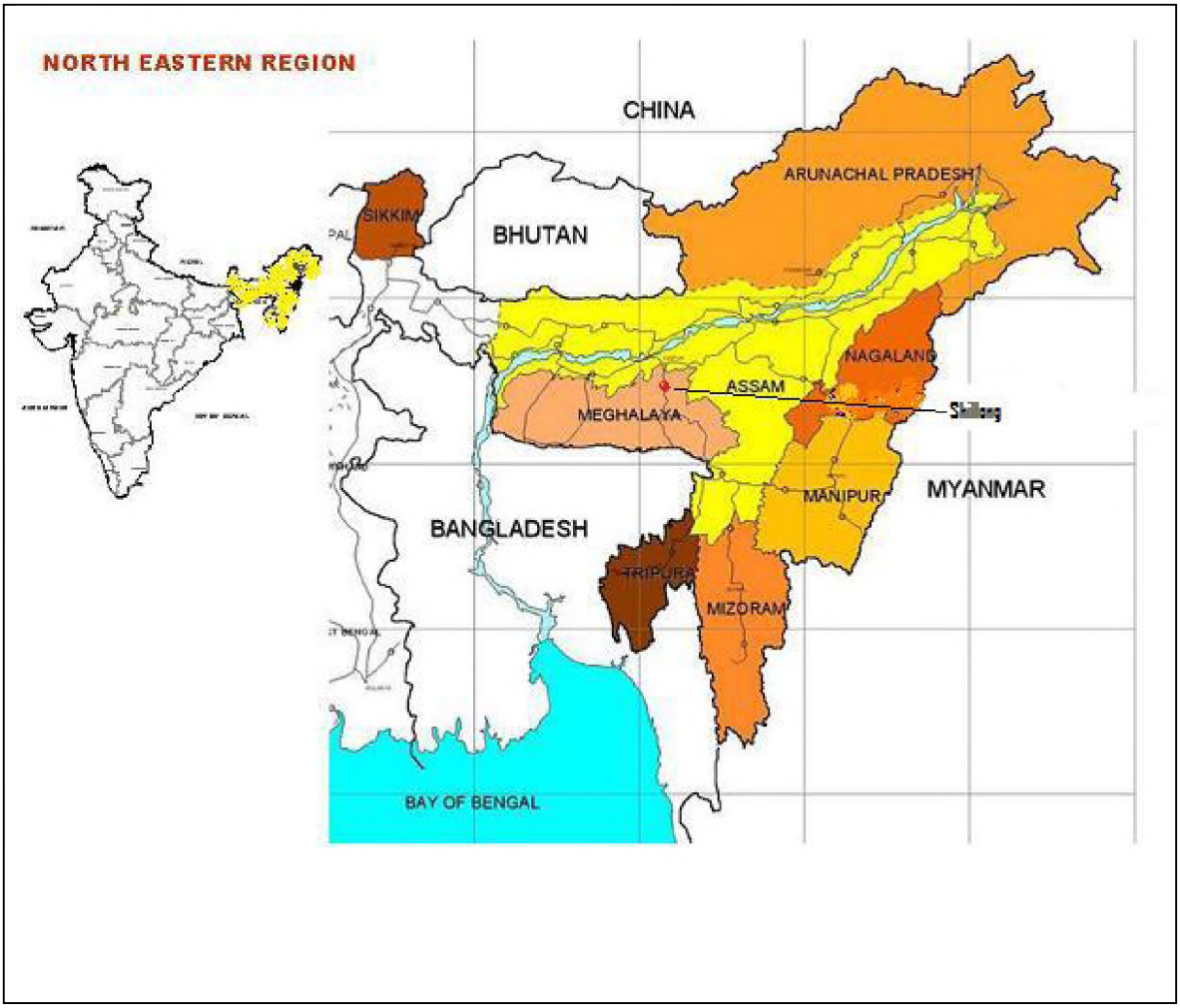

FIGURE 1.1: NORTH EASTERN REGION

6. Solid Waste Management is an obligatory function of the Urban Local Bodies as envisaged by the 74th Amendment of the Constitution of India. However, this service is poorly performed by most of the ULBs resulting in problems of public health, sanitation and environmental degradation. With rapid pace of urbanization the situation becomes more and more critical day-by-day. Infrastructure development is not in position to keep pace with population growth owing to poor financial health management of most of the ULBs. Lack of financial resources, institutional weakness, improper choice of technology, lack of public participation in SWM, non-involvement of private sector etc., have made the SWM service far from satisfactory. Therefore, there is a need to handle this problem in a concerted manner and adopt suitable strategies to tackle all aspects of solid waste management scientifically and economically involving private sector wherever necessary and possible. A policy framework is, therefore, necessary to guide and support the ULBs in the country for managing the solid waste more economically in a scientific manner.

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ultimate disposal of Municipal Solid Waste. These rules entrust the responsibility of Solid Waste Management to the ULBs towards:

i. Implementation of the provisions of the Rules, and

ii. Infrastructure development for collection, storage, segregation, transportation, processing and disposal of solid wastes.

1.4 EFFORTS OF THE GOVERNMENT OF MEGHALAYA

9. Shillong town, the capital of Meghalaya, faces many problems in managing solid waste in the town. These problems related to various factors such as financial health of the Shillong Municipal Board (SMB) - nodal agency for SWM in Shillong town, lack of institutional and administrative initiatives, lack of community awareness towards SWM, etc. compound the problems. In view of the importance of the town in Northeastern Region, the government of India and the government of Meghalaya have accorded high priority to development of infrastructure facilities including solid waste management in Greater Shillong Planning Area (GSPA). In view of the high priority attached to SWM in GSPA, a project on the preparation of Detailed Project Report (DPR) for SWM in GSPA has been taken up under Project Implementation in the North Eastern Region-Project ADB-TA-4779-India (Tranche-I).

10. In view of the objective of keeping the city neat and clean by adopting appropriate technologies which are techno-economically viable, methods for collection, transportation, processing and disposal of solid waste generated in GSPA have been suggested. It is proposed to provide SWM services to 100% population in SUA area under the project and thereafter (say after 2031) other areas covering 32 villages in GSPA will be taken up under Phase –II of the project. The DPR addresses all the above issues in detail including other relevant issues in their totality to be followed and implemented.

2. CITY PROFILE

2.1 BACKGROUND

11. Shillong located in the East Khasi Hills District, is the capital of Meghalaya, popularly referred as "The Scotland of the East". Shillong functioned, during the British regime, as the administrative capital of the erstwhile Assam province apart from being the only major tourist destination in the region. Situated at 25^0 31' 26" – 25^0 39' 56" N Latitude and 91^0 47' 20" – 92^0 0' 39" E Longitude, the altitude of the city varies between 1400 to 1900 m above mean sea level (MSL). The National Highway (NH – 40) links Shillong with Guwahati and rest of the country. There is an airport at Umroi, 35 km from Shillong. Guwahati, the largest urban centre of the region, located 120 km from Shillong, is the nearest railhead and National airport.

12. The Shillong city is located in Seismic Zone V. the slopes within the city are not very steep and ranges from 5% to 10%. Shillong experiences a humid sub tropical climate, and is characterized by moderate warm wet summers and cool dry winters. The average rainfall is about 2100 mm, mostly from the southwest monsoon. The growth trends in the city indicate a physical growth of the city towards the northeastern direction, where the new Shillong Township is proposed.

2.2 GREATER SHILLONG PLANNING AREA (GSPA)

2.2.1 AREA AND POPULATION

13. The Greater Shillong Planning Area (GSPA) is spread over an area of 174 sq. km. it comprises of two district areas viz., Shillong Urban Agglomeration (SUA) and the rural area. The SUA consists apart from the Shillong Municipal Board (SMB) area, and six other urban centers namely, Shillong Cantonment, Mawlai, Nongthymmai, Pynthorumkhrah, Madantring, and Nongmymynsong towns. The rural area comprises of 32 rural settlements.

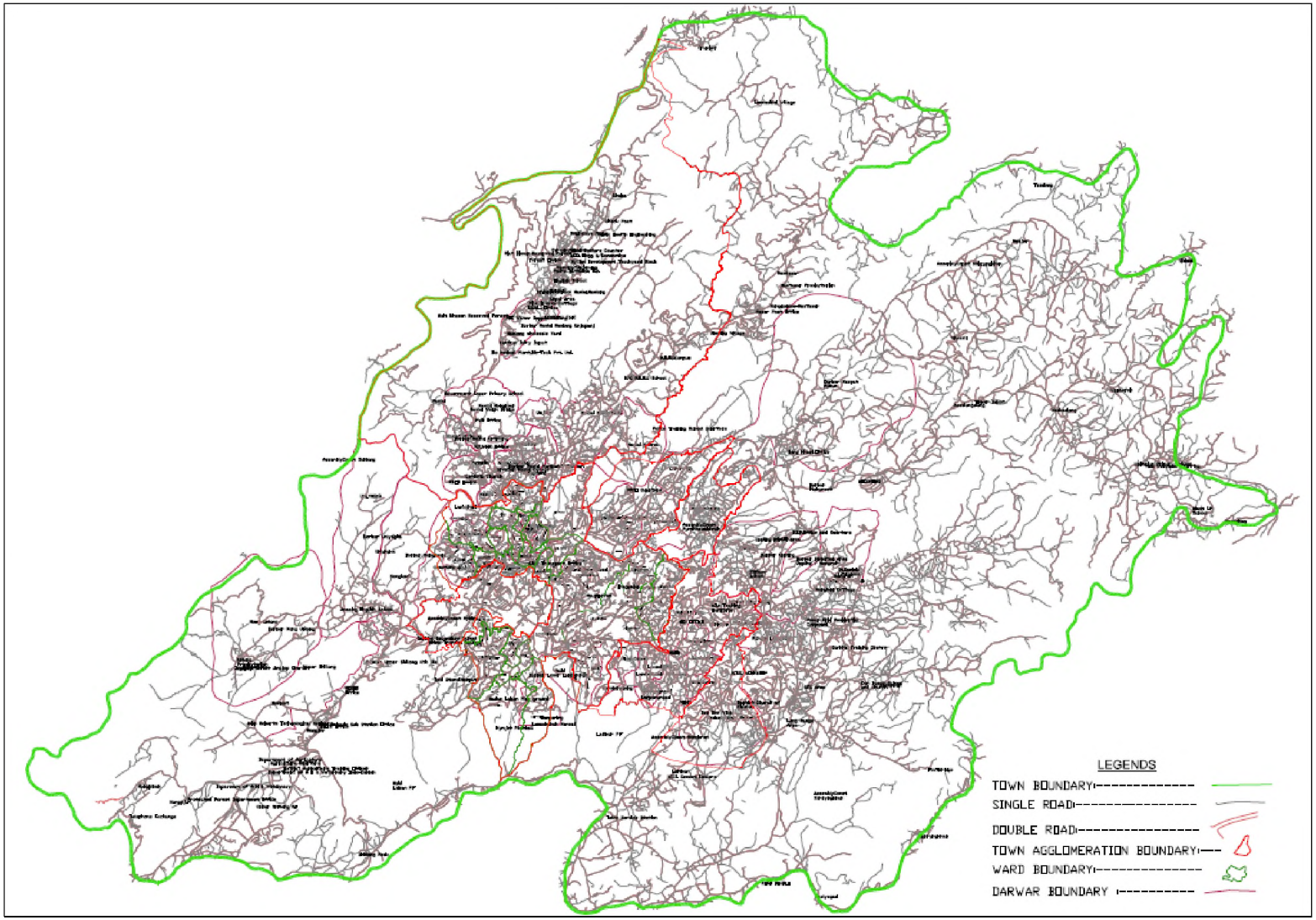


FIGURE 2.1: GREATER SHILLONG PLANNING AREA

14. GSPA, with its total population of 0.33 Million in 2001 accounts for 78% of the total urban population of Meghalaya. Shillong is mainly a service centre for the entire state, apart from being a major tourist destination. The city population is predominantly tribal, with about 98% of the population belonging to Khasi tribe. There are 19 notified slums within GSPA, which account for about 22% of the population. With a work participation rate of 27.6%, the largest share of workforce (89.3%) in Shillong is engaged in tertiary activities. The per capita income in 2005 was INR 1,881 per month, slightly above the Indian urban average of INR 1,695. About 26.8% of the city population is classified as low income, and 16% are poor.

15. Shillong is the only city, amongst other project cities in the Northeastern Region, which falls under the VI schedule of Indian Constitution. There are two distinct areas; one comprising the SMB, which does not fall within the power and ambit of the Autonomous District Council (ADC), and the rest of the GSPA governed by the Sixth Schedule. Outside the SMB and within GSPA, the ADC and the Dorbar Schnongs play an important role in provision of civic services and in development works.

16. It is pertinent to envisage the future growth potential of the city considering the recent developments in the form of greater accessibility, increased tourism development and the uplift that will be given to the State by the growth in the rest of the North East. Shillong is also developing as a center of institutional services and light industry. These developments are going to give an impetus to the trade and commerce activities in the city.

17. One of the main important features of the Shillong city is that all the State Government Offices and important Central Government Offices are located within the city limit. Some of the important institutions located here are, the headquarter of the North Eastern Council, North-Eastern Hill University, Eastern-Air Command, 102 Communication Zone of the Army and other Para-Military Organizations. The schools, colleges and other educational institutions attract students of North-Eastern Region. Recently, Indian Institute of Management and North-Eastern Indira Gandhi Regional Medical Science Institute have been established in Shillong. The Shillong State Library and Museum offer scope for study and research of the ethnic cultures in the region.

18. It is one of the few hill stations with motorable roads all around the city. Shillong has its own charm, different from other hill stations and presents a natural scenic beauty with waterfalls, brooks, pine grooves and gardens. The place, the people, the flora and fauna and the climate all combine to make Shillong an ideal resort throughout the year.

2.2.2 DEMOGRAPHIC PROJECTIONS IN GSPA

19. The total population of GSPA is 331,373 (as per 2001 Census), which is 14.35% of the state and 50.1% of East Khasi Hills District which consists of 7 urban centers and 32 villages as per the Master Plan of Shillong 1991-2011. The following **Table 2.1** gives the details of the population in Shillong Municipality and other constituent units of GSPA from 1971-81 to 1991-2001 along with decadal growth rate.

TABLE 2.1: POPULATION AND GROWTH RATE AMONG SEVERAL GSPA COMPONENTS

Sl. No.	GSPA Components	Population				Growth Rate %		
		1971	1981	1991	2001	1971-81	1981-91	1991-01
1.	Shillong Municipality	87659	109244	131719	132867	24.6	20.6	0.9
2.	Shillong Cantonment	4730	6520	11076	12396	37.8	69.9	11.9
3.	Nongthymmai	16103	21558	26938	34292	33.9	25.0	27.3
4.	Mawlai	14260	20405	30964	38303	43.1	51.8	23.7
5.	Madanrting	0	6165	8987	16318	0.00	45.8	81.6
6.	Pynthorumkhrah	0	10711	13682	22115	0.00	27.7	61.6
7.	Nongmynsong	0	0	0	11371	0.00	0.00	0.00
	Shillong Urban Agglomeration	**122752**	**174703**	**223366**	**267662**	**42.3**	**27.9**	**19.8**
8.	32 Villages	32848	42571	47747	63711	29.6	12.2	33.4
	GSPA	**155600**	**217274**	**271113**	**331373**	**39.6**	**24.8**	**22.2**

(Source: Master Plan of Shillong, Table 2.2, pp7 and Reports of Census of India 1991 & 2001)

20. Against the backdrop as stated above, it is very likely that Shillong will continue to grow rapidly. Its accessibility will improve and its tourism will continue to grow. Underlying these economic forces, it is likely that the rate of natural increase of the population will gradually decrease from its present level of about 1.9% per annum to the national average of about 1% per annum by 2041. This being the case, it is presumed that the projected growth of Shillong to increase at a rate of 3.4% per annum through 2011 and then decline gradually to 1.7% per annum by 2041. This results in a population of 660,183 in 2041. The population of GSPA would have increased from 14.35% of the State population in 2001 to 23% of the State population in 2041 (**Table-2.2**)

TABLE 2.2: POPULATION PROJECTION FOR MEGHALAYA AND GSPA, 2001-2041

S.No.	Meghalaya State		GSPA		
	Population	Assumed GR	Population	Assumed GR	% of State
2001	2,339,000	2.8	331,373	3.4	13
2011	2,648,000	1.25	394,238	3.4	17
2021	2,936,000	1.05	471,244	2.8	20
2031	3,256,000	1.0	557,770	1.9	21
2041	3,610,000	1.0	660,183	1.7	18.29

(Source: City Development Plan for Greater Shillong Planning Area, Govt. of Meghalaya, GR: Growth Rate)

21. Present growth trend suggests that the physical growth of the city is observed along Mawlong in the north Upper Shillong in the southwest and towards Madantring in the southeast. New development is seen in areas like Nongmynsong, Pynthorumkhrah, etc. The place is identified for the location of North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences. Future expansion of the city is anticipated in this direction. Furthermore, the New Shillong Township is also proposed in the same direction.

2.2.3 DENSITY

22. The density of population in urban agglomeration is presented in the following **Table 2.3.**

TABLE 2.3: DENSITY OF POPULATION IN VARIOUS COMPONENTS OF GSPA

Urban Components	Area in sq. km.	Population (as per 2001)	Density per sq. km.
Shillong Municipality	10.36	132867	12825
Shillong Cantonment	1.84	12396	6737
Nongthymmai	2.93	34292	11703
Mawlai	6.14	38303	6238
Madantring	2.02	16318	8078
Pynthorumkhrah	2.11	22115	10481
Nongmynsong	2.00	11371	5686
Shillong Urban Agglomeration	**27.40**	**267662**	**10538**
Villages (32 no.)	146.60	63711	428
Total GSPA	**174**	**331373**	**1904**

(Source: Census of India 2001 and The State of Environment of Shillong City – A Report – MSPCB)

23. From the above table it is concluded that the density of population is highest in SMB area followed by Nongthymmai and Pynthorumkhrah. The overall density of the Greater Shillong Planning Area is 1904 per sq.km.

24. Upgradation of the living conditions of the slum and other low income areas emerges as an important need. Although the Shillong Municipal Board (SMB) has underway several poverty alleviation programs, no concerted efforts have been made for upgradation of quality of life in these slums. The reason partly lies in the fact that these slums are located in private lands. The area upgradation therefore, to a large extent depends on the will of the owner and the community. An important positive feature of Shillong is the presence of a strong local governance structure in the form of traditional "Dorbars" that cater to the needs and priorities of the poor. While assigning the responsibility of SWM in Shillong to an agency, proper action plan such as community awareness generation, collection of waste at designated place, segregation, and transportation of waste to the disposal site should be taken on priority.

3. PHYSICAL ENVIRONMENT OF GSPA

3.1 HISTORY AND CULTURE OF SHILLONG

25. Shillong has grown from a tiny settlement of 1363 inhabitants in 1872 to one of the largest urban hill centers of India with a population of 0.33 Million as per 2001 Census, including contiguous urbanized settlements. As shown in **Figure 3.1** the boundaries of the seven urban centers included as the part of the Shillong Urban Agglomeration under census 2001. It clearly shows that urbanization is fast spreading in almost all directions beyond the municipal limits.

26. Urban growth of Shillong in the past 136 years is primarily attributed to its favorable climate, which attracted the British to set up a sanatorium and the cantonment. During the period the missionaries also established various educational institutions which helped in the development of the town as an educational center of the eastern region of India. The town experienced an accelerated growth in the post independence era due to high influx of migrants from neighboring states as well as other parts of the country in pursuit of employment opportunities. The creation of Meghalaya State in 1972 gave a further boost to urban growth and the town acquired a multi-functional character as an administrative, tourist, educational and regional commercial center for the north-east.

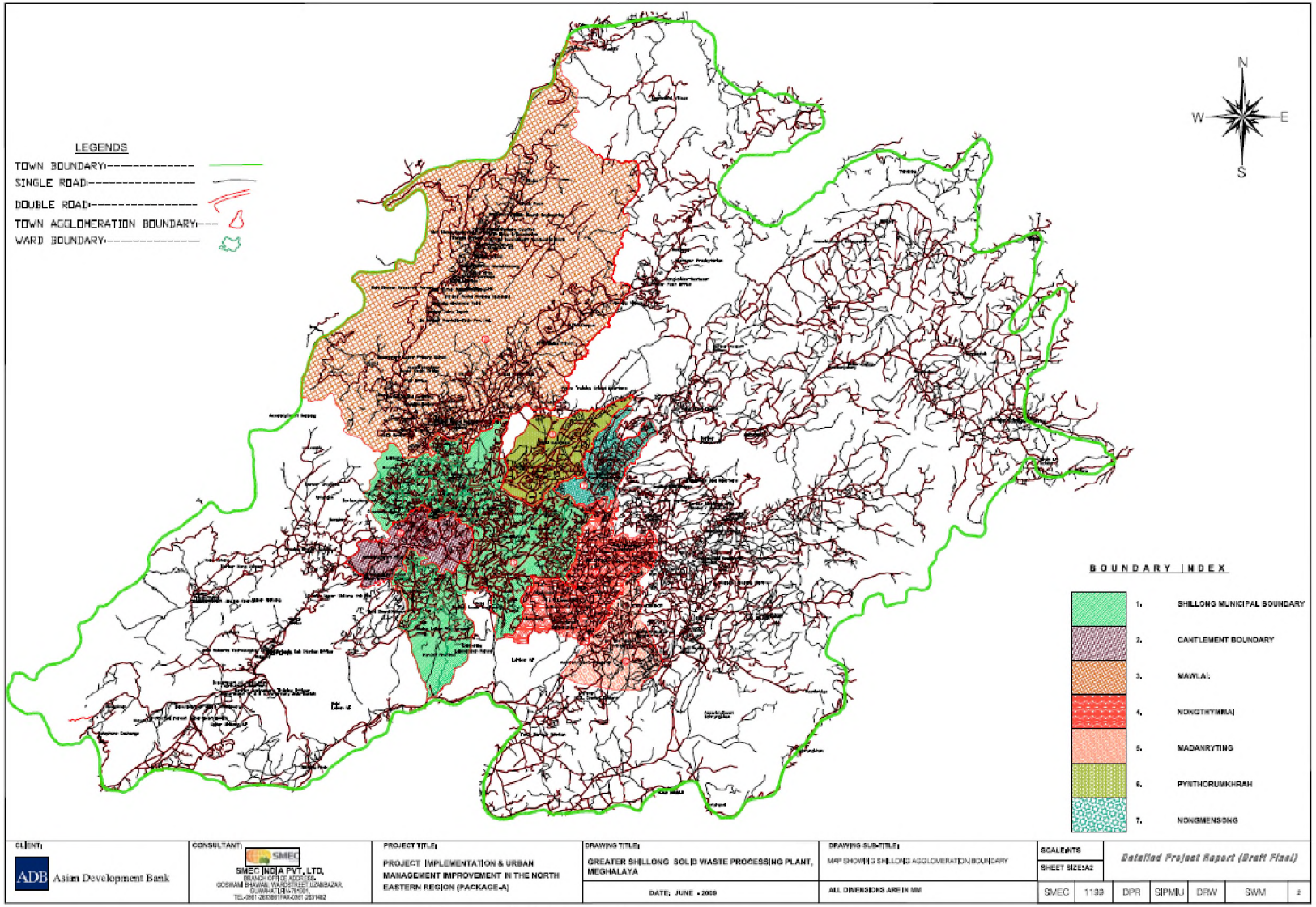


FIGURE 3.1: TOWN AGGLOMERATION BOUNDARY

3.2 TERRAIN

27. Shillong falls on deeply dissected central upland of the Meghalaya Plateau. The relief of the city varies from 1400 to 1900m above mean sea level (MSL). The Khasi Hills range at the south descends at a slope of 200+ towards the city and acts as a water divide. The slope within the city ranges from 5% to 10%, except at the locations such as Happy Valley, Pynthorumkhrah and Polo Ground area, where slope are gentle within the range of up to 5%. Wah Umkhrah, Wah Umshyrpi and Wah Umkhen are the three main streams draining the city through a number of second and third order tributaries.

3.3 HERITAGE AREAS OF SHILLONG

28. There is one centrally and one state government protected heritage site in Shillong viz., Motphran Obelix-War Memorial and Ravindranath Tagore Art Gallery respectively. The departments of Art and Culture, Dorbar Schnongs and others have identified following important heritage sites for development and preservation;

1. Motphran Obelix-War Memorial
2. Ravindranath Tagore Art Gallery
3. All Saints Cathedral
4. Capitol of Hima Shillong
5. Sacred Heart's Roman Catholic Church, Mawlai
6. Presbyterian Church
7. Red Cross Building
8. Monoliths of Laitkor Rngi and Hima Myllieum

3.4 WATER RESOURCES

29. The State is endowed with rich natural resources. The heavy monsoon season sustain a varied flora. The State has considerable coal reserves. Lime stone and industrial clay said to possess rich deposits of uranium. It has also vast untapped hydro-electric power potential. The State economy is mainly agriculture and 66% of the work force is said to be engaged in this activity. In spite of the fact that the State is endowed with rich natural resources, it remained as a backward State. All efforts need to be made to tap its resources to ensure a sustainable economic development of the State.

3.4.1 SURFACE WATER RESOURCES

30. There is no stream or surface water that drains in or near proposed disposal site; whereas natural streams/tributaries following valley slopes are approximately 1 km away proposed disposal site. The Umkhrah and Umsphyrpi Rivers are the two major rivers of Shillong city. These two rivers are running in the centre of the city and it is approximately 8 km away from proposed disposal site. These two rivers finally join the Umiam Reservoir. These are basically the second order rivers that flow across the city from south-east towards north-west directions and then join together to form River Wah Ro-Ro near Sunapani after a sudden fall known as "Bidon and Bishop Falls" prior to its confluence with the River Umiam further downstream. The water of these rivers is mostly used for irrigation, bathing and washing purposes. This river flows north into Lake Barapani (Umiam reservoir) and ultimately into Brahmaputra River. Other Rivulets such as Wah Demthring, Wah Nongrimbah flows towards the southeastern side and rivers Wah Dieng Lieng, Wah Um Jasai flows towards the western side of the city. The Drainage map of Shillong Urban Agglomeration with major watersheds is given in **Figure 3.1** Siltation in Umiam Lake has also been an issue raised by the government in recent years.

3.4.2 GROUND WATER RESOURCES

31. As per Central Ground Water Board (CGWB) the occurrence and movement of ground water in Shillong area is controlled by secondary structures and joints. Ground Water occurs under semi-confined conditions in the zone of permanent saturation. Drilling of good number of bore wells in Shillong area with the Down-the-Hole-Hammer Rig has proved that hard rock area holds and transmits sufficient quantity of water under favorable conditions. The yield of medium deep tube well varies from 5 to 25 cum per hour.

3.5 CLIMATE

32. The climate of Shillong is characterized by moderate warm wet summers and cool dry winters. Shillong experiences a humid sub tropical climate. There are four distinct seasons: mild summer (March to mid May), rainy season (mid May to mid October), autumn (mid October to November) and winter (December to February). The average maximum and minimum temperature is around 17°C and 7.5° C respectively. The average annual rainfall in Shillong is about 2100 mm. Shillong experiences a prolonged rainy seasons with intermittent rain for almost throughout the year, since it is located close to “Cherrapunjee”, the wettest place in the World (aerial distance approximately 30 km). Two thirds of the rainfall occurs in months from June to September from southwest monsoons. The relative humidity is highest during rainy season (above 80%). The humidity is generally more than 50% for all throughout the year (except March).

33. The State’s climatic condition is conducive to the development of horticulture, fruits and vegetables. The industries identified as thrust areas are: Horticulture-Based Units, Biotechnology Based Units, Tissue Culture and Orchid Units, Spices Oleoresin and other Essential Oil Units, Medicinal Plants, Tea and Rubber, Animal Husbandry and Meat Processing Industries, Development of Mineral based Industries, Coal-Based Industries, Limestone Based Industries, Electronic and Information Technology.

3.6 GEOLOGY AND SEISMICITY

34. Shillong lies on low-grade metamorphic rocks of Shillong Group. The rock types are predominantly of quartzite with subordinate of Phyllites and slates followed by schist and gneisses. The Quartzite band dips at 200 to 400 in North-North East to South-South West direction. The rock band is found at a depth of one to three meters from the topsoil level, except at places where the crusted Quartzite bands are exposed. Four sets of joints have been noted in this quartzite, which have rendered them splintery at places where all the sets are intensely developed. The quartzite exhibits broad open folds. The generalized lithological succession in the area is presented in the **Table 3.1**.

TABLE 3.1: LITHOLOGICAL SUCCESSION IN SHILLONG

Type of material	Nature of material	Depth of occurrence
Top soil	Sandy and micaceous	0m-1.5m
Weathered rock/debris	Unconsolidated, saturated with water	1.5m-4/6m
Weathered quartzite interbanded with metabasic	Hard and fresh bed rock	6m-20/30m
Hard and fresh quartzite interbanded with metabasic rocks	Hard and fresh rock	30m-35m

(Source: Draft Document on Initial Environment Examination for Solid Waste in Shillong, 2008)

35. No major fault or thrust occurs within the Shillong Urban Zone but prominent lineament and a major shear zone (Tyrsad-Barapani Shear) occur in the vicinity. Shillong falls in the seismic Zone V. The base of Shillong group is marked by conglomerate bed containing cobbles and boulders of Archaen rocks. In case of Shillong the other environmental factors like lithology, regolith characteristics have very limited or no influence on the foundation, which is already found to be suitable, and the area is free from landslide problems.

3.7 SOILS

36. The soil in Shillong is mainly laterite soil, deficient in phosphorus and potash content but rich in nitrogen and organic matter. The soils are mildly acidic in nature. PH value ranges from 4.8 to 6.2. Some areas have alluvial fills, which are heavy loams and contain larger amount of organic matter. The thickness of the soil varies from 1 to 10 meters.

37. Water Quality of Umiam Lake: The water quality of Umiam Lake is given in **Table 3.2.** As the table indicates, the water quality of Umiam Lake is considered moderately polluted according to the BOD levels. Siltation has also been an issue raised in recent years.

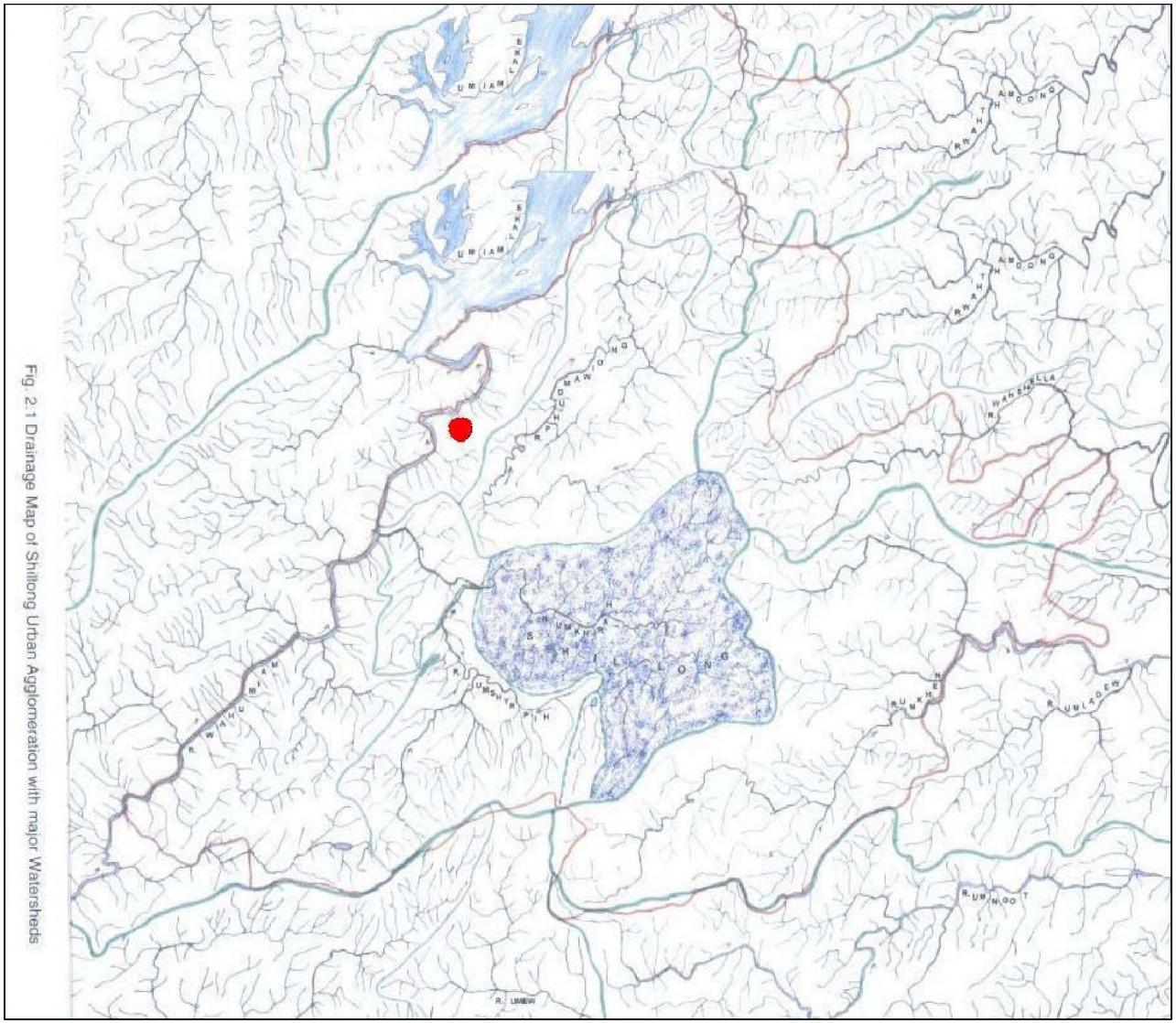


FIGURE 3.2: DRAINAGE MAP OF SHILLONG URBAN AGGLOMERATION WITH MAJOR WATERSHEDS

TABLE: 3.2: WATER QUALITY OF UMIAM LAKE

PARMETER	APRIL 2003	JULY 2003	OCT.2003	JAN. 2004
PI	7.0	7.5	7.2	6.8
Conductivity (µmho/cm^2	275.5	215.0	220.5	286.0
Turbidity (NTU)		32.0		
Chloride (mg/l)		12.0		
Hardness (mg/l)		32.0		
Alkalinity (mg/l) Proposed Solid		32.0		
Nitrite (mg/l)	0.3	Nil	Nil	0.06
Nitrate (mg/l)	11.6	2.0	2.5	8.0
Sulphate (nfg/l)		4.0		
Phospate (mg/l)		BDL		
Calcium (mg/l)		3.0		
Dissloved Oxygen (mg/l)	6.4	6.8	6.2	6.5
Biochemical Oxygen Demand (mg/l)	12.5	8.0	10.0	9.6
Chemical Oxygen Demand (mg/l)		24.0		
Ammonia Nitrogen (mg/l)		1.1		
Kjoldothl Nitrogen (mg/l)		1.8		
Total Dissolved Solids (mg/l)		150.8		
Total Coliform (MPN/100 ml)	3300	2200	3400	3500
Faccal Coliform (MPN/100 ml)	2600	1700	2200	1700
Sodium (mg/l)		4.0		
Potassium (mg/l)		3.4		
Magnesium (mg/l)		4.0		
TSS (mg/l)		90.2		
Floaride (mg/l)		0.04		
Arsenic (µg/l)		Nil		
Cadium (µg/l)		Nil		
Copper (µg/l)		Nil		
Lead (µg/l)		Nil		
Chromium (µg/l)		Nil		
Nickel (µg/l)		Nil		
Zinc (µg/l)		0.006		
Iron (mg/l)		0.1		
Temperature ° C	17.0	24.0	24.0	12.0

(Source: Meghalaya Sate Pollution Control Board)

4. PRESENT SCENARIO OF SWM IN GSPA

4.1 SALIENT FEATURES

4.1.1 AREA UNDER CONSIDERATION

38. The area under consideration, in relation to the project, is the Greater Shillong Planning Area (GSPA), comprised of the following areas:

i. Area falling inside the jurisdiction of Shillong Municipal Board (SMB),
ii. Shillong Cantonment Board, and
iii. Area falling outside the jurisdiction of Shillong Municipal Board

39. The area falling outside the jurisdiction of the Shillong Municipal Board, which is at least 4 times more than that under the Board's purview, consists of the following towns/villages:

i. Mawlai,
ii. Nongthymmai,
iii. Pynthorumkhrah,
iv. Madantring,
v. Nongmynsong
vi. Cantonment Board area
vii. Peri-urban villages/towns

4.1.2 PRESENT STATUS OF SOLID WASTE GENERATED IN THE GSPA

40. It is reported by the Meghalaya State Pollution Control Board (MSPCB) that the GSPA generates about 150 mtpd of solid waste of which 120 mtpd of waste is generated within the SMB area, while the remaining 30 mtpd of waste is generated outside the SMB area within GSPA. It is estimated that only about 45-47% of waste is collected and transported to the landfill disposal site at Mawiong. Shillong is the only city in North-Eastern Region wherein a compost plant with a 100 mtpd capacity had been installed under Private-Sector-Partnership, but due to some technical problems relating to incoming waste; it is not fully operational for some time. However, State government is making efforts to revive the plant and put it into full operation at the earliest.

41. Shillong Municipal Board (SMB) is responsible for management of solid waste within the municipal boundaries (10.6 sq. km) of Shillong. The municipal area is subdivided into 5 zones and is further sub-divided into 27 wards. The **Table 4.1** gives the summary of solid waste generation in GSPA by using per capita per day basis (gms/capita/day) of studies conducted by various agencies for Shillong. The population of Shillong Urban Agglomeration (SUA) area and solid waste generation during the different decade till year 2041 is shown in **Table 4.2**.

TABLE 4.1: SOLID WASTE GENERATED IN GSPA

Year	Population	Computation of solid Waste generation using different bases derived from different sources			
		AusAID study(450gpcd)	NEERI – CPCB(340gpcd)	PHED – Meghalaya(372gpcd)	ADB (452gpcd)
2001	331373	150	113	123	150
2011	394238	177	134	147	178

(Source: City Development Plan for GSPA, Department of Urban Affairs, Govt. of Meghalaya, 2007)

TABLE 4.2: POPULATION AND SOLID WASTE GENERATION IN SUA

Sl. No.	Area	2001	2011 (Projected)	2021 (Projected)	2031 (Projected)	2041 (Projected)
1	Shillong Urban Agglomeration	267662	307811	353982	407079	468141
2	Quantity of Solid Waste Generated (TPD)	120	138	159	183	210

(Source: City Development Plan for GSPA, Department of Urban Affairs, Govt. of Meghalaya, 2007)

42. Above figures regarding quantity of solid waste generated in GSPA marginally coincides with figures as assessed by the AusAID and ADB considering about 450 gms of solid waste generated per capita per day and same has been considered for a design period of 30 years hence in GSPA. The quantity of municipal solid waste generated from a town or city is a very important criterion in planning of collection, transportation and ultimately disposal systems to be adopted for a definite time frame or the design period. Efforts have been made to prepare the DPR in conformity to the methodologies and recommendations as brought out in the Manual on 'Municipal Solid Waste Management' published by the Ministry of Urban Development, Government of India, 2000.

4.1.3 TYPE OF WASTE AND ITS' STORAGE AT SOURCE

43. The practice of storage of solid waste at source is an essential component for effective collection of waste at its generation point. In the GSPA i.e. both inside the SMB and outside the SMB, for most residential areas, the garbage is stored in personal bins and disposed off in community bins daily/periodically or collected by municipality/community collection trucks or other types of vehicles from these community bins. However, there are areas, especially outside the SMB areas where the residents dump solid waste outside their houses where it is buried or burnt. It is the responsibility of the Meghalaya State Pollution Control Board to prohibit such acts of the community for indiscriminate disposal of waste by promulgating stringent measures through enforcing bye-laws. Commercial establishments dispose off their garbage outside their shops or even dump it in bins near their establishments. It may be added that more often, waste is dumped around and outside the bins. The larger commercial establishment like hotels, institutions, and commercial complex have their own bins/dumping areas from where the garbage is removed periodically.

44. In the case of bio-medical waste, some of the larger hospitals have a separate storage for each of the different categories of wastes. General waste which includes items like paper, cardboard boxes, plastic packaging; anatomical which are body parts and pathological which are blood-soaked dressings, cotton, swabs; and sharps which include syringes, needles, broken glass. There is a Bio-Medical waste treatment plant in the vicinity of Mawiong landfill site. It is under the control of Shillong Municipal Board. The capacity of the plant is 20 kg per hour and normally works for 6 to 8 hours a day depending upon the quantity of hazardous Bio-Medical waste to be incinerated and the duration of supply of electricity. Other non hazardous Bio-Medical waste is mixed with municipal solid waste and dumped to the landfill site. All these processes, as reported, are in conformity to the Bio-Medical Waste (Management and Handling) Rules, 1998, of Ministry of Environment and Forests, Government of India, (**Annexure-2).**

4.1.4 SEGREGATION OF WASTE

45. Segregation of solid waste at source is not practiced and generally the community is not aware of the need and its importance at source. The recycling market is ruled by middlemen who pay a very small sum and therefore the householder is not encouraged to store recyclables and dispose to the recyclables market. Rag-pickers often spread the garbage outside the bins to separate recyclables which make the surrounding dirty. The practice of segregation for bio-medical waste exists in some larger hospitals and some even follow the mandatory color-coded segregation. However, waste disinfection, autoclaving/micro-waving/chemical treatment and incineration is not being followed by most of the hospitals, clinics, dispensaries and pharmacies, and wastes generated taken to the bio-medical waste treatment plant at Mawiong by SMB for treatment, as mentioned under **Para 44.**

46. Recyclable wastes have been observed to contain newspaper, glass bottles, tins, plastic bags and old clothes which could have been segregated at source and fetch a small earning for a household, if the recyclables market is organized and segregation at source is encouraged. Recyclables waste material like waste paper, plastic, broken glass, metal and packaging material are picked by rag-pickers from dustbins and a large portion of remaining such recyclables are picked up by rag-pickers from the landfill area at Mawiong.

4.1.5 COLLECTION

(i) **In the SMB area:** the collection of solid waste in the city is through secondary collection from waste depots/garbage bins. There is also a system of street sweeping and this is another mode of primary collection of waste. In the residential areas, residents themselves deposit garbage in community bins. Some localities within the SMB area also have limited door-to-door collection. However, there is still uncontrolled dumping in open areas, drains water bodies, and burning in open spaces is being practiced.

(ii) **In the areas outside SMB:** collection of garbage is not uniform but managed on ad-hoc basis and operated along the lines of the system established by the respective Dorbar Schnongs /community/NGO. Typically, residents bring their garbage to the collection trucks or drop it at a designated location, which may be just an open spot. This garbage is then loaded into the trucks manually, and transported to the disposal site at Mawiong. This process necessitates multiple handling of solid waste.

47. There is no street sweeping or even cleaning of drains. However, there are cleaning drives once a while/year organized by the respective Dorbar Schnongs where the entire community is involved in this work of cleaning of their own compounds as well as drains running alongside their houses. Open burning of these wastes, even in designated collection points, is also practiced with its resultant negative effects. In the absence of a proper solid waste collection system, substantial quantity of the garbage generated finds its way into streams which ultimately join the Umkhrah and Umshyrpi, and then onwards to the Umiam Lake. The fact that there is almost 50% of inert material in the garbage and being high-density material, this heavier waste ultimately settles down on the beds of these streams raising their bed levels. This again leads to flooding of streams during heavy rains in monsoon and can even erode banks of the streams, which deteriorate the environment further.

48. There has been an extensive study done, for the areas outside the purview of the SMB, under the AusAID Shillong Water and Sanitation project, with the use of GIS tools and it is assessed that the need of collection stations of varying sizes in this area are 461 collection stations and 10 transfer stations. The same study also assessed the need of vehicles to clear this waste from such stations to 34 trailers and 15 tractors to service this area properly. The use of heavy vehicles had been evaluated as uneconomical and unsuitable under local conditions and hence discouraged.

49. The above AusAID study evaluation appears to be based on need based approach in solving the solid waste problem in GSPA ignoring the difficulties and limitation being faced by the concerned agency in operating the SWM system on the ground which is undulating terrain being the hilly area. Due precaution has been taken into consideration while recommending various methodologies for 100% efficient and cost effective SWM system for GSPA.

4.1.6 DOOR-TO-DOOR COLLECTION

50. In the GSPA i.e., inside SMB and outside SMB areas there is a limited amount of garbage, which is collected, door-to-door both by the Board and through community participation. The garbage collection trucks warn residents, through the use of a special horn or a bell, who come out and then dump their garbage into these trucks. Moreover, there are areas where municipal workers collect door-to-door manually and lift it on 'khohs' – traditional conical baskets made of cane.

51. In some other localities, the community/Dorbar Schnongs have outsourced this to a group, normally a youth group, who collect it from the doorstep of residents. This activity is supported through the collection of a monthly fee of INR.15-30 per household per month from residents. A case in point is the Lachaumiere Dorbar, where the waste is collected by the Seng Samla, which charges INR 30 per household per month. The Synjuk Ki Seng Samla Schnongs (SSSS) is currently operating a truck in Nongmynsong area and collects user-charges INR 15 per month from each household to sustain operations. As per the agreement drawn between Government of Meghalaya and Dorbars, it is the responsibility of Dorbars to operate and maintain the trucks provided to them by MUDA.

52. The Dorbars of the Nongthymmai area have also joined together and collect solid waste using a truck by a private operator who collects the waste once or twice in a week from each locality and community deposit their waste into the truck. There are other Dorbars in the Laitumkhrah and Nongthymmai areas that have also collaborated and with the help of a truck provided by MUDA, collect the waste weekly directly from residents through the help of the above private operator. In both the cases, the private operator does not collect any user-charges from the Dorbars.

4.1.7 SOLID WASTE TRAPS ON DRAINS AND STREAMS

53. There are two main streams – the Umkhrah and the Umshyrpi pass through the GSPA and flow into the Wah Ro-Ro that ultimately joins the Umiam Lake. There are also drains and streamlets that flow into these streams and eventually into the river. These drains and streamlets however carry with it solid waste like asbestos, broken glasses, plastic bags, paper waste, clothing and even bulk waste. The heavier waste settles down on the beds of these streams and rivers causing them to raise the bed level and in monsoon, there is an overflow of the river banks. The rest of the waste freely floats along or below the surface of the water.

54. There are civil structures like solid waste traps and weirs that can be built over streams and especially the discharge and confluence points to ensure that the solid waste is trapped and does not pollute and choke the streams. These structures, if properly constructed and installed would certainly restore the streams to their earlier pristine conditions. These structures are described below:

i. **Weir-cum-trash rack combination. This is comprised of Weirs** – These are the lower part of the structure and built across the stream and will trap the solid waste materials that are transported along the river bed.

ii. **Trash Rack** – This is a steel frame structure like a net, which will trap plastic bags, cloth, and freely floating debris. These are to be built in a strategic location on the larger streams like the Umkhrah and the Umshyrpi.

iii. **Suspended Solid Waste Traps (Screen Gratings)** - These are metal wire frames suspended freely on the streams and held by steel wire ropes that are fixed on both sides of the stream. These can be built along confluence points and discharge points of the drainage system in the city.

However, the critical issue is that these trash racks are to be maintained regularly else it would lead to flooding upstream in case the traps get clogged.

4.1.8 STREET SWEEPING

55. Street sweeping is also done on all major roads and is the most common method of collection of solid wastes, especially in commercial areas.

56. It is observed from the AusAID study that not all roads are being swept. The reason being the road length assigned to sweepers is inequitable. Moreover, the distance to a collection point for each sweeper varies greatly due to local conditions. There is also no scientific planning like use of GIS tools for allocation of road lengths to sweepers, although there is a sweeper assignment report arrived at through GIS tools by the AusAID study, yet this has not been followed by SMB rigorously.

57. The other reason attributed to inefficacy of street sweeping is the large-scale absenteeism of street sweepers. Drain cleaning is combined with sweeping in some assignments which can become very tedious and difficult, whereas other crews have only drains to clean. It has been estimated, in the AusAID study that a total of 140 km road length is to be covered under street sweeping. However, it was also reported that if we include major roads then both sides of the roads are to be swept which means an additional road length of 40Kms more is to be swept i.e. adding up to a total road length of 180 km. The AusAID study has however also reported that that only 72 km i.e., 40% of the total road length is being swept currently.

4.2 WASTE STORAGE DEPOTS

58. In SMB areas, waste is collected by municipal trucks from collection bins and then transported to the disposal site. According to a rough estimate there are 94 collection points/depots in the area and these range from fully or partially constructed with brick masonry, MS tanks, mobile collection system and even on open ground dumping areas. The details of the collection points/bins are as shown in **Table: 4.3.**

TABLE 4.3: TYPES AND NUMBER OF COMMUNITY BINS/POINTS IN SMB AREA

Sl. No.	Types of Community Bins/Points	Number
1.	Fully Masonry Constructed	16
2.	Partially Masonry Constructed	23
3.	Mild Steel Receptacles	5
4.	Open Dumping	23
5.	Mobile Collection System (Truck-Trailer)	27
	Total	**94**

(Source: Shillong Water and Sanitation Project, AuSAID, January 2006)

59. It may be added that some of these bins have been re-designed for effective disposal and better retrieval of garbage for onward transfer to the disposal site. It is observed that the distance or the locations of such bins are also far from places of generation. An AusAID study finding reported that the distance between such bins is about 225m whereas the norm in the Manual for SWM recommends a 100m distance between such bins. In a hilly terrain

like Shillong, the norm should be reduced to 75m or even 50m if walking uphill. There are few litter bins all over the city even in the SMB areas, and people on the move have no place to dispose of litter.

4.3 CHARACTERISTICS OF SOLID WASTE IN GSPA

60. Average Physical Characteristics (% of wet weight basis) and Chemical Characteristics (% of dry weight basis) of GSPA solid waste is given in **Table 4.4 & 4.5**. The composition of solid waste is shown in **Table 4.6**.

TABLE 4.4: AVERAGE PHYSICAL CHARACTERISTICS OF SOLID WASTE (% OF WET WT. BASIS)

Sl. No.	Characteristics	Contents (% of wet weight basis)
1.	Compostable matter	48.40
2.	Paper/Cardboard	10.91
3.	Rubber & Leather	1.81
4.	Plastics	0.96
5.	Rags/Textiles	2.85
6.	Wooden	1.85
7.	Metals	0.86
8.	Glass & Crockery	2.51
9.	Stone, Bricks, & other inert	29.85
	Total	**100.00**
10.	Moisture	44.80

(Source: The state of Environment of Shillong city, MSPCB)

TABLE 4.5: CHEMICAL CHARACTERISTICS OF SOLID WASTE

Sl. No.	Characteristics	Contents (Dry weight basis)
1.	pH	7.60
2.	Organic matter (%)	61.00
3.	Carbon (%)	35.40
4.	Nitrogen (%)	0.61
5.	Phosphorous (%)	0.20
6.	Potash (% as K_2O)	0.23
7.	C/N Ratio	58.31
8.	Calorific Value (K.cal/kg)	2704.80

(Source: The state of Environment of Shillong city, MSPCB)

TABLE 4.6: SOLID WASTE COMPOSITION

Sl. No.	Characteristics	Percentage (%)
1.	Compostable	48
2.	Recyclables	22
3.	Inert material	30

(Source: The state of Environment of Shillong city, MSPCB)

61. It may be observed from the above tables that the waste generated in GSPA is of heterogeneous in nature and therefore any disposal and treatment method may have direct impact of the waste characteristics. Collection, transportation and disposal systems need to be designed keeping in view the governing properties of the solid waste generated in GSPA.

4.4 TOOLS, EQUIPMENTS AND PERSONNEL PROTECTING GEARS

62. Municipal workers are ill-equipped and mostly use short-handled brooms which cause early fatigue and backache. Long-handled brooms are given to some and there is no uniformity in the number and quality of brooms given. The usage of proper tools will increase their efficiency. Handcarts are also in short supply and some of them have to be fully upturned for unloading its contents, which implies that properly designed handcarts have to be given for efficiency and faster turnaround time. There have been initiatives to provide better-designed handcarts.

63. Protective gears like gloves, boots and masks are not being used, even if given, by all municipal workers causing risky and hazardous conditions for them at work. The details of primary collection relating to ward-wise deployment of conservancy staff, equipment and number of community dust bins/open dumps in SMB area is given in **Table 4.7.**

TABLE 4.7:PRIMARY COLLECTIONS: DEPLOYMENT OF CONSERVANCY STAFF AND EQUIPMENT IN SMB JURISDICTION

Ward No	Total Population	Total Sweeping Staff	No. of Wheel Barrows	Dustbins			
				RCC	1.8M3	4.5M3	Open spaces
22-25	14932	44	1	13	4	0	0
1-4	9748	37	2	8	4	3	0
5 & 6	10907	30	0	6	1	4	0
26-27	11426	0	0	0	0	0	0
8	4261	6	1	1	0	0	0
9, 10	6517	18	2	1	0	0	5
7,8	9014	12	1	1	1	0	3
8	0	16	1	7	2	0	1
10,11	9524	17	0	1	0	0	2
12,17,18	10737	12	1	1	0	0	3
13-16	17142	50	1	0	0	0	0
17-18	8564	18	0	2	0	0	2
19-21	26836	28	1	0	0	0	3
		288	**11**	**41**	**12**	**7**	**19**

(Source: City Development Plan for GSPA, Department of Urban Affairs, Govt. of Meghalaya, 2007)

4.5 SOLID WASTES GENERATION

64. The daily waste generated in GSPA is about 150 mtpd. Residential and commercial wastes contribute a major fraction, accounting for about 80% of the wastes generated. The percentage of the wastes generated from various sources in GSPA is given in **Table 4.8**. The status of solid waste generated in Shillong Urban Agglomeration area is given in **Table 4.9**.

TABLE 4.8: SOURCES OF SOLID WASTES IN SHILLONG

Waste generating source	Proportion of wastes (%)
Residential	56
Commercial	23
Hotels and Restaurants	7
Hospital Waste	1
Industrial Solid Waste	4
Construction and Demolition Waste	2
Other wastes (Street sweepings & Horticulture, etc.)	7

(Source: Shillong Municipal Board, 2006)

TABLE 4.9: STATUS OF SOLID WASTE IN SUA AREA

Sl. No.	Status Details	Quantity
1.	Quantity of solid waste generated in SUA	138 TPD
2.	Percentage of solid waste collected in SUA	47%
3.	Quantity of solid waste collected in SUA	65 TPD
4.	Quantity of solid waste transported by SMB	50 TPD
5.	Quantity of SW transported by Dorbars from other areas	15 TPD
6.	Quantity of solid waste transported to compost plant	65 TPD

(Source: Shillong Municipal Board, 2006)

4.6 COLLECTION AND STORAGE

65. Primary collection within Shillong municipal area is done by the SMB through (i) street sweeping and (ii) house-to-house collection through refuse vehicles. Present solid waste collection is a manual multihandling system[1]. To improve the operational efficiencies, sweepers are allotted specific areas for sweeping by the concerned sanitary inspector. The conservancy staff works in shifts, the timings of which differ according to seasons.

66. House to house collection through refuse vehicles is carried out along the major arterial roads. Households come with their wastes, which is then loaded into refuse vehicles. This system is unhygienic and time consuming. Frequency of waste collection is not same throughout the city. Densely populated areas and major arteries are better serviced than the inaccessible areas. In un-served areas/isolated colonies, wastes are either burnt at source or dumped into the drains /water bodies. The existing status and frequency of waste collection is shown in **Figure 4.1(a), 4.1(b) & 4.1(c).**

FIGURE 4.1(a): HOUSE-HOUSE COLLECTION

FIGURE 4.1(b): MANUAL LOADING OF WASTES FROM STORAGE BINS TO COLLECTION VEHICLES.

[1] Wastes collected through street sweeping are manually taken, using cane baskets of capacity 0.03cu.m to a nearby community bin.

FIGURE 4.1 (C): WASTE STORAGE BINS CONSTRUCTED BY AUSAID

67. The SMB uses trucks for primary collection of waste. A few Dorbars use auto-rickshaws due to the inaccessibility of some localities and in non-truckable areas, waste is manually carried and hence, there is multiple handling of waste. There is no optimization of the vehicles used by the Board, and no scientific routing and scheduling of these vehicle routes. Outside the SMB the vehicles used presently for garbage collection and for transportation trucks are provided by MUDA, 2 trucks of Cantonment Board, 2 trucks of Syiem of Mylliem, 1 truck provided by Nongthymmai Constituency and 1 truck of Golf link. The system operates on user charges basis.

68. The dumping charges, as reported by SMB, are as follows;

For Trucks –INR. 200 For Jeeps – INR. 100 and forThree wheelers – INR. 50.

In case of regular users like Dorbars/NGOs/SHGs, they are charged on monthly/annual basis with varied rates depending on the frequency of dumping. The rates vary from INR 400 to INR 4000 per month. Cantonment Board is paying to SMB, INR 30,000 per annum. The total collection per annum, as reported by SMB, is roughly about INR 150000

69. The existing system of waste collection is through a manual/ multihandling[2] system, which is not in compliance to the SWHR. Moreover, no waste segregation (biodegradable mixed with non-biodegradable) is practiced. In addition, wastes from hospitals, industries and construction activities also get mixed with municipal solid waste disposal stream. For waste storage, fixed community bins are used. A total of 7 bins exist within the SMB area. Community is of the view that the siting (locations) of these bins is not proper. The total storage capacity of these bins (77 mtpd), less than actually required, resulting in open waste dumping on roads, lanes and drains in areas where collection is inefficient and irregular.

70. To provide for additional bins, the AusAID has recently constructed some storage bins as part of the Shillong Urban Water Supply and Environmental Sanitation project. As this fixed community bin system involves multihandling, it is not recommended in the SWHR. Such bins are outdated for the following limitations: (i) difficult to clean and hence become breeding ground for vermin[3], and (ii) occupy large areas along the roadside, which is one of the major constraints in Shillong.

71. Area served and frequency of SWM services provided in GSPA is shown in **Figure 4.2** as under;

[2] Waste collected through street sweeping is first stored manually, then from the storage point to the refuse vehicles it is loaded manually and then form the refuse vehicles to the disposal site it is unloaded manually and wastes are segregated at the disposal site for the recyclables, leads to multihandling.
[3] Flies, mosquitoes and rodents.

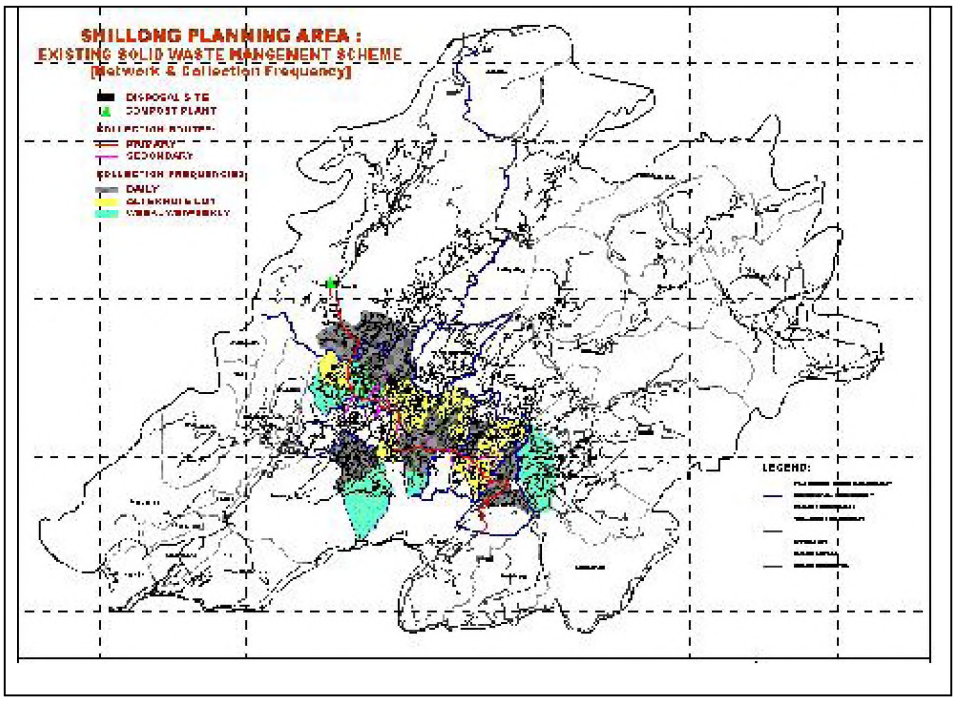


FIGURE 4.2: AREA SERVED AND FREQUENCY OF SWM SERVICES PROVIDED IN GSPA

4.7 TRANSPORTATION

4.7.1 TRANSPORTATION VEHICLES DEPLOYED BY SMB

72. The Shillong Municipal Board has 6 LCV's, 4 trucks, 4 dumpers and 3 tractors which are in operation presently for transportation of garbage to disposal site at Mawiong. This does not include vehicles given by MUDA directly to localities and used for primary collection and transportation. These are being manned by 17 drivers and 60 attendants. There are hydraulic tippers with manual loading which is done by about 4-5 sweepers per truck. There are also multiplicities of models of trucks, which implies that planning and inventory for spares is a costly proposition. As mentioned in the Aus AID study report the operational costs of these vehicles have been worked out to be about INR 450 – 500 per vehicle per day. Full utilization of existing fleet of vehicles with SMB for the purpose of transportation of solid waste in SUA has already been considered while assessing additional number of vehicles for collection and transportation of solid waste from different areas/localities in SUA.

73. Due to inaccessibility of some localities, there is multiple handling of waste and hence the type and design of vehicle used is to be evaluated but presently there are no refuse collection machines or mechanized container bin services, garbage lifters or compactors being used on a limited scale. There are also no mechanized street sweeping machines which may be a solution for the city like Shillong in case of large absenteeism of street sweepers. There are also no front-end loaders used for waste handling and loading. Uncovered trucks are used for waste transportation. There have been complaints from localities because garbage spilling occurs frequently. Since auto-rickshaws and manual lifting of waste is being practiced, the setting up of transfer points is much needed. Locations of such mobile transfer points (35 in numbers) have been shown in the GSPA map along with a list of their locations as appended in Vol.-II.

74. There are also no garage or workshop facilities for breakdown maintenance of vehicles. Hydraulic vehicles need proper preventive maintenance and there is a need for specialized and trained personnel for the maintenance of such special types of vehicles.

There is a need for evaluation whether the maintenance of the vehicles could be outsourced for efficient and better services.

75. Waste accumulated in the community bins are removed by open body trucks and tractor-trailers. The refuse vehicle fleet and their waste carrying capacities are given in **Table 4.10**. The present system of waste transportation is a manual and multihandling system[4]. The scheduling of trips and routing of the refuse vehicles are decided and fixed by sanitary inspectors in unscientific and uneconomical. Out of 16 vehicles, only 13 are in working condition. Since only 2 tippers are functioning properly, manual loading and unloading has become a common practice. The number of trips made by the vehicles per day is reduced due to manual loading and unloading which is time consuming. Hence most of the vehicles make only 1 trip per day against the scheduled 2 trips. The average waste carrying capacity of these vehicles ranges from 2-5 MT per trip and the total waste thus transported is about 50 mtpd from the SMB areas as given in the **Table as under**. Another 15-16 mtpd of waste is transported from other urban areas within GSPA.

[4] Every truck is normally allotted with 5 labors who travel along with it and help in loading and unloading of wastes.

TABLE 4.10: REFUSE VEHICLES WITH SMB

Sl. No.	Vehicle Details	Registration No.	Capacity in T	Working or Non working	Daily No. of Trips	Distance Covered in average	Loading/ Unloading (manual or hydraulic)	No. of person with vehicles
1	Tipper-709 (Medium)	ML-05B 1658	2.5	W	2	20 km	Manual/ Hydraulic	3 + 1 (Driver)
2	Big Truck	ML-05-A-8194	5	W	1	20 km	Manual/Manual	5+1 (Driver)
3	Tipper-709 (Medium)	ML-05-D-5213	2.5	NW	-	-	Manual/Hydraulic	3+1(driver)
4	Truck (Mini)	ML05D9230	2-2.5	W	1	20 km	Manual/Manual	5+1(Driver)
5	Tipper Big	ML-05-B-0264	5	W	1	Do	Manual/Hydraulic	3+1 (Driver)
6	Tipper-709 (Medium)	ML-05-C 3350	2.5	NW	-	-	Do	3+1(Driver)
7	Tipper (Big)	ML-05-B-0265	5	W	1	20Km	Do	Do
8	Truck-709 (Mini)	ML-05-B 2517	2	W	1	Do	Manual/Manual	5+1(Driver)
9	Truck (Mini)	ML-05-D 5210	2	NW	-	-	Do	5+1(Driver)
10	Truck (Mini)	ML-05-D-1656	2	W	1	20Km	Do	4+1(Driver)
11	Tipper-709 (Medium)	ML-05 C-3349	2.5	NW	-	-	Manual/Hydraulic	3+1(Driver)
12	Truck (Big)	ML-05 8193	5	W	2	20km	Manual/Manual	5+1(Driver)
13	Truck (Mini)	ML-05D 1657	2	W	1	-Do-	Do	4 + 1 (Driver)
14	Tipper - 909	ML-05B 6954	5	W	2	40	Manual/Hydraulic	5+1(Driver)
15	Truck (Medium)	ML-05B 2513	2.5	W	2	-Do-	Manual/Manual	5 + 1 (Driver)
16	Truck (Medium)	ML-05 D 5209	2	NW	-	-	Do	5 + 1 (Driver)
Total Solid Waste Collection Efficiency = 50T (Approx) within SMB areas.								

(Source: Shillong Municipal Board, 2006)

76. Vehicles normally cover about 20 km per trip from the collection points to the disposal site at Mawiong. In the absence of a proper garage facility with regular maintenance and servicing, the operational efficiencies of the vehicles get reduced. This also results in high O&M costs. The major repairs to these vehicles are outsourced. The fuel for the vehicles is procured from private petrol pumps based on the number of trips to be made on a particular day. Interactions with the SMB officials indicate a lack of definite accountability in terms of the collection routes or regarding fuel consumption.

4.8 DISPOSAL AND TREATMENT

77. The Central Pollution Control Board carried out a study concluded that the average composition of the present waste being generated in the GSPA comprises about 48% of a compostable fraction, and about 52% of inert and recyclables. It is seen therefore that almost half of the waste is compostable matter. Moreover, the calorific value of this waste has also been found not suitable for a "waste to energy" project. Hence, a compost plant with a 100 mtpd capacity had been set up to cater to the need of disposing of at least the biodegradable component of the solid waste.

78. Once intensive source segregation is in place then a fairly large quantity of waste need not be transported to the disposal site at Mawiong. This implies that ultimately a large part of the 52% of the entire 150 mtpd will be disposed off into the recyclable market or landfill site. However, the balance 48% compostable matter to be disposed off in the existing compost plant, if an intensive segregation system is in operation. To achieve the optimum capacity utilization and efficiencies in the plant operation, it is required to segregate the incoming waste before it is processed for composting.

79. The benefits of decentralization of segregation are however very tangible and are sought to be achieved through the proposed intensive activity of segregation at source at both residential and institutional levels. This would reduce quantity of waste to be transported hence reduces cost of transportation and improves the economics of the present waste disposal system. Construction and demolition waste can also be disposed of on the proposed sanitary landfill site that could also be used as covering material.

4.8.1 COMPOST PLANT FOR BIO-DEGRADABLE WASTE

80. The Compost Plant of bio-degradable waste with a capacity of 100 MT per day had been installed at Mawiong by the Government of Meghalaya with the help of a Private Sector Partnership through investment and operational management of the compost plant. This is the first such plant in the North-East Region in India. However, problems associated with technical deficiencies and marketing of compost have adversely affected the functioning of the plant. The compost plant has been working under capacity for quite some time and may need some emergent action, as mentioned above, to utilize the full capacity of the plant.

81. The proposal for augmentation of the plant is not considered in view of the fact that the priority should be for full utilization of the rated capacity by increased level of collection and segregation of the waste. The plant operator may resort to double working shift if deemed necessary.

4.9 DISPOSAL OF OTHER SOLID WASTES

82. There are other types of solid wastes which ultimately find their disposal in the municipal solid waste stream. The methodology adopted by various agencies generating such wastes is briefly described as under;

4.9.1 BIO-MEDICAL WASTE & INDUSTRIAL WASTE

83. The bio-medical waste plant is not fully operational due to frequent load shedding. It should have a power back up arrangement for its proper functioning. There is a need to adhere and strictly comply with the regulations of the Bio-medical Waste (Management & Handling) Rules, 1998 **(Annexure -2).**

84. It is reported that incinerators have been set up in healthcare units like hospitals although the Central Pollution Control Board, Government of India guidelines clearly state that use of incinerators should be allowed only at a Common Biomedical Waste Treatment Facility, as mentioned under **Para 44**, except where it is absent or in inevitable situations.

4.9.2 CONSTRUCTION/ DEMOLITION WASTE

85. Construction and demolition waste like bricks, cement concrete, stones, tiles and wood etc. have to be disposed off at proposed sanitary landfill site at Mawiong that could be used as a layer (earth) for covering of compacted garbage.

4.9.3 DISPOSAL OF SLAUGHTERHOUSE WASTE

86. Slaughter house waste should be separately collected and be disposed of as per the guidelines and directives given in the following references;

a. 'Basic requirement of Abattoir', (First Revision), IS: 4393: 1979, Indian Standards brought by the Bureau of Indian Standards, Government of India.

b. The standards for discharge of effluents from the slaughter houses have been laid down and notified under the Environment (Protection) Act, 1986, published by the Ministry of Environment and Forests, Government of India,

c. 'Draft Guidelines for Sanitation in Slaughter Houses', published by the Central Pollution Control Board, Government of India, 1986.

The State Government and Shillong Municipal Board should make all out efforts to follow above guidelines as referred, so as to adopt proper disposal of slaughter house waste. These references have been mentioned in the Manual on 'Municipal Solid Waste Management' published by the Ministry of urban Development, Government of India, 2000.

4.10 DISPOSAL SYSTEM

87. Waste collected from GSPA dumped at Mawiong disposal site, 7km away from the city and adjacent to NH-40 (the Shillong Guwahati Road). The site (area of 4.706 hectares) is located within the Riat Khwan forest with hills on one side and a deep valley on the other and is operational since 1938 as shown in **Figure 4.3**. Since no sanitary landfill method is followed, waste is crudely dumped at the valley portion of the site, which drains into Umiam (Barapani) lake, posing a high pollution threat from leachate[5] and surface runoff during monsoon. Other impacts associated with the site are: (i) the site is a breeding ground for vermin and gives rise to foul odor and burning of waste is common[6] (ii) the health of the workers involved in manual unloading of wastes is affected, and (iii) health of the rag pickers involved in waste segregation is affected. In the absence of a weighbridge, the quantity of wastes transported to the site is not recorded.

FIGURE 4.3: EXISTING LANDFILL SITE AT MAWIONG (INSET-UMIAM LAKE WITHIN 3-5KM OF THE SITE

[5] Leachate is generated on account of the infiltration of water into landfills and its percolation through waste as well as by the squeezing of waste due to its self-weight. Thus, leachate can be defined as a liquid that is produced when water or another liquid comes in contact with solid waste. Leachate is a contaminated liquid that contains a number of dissolved and suspended materials. The typical characteristics of leachate quality (through studies conducted by IIT Delhi, NEERI Nagpur and some State Pollution Control Board) have potential for surface water and ground water contamination. Typical constituents of leachate are given in Appendix 7.1.

[6] Burning of waste generates harmful toxic gases like dioxin, which is carcinogenic in nature.

4.11 SWM PROJECTS TAKEN UP SO FAR

88. The National Environmental and Engineering Research Institute (NEERI), Nagpur prepared a master plan for Shillong towards management of solid wastes, in 1991. The report suggested biogas generation as a treatment option towards efficient SWM along with better collection, transportation and disposal methods. A revenue of INR 0.8 million and INR1.84 million were estimated (during 1990-1991) respectively from biogas supply for cooking (domestic use with bio chullah) and electricity generation. The implementation was not taken up immediately due to financial constraints.

89. After the provisions of the SWHR became effective in 2000, the Government of Meghalaya took up initiatives towards waste treatment. Accordingly an organic compost plant with involvement of a private entrepreneur[7] was set up and had been in operation since 2002, at the Mawiong disposal site. This plant is the first compost plant in the northeast region. The operation of the plant had not shown satisfactory results due to inadequate waste supply, with hardly 60 mtpd wastes reaching the plant out of the 150 mtpd wastes generated in the GSPA. However, the quality and quantity of solid waste coming to the compost plant was not in conformity to the required designed parameters. In addition to the technical problems, there was a problem relating to the marketing of compost produced.

FIGURE 4.4: VEHICLES PROVIDED BY-AUSAID

90. The Shillong Urban Water Supply and Environmental Sanitation project [8] worked out several measures towards efficient waste collection and supply to compost plant. The infrastructure facilities provided under this service are (i) construction of community bins and (ii) improvement of collection and transportation through provision of tractor-trailers as shown in **Figure 4.4**. The efforts made, though are major initiatives towards efficient collection and transportation, is not fully in compliance with the provisions of SWHR. These are because the fixed masonry community bins and tractor-trailers provided towards efficient collection and transportation facilities increase multihandling[9], difficult in maneuvering of the vehicles provided due to narrow roads, undulating terrains and also result in high O&M costs. It also reduces road capacity due to low speed of movement.

91. The clean Shillong campaign is initiated by the GoM. And action plan is being framed towards involvement of Dorbars and communities in SWM. There has been a significant effort towards sensitizing the Dorbars on the severity of the issue. Following initiatives have been discussed at length in the following chapters are (i) involvement of Dorbars / NGOs in house-to-house collection; (ii) empowering the Dorbars towards enforcement measures for defaulter. It has been agreed that volunteers be appointed locality wise to affectively monitor the SW disposal. It is recommended that the initiatives proposed in this campaign be further continued and expanded to covered the entire GSPA

[7] Anderson Biotech Pvt. Ltd. (ABPL)
[8] Funded by AusAID
[9] Waste collected through street sweeping and from households are then stored manually at the community bins and then loaded manually to the tractor trailers and again unloaded to disposal site manually, hence multihandling. Moreover, if wastes are not cleaned regularly from the bins then vermin breeding is also encouraged. On the other hand the usage of tractor-trailers for transport of MSW is not recommended for the following reasons: (i) involve high wear and tear cost in city roads; (ii) slow movement along city roads further adding to congestion along narrow roads; and, (iii) involve manual handling of wastes.

4.12 PROCESSING & RECYCLING

92. As mentioned in Para 4.12 above a mechanical compost plant[10] had been in function from October 2002 at the Mawiong, as shown in **Figure 4.5** disposal site with 100mtpd compost production capacity which is not fully operational for the last many months due to various problems encountered by the private agency responsible for running the plant. The quantity of compost production had been far less than the installed capacity. This is due to (i) inadequate[11] quantity of solid waste of desired quality supply to the plant and (ii) rejection of huge quantity of rejects[12] from the total solid waste. To ensure an effective utilization of this plant, a continuous waste supply of 130-150 mtpd is necessary coupled with proper marketing strategy of organic composts to the potential buyers.

FIGURE 4.5: COMPOST PLANT AT MAWIONG

93. Information gathered from the Mawiong on the solid wastes reaching the compost plant on a particular day indicated an incoming waste of 60 mtpd as against a total of 150 mtpd generated in GSPA per day. The quantity of wastes reaching the compost plant was far less than (i) capacity of the compost plant (100 mtpd), and (ii) capacity of the refuse vehicles fleet available with the SMB due to the reasons mentioned.

94. The operator has been allowed to operate maintain and sell the compost by Govt. of Meghalaya on the basis of a tripartite agreement with the GOM, SMB with an annual payment of INR 1.2 million to SMB. The agreement period is for 10 years on renewable basis. In addition, INR 50 per MT of compost production shall also be payable to Government of Meghalaya. However, as mentioned above, the plan is not fully operational.

95. For the waste from 32 villages generating about 30 mtpd of organic waste, it expected that beyond 2031, these villages may also be provided with the same system as being proposed for non-municipal areas covered under SUA under Phase – II of the project.

4.13 EXPENDITURE ON O & M

96. As regards O&M costs (2003-2004), for SWM system delivery the expenditure incurred by SMB was INR 2.2 million. The detailed break up of O&M cost is presented in **Table 4.11.** The revenue sources of SMB are limited to taxes on, water, lighting, sanitation, fees, rent and toll tax. SMB have collected INR 0.2749 million for garbage cleaning. The revenue from the compost plant, as reported was negligible and was collected by the Urban Affairs Department (UAD) of Government of Meghalaya.

[10] Anderson Biotech Pvt. Ltd (ABPL)
[11] Only 69-70 mtpd of waste is transported to the plant out of total generation of 145 mtpd of waste.
[12] There are three screening chambers in the plant, which screen rejects and recyclables from the biodegradable parts. The amount is huge because no segregation of waste is followed in the city.

TABLE 4.11: O&M COST (INR) OF SMB FOR SWM

Sr. No.	Description of Item	Cost Incurred in (INR)		
		2001-2002	2002-2003	2003-2004
1	Worker's share for septic tank cleaning	NA	NA	93,160
2	Allowance to sweeper	NA	NA	12,000
3	Clearing of garbage	NA	NA	16,150
4	Vehicle maintenance			
(i)	POL	NA	NA	1,483,697
(ii)	Repair	NA	NA	588,131
(iii)	Insurance	NA	NA	0
	Total	**NA**	**NA**	**2193138**

(Source: Shillong Municipal Board, 2005)

4.14 URBAN AREAS OUTSIDE SMB

97. In urban areas beyond the jurisdiction of SMB, municipal taxes are not being imposed in the absence of a statutorily constituted municipal body. Hence a few Dorbars have taken initiative to provide and manage the basic services and collect contribution from households. The position of income generated by the Dorbars from the localities where they are providing the urban services is presented in the following **Table 4.12**

TABLE 4.12: ESTIMATED CONTRIBUTION OF COLLECTION BY DORBARS FOR SWM SERVICES

Sl. No.	Number of Dorbars	Number of Households served by each Dorbar	Contribution by each household (INR/month)	Estimated collection per month (INR)	Estimated collection per year (INR)
1.	3	680	50	34000	408000
2.	2	1200	35	42000	504000
3.	1	408	25	10200	122400
4.	3	1786	20	35720	428640
5.	2	3153	15	47295	567540
6.	7	6795	10	67950	815400
7.	1	431	8	3448	41376
8.	4	4740	5	23700	284400
9.	1	912	25	22800	273600
10.	4	3773	0.83	3132	37579
Total	**28**	**23878**		**2,90,245**	**34,82,940**

(Source: City Development Plan for Greater Shillong Planning Area, Department of Urban Affairs, Government of Meghalaya, February 2006)

98. Out of 43 Dorbars 28 is collecting contributions from households for providing basic urban services like water supply, solid waste management, street lighting etc. Out of 28 Dorbars, 22 collecting contribution on monthly basis and remaining 6 collect on yearly basis. The fact that Dorbars collecting charges for the services provided by them in their respective jurisdictions disproves the nonpayment of user charges by the beneficiaries. From this, it is concluded that beneficiaries are willing to pay for efficient and regular services.

99. Overall the financial status of the Shillong Municipal Board is weak in providing the efficient SWM services. SMB's financial resources are mainly from State Government grants and loans. Further development in the field of solid waste management is adversely affected by inadequate revenue generated from the community for the services provided. There is an emergent need to draw an action plan for generating adequate user charges from the community so as to make the SWM services self sustainable.

4.15 PRESENT SWM INSTITUTIONAL FRAMEWORK IN SMB

100. A Chief Executive Officer (CEO) heads the SMB. The CEO is supported by 2 executive officers (EO), sanitary inspectors, jamadars and sanitary workers for SWM. The sanitary inspectors oversee the operations and are normally assigned with responsibility of 4-5 wards. The staff strength and institutional framework of SMB are shown in **Table 4.13**.

TABLE 4.13: SWM TEAM IN SMB

Sl. No.	Staff	Total Strength
1.	Chief executive officer	1
2.	Executive officers	2
3.	Senior sanitary inspectors	3
4.	Sanitary inspectors	5
5.	Sanitary supervisors	5
6.	Jamadars	8
7	Sweepers	310
9.	Drivers	14
Total		**348**

(Source: Shillong Municipal Board, 2006)

101. The staff available with SMB for sweeping is in a ratio of 1 per 1146 persons, which is less than the prescribed norm of 1:500 in Central Public Health and Environmental Engineering Organization (CPHEEO) manual. Also, the other sanitary staff available with SMB is less than what is specified in the CPHEEO manual. Moreover, the technical capability of staff is not adequate towards management of MSW. Towards enhancing the efficiencies of the present framework, adequate capacity building, training and induction of technical staff is required.

102. Outside the Municipal Area, Dorbar Schnongs manage the wastes, while the defense authority is responsible within the cantonments. Within Shillong, in consultation with MUDA and SMB, apart from the Dorbar Schnongs, there are several NGOs and community based organizations (CBOs) that take an active role for awareness generation in matters related to environment protection, women's affairs and community development in Shillong. Activities and focus areas of some of the NGOs active in Shillong, shown in **Table 4.14**. The direct involvement of the NGOs/CBOs in collection and transportation of solid wastes is limited.

TABLE 4.14: NGOS AND THEIR ACTIVITIES IN SHILLONG

Name of the NGO	Focus areas
Shillong We Care	A people's movement against extortion, fear psychosis, Emphasis on caring for the environment.
North East India Council on Relief and Development	Active NGO involved in relief and development in Shillong, including sanitation.
Ka Synjuk Kynthei	A woman voluntary welfare organization working on upliftment of women and society.
Tribal Women Welfare and Development Association of Meghalaya	Main concern is the protection of tribal land; the foreigner's issues; social evils and cultural issues.
Y.W.C.A.	All types of activities for women.

(Source: City Development Plan for Greater Shillong Planning Area, Department of Urban Affairs, Government of Meghalaya, February 2006)

4.16 SUMMARY OF FUNCTIONAL ELEMENTS

4.16.1 WITHIN SMB AREA

103. In summary, the functional elements and brief description of the existing SWM system in the area under jurisdiction of the SMB are as given in **Table: 4.15**.

TABLE 4.15: SUMMERY OF FUNCTIONAL ELEMENTS IN SMB AREA

Functional Element	Description
Storage at source	Generally absent. In residential areas, this is absent but in Commercial areas, waste are deposited in community bins.
Segregation	Absent
Primary collection	Organized system but large amount of garbage not removed.
Waste storage depot	Some depots have been re-designed for more accessibility for garbage dumping and retrieval.
Street sweeping	Present but affected by absenteeism and monitoring.
Frequency of waste disposal	Once daily.
Tools, Equipment, Gear	Handcarts, rudimentary protective gear and not well designed tools.
Transportation	Manual loading in open trucks. There are hydraulic tippers also.
Processing	There is a compost unit for processing bio-degradable waste
Final Disposal	No sanitary landfill
Recycling	Waste pickers pick up some amount for recyclables industry but these are in soiled condition and middlemen pay a low price

(Source: City Development Plan for Greater Shillong Planning Area, Department of Urban Affairs, Government of Meghalaya, February 2006)

4.16.2 OUTSIDE SMB AREA – WITHIN GSPA

104. In summary, the functional elements and brief description of the existing solid waste management system in the area outside the jurisdiction of the Municipality are as follows shown in **Table 4.16**.

TABLE 4.16: SUMMARY OF FUNCTIONAL ELEMENTS OUTSIDE SMB AREA

Functional Element	Description
Storage at source	Absent. Waste is deposited in community bins/thrown in open places/drains/streams
Segregation at source	Absent
Primary collection	Unorganized system and large amount of garbage is not removed. Lost due to open burial or burning
Street sweeping	Absent
Frequency- waste disposal	Periodically ranging from daily to weekly
Transportation	Manual loading in open trucks
Institutional aspects	No single authority for management of solid waste. System managed locally by Dorbars.
Community Involvement	Some are involved in waste collection and charge a small fee for services rendered.
Disposal	Compost plant capacity needs to be enhanced if garbage from this area is removed efficiently.

(Source: City Development Plan for Greater Shillong Planning Area, Department of Urban Affairs, Government of Meghalaya, February 2006)

4.17 SWM PRACTICES WITHIN & OUTSIDE SMB

105. Details of SWM services given by the various Dorbar Schnongs are given in **Table 4.17** below:

4.17.1 SWM WITHIN SMB AREAS

TABLE 4.17: SWM INSIDE SMB

Sl. No	Names of Dorbars	Pop.	Solid Waste				
			Service Provided	Agency	Method Adopted	Frequency	Satisfaction
1	Jail Road	3500	Yes	SMB		Daily once	No
2	Police Bazar	5000	Yes	SMB		4-5timesa day	Yes
3	Madan Laban &Riat Laban	1500	Yes	SMB		3 days in a week	Yes
4	Lower Lumparing	6325	Yes	SMB	Major section of the locality is not accessible for motor transport so refuse are dumped into drains and Forest/streams.	Twice a week	No Major section of the locality is not accessible for motor transport so refuse are dumped into drains and Forest/streams.
5	Laban	6500	Yes	SMB	Nil	Once a week	No, should be twice a day morning & Evening.
6	Oakland/Bivar Road	3500	Yes	SMB	Nil	Daily collection is carried in Bivar Road & alternate days in Oakland Road.	Yes but services requires to be toned up.

(Source: Data provided by Dorbar Schnongs, 2006)

4.17.2 SWM OUTSIDE SMB AREA – WITHIN GSPA

106. Details of SWM activities of Dorbars outside SMB areas within GSPA is given in **Table: 4.18**

TABLE 4.18: SWM OUTSIDE SMB AREAS WITHIN GSPA

Names of Dorbars	Pop.	Solid Waste				
		Service Provided	Agency	Method Adopted	Frequency	Satisfaction
Pynthorbah	12,000	Yes	NGOS	Nil	3 times a week	Yes
Mawlai Syllai Kariah	3000	No	Nil	Running by household itself	Nil	No
Nongpiur	1700	No	Nil	Nil	Nil	Nil
Mawlyngngad	1908	No	Nil	Dumping to any free place	Nil	No
Laitkor Rngi	8110	No	Nil	Dispose of refuse in their own compound by drying their own pit	Nil	Yes
Lumpyngngad	1800	No	Does not arise	By burning in their own backyard	Does not arise	Does not arise
Nongshiliang	2600	Yes	Dorbar	Nil	Twice a week	Yes
Demthring	6523	No	Does not arise	Disposed by burning etc (individual disposal)	Does not arise	Does not arise
Mawlynrei	3268	No	Nil	Pit system	Nil	Nil
Nongrah	6000	Yes	Dorbar	Nil	Twice a week	Yes
Mawlai Mawroh	3500	Yes	Private Agency	Nil	Ones a week	No because the collection is irregular.
Mawlai Mawtawar	Nil	No	Nil	Nil	Nil	Nil
Lumdiengsoh Motinagar	1250	No	Nil	By burning in the Backyard and by engaging a sweeper everyday	Nil	Nil
Itshyrwat	500	No	Nil	By digging a pit or throw by the roadside	Nil	No because it dirties the whole surrounding
Wahdienglieng	400	Yes	Dorbar	Nil	Ones a week	Yes
Lum Batngen	30,000	Yes but not regular	Private Agency	Nil	Nominal	No not regular house waste being disposed randomly
Rynjah (Relief & Rehabilitation Colony Welfare ociety	8000	No	Nil	M/S Anderson Biotech(P) LTD Company for their own commercial purpose collecting the household and waste from house to house once a week	Ones a week	No insufficient for the 8000 population of the locality to clear their last one week staged garbage in a single trip.
Lyngkien	1500	No	Nil	Nil	Nil	No
Mawpat Pyllun	8516	No	Nil	By digging a pit in their own compound	Nil	No

(Source: Data provided by Dorbar Schnongs, 2006)

107. Out of 22 Dorbars who have provided the data 11 Dorbars have reported that no service is being provided by any agency and the households disposed of the waste on their own either by burning or burying or throwing the same on the roads. In six Dorbars where the provision of service is by private agency, the frequency in majority of cases is once a week and five Dorbars expressed satisfaction with the service provided by these agencies.

4.18 ISSUES

108. The critical issues and deficiencies arising out of the Existing Situation Analysis are:

4.18.1 GENERATION

i. There are very few commercial establishments that have storage facilities for waste at source. Commercial establishments dispose off their garbage outside their shops or even dump it in bins near their establishments but do so only after their shop opens at around 9 am while the municipality clears garbage in early morning hours before shops are opened.

ii. There is community apathy towards SWM practices and there is lack of strict enforcement measures by municipality towards dumping in drains and streams. There are no significant measures in creating awareness by civic authorities and the community leaders.

iii. Segregation at source is not practiced and generally, citizens are not aware of the need to segregate at source. Recyclables are sold to middlemen who pay low prices and households are not encouraged to segregate garbage. Since segregation is not organized, recyclables reach the dustbin get soiled and fetch even lower prices.

4.18.2 COLLECTION

i. Door-to-Door collection of garbage is not promoted aggressively. This would trap garbage in the doorstep otherwise it finds its way to drains and streams.

ii. In relation to street sweeping, which is the primary collection mode for garbage, not all roads are swept due to large-scale absenteeism and also lack of proper monitoring and allocation of road lengths as per the work norms.

iii. There is manual handling of waste for loading and unloading of waste for transportation of waste. There is no scientific routing and scheduling of garbage trucks and optimum utilization of these available vehicles. In the absence of mechanization, container bin facilities and the proper management of these trucks, there may be under-utilization and the loss of productivity of manpower and equipment.

iv. There is still a large quantity of garbage not removed even from areas falling under the jurisdiction of the SMB. The efficiency obtained from proper vehicle routing and scheduling can increase the removed quantity but there is also the need to examine the need to introduce additional vehicles to ensure removal of the garbage generated.

4.18.3 DISPOSAL

i. There is an urgent need for establishment of a scientific sanitary land-fill for the disposal of waste along with the rejects of the compost plant. Moreover, there is also need for adequate protection by way of constructing retaining walls for landslips caused by disposal of wastes at the landfill site.

ii. There is a need at present to enhance the collection efficiency and ensure adequate flow of waste to the compost plant. SMB may support the marketing of compost for long-term sustainability and Utilization of the full capacity of the plant.

iii. There is a need to evaluate the economics and hence sustainability of the Public Private Partnership model and restructure it for viability and long-term interest of the project.

4.18.4 INSTITUTIONAL

i. There is no single authority for coordination and management of the SWM system in areas outside the SMB area and this activity is being coordinated by multiple agencies. There is therefore the need to establish a uniform system of collection of waste to share resources and hence derive economies of scale.

ii. The Shillong Cantonment Board manages the collection and transportation of garbage in the military cantonment area of Shillong.

iii. The other villages/towns in this area do not have a formal structure and system for arrangement of solid waste. The collection of waste in these villages/towns is through community participation (Dorbars), with and without help from the Government of Meghalaya through the MUDA. The Authority has provided trucks to the community and these communities manage the collection through payment of user charges. However, in providing such resources among these communities (Dorbars), there remains a question of ensuring an equitable sharing of such resources.

iv. Multiple SWM practices in the areas exist outside the municipality. This system is wasteful and inefficient and also implies that a uniform system is must. There is need to have a uniform system may not be easy to implement. The Dorbars/ Community/NGO do not have the capacity to invest in infrastructure and systems like the one existing in the areas under the purview of the SMB. If there is an investment is to be made, then a proper structure with a single authority, without negating the powers of the Dorbars is to be carefully conceptualized. This would mean sharing of resources and using systems that need to be cross jurisdictional, cutting across lines of dorbars.

v. It may be mentioned that this is already being practiced in some dorbars of the Nongthymmai area, where 3 to 4 dorbars are sharing the asset in the form of a truck and a waste collection system, and agreed through a Memorandum of Understanding (MOU) signed between the dorbars.

vi. The Synjuk Ki Seng Samla Schnongs (SSSS) is currently operating a truck in Nongmynsong area and collects user-charges from each household to sustain operations. A user-charge system for collection and management of waste in these areas is therefore already in vogue and the charges are about Rs.15 per month per household.

4.19 SUGGESTIONS FOR IMPROVEMENT

i. There is the essential need in the areas lying outside the jurisdiction of the Shillong Municipal Board to invest in infrastructure and enable a system of monitoring and coordination of waste collection and transportation.

ii. There is the need to gradually introduce the concept of user-charges to sustain the entire system of solid waste management practices. Community involvement and especially the role of the dorbars are critical in this respect.

4.19.1 PERSONNEL ISSUES

i. There is no rationalization of staff especially in relation to their sanitation and conservancy section. The recommended norms for a city like Shillong even for the existing SMB area for the sanitation and conservancy section should have been as **Table: 4.19** below:

TABLE 4.19: NORMS LAID BY THE SUPREME COURT

	SMB	Size of city		
		0.1 Million	0.2 Million	0.5 Million
Executive Engineer/ Executive Officer	**1**	-	-	1
Asst. Executive Engineer	**-**	-	1	1
Asst. Engineer	**1**	1	1	2
Sanitary officer	**3**	2	4	10
Sanitary Inspector	**3**	2	4	10
Sanitary Sub-Inspector	**5**	4	8	20
Sanitary Supervisor	**5**	8	16	40
Total	**15**	16	32	79

(Source: Report of the Supreme Court on SWM, March 1999)

ii. There is large-scale absenteeism and is proving very difficult for the Board to supervise and control this. The supervisors may have to monitor close to 50 workers in three to four different parts of the city and the supervisors often have no means of transport to closely check attendance and even monitor performance.

4.19.2 COMMUNITY PARTICIPATION

i. Community participation is essential for any SWM practice to succeed. It is observed that there is only limited participation in SWM except in the collection of waste. It is important to sensitize the Dorbars to play a greater role in SWM. This is even more critical in the areas falling outside the purview of the SMB, which is a much larger area for consideration in relation to the project.

ii. There has been no large-scale effort for promotion of successful SWM practices and to elicit support of citizens in segregation and to promote the practice of 3 R's – Reduce, Reuse and Recycle. Hoardings relating to SWM have been observed in the past but are no longer there at present.

4.20 LEGAL ASPECTS

i. In relation to legal aspects, there have been efforts to reduce the use of plastic in both SMB areas and areas falling outside its jurisdiction. These have been directed at banning the use of 20 micron size of plastic packaging and have had a limited success.

ii. There is at present, no appreciable effort made in enforcing or legislating legal provisions to maintain appropriate SWM practices and also to penalize offenders. These legal provisions could have been in the area of storage of waste at source of generation, segregation, provision of community bins in market and commercial areas, littering and even to ensure accountability and responsibility to the urban local body

109. All the above issues have been discussed in details in the following chapters and suggestions along with have been made so as to draw an action plan for providing better and healthy environment to the people living in GSPA, within the prescribed time frame.

4.21. MARKET ABILITY AND INVESTOR STUDY

110. In municipal solid waste management activity plan, studies on the following aspects need to be carried out before or during the implementation of the SWM plan. These studies are important for the success of the SWM plan.

i. Study on market availability for compost and recyclable materials: This study is necessary in order to assess the market for compost prepared at the compost plant for its sustainability. This needs a detailed survey to assess the market for the compost which may require interactions with state government departments, marketers, farmers, private buyers, NGOs and others those who are likely to be benefitted with the organic compost as soil conditioner.

ii. The second aspect that needs a careful study is on the sale and utilization of recyclables. This will no doubt economize the SWM system to great extent, provided a careful study is carried out regarding income generation by way of sell of recyclables as well as reuse of the recycled materials. This may require study from investor angles.

A provision of INR 0.100 million has been made in the cost estimate for such study to be pondered by the State Government or SMB.

5. PROPOSED ACTION PLAN FOR SWM IN GSPA

5.1 APPROACH ADOPTED FOR ACTION PLAN

111. Following approaches have been adopted keeping in view the activities involved in achieving 100% coverage in Solid Waste Management in Shillong Urban Agglomeration Area in line with Solid Waste (Management & Handling) Rules 2000 of Ministry of Environment & Forests, Government of India **(Annexure-I)** and also considering the activities highlighted in the ADB Admemoire for solving solid waste problems outside SUA area and inside GSPA.

Approach adopted for various SWM activities for achieving 100% coverage are discussed, as under;

112. The improvement of SWM services in GSPA requires a carefully planned program incorporating all the major activities including minor details such as collection and segregation of solid waste form all the waste generating sources in GSPA, its transportation and safe disposal, management and the institutions responsible for providing SWM services. Economic viability of all the activities in SWM system play a very important role and in order to have a long term sustainability of the SWM project it is essential to generate adequate revenue from the beneficiaries depending upon their capacity and willingness to pay.

113. Following considerations are made in respect of improving SWM activities within GSPA;

5.1.1 PRIMARY COLLECTION

114. House to House collection and segregation of waste at source,

i. In all 125000 LLDP bins will be provided to 62500 households. Each household will be given 2 nos. of LLDP bins-green for bio-degradable waste and blue for non-biodegradable waste.

ii. A set of 40-45 PVC bags will be given to each household for collection and storage of segregated waste, and its disposal accordingly.

iii. Segregation and collection of wastes from as commercial, institutional, market and other sources,

iv. Wastes which are hazardous in nature mixed with municipal waste stream have to be taken care of with proper precaution while selecting the disposal methods.

5.1.2 SECONDARY COLLECTION

i. Collection of domestic, commercial, institutional and other wastes and transporting to the community movable bins placed at convenient locations.

ii. Collection of Street sweepings, horticulture waste etc. And transferring to the appropriate locations/bins meant for the purpose for onward transportation to the disposal site.

iii. 30 numbers of TATA-ACE trucks with 1.50 cum capacity, as shown in **Figure 5.1,** will be procured and put into operation for collection of domestic, commercial, market and other wastes for transporting the same for unloading to 4.5 cum capacity tipper trucks for onwards transportation to sanitary landfill site at Mawiong.

iv. Transportation of garbage to the landfill site would be around 88 mtpd. This will be in addition to the 50 mtpd transported by SMB. Thus the total waste generated about 138 mtpd will be taken care of as 100% coverage has been proposed in DPR.

v. Waste will be collected from the households, market and commercial places, street sweepings, through mechanized system mounted on a 4-wheeler (Hydraulic system). The waste collected will be taken to transfer points and from transfer points waste will be transferred in higher capacity vehicles and directly taken to treatment and disposal site. The location map of transfer points is shown in **Figure 5.2** and names of the transfer points in SUA area are given in **Table 5.1**

vi. Bio-medical and such wastes from other sources to be collected using special types of waste collecting mechanized systems and disposed of as per the Bio-Medical (Management & Handling) Rules 1998 of Government of India.

5.1.3 TRANSPORTATION

i. Transportation of waste collected from various primary and secondary collection vehicles at strategic locations and transported by proper designed vehicles to the disposal site and unloaded without much of manual handling.

ii. Wastes that need special care have to be transported by suitably designed vehicles to the disposal site fulfilling all the compliance brought out in the Municipal Solid Waste (Management & Handling) Rules, 2000 of Government of India.

iii. Approach adopted for achieving 100% coverage by collection and transportation of 138 mtpd of solid waste generated in SUA from 2011, with incremental coverage of 100% by 2041 in the entire GSPA. This has been elaborately discussed under **Para 5.1.2**.above.

5.1.4 DISPOSAL OF SOLID WASTE

i. Sanitary Landfill has been proposed as the only alternative at present for the safe disposal of solid waste generated in GSPA.

ii. All the precautions have been taken into account while recommending the disposal of solid waste in developed sanitary landfill as per the terms and conditions of the Ministry of Environment & Forests, Government of India have been stipulated in **Annexure-I.**

iii. Proper methodology has been proposed for Leachate treatment so as to abate the pollution of ground water and Umiam Lake.

iv. A detailed approach has been mentioned in the following chapter on '**The Design of Sanitary Landfill'**, covering all the aspects of a safe sanitary landfill in operation for solid waste disposal from GSPA.

5.2 WASTE GENERATION PROJECTIONS

115. The waste generation projections have been done for the SUA area. Average per capita waste generation of 0.45 kg per day has been considered for population within the SUA area. The projected waste generation thus obtained for the GSPA is shown in **Table 4.1.**

FIGURE 5.1: TATA – ACE HT MINI-TRUCK (CAPACITY 1.00 CUM.)

NOTE (From the Manufacturer): Product description – The ACE Dumper Placer is an efficient mechanized method of collection, transportation, and dumping of debris / garbage / refuse and other waste materials. The side loading-unloading prevents the blockage of passer-by traffic. The container has a volume of 1.5 cubic meters.

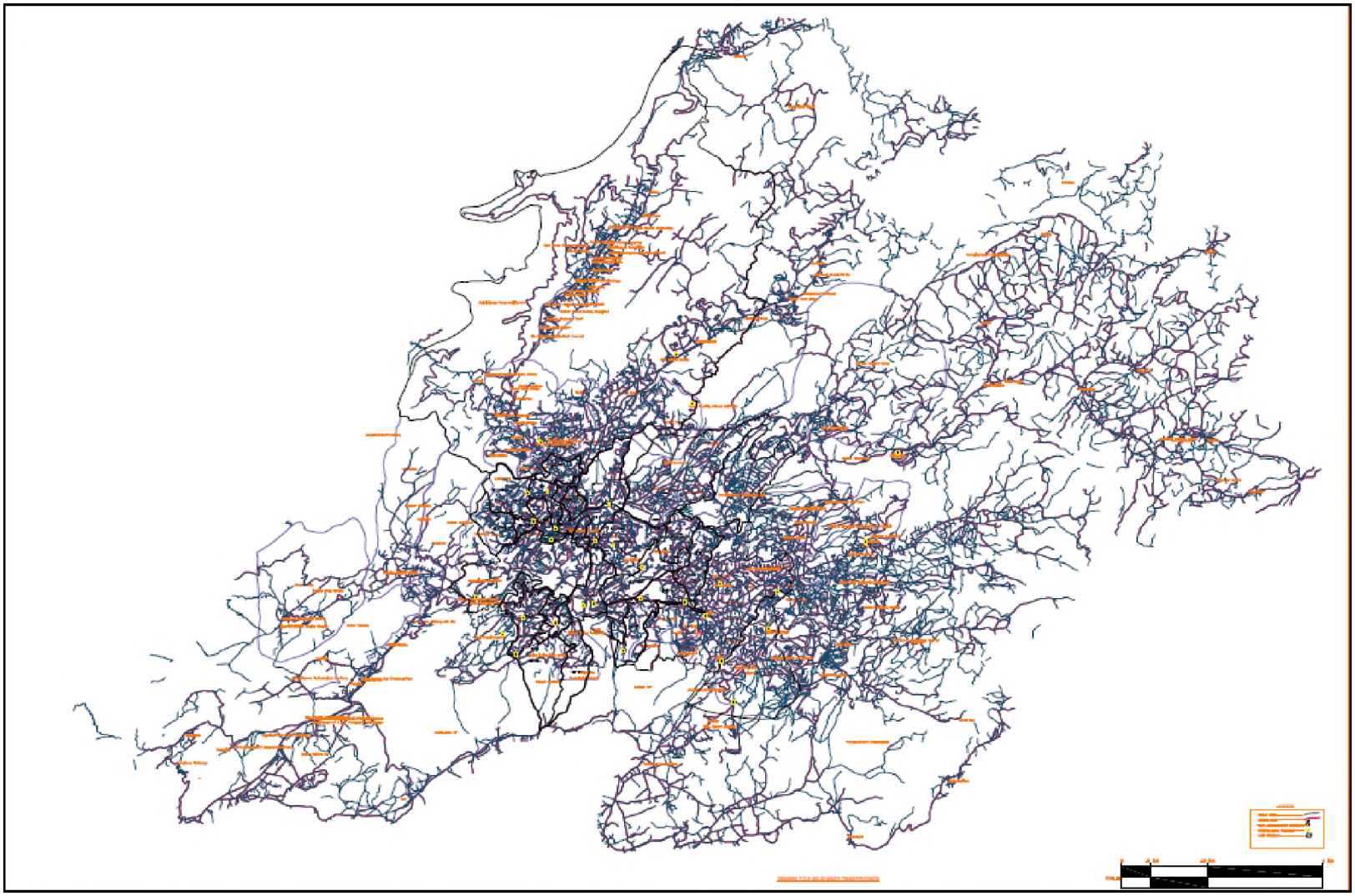


FIGURE 5.2: LOCATIONS OF TRANSFER POINTS IN SUA AREA

TABLE 5.1: LOCATIONS OF TRANSFER POINTS IN SUA AREA

Sl. No	Location of Transfer Points
1.	Near Nongthymmai Play Field
2.	Near Laitumkhrah Market
3.	Near Gora Lane Junction
4.	Near Khliehschnong Junction
5.	Near Polo Tower
6.	Near Fire Sub-Station
7.	Near Parking Lot at Khasi Hill Autonola District Corner
8.	Near Cooperative Society Office
9.	Near the Junction of Upper Lansonalane and Jaiaw Pdeng
10.	Near Motphran Point
11.	Near City Bus Stand
12.	Near St. Mary's College
13.	Near Government Quarters Lower Colony
14.	Opposite Treasury Office
15.	Near M.T.C. Office
16.	Near Ladies Club Parking Lot
17.	Near I.I.M. Shillong
18.	Near N.E.C. Complex
19.	Opposite Step by Step School
20.	Behind Survey of India Office
21.	Near Circuit House
22.	Near Seri-Culture Office
23.	Near Shillong Time's Office
24.	Near Shankar Deb Cultural Center
25.	Near Basket Ball Court
26.	Near M.T.C. Workshop
27.	Near I.T.I.
28.	Near Nonghrah Bus Stop
29.	Near N.E.I.G.R.I.H.M.S.
30.	Near Flying Angle School
31.	Near Police School Training Quarters
32.	Near Umshirpi Bridge
33.	Near N.E.H.U.
34.	Near Anjali Cinema
35.	Near Nongum Bus Stop

(Source: SMEC-India Pvt. Ltd.)

116. Requirement of fleet of ACE - Mini Trucks and Tipper Trucks has been calculated on the basis of Solid Waste to be collected and transported. Calculations for the requirement of transportation vehicles are given in **Annexure-3**. The existing fleet of transportation vehicles with SMB has been considered to the extent serviceable.

6. DESIGN OF SANITARY LANDFILL

6.1 INTRODUCTION

117. The sanitary landfill site is designed to meet the standards of the Municipal Solid Waste (Management & Handling) Rules, 2000 of Ministry of Environment & Forests, Government of India including leachate treatment and collection. The Municipality is also required to improve the existing dumping site as per provisions of the MSWHR, 2000 (Schedule I). The project will make provisions of environmental protection measures and long-term sanitary landfill facilities (about 2.12 hectare) at the present disposal site at Mawiong.

6.2 SELECTION OF LANDFILL SITE

118. Solid Waste Management is managed by three different authorities' viz. (i) The Shillong Municipal Board (SMB) within the municipal area (ii) The Dorbars, outside the municipal area, and (iii) The Defense Authorities, within the cantonment area. The Municipal Solid Waste in Shillong in general is a mixture of bio-medical, residential, commercial and hotel wastes apart from construction debris. The proposed garage and disposal site will be located within the existing landfill site at Municipal Trenching Ground at Marten, Mawiong which has been operational and used for disposal purposes since 1938. The site already includes an operating compost facility.

119. The collected wastes throughout the city are disposed at Mawiong disposal site at a distance of about 8 km from the city. The proposed land fill area is 2.12 hact. The proposed Solid Waste Disposal site and Umiam reservoir is shown in **Figure 6.1.** Plot No-1 is proposed solid waste disposal site, which is the part of Compartment no-4 (It includes Plot No-1, Plot No-2 and Plot-3 of 7.0866 hact. of land) in Forest Department's record and the Possession Certificate for the same has been issued by the Forest Department under Notification letter no FOR 76/99/16 dated 25 February, 2000 (**Annexure-4**). There are no sensitive receptors occurring within 500 m of the site. Umiam Lake is approximately 3.0 km from proposed disposal site.. The existing and proposed solid waste disposal site and existing compost plant of 100 mtpd capacity is the part of Riatkhwan Reserve Forest, which is shown in **Figure 6.2.** The Meghalaya Forests and Environment Department has officially granted permission to use the land for solid waste disposal site purposes **(Annexure-5).**The soil used as base with a thickness of 0.95 m for landfill site will be amended with 10% Bantonite. the soil used for preparing base for landfill is available within 5 km radius of the landfill site at Mawiong as per the Soil Investigation Report at **Annexue-7**

6.2.1 EVALUATION OF LANDFILL FACILITY FOR DISPOSAL OF MUNICIPAL SOLID WASTE

120. **Scope and Applicability:** The exercise for evaluating the most suitable site is to provide policy and procedure to protect community, environment and ecosystem and to assist the appropriate agency in evaluation of new facilities for disposal of municipal solid waste on techno-enviro-economic compatibility in suitable locations. Further, these are oriented primarily to the setting of independent disposal facilities, located away from the source of waste generation.

121. The main purpose of evaluation process is to make the best use of the land resources available. The evaluation of landfill site for disposal of solid waste and disposal facilities requires the synthesis of two distinct selection procedures, viz. a technical screening process based upon economic, engineering and environmental suitability, and public approval process. A general listing of various factors to be considered for evaluation is

presented in **Table 6.1 & 6.2**. The relative importance of these factors depends on the site consideration as well as the chosen method of solid waste disposal.

6.3 CRITERIA FOR CONSIDERATION FOR SANITARY LANDFILL

122. The layout of Sanitary Landfill will be fulfilling all the terms and conditions as stipulate in the above referred Rules of Government of India at **Para 5.1.3**.

123. Following important criteria about Site Selection (Location Criteria) of Landfill site, which have been as per the "Manual on Municipal Solid Waste Management (First Edition), prepared by The Expert Committee, Central Public Health and Environmental Engineering Organisation (CPHEEO) Ministry of Urban Development, Government of India, New Delhi, May, 2000" have been considered. Layout plan of the SWM site is shown in **Figure 6.3**. Phasing of the landfill is shown in **Figure 6.4**.

i. **Lake or Pond:** No landfill should be constructed within 200 m of any lake or pond. Because of concerns regarding runoff of waste water contact, a surface water monitoring program should be established if a landfill is sited less than 200 m from a lake or pond;

ii. **River:** No landfill site should be constructed within 100 m of a navigable river or stream. The distance may be reduced in some instances for non meandering rivers but a minimum of 30 m should be maintained in all cases;

iii. **Flood Plain:** No landfill should be constructed within 100 year flood plain. A land fill may be built within the flood plains of secondary streams if an embankment is built along the stream to avoid flooding of the area. However, landfills must not be built within the flood plains of major rivers unless properly designed protection embankments are constructed around the landfills;

iv. **Highway:** No landfill should be constructed within 200 m of the right of way of any State or National Highway. This restriction is mainly for aesthetic reason. A landfill may be built within the restricted distance, but no closer than 50 m, if trees and berms are used to screen the landfill site;

v. **Habitation:** A landfill site should be at least 500 m from a notified habitat area. A zone of 500 m around landfill site should be declared a No-Development Buffer Zone after the landfill location is finalized;

vi. **Public Parks:** No landfill should be constructed within 300 m of a Public Park.

vii. **Critical Habitat Area:** No landfill should be constructed within Critical Habitat Areas. A critical habitat area is defined as the area in which one or more endangered species live;

viii. **Wetlands**: No landfill should be constructed within Wetlands;

ix. **Ground Water Table:** A landfill should not be constructed in areas where water table is less than 2 m below ground surface. Special design measures be adopted, if this cannot be adhered to;

x. **Airport:** No landfills should be constructed within the limits prescribed by regulatory agencies (MoEF/ CPCB/ Aviation Authority) from time to time;

xi. **Water Supply Well:** No landfill should be constructed within 500 m of any water supply well;

xii. **Coastal Regulation Zone:** A landfill should not be sited in a coastal regulation zone;

xiii. **Unstable Zone:** A landfill should not be located in potentially unstable zones such as landslide prone areas, fault zone etc.; and

xiv. **Buffer Zone:** A landfill should have a buffer zone around it, up to a distance provided by regulatory agencies.

TABLE 6.1 WORKSHEET FOR EVALUATION OF SANITARY LANDFILL SITE

(Name of Site – Sanitary Landfill Site at Mawiong, Shillong)

Sl. No.	Attributes	Attributes Measurements	Sensitivity Index	Weightage	Attribute Score
Accessibility Related					
1.	Type of road	National Highway	0.1	25	2.5
2.	Distance from collection point	15 km	0.5	35	17.5
Total				**60**	**20**
Receptor Related					
3.	Population within 500 meters	None	0.0	50	0.0
4.	Distance to nearest drinking water source	4000 meters	0.4	55	22
5.	Use of site by nearby residence	Not used	0.0	25	0.0
6.	Distance to nearest building	4000 meters	0.0	15	0.0
7.	Land use/zoning	Completely remote	0.0	35	0.0
8.	Decrease in property value with respect to distance	No decrease in property value	0.0	15	0.0
9.	Public utility facility within 2 kilometers	No public utility	0.0	25	0.0
10.	Public acceptability	No complaints	0.0	30	0.0
Total				**250**	**22**
Environmental Related					
11.	Critical environment	Not a critical environment	0.1	45	4.5
12.	Distance to nearest surface water	500 meters	0.75	55	41.25
13.	Depth to ground water	50 meters	0.0	65	0.0
14.	Contamination	Nil	0.0	35	0.0
15.	Water supply	Nil	0.0	40	0.0
16.	Air quality	Not polluted	0.0	33	0.0
17.	Soil quality	Average	0.5	30	15.0
Total				**305**	**60.75**
Socio-economic Related					
18.	Health	No problems	0.15	40	6.0
19.	Job opportunities	Very low	0.1	20	2.0
20.	Odor	Moderate	0.1	30	3.0
21.	Vision	Not visible	0.0	20	0.0
Total				**110**	**11.0**

Waste Management Practice Related					
22.	Waste quantity - TPD	36.5 TPD	0.3	45	13.5
23.	Site area that can serve	≥ 15 yrs	0.35	40	14.0
Total				**85**	**27.5**

Sl. No.	Attributes	Attributes measurements	Sensitivity index	Weightage	Attribute score
Climatologically Related					
24.	Precipitation effectiveness index*	31 to 63	0.25	25	6.25
25.	Climatic features contributing to Air pollution	No problem	0.0	15	0.0
Total				**40**	**6.25**
Geological Related					
26.	Soil permeability	$1x10^{-4}$ to$1x10^{-5}$	0.5	35	17.5
27.	Depth of bed rock	20 to 40 m	0.4	20	8.0
28.	Susceptibility to erosion & run-off	Moderate	0.5	15	7.5
29.	Physical characteristics of rocks	Weathered	0.5	15	7.5
30.	Depth of soil layer	3-5 m	0.75	30	22.5
31.	Slope pattern	5%	0.3	15	4.5
32.	Seismicity	Zone V	0.8	20	16.0
Total				**150**	**83.5**
Grand Total				**1000**	**231.00**

***Precipitation effectiveness index is the ratio of annual precipitation to annual evaporation**

TABLE 6.2 EVALUATION OF SANITARY LANDFILL SITE AT MAWIONG, SHILLONG

Sl. No.	Attribute category	Maximum Weightage	Attribute score
1.	Receptor related	250	22.00
2.	Environmental related	305	60.75
3.	Accessibility related	60	20.00
4.	Socio-economic related	110	11.00
5.	Waste management practice related	85	27.50
6.	Climatological related	40	6.25
7.	Geological related	150	83.5
Total		1000	231.00

(Source: Guidelines for the Selection of Site for Landfill. Central Pollution Control Board, Ministry of Environment & Forests, Government of India, February 2003)

Concluding Remarks:- Based on the above evaluation it is observed that the attribute score is well below 300, therefore, the sanitary landfill site at Mawiong, Shillong is less sensitive to the impact on environment and is the most preferable and suitable site for the sanitary landfill.

6.2.2 Regulatory Approval

124. The site should be in accordance with the specifications prescribed in the Schedule III of Municipal Solid Waste (Management & Handling) Rules, 2000 and require approval from regulatory agency for all facilities related to disposal of municipal solid waste.

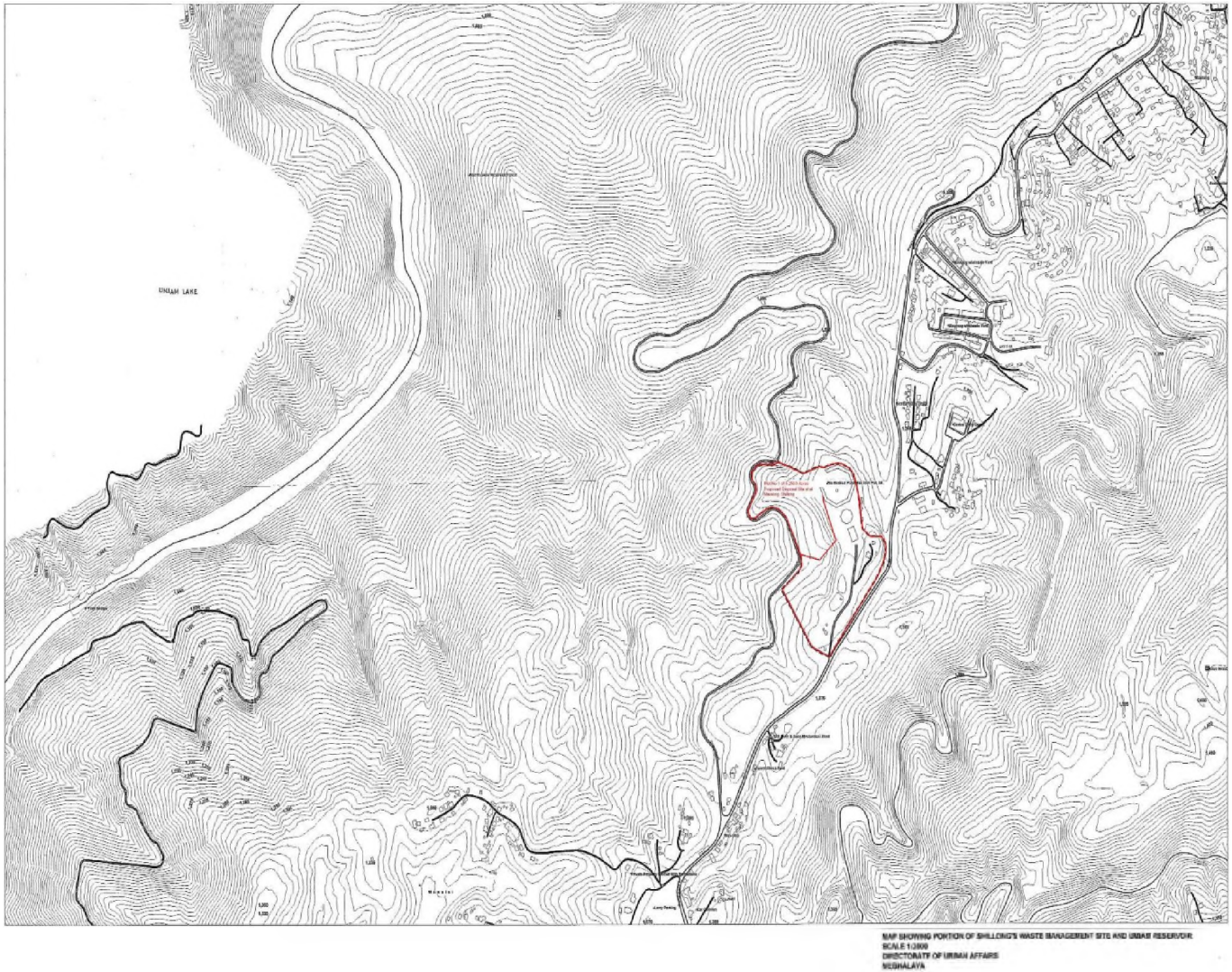
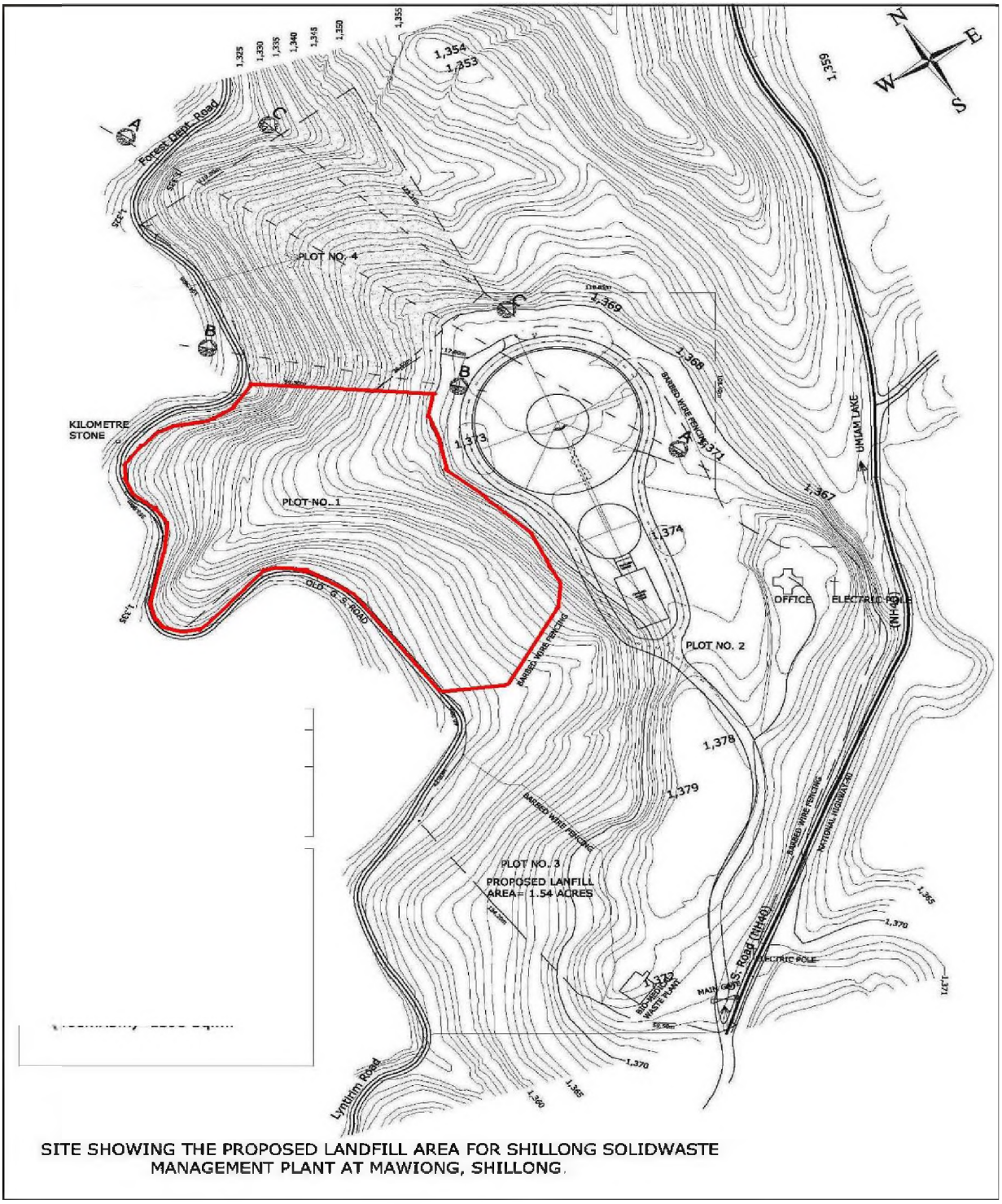


FIGURE 6.1: SHOWING LOCATIONS OF LANDFILL SITE AND UMIUM LAKE



SITE SHOWING THE PROPOSED LANDFILL AREA FOR SHILLONG SOLIDWASTE MANAGEMENT PLANT AT MAWIONG, SHILLONG.

FIGURE 6.2: SHOWING SITE OF LANDFILL AND EXISTING COMPOST PLANT

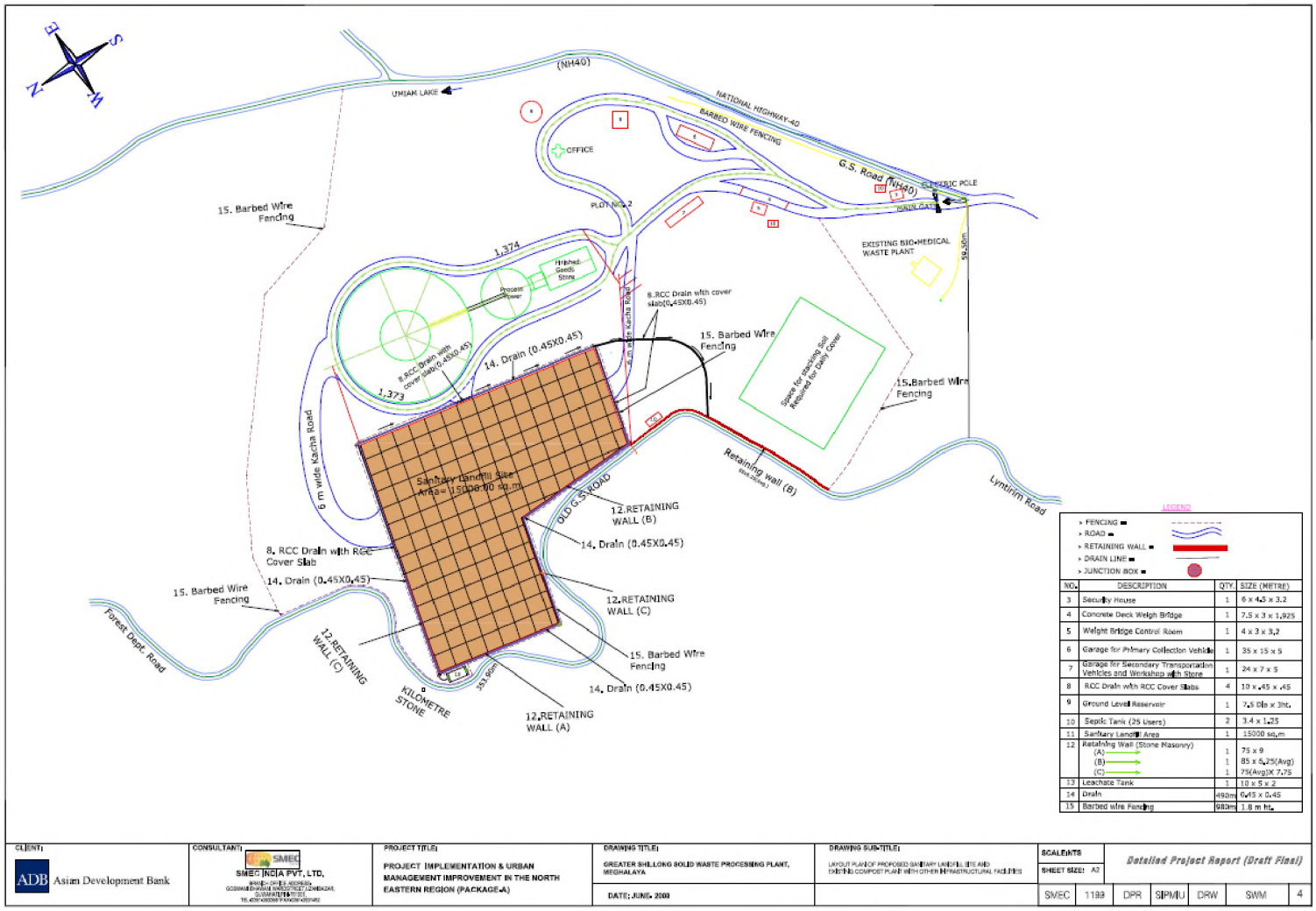


FIGURE 6.3: LAYOUT PLAN OF LANDFILL SITE AT MAWIONG, SHILLONG

6.4 ESTIMATION OF CAPACITY, HEIGHT, AND AREA OF SANITARY LANDFILL AT MAWIONG, SHILLONG

125. Following methodology has been adopted to determine the capacity, height, and area of the sanitary landfill site at Mawiong, Shillong. This exercise is mainly to assess the life of the landfill site depending upon the quality and quantity of solid waste generated in the project area. The method adopted for this exercise has been referred from the Manual on Municipal Solid Waste Management (CPHEEO) Ministry of Urban Development, Govt. of India.

126. Following methodology has been adopted to determine the capacity, height, and area of the sanitary landfill site at Mawiong, Shillong. This exercise is mainly to assess the life of the landfill site depending upon the quality and quantity of solid waste generated in the project area. The method adopted for this exercise has been referred from the Manual on Municipal Solid Waste Management (CPHEEO) Ministry of Urban Development, Govt. of India.

127. Following steps have been adopted in determining the parameters of landfill.

1. Present Waste Generation per Year = W (tons per yr.)

   Daily expected disposal of waste = 120 TPD
   Assuming 85% collection of total
   Generation of waste of 138 TPD
   Compostable (42%) = 50.4 TPD – (A)
   Inert (28%) = 33.8 TPD – (B)
   Recyclable (30%) = 36.0 TPD – (C)
   Rejects from compost plant (30%) = 15.12 TPD – (D)
   Now, disposal at L.F Site = (B) + (D) = 48.92 TPD
   ∴ W = 365 x 48.92 = 17,855.8 TP Yr
   or say = 17,856 TP Yr.

2. Estimated rate of increase/ decrease of
   waste generation per year = X (percent)
   (Based on Growth of population as per current data) = 1.25%
   Say = 10% in 8 years)

3. Proposed L.F Life (in years) = n = 8 years

4. Waste generation after n years = $W\left(1+\frac{X}{100}\right)^{n}$ Tons

5. Total Waste generation in n = 8 years (T) in tons

   $T = ½ \{ W + W(1 + X/100)^{n} \} * n$ (in Tons)
   $= ½ \{ 17,856 + 17,856(1 + 0.0125)^{8} \}* n$ (in Tons)
   $= ½ \{ 17,856 + 19,713 \} n$
   = 1,50,276 (Tons)

   ∴ T = 1,50,276 Tons

6. Total volume of waste in n years (Vw)
   (On assumption of 0.85 tons/cum density of waste)

Vw = T/0.85 cum
Vw = 150276/ 0.85 = 1,76,795 Cum
Vw = 1,76,795 Cum

7. Total volume of daily cover in n years (Vdc)
(on the basis of 15 cm soil cover on the top and sides of lift of ht 1.5 to 2 m)

Vdc = 0.1 Vw (Cum)
= 0.1 x 1,76,795
= 17679.5
Or say Vdc = 17680 Cum

8. Total volume required for components of liner system and cover system (on the assumption of 1.5 m thick liner system (i/c leachate collection layer) and 0.1 m thick cover (i/c gas collection layer)

Vc = K Vw (Cum) = 0.20 x 1,76,795 (in Cum)
Vc = 35,359 cum
Or say = 35,360 cum
(K = 0.20 for 10m high landfill)

9. Volume likely to become available within 8 years one to settlement/ biodegradation of waste

Vs = mVw (in Cum)
m considered to be 0.1. for biodegradable waste & 0.05 for inert,
assuming 0.08 for the combined waste .
Vs = 0.08 x 176795 cu m = 14,143.6
or Say 14,144 Cu m

10. First estimate of landfill capacity (C_i)

C_i = Vw + Vde + Vc – Vs (in Cum)
= (176795 + 17680 +35360) – 14144 (in Cum)
= 2.15,691 or Say 2,15,700

11. Phasing Plan of landfill is shown in Volume II of DPR

12. Likely shape estimate of landfill height & area

Area available for L.F Site = 15,000 Sq m
(Net area after leaving area for infrastructural facilities)
A_i = 15,000 sq m
Expected height of landfill considering 15,000 sq m L.F. Area

$$H_i = \frac{C_i}{A_i} \text{ (in m)}$$

= 2,15,700/ 15,000
= 14.38 or say 14.00 m

128. As such, based on the above calculation, the landfill area under consideration may last up to 8 years as the expected height of the waste at landfill site after its closure will be within the range of 10 to 20 m as recommended in the Manual on 'Municipal Solid Waste Management' published by the Ministry of Urban Development, Government of India, 2000. Normally the landfill site is designed for a period of 20 – 25 years. In view of the land

constraint the land fill site is designed for a maximum period of 8 years. This is designed as a temporary measure to ensure that the waste is treated and disposed off in accordance with the rules "Municipal Solid Waste Management (CPHEEO) Ministry of Urban Development, Govt. of India 2000". The state government is making efforts to locate a suitable plot of land for having land fill site for a period of 25 to 30 years.

129. The process of remediation could also help in increasing the life of present landfill site. Since the present landfill site is being used for quite a long period (as per record since 1938), the solid waste accumulated for such a long time must have been fully decomposed. This decomposed waste could be utilized as raw material for the existing compost plant to convert it into organic compost. This process will serve dual purposes as:

(i) Already decomposed material available for composting reduces time for decomposition by using windrows for a long period; and secondly

(ii) Space / volume thus excavated could be further utilized for sanitary landfill for incoming fresh waste.

130. This process of remediation will increase the life of sanitary landfill further may be for a period of about or more than 10 years. Thus the efforts of the State Government for searching an alternative site for landfill for a longer period could be deferred. Finding a suitable additional site for landfill is a major problem before the State Government.

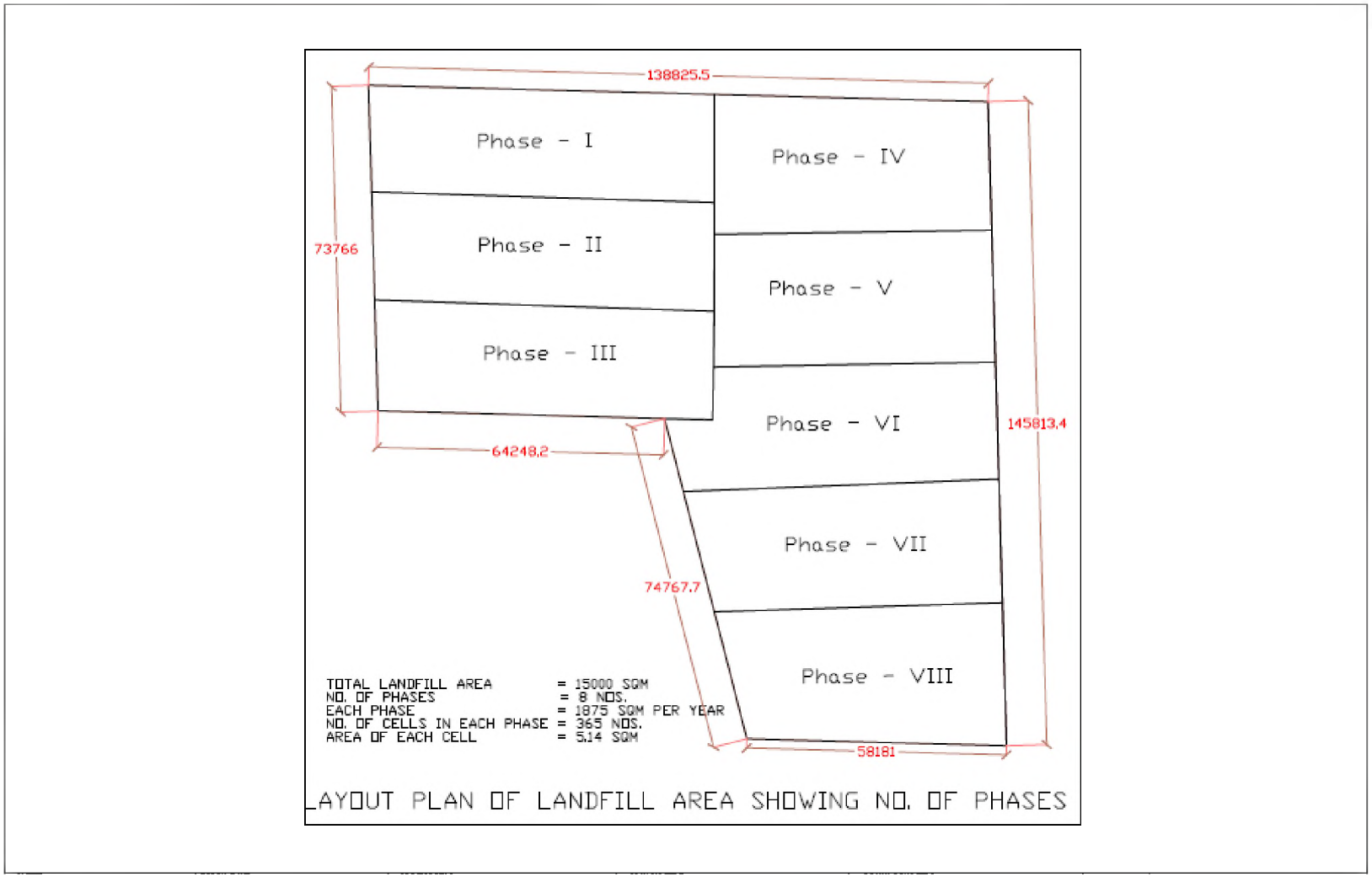


FIGURE 6.4: LAYOUT PLAN OF LANDFILL AREA SHOWING NO. OF PHASES

6.5 DESIGN IMPACTS:

(i) The dumping of garbage causes side slippage during heavy rainfall. Appropriate slope protection measures such as provision of retaining walls with weep holes, storm water drainage channels have been incorporated into the design of sanitary landfill by constructing retaining walls and others protective measures..

(ii) There is the risk of runoff from the uphill areas contaminating the water bodies in the downhill areas. Provision of drainage interceptors (impermeable lining and collection pipes) to capture the runoff and redirect into the leachate tank have been provided.

(iii) The proposed landfill site at Mawiong is located in a densely vegetated area. The layouts of the landfill site by providing terracing minimize adverse impact on environment and the same system has been designed and proposed.

(iv) Remediation of landfill site is suggested so as to use the decomposed material for composting. This process is going to serve dual purpose e.g. reducing the burden on compost plant which can work fully on its designed capacity, and secondly creating space in existing landfill site for accommodating more fresh waste.

6.6 ENVIRONMENTAL IMPACTS AND MITIGATION: CONSTRUCTION

131. There will therefore be quite large physical changes at the site as a result of the excavation and other earthworks, and this relatively large quantity of waste could not be dumped without causing further adverse physical impacts (on air quality (dust), topography, soil quality, etc) at the disposal site. The Geo Technical report on SWM site is at **Annexure 6** and Geological Investigation report for landfill site is given at **Annexure 7**. It will be important therefore to take steps to reduce the amount of dumping by finding beneficial uses for as much of the waste material as possible. The civil works contractor (appointed to carry out the construction work) should be required to:

(i) Re-use as much excavated material in the project as possible (for example in creating the bunds or for landfill cover as outlined above);

(ii) Retain suitable soil in stockpiles for use when the landfill is operating, to cover waste periodically and for the final covering when each cell is full.

132. Most excavation is likely to be conducted in the dry season to avoid the difficult conditions that can occur when earthworks are carried out during rain. There will therefore be a risk of producing dust. Although this is a rural location where there is no inhabitation nearby, precautions will nevertheless be needed to reduce dust to provide a suitable and safe environment for workers. Contractors should therefore be required to:

(i) Cover or damp down working areas and stockpiled soil in dry, windy weather;

(ii) Use tarpaulins to cover loose material during transportation to and from the site.

133. Another physical impact associated with large-scale excavation is the effect on drainage and the local water table if groundwater and/or surface water collect in the cavities as they are dug. Conducting the work in the dry season will reduce these impacts, but as the area surrounding the site contains downhill surface waters careful design and engineering will be required to protect these waters from leachate. The other construction work at the landfill site (e.g., applying impermeable sheeting, installing pipes, etc.) will all have physical impacts but these will be small compared to those of the landfill excavation, and will thus be of little significance.

134. There are no protected areas in the vicinity of this site (the closest sensitive area is Umiam Lake which is sufficiently away about 3 km) and no special ecological interest, because natural habitat of the site was destroyed many years ago (1938) when the area was cleared for waste disposal purposes. Any surface waters located downhill of the proposed site will be carefully considered for their protection detailed design and engineering stage. Construction should therefore have no major ecological impacts. To ensure further environmental protections of surrounding area the contractor should be required to ensure that:

(i) No toxic materials (fuel, oil, cement, etc) are stored at or near the site;

(ii) The contractor's Method Statement (submitted with the tender) includes adequate safety measures to prevent fuel and other spills as a result of accidents.

FIGURE 6.5: SCHEMATIC DIAGRAM OF LEACHATE CONTROL MECHANISM AT SANITARY LANDFILL

135. The other aspect of the work that may have economic implications is the transportation of waste material to a disposal site and to locations where it can be put to beneficial use as recommended above. This will require a large number of truck movements, which could disrupt traffic, particularly if such vehicles were to enter the town. This activity will be implemented by the contractor in liaison with Shillong Municipality, and the following precautions should be adopted to reduce effects on traffic.

(i) Plan transportation routes carefully to prevent heavy vehicles entering town; and ensure that if this cannot be avoided, vehicles use main roads only, and do not use narrow local roads, except in the immediate vicinity of delivery sites;

(ii) Schedule transportation activities to avoid peak traffic periods.

136. Construction activities inevitably produce noise and dust, and these plus the visual appearance of the site and restrictions in access caused by excavation and the presence of vehicles and machinery, are generally the factors that disturb people who live or work in the vicinity. These should however not be major problems in this case as the facilities are all located in rural areas outside the town, and there are no people living nearby as shown in Schematic Diagram **Figure 6.5.**

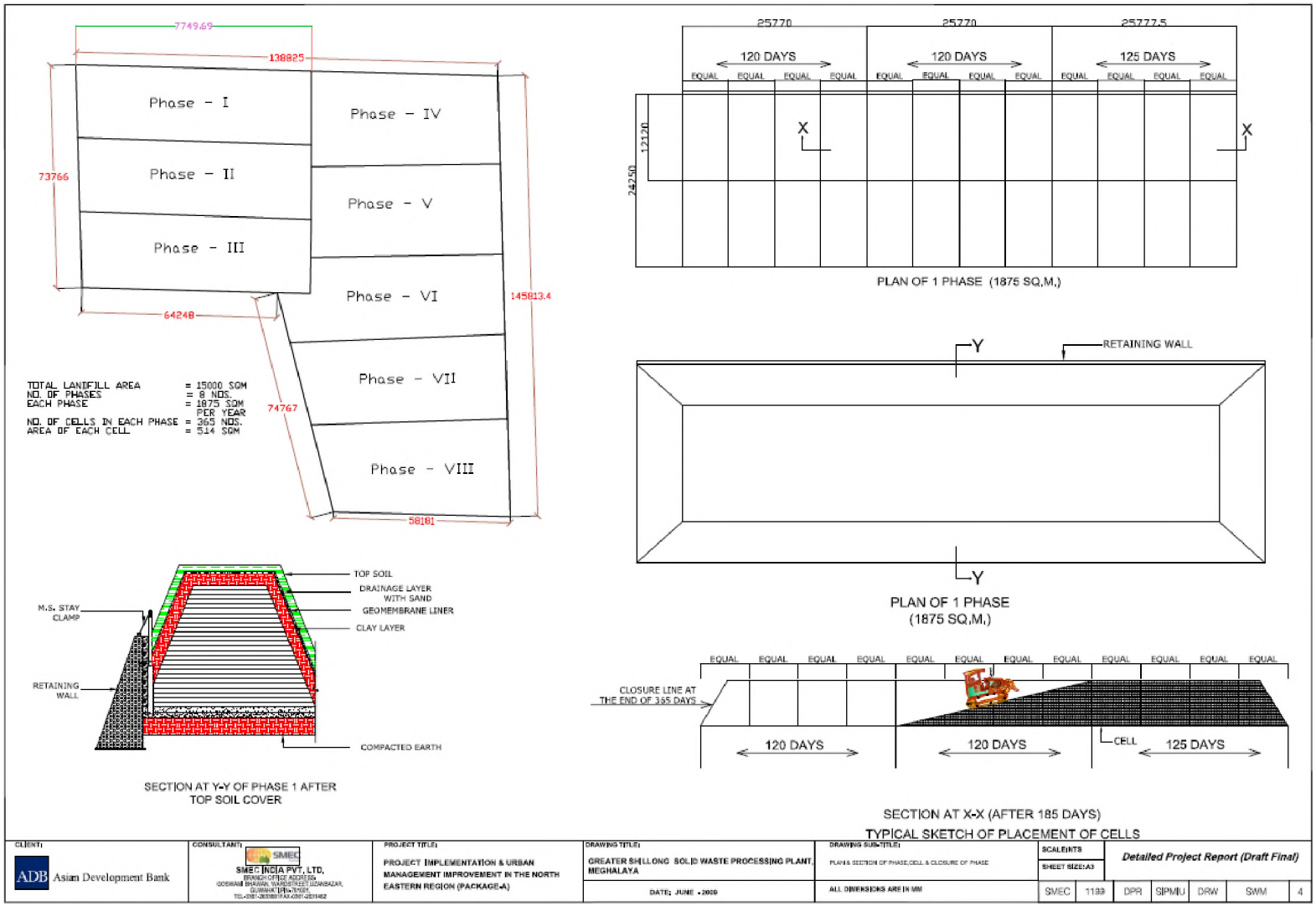


FIGURE 6.6: CELL DRAWING

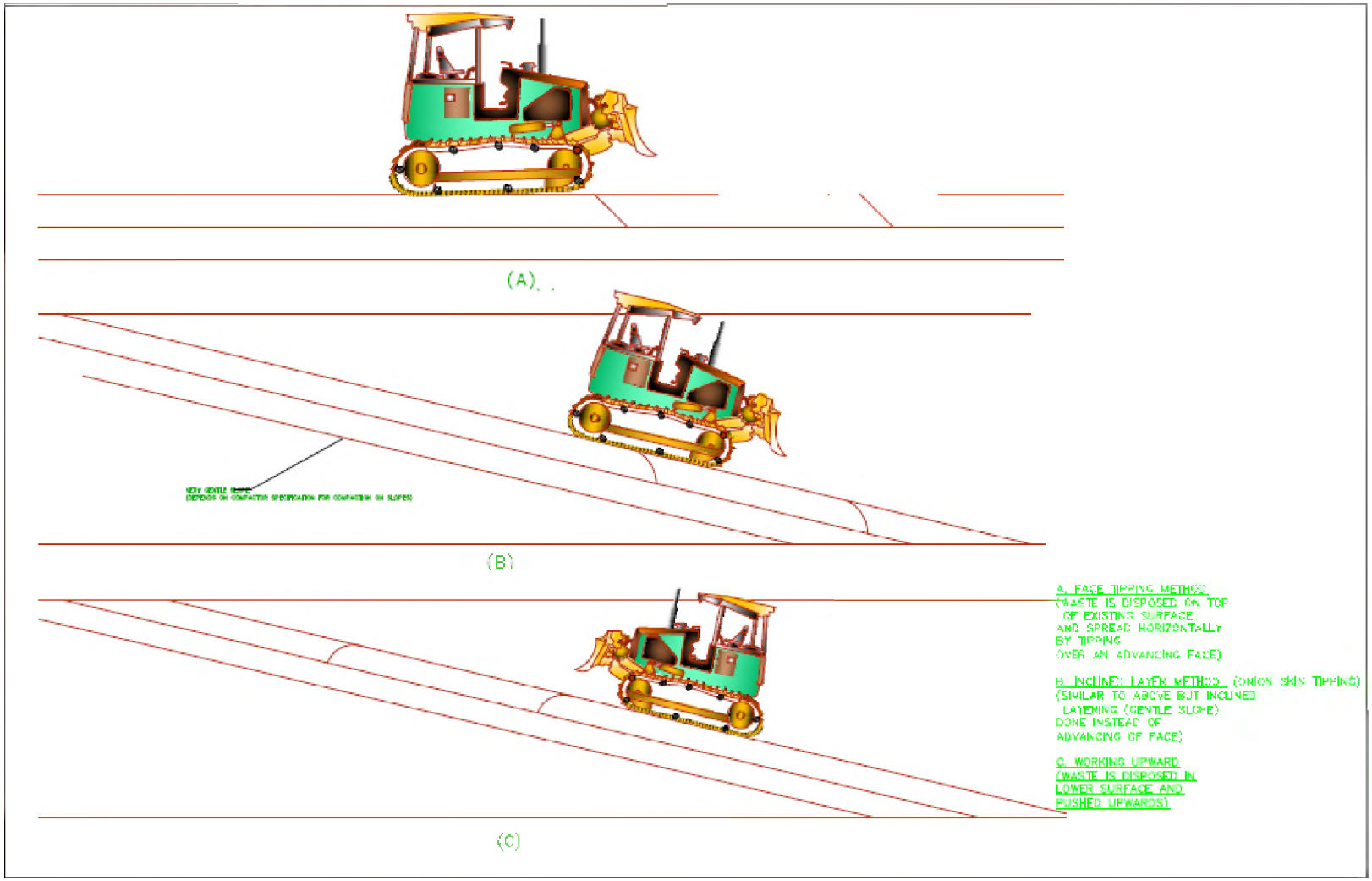


FIGURE 6.7: TYPICAL DRAWING – WASTE PLACEMENT AT LANDFILL SITE

137. The health and safety of workers will be protected by measures included in a Health and Safety Plan, Exclusion of the public from all sites;

(i) Provision and use of appropriate Personal Protective Equipment (PPE) by all workers;

(ii) Health and Safety Training for all site personnel;

(iii) Documented procedures to be followed for all site activities;

(iv) Accident reports and records;

138. Construction work can provide short-term socio-economic gains for local communities if contractors employ local people in the workforce. To ensure that these benefits are directed to communities that are most affected by the work, contractors should be encouraged to employ at least 50% of their workforce from communities in the vicinity of construction sites. This will help to mitigate the impacts of any disturbance as well as creating a positive impression of the project. Building a workforce from mainly local people will also avoid problems that can occur if workers are imported, including social difficulties in the host community and issues of health and sanitation in poorly serviced temporary accommodation camps.

6.7 CONSTRUCTION IMPACTS:

(i) Construction activities associated with sanitary landfill site (at Mawiong) will result in increase in daytime noise levels. Impacts to be mitigated through procurement of equipments / vehicles with inbuilt mechanism to arrest high noise levels. Construction during the night time to be strictly avoided.

(ii) Leveling, compaction and construction of the landfill site will result in generation of fugitive dust, which needs to be suppressed with regular water sprinkling.

(iii) Health impact on construction workers associated with dust and noise generation. Workers to be provided with appropriate PPEs

6.8 ENVIRONMENTAL IMPACTS AND MITIGATION: O&M

139. Shillong Municipality will be responsible for operating the waste management facilities and will be given further support by the project in the form of staff training and financial assistance. All solid waste management activity is required to comply with the GoI Municipal Solid Waste Handling Rules, 2000. Waste for landfill will be moved into position by bulldozer, and will be compacted when the vehicles move over the surface. When a cell is full, vertical gas venting pipes will be installed and the waste will be covered with compacted clay, sand and layer of topsoil, to seal the cell and control odor and pests.

140. If the composting plant is to be successful, Shillong Municipality will need to ensure that residents separate out their biodegradable waste at source, and that the segregation is maintained during secondary transfer and transportation. It is also proposed in the project for segregation of garbage at landfill site. Community awareness program to educate community about facilities provided and the importance of waste segregation needs to be taken up by SMB with the help of NGOs and other agencies. Adequate funds in the IEE estimate have been provided for the purpose.

6.9 DEVELOPMENT OF DAILY CELL (PHASE DEVELOPMENT)

141. Development of each cell (phase) is done in stages. These stages are:

(i) Cleaning the area of all shrubs and vegetation,
(ii) Excavation (if required),
(iii) Stockpiling of excavated material and material imported from borrow area,
(iv) Leveling of base and side slopes of landfill and achieving desirable grades at the base of the landfill,
(v) Construction of embankment and temporary terms along the perimeter of the cell,
(vi) Construction of temporary surface water drains,
(vii) Installation of monitoring instruments,
(viii) Liner construction,
(ix) Leachate collection and removal system.

6.9.1 PHASE OPERATION

142. At the design stage the phases (cells) of the landfill are clearly demarcated. Operation of phase planning and execution of daily activities – daily waste filling plan and demarcation, waste discharge and inspection, waste placement, waste compaction, daily covering of waste, prevention of pollution and fire.

6.9.1.1 DAILY WASTE FILLING PLAN AND DEMARCATION AT SITE

143. On the completion of a phase and before the start of a new phase, a waste filling plan for daily cell must be evolved. A study of the landfill base contour map and final cover levels of the phase allows such a plan to be developed. If the phase is to be operational for 365 days, all 365 cells must be marked in the plan and in drawings. These may require revision as a landfill is constructed because waste quantities may vary in an unforeseen manner. The area and height proposed to be filled every day should be demarcated at the site on a daily or weekly basis using temporary markers or bunds. Plan and section of sanitary land fill is shown in **Figure 6.6.**

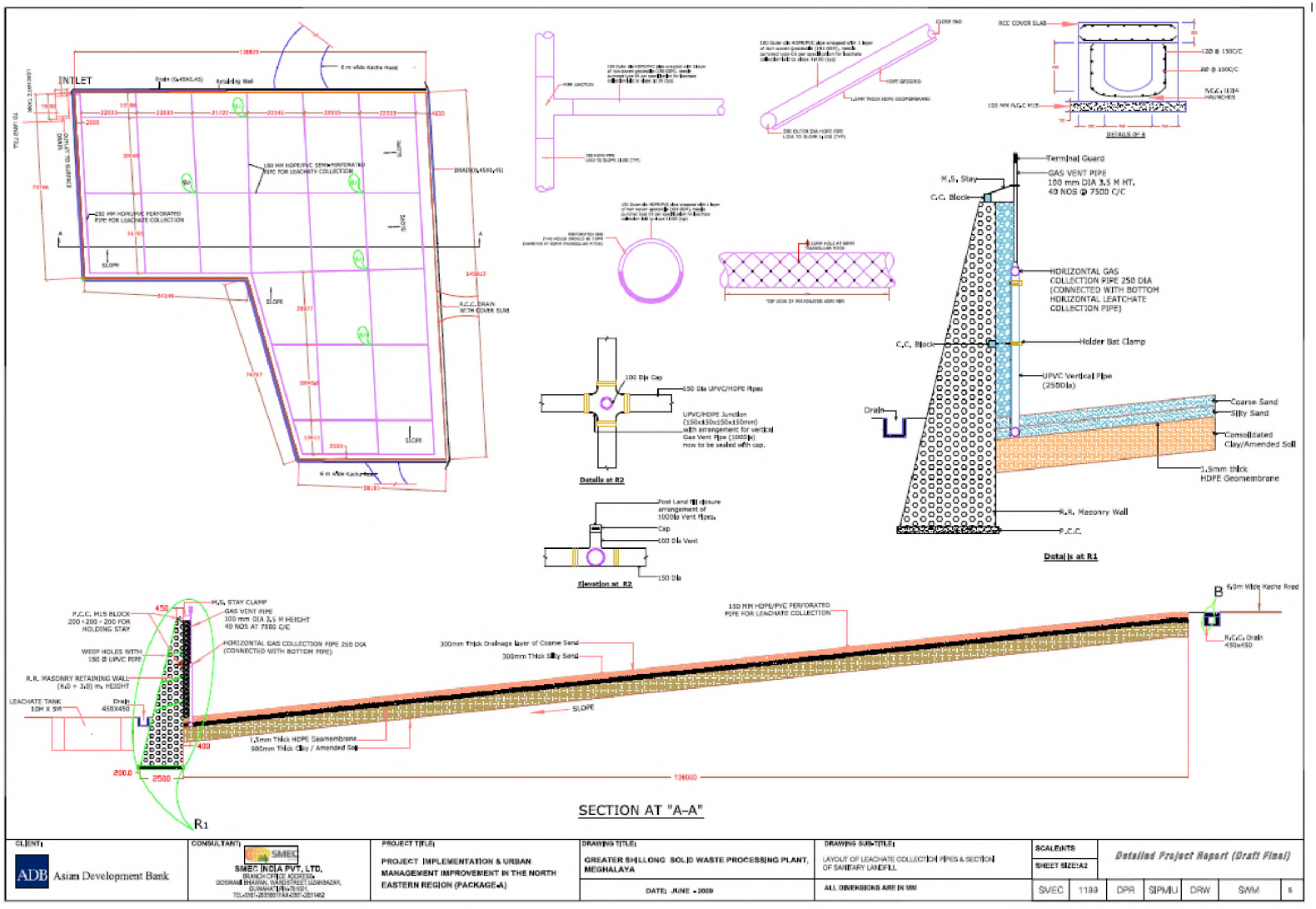


FIGURE.6.8: LAYOUT OF LEACHATE COLLECTION & SECTION OF SANITARY LANDFILL

6.9.1.2 WASTE PLACEMENT (SPREADING)

144. Waste must be discharged by tipping at the working area of the landfill, within the area demarcated for the cell. Every discharge of the waste should be carefully examined so as the waste coming to the landfill site is in conformity to the prescribed standard in MSWMH-Rules, 2000 of Government of India. Once the waste has been discharged it must be sprayed in layers and compacted in well defined manner to ensure that the completed slopes of a daily cell are at the designed gradients. A typical drawing showing waste placement at landfill site is shown in **Figure 6.7.**

145. Waste placement (spreading) can be done by the following methods;

i. Face tipping method: Waste is deposited on the top of the existing surface and spread horizontally by tipping over an advancing phase.

ii. Inclined layering method (onion skin tipping): Similar to (i) but inclined layering (gentle slope) done instead of advancing of face.

iii. Working upwards: Waste is deposited on the lower surface and pushed upwards. Operational guidelines of the land fill are given in the **Annexure 3**

146. Clearly it is imperative that Shillong Municipality maintains both the transfer points and the landfill in proper working order, because if the system begins to fall into disrepair then waste will rapidly accumulate in the open space and the sanitary landfill will become an insanitary dumpsite, with consequent adverse impacts on environmental health. Capacity building, public education campaigns and other support provided by this subproject are aimed at promoting the long-term successful operation of the system.

147. If waste is collected regularly from the transfer points and full or partially full bins are not left in or around the facility for extended periods then there should be no direct physical impacts during operation. Even air quality should not deteriorate greatly if bins are taken care of regularly by collecting waste by collection vehicles and taken to transfer points regularly.

i. Staffs at the transfer points collect any spilled waste immediately and clean the area around transfer points regularly.

ii. Personnel engaged in collection and transportation of waste need to be fully trained before they begin work at the transfer points, refresher training be imparted annually;

iii. The transfer points should include adequate drainage that is connected to the municipal drainage system.

148. The greatest physical impacts will occur at the landfill, where decomposing waste will rise to higher heights ground level, which will alter the topography and appearance of the site. Although these impacts would be significant at certain locations that should not be the case here as there are no habitations in the immediate vicinity whose views of that landscape would be impeded. However, the landfill design includes effective screening by the planting of densely-leaved trees at the perimeter of the site as shown in **Figure 6.8**.

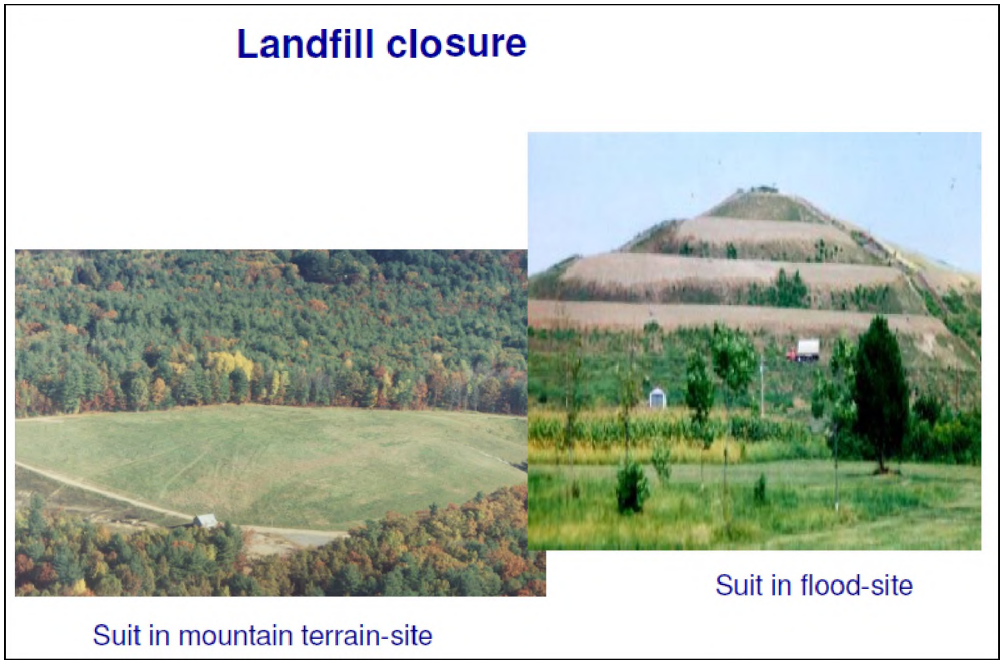


FIGURE 6.9: LANDFILL CLOSURE

149. The landfill design includes measures to collect leachate and prevent pollution of surface- and ground- water. Leachate will be treated by simple sedimentation and filtration, and sludge that collects in the bottom of influent chamber will be re-circulated to the landfill as shown in **Figure 6.9**. Detailed design of Leachate Treatment System is given as under and the drawing of the Leachate Tank is given in **Table 6.1**. Surface storm water drains around landfill site and leachate treatment tank should be provided for adequate drainage of rain water.

150.

6.9 CALCULATION OF LEACHATE FLOW AND DESIGN OF LEACHATE TANK FOR PROPOSED SANITARY LANDFILL SITE AT MAWIONG, SHILLONG

TABLE 6.3 CALCULATION OF LEACHATE FLOW AT LANDFILL SITE AT MAWIONG, SHILLONG

Sl.No.	Parameters	Qty	Unit
1	Formula adopted for Leachate calculation		
	Q = 1/t x P x A x K		
	Where :		
	Q = Mean flow of leachate (litres per sec.)		
	P = Mean annual precipitation (mm per sec.)		
	A= Surface area if landfill (sq m)		
	T= No. of seconds in year (31536000)		
	Considerations:		
	K= Coefficient, that depends on the degree of compaction of waste. The recommended values of which are the following :		
	(i) For weakly compacted landfills with a specific gravity of 0.4 to 0.7 t/m3, the estimated production of leachate is between 25 to 50% (K = 0.25 to 0.50) of the mean annual precipitation for the landfill area. (ii) For strongly compacted landfills with a specific gravity of > 0.7 t/m3, the estimated production of leachate is between 15 to 25% (K = 0.15 to 0.25) of the mean annual precipitation for the landfill area		
2	Values assumed for calculations:		
	Q = Mean flow of leachate		ltrs per sec.
	P = Mean annual precipitation	2100	MM per year
	A= Surface area of landfill	15000	Sq m
	T= No. of seconds in year (31536000)	31536000	Seconds
	K= Coefficient assumed from (i) above	0.04	
3	**Therefore, the quantity of leachate generated**	40	Cu m per day
	Q = 2100 x 15000 x 0.4 / 31536000 = 0.399 lit per sec		
4	**Calculation for the size of the leachate tank**		
	Assuming a cross section area of 10 sq m, having:		
	Width = 5 m and depth = 2 m		
	Therefore, the length of the leachate required will be =		
	40 m^3 / 10 m^2 = 4 m,		

Sl.No.	Parameters	Qty	Unit
	Assuming the length of the leachate tank 2.5 times the length calculated (4 x 2.5 = 10 m) for including the inlet and outlet chambers and also for secondary filtration unit).		
	Therefore, the size of the leachate tank will be as;		
	Length = 10 m		
	Width = 5 m, and		
	Depth = 2 m		
5	**The leachate tank will have four compartments as mentioned below;**		
	(i) Inlet chamber having size, L = 1m, W = 5m & D = 2 m		
	(ii)Primary filter having size, L = 6.5m, W = 5m & D = 2m		
	(iii)Secondary filter having size, L=3.5m, W=5m, & D=2m		
	(iv)Out chamber having size, L = 1m, W = 5m & D = 2m		
6	**Other considerations;**		
	Holding tank for evaporation of leachate has not been suggested due to colder climate of Shillong.		
	Following methodologies suggested for leachate tank operation;		
	(i) Leachate sludge accumulated in inlet and outlet chambers may be disposed on the landfill.		
	(ii) Filtered leachate from the outlet chamber may be used for recirculation on landfill for better compaction and enhance decomposition of waste in landfill.		
	(iii) Filtered leachate (effluent) fulfilling the required standards as per MSWMH-Rules, 2000 of Government of India, may be either disposed of on land or water bodies or into sanitary sewers as the case may be.		

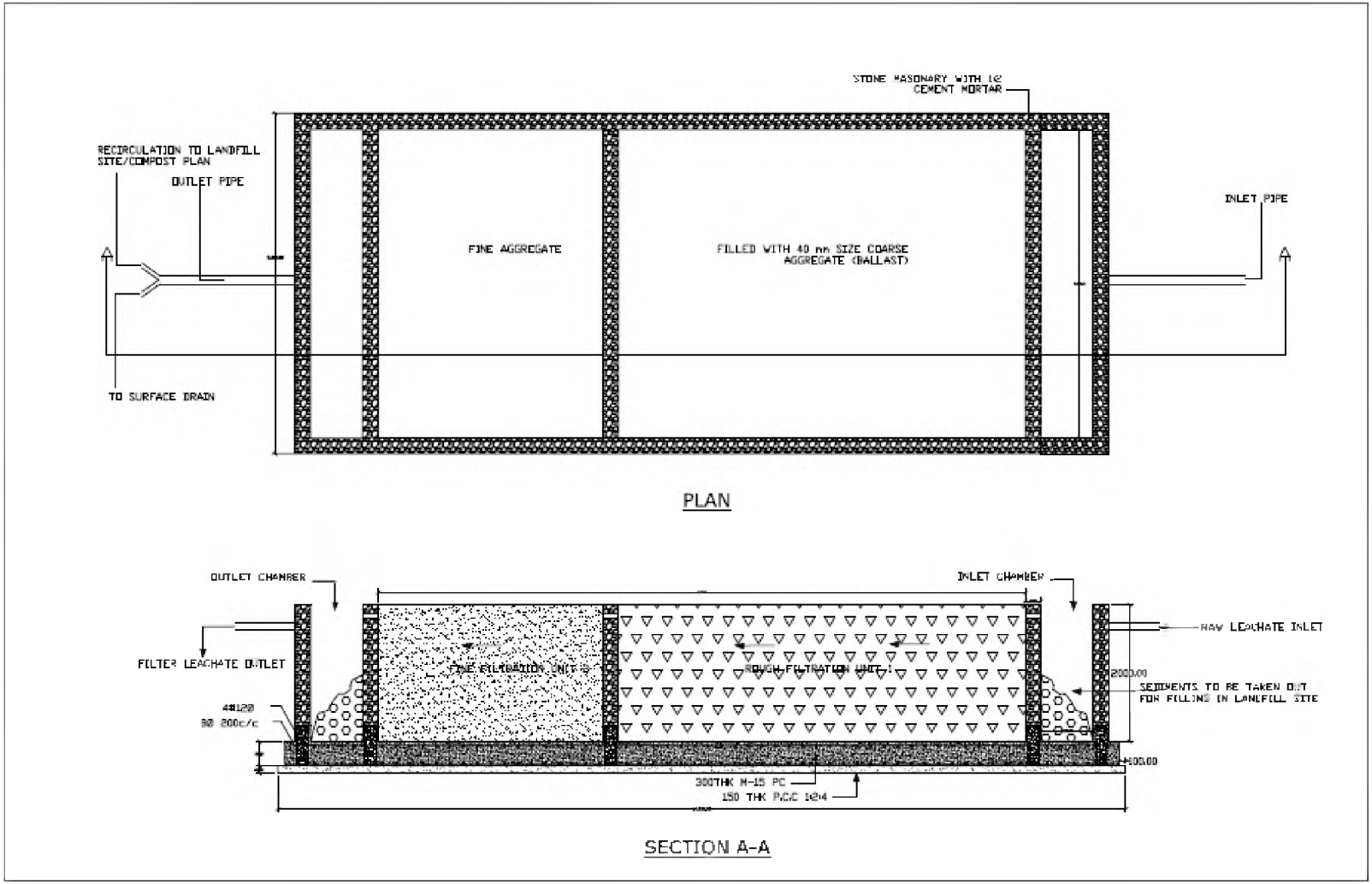


FIGURE 6.10: PLAN AND SECTION OF LEACHATE TREATMENT RCC TANK

151. Landfill management must involve the covering of waste until a cell is full and is being closed. The site therefore will need to operate as a sanitary landfill as noxious odors and pests that are associated with open dumping are also present. Two actions are required in order to prevent this:

(i) Operating procedures should involve periodic covering of deposited waste, and not when a cell is full; and

(ii) O&M procedures including location of the transfer points and landfill should be prepared by an experienced solid waste management expert.

152. As described above, proper design and engineering, and O&M should ensure that no significant impacts on surface waters in or around the proposed landfill site, and therefore the solid waste management system should operate without adverse ecological impacts. Routine environmental monitoring, as described below, will track environmental quality around the site during operation.

153. Poorly-managed landfills can cause negative ecological impacts by allowing the development of large colonies of scavenging birds, rodents and other vermin, which can then be a nuisance and a health, hazard in nearby communities, and can damage crops on surrounding farmland. Such nuisances are discouraged by the regular covering of waste, so this reinforces the need to adopt this mitigation measure. Shillong Municipality should also routinely monitor the incidence of pests at the site so that controlling action (for example by regular culling) can be taken if necessary. There can be small ecological gains as well as improvements in the appearance of such sites if trees are planted at the periphery and on completed waste cells, so this should be done, as shown in **Figure 6.8.**

154. Business and small industry in the town should operate more efficiently if their waste is removed speedily and efficiently, so there should be small economic gains once the system is operating. The main direct economic benefit will be obtained by companies that are involved in operating the secondary transfer system, supplying the trucks to transport the waste, and/or operating the landfill if this is contracted out to local business.

155. There should also be a significant economic benefit in the long term from the commercial sale of organic fertilizer produced at the composting plant. There should also be economic gains from increased yields in farms where the compost is used to fertilize the land, and these could be significant in areas where nutrients have been leached out by paddy cultivation and denuded by regular planting of the same or similar crops.

156. The only negative economic impact from the operating waste management system will be on traffic and transport in and around the transfer points in the town and on roads leading to the landfill, as there will be more heavy traffic on roads at these locations. This should be mitigated by carrying waste to the landfill outside peak traffic periods, even in the early morning if necessary. Any remaining economic impacts should be counterbalanced by the economic and other benefits of the scheme.

157. The main beneficiaries of the improved waste management infrastructure and system will be the citizens of the town, whose general environment, and in some cases living conditions, will be improved considerably. There should be fewer unsightly mounds of garbage in the town, including in slum areas, and the attendant appearance, smell and public health risks should be reduced. There will also be socio-economic benefits for people who are able to gain employment to operate the scheme and/or with Shillong Municipality if they operate elements of the system themselves. Farmers who benefit from fertilizer produced at the composting plant should also experience an increase in their income.

158. Following procedure should be followed at the landfill site during project implementation.

(i) Noise pollution due to movement of the heavy refuse vehicles to the site to be reduced through development of vegetative buffer.

(ii) Everyday earth covers of 20-30 cm. above the garbage layer will require significant quantities of borrow materials. Earth obtained from excavation of the cells and of leachate pits is to be used as earth cover.

(iii) Overflowing of leachate pipes due to heavy loads (especially in the rainy season) and choking due to accumulation of debris and wastes leading to pollution of nearby streams. Proper protective geo-membrane layers over the leachate collection pipes are suggested.

(iv) Floor washing in the garage and workshop may have oil and grease which can contaminate the storm water drain and ultimately the nearby streams. An oil and grease trap to be provided at the outfall line from the garage.

6.9 ENVIRONMENTAL BUDGET

159. As part of good engineering practices, there have been several measures as erosion prevention, rehabilitation of borrow areas, safety, signage, provision of temporary drains, etc the costs for which are included in the design costs of specific subprojects. Therefore, these items of costs have not been included in the IEE budget. Only those items not covered under budgets for construction and RAP are cost in the IEE budget. The IEE costs include mitigation, monitoring and capacity building costs. The summary budget for the environmental management costs for different subprojects is presented in **Table 6.4**.

TABLE 6.4: ENVIRONMENTAL BUDGET, SOLID WASTE

Sl. No.	Particulars	Stages	Unit	Rate (INR)	Cost (INR Million)
A.	**Mitigation Measures**				
3.1	Silt Fencing	Construction	Per running meter	500	0.025
3.2	Vegetative Buffer	Operation	Per tree	350	0.182
3.3	Oil and Grease Trap	Operation	Per Unit	5000	0.005
3.4	Grit Chamber	Operation	Per Unit	3500	0.004
	Sub -Total (A)				**0.216**
B.	**Monitoring Measures**				
3.1	Leachate Monitoring	Operation	Per sample	3000	0.018
3.2	Odor Monitoring	Operation	Per sample	3000	0.018
3.3	Wash Water Quality	Operation	Per sample	2000	0.012
	Sub -Total (B)				**0.048**
C	**Capacity Building**				
1	Sensitization Workshop	Pre-Construction	L.S		0.075
2	Training Session I	Pre-Construction	L.S		0.300
3	Training Session II	Construction	L.S		0.150
	Sub-Total C				**0.525**
	Total (A+B+C)				**0.789**
	Add Contingencies (@5 %)				**0.828**

(Source: SMEC Report on IEE, Shillong, December 2008)

160. Monitoring of odor at landfill site is essential as it may have some undesirable effects on the workers working at the landfill site and also to the people living in nearby vicinity if the site. For collection of landfill gas adequate number of HDPE pipes, as designed, laid at the bottom of the

landfill and connected to horizontal pipes at regular intervals for discharging the landfill gas into atmosphere. Proper provision has been suggested for the height of the stack for the release of LFG in atmosphere. Designs of such arrangements have been made and shown in the drawing in **Volume-II**

6.10 PROVISION OF A GROUND LEVEL RESERVOIR

161. A 100 KL capacity ground water tank has been proposed for landfill site at Mawiong, Shillong, as per the norms and guidelines mentioned in the Manual on Municipal Solid Waste Management published by the Ministry of Urban Development and SWMH, Rules, 2000 of Ministry of Environment & Forests, Govt. of India. The capacity of the tank has been fixed and designed considering requirements for the following:

(i) Daily washing of vehicles used at landfill site and refuse transportation vehicles (around 40 to 45 nos.)
(ii) Daily sprinkling of roads and landfill area to suppress dust.
(iii) Daily use for washing and bathing of workers working on landfill site.
(iv) Horticulture and maintaining the green belt around landfill site.
(v) Water mixed with re circulated leachate required to sprinkle over the fresh refuse for better compaction. (Re circulated leachate is added so as to reduce the quantity of water and at the time leachate is disposed off as a temporary measure)

Any reduction in capacity of the tank will adversely affect functioning of activities at landfill site.

7. ELECTRICAL REQUIREMENT IN THE REFURBISHMENT OF SOLID WASTE MANAGEMENT PLANT AT MAWIONG, SHILLONG

162. For the improvement/ refurbishment of the plant the following additional facilities have been envisaged:

i. A landfill area with proper approach road with yard lighting
ii. A new building for Operator's Rest Room
iii. A parking shed(garage) for 4 Nos Secondary vehicles, such as the bulldozer- cum-backhoe.
iv. A parking shed (garage) for 20 Nos Primary transport vehicles.
v. A weigh bridge with a Control Room
vi. A room for a security guard near the gate.
vii. Proper road lighting throughout the length of the road in the plant.

163. Existing Electrical equipment installed in the plant comprises a 100 KVA ,11/.433 KV Transformer with its substation near the office building ,and a 25 KVA , 11/.433 KV with its substation near the bio-medical plant supplying power to it only. It is understood that presently the 100 KVA transformer is loaded to about 75 % of its rating and the 25 KVA transformer is loaded to about 18 KW.

164. Additional Load for the SWM plant is detailed as below

A Load for Security Guard Room will be 664 W can be taken up by the 25 KVA transformer near the Bio Medical Waste Management and as such this buildings can be supplied from 25 KVA transformer through the switching panel with 1X3 C, PVC insulated and sheathed cables copper conductors laid in trenches.

B Yard Lighting at Land Fill Site

165. 8 Nos of Havells 'ORION' fixture with 1X70 W, SON lamp each mounted on swaged poles to be connected by 1 X 3 C ,2.5 sq mm copper cable with PVC insulation and sheathing from a MS sheet box with adequate MCBs , which shall get its power from the MDP at the machinery plant through a 1 x3C 6 sq mm armoured cable with PVC insulation and PVC sheathing . The total connected load will be 560 Watts.

Operator Rest Room

166. The Operator's Rest Room will have 4 Nos of 1 X 40 W FTL Lamps, 5 Nos of 8/11 W CFL, 2 Nos of 1200 mm ceiling fans, 1 Nos 200 mm exhaust fans, 1 No of 16 A, 6 Pin sockets . Total connected load will be 1.3 KW.

Secondary Vehicle Parking Garage

167. This garage shall house 4 Nos of landfill machinery vehicles as Bull Dozer -cum-backhoe, etc with high roof. It is planned to place 1 No of Havells 'SOLAR1' 1X70 W Metal Halide SEE Lamps on the beam between each of two vehicles having individual control switch. In addition there will be 2 Nos of single FTL lamps outside the side walls and 2 Nos of 16 A,6 Pin sockets. As such the total electrical connected load will be 2.3 KW.

Primary Transport Vehicle Parking Garage

168. This transport vehicle parking garage is arranged to have 2 Rows of parking slots with 10 Nos of vehicle in each row. The garage will be provided with 1 No of Havells 'MAGNUM1' 1X36 W FTL mounted on the beam between the sides of the two vehicles each with additional single tube

FTL lamp on outside the side wall. Thus the total connected load comes to about 3.0 KW including 2 nos of 16 Amps, 6 Pin Sockets.

Control Room for Weigh Bridge

169. The Control Room for the 30 MT Weigh Bridge will be lit by 3 Nos of 8W, CFL on batten Angle holders and a 40 W FTL . Additionally a 1200 mm ceiling fan and a 16 A socket will be provided in the room . The total connected load will be 664 Watts.

Tube Well

170. A provision for a 3 HP pump for the Plant tube well has been made with 1 X 4 Core , 10 Sq mm stranded copper wires PVC Insulated and sheathed laid in ground.

Road Lighting

171. Havells 'ORION' fixture with 70 W, SON lamps are to be fitted with swaged steel poles along the road of the plant from the main gate to the end of the road at convenient distances to be connected by 2.5 Sq mm ,3 core under ground cables. The lamps should be mounted on outer side of the curves and on one side of the straight road to be determined at site. The total connected load for the road lighting is expected to be 5.25 KW

172. This total connected load of 16 KW approx can be accommodated in the 100 KVA transformer. An additional switching panel , as described in item (i) in the attached BOQ shall be mounted near the Main Distribution Panel in the machinery plant.

173. It is also proposed to have a communication system in the plant area with two way hand sets in each building with paging facilities in the landfill areas also. The cost for the same would be approx INR .35 Million additionally. All works of Electrical Engineering will carried out through Licensed Electrical Contractors Only

174. The expenditure of the electrical works will involve an investment of INR 1,724,178

175. The expenditure of the electrical works will involve an investment of INR 1.72 million as mentioned in **Table 7.1** and annual energy charges at landfill site at Mawiong is shown in **Table 7.1**

176.

TABLE 7.1: ESTIMATES FOR REQUIREMENTS OF ELECTRICAL INSTALLATIONS FOR LANDFILL SITE AT MAWLONG, SHILLONG

BOQ OF ADDITIONAL REQUIREMENT OF ELECTRICAL DISTRIBUTION IN SOLID WASTE MANAGEMENT PLANT AT MAWIONG,SHILLONG INCLUDING BOQ and SITC COSTS									
(i) MCB DB at Machinery Plant Unit , SWM, Shillong									
Supply, Installation, Testing, Commissioning (SITC) of One No, 6 Way MCB DB with Outgoing Terminal Block and a set of indicating Lamps comprising of:									
Sl No	**Description**					**Unit**	**Qty**	**Rate**	**Amount**
1	40 A, 4 Pole, MCB as Incomer from MDP					No	1	LS	18000
2	6 A, TPN MCB as Outgoing for **Water Pump**					No	1		
3	10 A, DP MCB for Outgoing to Weigh Bridgee and Control Room					No	3		
4	10 A, DP MCB for Outgoing to **Operator's Rest Room**					No	1		
5	10 A, DP, MCB for outgoing to (4 Nos) **Secondary Vehicle Parking Garage**					No	1		
6	16 A, DP, MCB for Outgoing to (20 Nos) of **Primary Transportation Vehicle Parking**					No	1		
					Total (i)				**18000**
(ii)Security Guard Room at SWM, Shillong									
(Near the main gate to be supplied from the Bio Medical Plant Transformer)									
Sl No	**Description**					**Unit**	**Qty**	**Rate**	**Amount**
1	6 A,SPN,MCB in 4 Way MCB DB					No	1	864	864
2	40 W, Havells MAGNUM 1 FTL					No	2	2040	4080
3	8 W, CFL on Batten Holders					No	5	200	1000
4	48 "(1200 mm) Ceiling Fans inc. all Accessories					No	1	1600	1600
6	6 A, 5 Pin sockets					No	1	60	60
7	Circuit Wiring with 3 X 1C,2.5 Sq mm Stranded Copper Wires in PVC conduit					Rm	16	150	2400
8	Point Wiring with 3 X 1 C, 1.5 Sq mm Stranded Copper Wires including all accessories;								
	i	Short Points (3 Mts)				No	4	636	2544
	ii	Long Points (3 to 6 Mts)				No	3	696	2088
9	Incomer with 1 X 3 C, 6 Sq mm PVC insulated and sheathed copper conductor including all mounting and laying in 50 cm trenches with bricks & sand protection, from the biomedical plant to the S/G Room					Rm	50	540	27000
					Total (ii)				**37556**
(iii) Weigh Bridge cum Control Room at SWM, Shillong									
Sl No	**Description**					**Unit**	**Qty**	**Rate**	**Amount**
1	6 A,SPN,MCB in 4 Way MCB DB					No	1	864	864
2	40 W,Havells MAGNUM 1 FTL					No	2	2040	4080
3	8 W, CFL on Batten Holders					No	5	200	1000
4	48 "(1200 mm) Ceiling Fans inc. all Accessories					No	1	600	1600
5	6 A, 5 Pin sockets					No	1	60	60

6	Circuit Wiring with 3 X 1 C, 2.5 Sq mm Stranded Copper Wires in PVC conduit					Rm	16	150	2400
7	Point Wiring with 3 X 1 C, 1.5 Sq mm Stranded Copper Wires (1X3) including all accessories;								
	i	Short Points (3 Mts)				No	4	636	2544
	ii	Long Points(3 to 6 Mts)				No	3	696	2088
8	Incomer with 1X3 C, 6 Sq mm PVC insulated and sheathed copper conductor including all mountingin 50 cm trenches with bricks & sand protection.					Rm	50	540	27000
					Total(iii)				**41636**
(iv) Operator's Rest Room at SWM, Shillong									
Sl No	**Description**					**Unit**	**Qty**	**Rate**	**Amount**
1	2+8 Way, DP MCB as Incomer and SP MCB as outgoing with common neutral Terminal Block					No	1	LS	7068
2	Circuit Wiring with 3 X 1 C, 2.5 Sq mm stranded Copper conductor with PVC insulation in PVC Conduit					Rm	30	150	4500
3	Point Wiring with 3 X 1 C , 1.5 sq mm stranded copper conductor with PVC insulation with PVC Conduit								
	i) Short Point (<3 Mts)					No	3	636	1908
	ii)Medium Point(3 to 6 Mts)					No	6	696	4176
	iii) Long Point (6 to 9 Mts)					No	2	756	1512
4	1 X 40 W, FTL					No	4	200	800
5	8 W CFL on Batten Holders					No	5	200	1000
6	48 "(1200 mm) Ceiling Fans inc. all Accessories					No	2	1600	3200
7	8" (200 mm) Exhaust Fan					No	1	1000	1000
8	16 A, 6 Pin sockets					No	1	120	120
9	Incomer with 1 X 2 C, 10 sq mm PVC insulated and sheated copper cable laid in 50 mm deep trenches covered in sand and protected by loose bricks including all accessories and labour.					Mts	100	564	56400
					Total (iv)				**81684**
(v) Garage for 4 nos of Secondary Transportation vehicles at SWM, Shillong									
Sl No	**Description**					**Unit**	**Qty**	**Rate**	**Amount**
1	2+6 Way, DP MCB as Incomer and SP MCB as outgoing with common neutral Terminal Block					No	1	LS	7068
2	Circuit Wiring with 3 X 1 C, 2.5 Sq mm stranded Copper conductor with PVC insulation in PVC Conduit					Rm	50	150	7500
3	Point Wiring with 3x1C , 1.5 sq mm stranded copper conductor with PVC insulation with PVC Conduit								
	i) Short Point (<3 Mts)					Nos	2	636	1272
	ii)Medium Point(3 to 6 Mts)					Nos	2	696	1392
	iii) Long Point (6 to 9 Mts)					Nos	3	756	2268
4	Havells ' SOLAR1' with 1 x70 W, MH Lamp					Nos	5	3600	18000
5	1X 40 W, FTL					Nos	2	200	400
6	16 A, 6 Pin Sockets					Nos	2	120	240
7	Incomer with 1 X 2 C, 10 sq mm PVC insulated and sheated copper cable laid in 50 mm deep trenches covered in sand and protected by loose bricks including all accessories and labour.					Mts	150	564	84600
					Total (v)				**122740**
(vi) Garage for Primary Transportation vehicles (20 Nos) Parking at SWM, Shillong									

Sl No	Description	Unit	Qty	Rate	Amount
1	2+12 Way, DP MCB as Incomer and SP MCB as outgoing with common neutral Terminal Block	No	1	LS	7086
2	Circuit Wiring with 3 X 1 C, 2.5 Sq mm stranded Copper conductor with PVC insulation in PVC Conduit	Rm	90	150	13500
3	Point Wiring with 3x1C , 1.5 sq mm stranded copper conductor with PVC insulation with PVC Conduit				
	i) Short Point (<3 Mts)	Nos	6	636	3816
	ii)Medium Point(3 to 6 Mts)	Nos	10	696	6960
	iii) Long Point (6 to 9 Mts)	Nos	11	756	8316
4	'MAGNUM 1' with 1X 36 W FTL	Nos	22	2040	44880
5	1X 40 W, FTL	Nos	2	200	400
6	16 A, 6 Pin Sockets	Nos	3	120	360
7	Incomer with 1 X 2 C, 10 sq mm PVC insulated and sheated copper cable laid in 50 mm deep trenches covered in sand and protected by loose bricks including all accessories and labour.	Mts	150	564	84600
	Total (vi)				**169918**

(viii) Earthing Connection

Earthing will be done using 3.0 Mts long 50 mm dia GI pipes with 2 mm holed spaced crosswise, with flange/clamp for connection at the top end to be buried in a pit of 50 mm or more dia. Specified electrodes shall be surrounded with salt and charcoal layers of 300 mm thick with provision for water arrangement. Connections to panel and equipments shall be made by GI Strip or wires.

Sl No	Description	Unit	Qty	Rate	Amount
1	Earth Electrode with salt and Charcoal in pit	Nos	1	7200	7200
2	Earth Electrode without salt and Charcoal	Nos	5	3600	18000
3	25 x3 mm GI Strip	Mts	30	60	1800
4	8 SWG GI Wire	Mts	15	21.6	324
	Total (vii)				**27324**

(ix) Tube Well at SWM, Shillong

Sl No	Description	Unit	Qty	Rate	Amount
1	1 x 4 C , 10 Sq mm stranded copper wires PVC insulated and sheathed cables laid in ground	Rm	120	576	69120
2	Terminal Block with DOL Starter	No	1	4500	4500
	Total (ix)				**73620**

(x) Road Lighting at SWM , Shillong

Sl No	Description	Unit	Qty	Rate	Amount
1	Havells 'ORION' fixture with 70 W, SON lamps are to be fitted with swaged steel poles along the road of the plant from the main gate to the end of the road at convenient distances to be connected by 2.5 Sq mm ,3 core under ground cables. The lamps should be mounted on outer side of the curves and on one side of the straight road to be determined at site.	Nos	75	12000	900000

					Total (x)				**900000**
(xi) Lighting at Landfill Yard at SWM, Shillong									
Sl No	**Description**					**Unit**	**Qty**	**Rate**	**Amount**
1	1 X 3 C, 6 Sq mm PVC insulated and sheathed copper conductor including all mounting in 50 cm trenches with bricks & sand protection laying through GI pipes at road & pavement crossing (terminals not needed) including earth boring if required.					Mts	50	540	27000
2	4 way, MCB DB with 10 A MCB as outgoing including installation thereof as in the office building					Each	1	2500	2500
3	One independent free standing sheet steel (16 Gauge) outdoor cubicle comprising 4 way MCB DB including DN Rails and neutral terminal block								
a	10 A ,DP, MCB as Incomer					Nos	1		
b	6 A, SP,MCB with outgoing terminal blocks					Nos	2	7000	7000
4	Havell's ORION FTL,1 X36/40 W to be mounted on equal no of Ms swaged tubular poles connected by 3 core underground cables. The mounting of the lamp should be on the outside of the landfill site.					No	8	12000	96000
5	3 X 1 C , 4 sq mm PVC stranded copper wires					Mts	280	250	70000
6	3 X 1 C , 2.5 sq mm PVC stranded copper wires					Mts	280	150	42000
7	Earthing Electrode without salt and charcoal in pit					No	2	3600	7200
	Total (xi)								**251700**
Grand Total(i+ii+iii+iv+v+vi+vii+viii+ix+x+xi)									**1724178**
Rupees Seventeen Lakh Twenty Four Thousand One Hundred and Seventy Eight Only									

8. INSTITUTIONAL STRENGTHENING AND CAPACITY BUILDING

8.1 INSTITUTIONAL STRENGTHENING

177. At present the sanitary department is responsible for solid waste management in Shillong Municipal Board Area. Creation of a separate department to deal with solid waste management in Greater Shillong Planning Area and its strengthening is required on emergent basis for effective implementation of improved solid waste management program.

178. To create and strengthen the solid waste management department, few suggestions are made for implementation, as follows;

i. Appointment of the professional in-charge of SWM in GSPA,

ii. Development of mechanism for coordination with private sector, NGOs and CBOs,

iii. Implementation of double accounting system,

iv. Implementation of modified by-laws so as to make the SWM system more effective and sustainable in the long-run.

8.2 HUMAN RESOURCES DEVELOPMENT

179. The institutional development framework proposed for SWM for GSPA is shown in **Figure 8.1**. It is proposed that a separate department headed by the Chief Executive Officer (SMB) be created. The proposed organizational chart is as under:

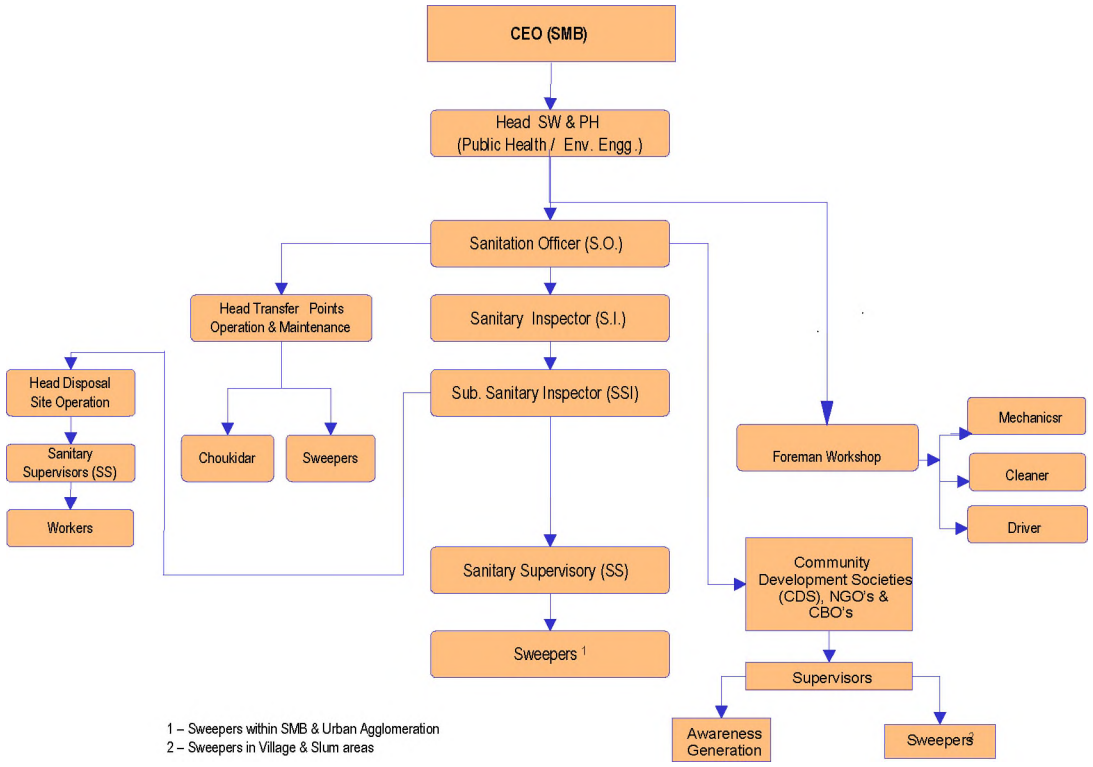


FIGURE 8.1: PROPOSED STRUCTURE OF SWM DIVISION

180. The proposed strength of institution responsible for SWM activities in GSPA has been recommended in line with the suggested organizational structure for a developing town like Shillong in the manual on 'Municipal Solid Waste Management' published by the Ministry of Urban Development, Government of India. Institutional strengthening has been suggested as a part of the project, to ensure that the efforts can be sustained for a long period and the system put in place has long-term sustainability. This has been suggested keeping in view the recommendations made in 74th Constitution Amendment wherein decentralization of administration, and delegation of powers to more qualified and experienced professionals have been recommended.

181. The above suggestion is valid if the SMB takes over the entire functions which may not be desirable in view of the past experience and is strongly recommended that the SWM in Shillong is outsourced and private sector/ CBO/NGO may be involved in greater measures. This is likely to be more efficient and also cost effective.

182. In the proposal there is a strong component of human resource development by imparting adequate training to all the personnel involved in SWM program irrespective of their cadre including all the stakeholders responsible for municipal solid waste management. Such efforts not only will reduce the burden on the part of SMB but at the time increase the efficiency.

8.3 HUMAN RESOURCE DEVELOPMENT AND TRAINING

183. The human resource development and training is essential component of the solid waste management program to achieve its objectives. Adequate training by way of awareness creation amongst all the stakeholders and also to those involve in SWM activities such as collection, transportation, treatment and disposal of solid waste. Training program of personnel involved in SWM may have different training modules for different personnel and may have different modules for a person involved in the program, however, structure of these modules depend on the job to be performed and activities associated with a particular job.

184. There are certain approaches have been highlighted for different categories of personnel involved in SWM program as under:

8.3.1 TRAINING FOR SOLID WASTE MANAGEMENT STAFFS

i. House-to-house collection and source segregation;
ii. Qualitative and quantitative analysis of solid wastes generated;
iii. Safe handling procedures of waste;
iv. Waste collection procedures in isolated areas and slums;
v. Procedure for location of community bins;
vi. Routing and scheduling of transportation vehicles and pick-up frequency of solid waste;
vii. Loading and unloading of solid waste from bigger vehicles to smaller ones;
viii. Compost plant operation;
ix. Sanitary landfill operation;
x. Leachate management;
xi. Centralized segregation of recyclables;
xii. Reduction in environmental degradation with the help of processing of solid waste and sanitary landfills.

8.3.2 SPECIAL VALUE ADDED TRAINING PROGRAM FOR SMB STAFF

185. In addition to the training during;

i) Pre-implementation;
ii) During implementation and;
iii) Post-implementation i.e. operational stage.

186. Short-term and medium-term training programs shall be designed for supervisory staff and sanitation workers. Special training programs be prepared by way of conducting refresher courses by SMB to train their staffs for efficient and effectiveness of the SWM system. Some of the important training courses are mentioned as follows:

i. **Computer Training Course:** Presently, there is no computer training facility available in SMB. The computer training shall increase in efficiency towards better management of SWM services;

ii. **Special Training to Under-qualified Staff:** Under-qualified supervisory staff should be given in service training to qualify for supervising sanitation works. They may be sent to those institutions imparting training program on such topics;

iii. **Refresher courses for all levels of Staff:** Refresher courses should be conducted for the sanitation workers as well as supervisory staff atleast once in every 2-3 years or can be sent to training institutions for exposure in the related subject;

iv. **Exposure to Public Representatives:** it is necessary to give an orientation to the public representatives in SWM to make them aware of the importance of the SWM program.

8.3.3 AWARENESS GENERATION AMONGST STAKEHOLDERS

187. Education and awareness programs through IEC are very important to increase public sensitivity towards the SWM issues. Specially NGOs and other volunteer organizations will be responsible for drawing public attention on SWM program. This training program could be taken up through print, electronic media and all other available sources as already mentioned in the above referred Manual on Municipal Solid Waste Management.

8.4 RECOMMENDATIONS FOR SUCCESSFUL IMPLEMENTATION OF THE PROJECT

8.4.1 ORIENTATION OF KEY PERSONALITIES, SOCIAL ACTIVISTS AND POLICY MAKERS

188. The successful implementation of the SWM program depends on the awareness of all the stakeholders. The need for house-to-house collection by the community to be emphasized by way of educating them about the benefits of the program.

189. In addition to the above activity, vigorous sanitation campaign across the town community shall also be taken up

190. Sensitization of all the groups of the people is necessary and suitable modules shall be prepared for educating the masses

8.4.2 MEDIA CAMPAIGNING AND ENVIRONMENTAL AWARENESS

191. Media serve as a very important tool for creating public awareness. All types of media tools such as print, electronic, road shows etc. shall be used for the purpose.

9. MANAGEMENT INFORMATION SYSTEM

9.1 INTRODUCTION

192. Keeping of records relating to all the activities of SWM with respect to specific time-frame for each activity is of utmost important for efficient system. Such information/data collected may require time to time examination of each activity and may require some corrective measures for achieving the desired objectives. These information/data will not only help in enhancing the efficiency of the system but also helps in future planning of the system. Few formats are designed and developed for monitoring of various activities of SWM as given below.

9.2 GENERAL INFORMATION TO BE COLLECTED

193. The general information to be collected with respect to town profile and solid waste generation is given in **Table 9.1**

TABLE 9.1: INFORMATION TO BE COLLECTED FOR SOLID WASTE MANAGEMENT

a) General Information to be collected	b) Waste Generation	c) Waste Storage Depots
1. Area of the town and population 2. Decadal growth of population 3. Ward-wise information in respect to: -Population density, no. of households, shops and other establishments -No. and types of market places -No. of hotels and restaurants -Number of industries -Number of slums with population -Road length and width -Area with sewerage system -Area with surface drains -Area having no drainage -Number of public utilities 4. Number of vulnerable spots	1. Average quantity of waste generated per day ward-wise 2. Seasonal variation in waste generation 3. Total quantity of waste generated, collected during the last 5 years 4. Break-up of quantity of waste generated from; -Households -Market areas -Institutions and commercial places -Biomedical waste -Construction and Demolition waste 5. Average number of carcasses removed each day	1. Number of sites designate/notified for temporary storage of waste in community bins (optional) 2. Types of collection points provided in each ward 3. Quantity of waste generated each day ward-wise **d) Waste Processing and Disposal** 1. Number of waste processing and disposal sites in the city 2. Their distances from the center of the city 3. Areas of these sites 4. Quantity of waste treated and disposed of at each site 5. Expected life of the landfill site
e) Transportation	**f) Financial Aspects**	**g) Staff Position**
1. Inventory of each vehicle deployed for various purposes 2. Average haulage distance and number of trips each day 3. Number of vehicles used in each shift 4. Quantity of waste transported in each trip and per day by volume and weight	1. Operating cost. 2. Cost of collection per ton of waste generated. 3. Cost of transportation per ton of waste collected 4. Cost of transportation per ton of waste handled by private vehicle. 5. Cost of per ton of disposal of waste	1. Number of sanitary workers deployed in the town for collection of waste 2. Number of sanitary workers deployed for transportation of waste 3. Ward-wise allocation of sanitary workers 4. Sweeper per 1000 population in each ward 5. Sweeper road length ratio in each ward 6. Sweeper supervisor ratio in each ward

9.3 MONITORING OF SOLID WASTE MANAGEMENT SERVICES

Requirements of Daily Reporting

a) Collection of waste

i. Number of sweepers required to report for duty at each ward

ii. Number of sweepers actually reporting on duty

iii. Number of sweepers absent from duty ward-wise

iv. Areas left unattended ward-wise

v. Arrangements made or proposed to be made for clearing the backlog ward-wise

b) Inspection by supervisors for street sweepings and primary collection

i. Number of persons he requires to supervise in each ward

ii. Number of persons supervised during the day

iii. Number of beats where performance found satisfactory ward-wise

iv. Number of cases where performance was unsatisfactory

v. Action taken or proposed to be taken ward-wise

vi. Complained received and attended ward-wise

c) Inspection of cost recovery services such as hotels, hospitals, commercial complexes etc.

i. Number of cost recovery sites under his charge

ii. Number of site inspected

iii. Deficiencies noticed

iv. Complaint received and attended

v. Action taken or proposed to be taken

d) Inspection of bulk community waste storage sites

i. Number of sites in the area under his charge

ii. Number of sites inspected

iii. Number of sites found well maintained

iv. Number of sites found ill maintained or needing repairs or replacement

v. Action taken

vi. Number of unauthorized waste disposal sites or sites identified during field visits

e) Inspection of silt removal sites and construction & demolition waste sites

i. Number of silt removal site inspected

ii. Number of sites found satisfactory

iii. Number of sites where silt was found lying outside the manhole or the surface drains

iv. Number of construction and demolition sites visited

v. Number unauthorized disposal of C & D waste sites visited

f) Transportation of waste (Report to be furnished by A.E. in-charge garage)

i. Inventory of vehicles available in garage

ii. Number and specification of equipment and vehicles required

iii. Number of vehicles break-down reported each day and action taken

iv. Number of trips made by each vehicle per day and its performance

v. Quantity of waste transported by each vehicle deployed for the purpose

vi. Number of bins cleared during the day

vii. Number of bins left unattended

viii. Arrangement made for clearing the backlog with specific time-frame

g) Quantities of waste transported

i. Number of vehicles deployed each day

ii. Number of trips made by each vehicle

iii. Quantity of waste transported

iv. Number of defaulting vehicles –less no. of trips or under-capacity

v. Any abnormality observed

vi. Action taken or proposed to be taken against defaulters

h) Recovery of additional cleaning or penal charges

i. Name of the ward

ii. Area visited

iii. Additional charges recovered

i) Registration and monitoring of complaints

a. All complaints regarding SWM services should be registered at the relevant ward office and monitored on day-to-day basis by the engineer who should assign the job to supervisor with specific time limit and report back the action taken.

b. Monitoring of all the complaints with respect to their type, and time taken for proper compliance.

9.4 WEEKLY REPORTING

a) Inspection of processing sites

i. Whether the plant was functional during the week

ii. Whether it received the adequate quantity of waste every day

iii. Whether the processing site is properly maintained

iv. Quantity of compost of desired quality produced

v. Quantity of compost produced and sold during the week

vi. Quantity of finished goods in stock

vii. Any irregularity observed

viii. Action taken

b) Inspection of waste disposal site

i. Name of the landfill site visited

ii. Whether all the staff were present on duty during the day/week

iii. Whether the required machineries were available on the site for all the days

iv. Whether the approach road and internal roads are properly maintained

v. Whether the weighing bridge was functioning properly and used

vi. Quantity of waste received at the site on each day

vii. Number of bulldozer and compactor operated during the day with their working hours, fuel consumption every day during the week

viii. Whether all the communication facilities remain functional during the week

ix. Whether adequate shelter and drinking water facilities available for workers

x. Deficiencies observed

xi. Remedial action taken or proposed to be taken

c) Record of trips made by transport vehicle at processing and disposal sites

i. Week ending -------

ii. Number of vehicles operated during the transportation of waste ward-wise

iii. Name of the driver

iv. Arrival time of the vehicle

v. Number of trips made by each group of vehicle in a week

vi. Weight of waste brought at processing and landfill site

vii. Deficiencies observed, if any

viii. Remedial measures taken

d) Workshop performance to be submitted by the A.E. (garage)

(A)

i. Number (in %) of vehicles on road

ii. Number and type of vehicles under repairs at Council's or private workshop

iii. Nature of breakdown

iv. Duration of breakdown in days and weeks

v. Reasons for delay in repairs

vi. Expected date of vehicle to be back on the road

(B)

i. Number and type of vehicle and equipment required to be given to the SWM dept. by the workshop

ii. Number and type of vehicle actually given

iii. Shortfall, if any

iv. Reasons, thereof

v. Alternative arrangement made/action proposed

(C)

i. Each vehicle should maintain a log book showing information of its movement and performance as under:

9.5 VEHICLE LOG BOOK

Department

Vehicle number Date

Driver's name Shift

1. Departure from workshop
2. Return to workshop
3. Fuel consumed (in liters)
4. Kilometer reading at start of work
5. Kilometer reading at the end of the work
6. Total kilometers travelled
7. Details of trip made and location covered
8. Inspected at point number-------- by---------at------- am/pm
9. Weight of waste recorded at weigh bridge – time in ------ time out------
10. Total waste transported ----- MT per day

Weigh bridge operator's signature

Driver's signature Use Dept's Signature

9.6 MONTHLY REPORT

a) Primary Collection

i. Number of absenteeism of sweepers and area not swept due to absenteeism

ii. Action taken or proposed to be taken

iii. Number of waste collection point not maintained well

iv. Action taken or proposed to be taken

b) Cost recoveries and penalties

i. Action taken against defaulters

ii. Ward-wise recovery, amount collected and shortfall, if there is any, reasons there for

c) Transportation

i. Number of municipality/Pvt. vehicles deployed and actual requirement

ii. Reasons for shortfall, action taken/proposed

iii. Number of collection points cleared, if any shortfall, reasons and action taken/proposed

iv. Total number of trips made by municipal vehicles against the targets

d) Incentives and disincentives for workshop performance

i. Maintain the list of all the important equipment and vehicles

ii. Satisfactory maintenance of such equipment and vehicles

iii. Inventory of spares

iv. Deficiency/irregularity observed

v. Action taken/proposed

vi. Duration of vehicle out of road in days and weeks, reasons, and corrective measures taken

e) Monitoring of public complaints

i. Proper redressal system be developed

ii. All the complaints and grievances properly attended to

iii. Compliance must be recorded properly

f) Monitoring of public responses

i. Number of sweepers allotted to door-to-door collection

ii. Response from the households

iii. Percentage of public participation

iv. Improvement over the last month activities

i) Submission of report every month showing the public response

ii) Review of such report by the decision making competent authority

10. PRIVATE SECTOR PARTICIPATION

10.1 INTRODUCTION

194. Solid Waste Management (SWM) service is highly labor intensive and on account of increased wage structure of the Government and municipal employees, this service is becoming more and more expensive. Besides, the efficiency of the labor force employed in the urban local bodies is far from satisfactory. It is, therefore, necessary that the local bodies may seriously consider private sector participation in solid waste management.

10.2 AREAS WHERE PRIVATIZATION CAN BE ATTEMPTED

195. Private sector participation may be considered under the following scenario:

i. Newly developed areas, underserved areas and particularly for those areas where local bodies have not been providing services through their own labor force,

ii. Door-to-door collection of domestic waste and collection of waste from other waste generating sources, such as commercial and institutional complexes, market places, hotels and restaurants, hospitals and nursing homes etc.

iii. Facilities providing for operation and maintenance of equipment and vehicles used for collection, transportation, treatment and disposal of waste;

iv. Transportation of waste on contractual basis;

v. Involvement of NGOs may also be explored in SWM management program. Proper terms and conditions shall be drawn with all the parties involved on SWM activity;

vi. The contract shall carry a provision for incentive providing excellent services and at the same time a provision of a heavy penalty be included for failure to perform the contractual obligations.

10.3 INCENTIVES FOR PRIVATE SECTOR

196. Solid waste management is one of the areas where private sector has interest. In Shillong Private Sectors are actively involved in collection, transportation of solid waste to the disposal site and even the existing compost plant of 100 mtpd capacity is managed by private sector. Therefore, these private entrepreneurs be given incentives so that they can be attracted towards SWM activity. These incentives are listed as under;

i. Contracts for collection of waste from various generating sources be given on long-term for a period of about 5 years so that private sector can invest and earn economically,

ii. Private sector may be offered land on a nominal rent for a longer period of about 30 years for treatment and disposal of waste,

iii. Privatization of maintenance of vehicles shall be for a reasonably long period. However, the performance of the repaired vehicles should be assessed periodically,

iv. Any Arrangements made shall be transparent and effective in keeping Shillong clean and environment friendly,

v. Management of labor force by private sector and urban local bodies is a very sensitive issue and therefore, a proper strategy be evolved without jeopardizing the interest of either parties and more so the efficiency of the SWM,

vi. In the situation where the land for treatment and disposal of solid waste is not available within the economical limits of the urban local body, whereas the land with private party may be available for the purpose, under such situation a viable agreement with the private sector could be drawn keeping in view all the aspects from economical angles.

10.4 IMPLEMENTATION OF P-S-P APPROACH IN SWM

197. In India, private sector participation in SWM is a relatively new. Its economical viability is yet to be thoroughly evaluated keeping in view of all the parameters related to engineering, administrative, financial, legal etc. in the management of solid waste in a town or city. Under the present scenario, it is suggested that the SMB may look into the involvement of P-S-P in SWM in a big way so as to project Shillong as a modal town to be followed by other ULBs in the country as it has done in the past by installing the first compost plant in the Northeast and also the first such project under public and private partnership.

10.5 AREAS OF P-S-P INVOLVEMENT

198. Following are the areas suggested for involvement of private sector participation:

i. Collection of domestic, commercial, institutional, hospital and nursing home, etc. wastes and depositing the collected waste to the transfer points;

ii. Street sweepings and clearing other part of the town;

iii. Transportation of waste from transfer points to the treatment and disposal site;

iv. Recycling of recyclable wastes;

v. Disposal of hazardous waste as per the MoEF guidelines,

vi. Marketing of compost;

vii. Community awareness and educating the public;

viii. Various training program on SWM for all section of the society and for all the stakeholders;

ix. Performance evaluation of SWM activities in the town;

x. Evaluation of various training programs imparted to stakeholders.

11. COST-BENEFIT ANALYSIS OF THE PROJECT

11.1 OBJECTIVE

199. The cost-benefit analysis of SWM project on its sustainability is impracticable to implement so as to make the system self-sustainable. This exercise may appear feasible in theory but difficult to implement under prevailing local conditions in ULBs the country.

200. The main objective of the project to keep the environment of the town or city neat and clean and make the people free from any disease arising out from the mismanagement of solid waste. The SWM services shall be available throughout the year without fail due to the fact that any negligence on the part of urban local body responsible for managing the solid waste may lead to spread of many diseases through vectors. And therefore, the Cost-Benefit Analysis for the project such as this SWM Project for GSPA under social sector shall be analyzed for **Cost-Effectiveness** of the project.

201. The expenditure incurred on SWM activities can be compensated to some extent in earning revenue by adopting following approaches:

i. By levying suitable charges to the beneficiaries. This is a very elaborate exercise involving the entire cross-section of the society, different professional activities, willingness to pay for the services rendered etc.

ii. Charging heavy penalty for the defaulters. It is a very important component to be given due consideration while modifying the State/City by-laws. Such by-laws shall make necessary provisions for imposing suitable penalty for defaulters. It would be a very good for making the break-even approach for keeping the area neat and clean on one hand will generate revenue for sustainability of the SWM activities to some extent.

iii. A proper mix of private and public sector may be thought of and an exercise may be done keeping in view the economic viability of involvement to the possible extent. This approach would certainly make the SWM system more efficient.

iv. A proper strategy need to be evolved for marketing of the compost. All the methodologies for propagating the sale of compost shall be used. If possible, central/state governments could suitably subsidize the sale of compost as in case of inorganic fertilizers.

11.2. SUMMARY OF THE COST ESTIMATES OF SWM IN GSPA

202. Cost estimates for the different components of SWM system in GSPA has been worked out on the basis of Market Rates. The summary of the estimate is shown in the following **Table: 11.1**

TABLE: 11.1 SUMMARY OF ABSTRACT COST ESTIMATE FOR SWM SCHEME IN GSPA

Abstract of Cost for Solid Waste Management Scheme for Shillong			
Sl. No.	Description of Items with Specification	Number Unit Cost (INR)	Total Estimated Cost (INR million.)
I	**Primary Collection**		
a)	Providing 50 liter capacity LLDP bins of approved make for road side litter bins at strategic locations	300,000.00	0.30
b)	Providing 250 liter capacity bins of LLDP approved make for street sweeping.	750,000.00	0.75
I	**Sub Total**		**1.05**
II.	**Primary Collection and transportation Vehicles**		
a)	4-Wheeler Hydraulic Operated Vehicles (30 nos)	10,500,000.00	10.50
b)	Supply of equipment and PP Gears to personnel responsible for street sweeping	250,000.00	0.25
II	**Sub Total - II**		**10.75**
III.	**Secondary Collection and transportation Vehicles**		
a).	4.5 cum. capacity Tipper Truck of approved make complying to all the requirements for the purpose.(17 nos).	14,960,000.00	14.96
III	**Sub Total**		**14.96**
IV	**Development of Sanitary Landfill Site**		
a)	**Weigh Bridge**		
i)	30 ton Weigh Bridge	325,000.00	0.33
ii)	Concrete Deck with pit	227,285.99	0.23
iii)	Weigh Bridge Operator' Room	228,493.38	0.23
iv)	Septic Tank	45,774.49	0.05
b)	Skid Steer Loader (JCB – 190)	2,700,000.00	2.70
c)	Bulldozer for dozing, leveling & back filling	5,600,000.00	5.60
d)	Approach road to land fill site	3,070,361.55	3.07
e)	Construction of retaining walls	8,516,468.45	8.52
f)	Construction of Sanitary land fill site	18,713,181.25	18.71
g)	Security Fencing	291,966.26	0.29
h)	Drainage	937,643.83	0.94
i)	R.C.C. Tank for Leachate Collection and Treatment	518,202.59	0.52
j)	Tube well with pumping mains	311,500.00	0.31
k)	Ground Level Reservoir	785,976.89	0.79
l)	Fire Fighting Arrangements	99,600.00	0.10
IV	**Sub Total**		**42.25**
V	**Electrical Installations in Solid Waste Management Plant**		
a)	Weigh Bridge, Control Room, Tube Well and Lighting of Landfill Yard.	1,724,178.00	1.72
V	**Sub Total**		**1.72**
VI	**Other Infrastructure Facilities**		
a)	Garages for Primary Transportation vehicles	2,237,957.48	2.24
b)	Garages for Secondary Transportation Vehicles	1,315,191.61	1.32
c)	Operator's Rest Room	1,026,201.61	1.03
d)	Security Guard's Room	454,958.17	0.45
VI	**Sub Total**		**5.03**
VII	Environmental Budget (Mitigation & Monitoring Measure and Capacity Building)	828,000.00	**0.83**
	Sub Total		**0.83**
	TOTAL (I + II + III + IV + V + VI + VII)	76,598,557.92	**76.59**
Say			**76.60**

(Source: SMEC-India Pvt. Ltd.)

11.3 EXPENDITURE TOWARDS OPERATION & MAINTENANCE ON SWM BY SMB

203. In addition to salary and wages, expenditure incurred by SMB on various activities of SWM towards annual operation and maintenance cost is given in **Table 11.2**. In view of the deteriorating environmental conditions of the towns in North-East Region, the Government of India proposed to take up SWM project with ADB assistance and hence this proposal. State government is to make all out efforts with the help of Shillong Municipal Board and all the stakeholders for the success of the project on a long-term basis.

TABLE 11.2 EXPENDITURE ON VARIOUS ITEMS OF SWM

Sl. No.	Item Details	INR million
I	**Expenditure on Primary collection vehicles**	
1.	Number of collection vehicles - 30 {(4-wheeler TATA-mini-truck, 1.5 cu m capacity Hydraulically Operated),Number of drivers :- 30	
2.	Distance covered by each vehicle per day – 30 km	
3.	Total distance covered by vehicles per day =30 x 30 = 900 km	
4.	Fuel consumption per vehicle 10 km per liter	
5.	Total quantity of fuel required 900/10 =90 liters	
6.	Cost of fuel per liter – INR 32 per liter	
7.	Cost of fuel per day 90 x 32 = 2880 for 30 vehicles	
8.	**Cost of fuel per year = 2880 x 30 x 12 = 10,36,800**	
9	Salary of driver per day – INR 300	
10.	**Total salary of 30 drivers per year – 300 x 30 x 30 x 12 = 32,40,000.00**	
11.	Salary of helper and other expenses 700 per day per vehicle	
12.	**Total salary of helpers and other expenses per year – 700 x 30 x 30 x 12 = 75,60,000.00**	
13.	Total expenditure on primary collection vehicles 118,36,800 0r =INR 11.84 million	= 11.84
II	**Expenditure on Secondary collection vehicles**	
14.	Number of secondary collection vehicles - 17 (Tipper-trucks, 4.5 cu m capacity, Hydraulically operated). Number of drivers :- 17	
15.	Distance covered by each vehicle per day – 30 km	
16.	Total distance covered by vehicles per day 17 x 30 = 510 km	
17.	Fuel consumption per vehicle 6 km per liter	
18.	Total quantity of fuel required 510/6 = 85 liters	
19.	Cost of fuel per liter – INR 32 per liter	
20.	Cost of fuel per day – 85 x 32 = 2720	
21.	Total cost of fuel per year – 2720 x 30 x 12 = INR 9,79,200	
22.	Salary of driver per day – INR 300	
23	**Total salary of 17 drivers per year – 300 x 17 x 30 x 12 = 18,36,000.00**	
24.	Salary of helper and other expenses – INR 700	
25.	**Total salary of helpers and other expenses per year – 700 x 17 x 30 x 12 = 42,84,000.00**	
26	**Total expenditure per year 70,99,200 or = INR 7.10 million**	**= 7.10**
III	**Expenditure on SWM personnel**	
27.	Executive Engineer In-charge SWM -1 (1 x 30,000 = 30,000) per month	
28.	Senior Sanitary Officer – 3 (3 x 8000 = 24000) per month	
29.	Sanitary Inspector – 5 (5 x 7000 = 35000) per month	
30.	Sanitary Sub-Inspector – 5 (5 x 5000 = 25000) per month	
31.	Sanitary Supervisor – 8 (8 x 4000 = 32000) per month	

Sl. No.	Item Details	INR million
32.	Street Sweepers – 310 (155 x 3000 = 4,65,000) per month (considering half day work of each sweeper)	
33.	Total Salary per month = INR 6,11,000.00	
34.	**Total Salary of SWM personnel per year INR 6,11,000.00 x 12= 73,32,000 or = INR 7.33 million**	**7.33**
IV	**Expenditure on other staff at SWM site**	
35.	Security Guard 3 shifts (3 x 7500 = 22500) per month	
36.	Weigh-Bridge operator – 1 (1 x 7500 = 7500) per month	
37.	Electrician-cum-Pump operator – 1 (1 x 8000 = 8000) per month	
38.	Total salary per month = INR 38000	
39.	**Total salary per year (38000 x 12 = 456000) or = INR .46 million**	**0.46**
V	**Expenditure on Operational Staff**	
40.	Salary of Bulldozer driver – 1 (1 x 10000 = 10000) per month	
41.	Salary of JCB driver – 1 (1 x 10000 = 10000) per month	
43.	Total salary per month = INR 20000	
44.	**Total salary per year 20000 x 12 = 2,40,000 or INR 0.24 million**	**0.24**
VI	**Electrical charges per year**	
47.	Energy consumption per year = INR 0.370 million	
48.	**Total expenditure on electrical charges =2,54160 or = INR 0.25m**	**0.25**
VII	**Cost of earth for daily cell coverage**	
51	Area of each cell = 5.14 sq.m	
52.	Thickness of daily coverage = 0.10 m	
53.	Volume of earth for daily coverage = 5.14 x 0.10 = 0.514 cu.m	
54.	Total volume of earth per year 0.514 x 365 = 187.61 cu m. Say 190 cu.m	
55.	Cost of earth cover per year = 190 x 150 = 28,500 or = INR 0.03m	0.03
56.	**(Earth for daily coverage available near landfill @ 150 per cu.m)**	
ANNUAL EXPENDITURE ON SWM ACTIVITIES (I+II+III+IV+V+VI+VII)		**INR 27.25 million**

11.4 INCOME FROM VARIOUS SOURCES RELATING TO SWM

204. Expected income from various sources and activities related to SWM for SMB has been arrived at on the basis of number of assumption for drawing income from all the possible sources so as to make the SWM system self sustainable. An exercise has been carried out to assess the total income generated from various sources and has been tabulated in **Table 11.3.**

TABLE 11.3 INCOME FROM VARIOUS SOURCES RELATING TO SWM

Sl. No. (1)	Items Details (2)	INR million (3)
I	**Income from collection of user charges**	
	Total number of households in SUA area (2010 – 11)	61,562
	Number of HHs for user charges (less 20% urban poor)	49,250
	Number of HHs for user charges (less 75% of 49,250)	36,937
	Collection rate of user charges per month	30.00
	Revenue from user charges per year	**13.3**
II	**Income from Recyclables**	
	Total number of households in Shillong Urban Agglomeration Area (Yr 2010-11)	61,562

Sl. No. (1)	Items Details (2)	INR million (3)
	No. of persons per HHs	5
	Total population	307810
	Waste generated per person per day (kg)	**0.45**
	Total quantity of waste generated per year (in Tons)	50557.79
	Proportion of recyclable waste (35%)	17695.23
	Saleable waste (45% of recyclable waste)	7962.85
	Monetary value of recyclable waste Rs. 3000.00 per ton)	**23888550**
	Revenue from Recyclable Waste Per Year	**23.89**
III	**Revenue from Property Tax**	
	Total Households in SUA Area (2010-11)	61562
	Assessed households (75% of Total Households)	46172
	Proposed average property tax per year	500
	Conservancy tax (3% of proposed average ARV per property tax per year) (3% of AV property tax per year)	15
	Total Revenue through Conservancy Tax per year (INR in million) (46172 x 15 = 6,92,580	0.69
IV	**Revenue from waste collection dumping charges from Cantonment and 5 municipalities**	
	Generation of Total Waste	40 T.P.D
	Tipping charges per month (40 x 50 x 30) @ Rs. 50/- per ton per day	INR 60,000.00
	Tipping Charges per year (60,000.00 x 12) = 7,20,000 = INR 0.72 million	**I0.72**
TOTAL INCOME PER YEAR AS ASSESSED (I + II + III + IV)		**INR 38.60 million**

205. From the above Table 11.2, it could be inferred that the total expenditure on SWM is about INR 18.76 million which is about 24.5% of the capital investment per year. Whereas, as mentioned in Table 11.3, income from various sources relating to SWM activities is around INR 28.85 million per year. From this exercise, it is concluded that the income or revenue generated is more than 1.5 times more than of the expenditure uncured on SWM per year. This a very encouraging indication with regard to implementation of SWM Project in Shillong, provided Government of Meghalaya, Shillong Municipal Board, and all other concerned agency (s) make concerted efforts to translate all the necessary actions on the ground with the help and involvement of all stake holders with a proper legal support.

11.5 IMPLEMENTATION OF VARIOUS SWM ACTIVITIES

192. The implementation schedule of SWM project for GSPA could be divided into various categories of activities mentioned below. Some the activities have to be taken up from the beginning of the SWM project simultaneously, whereas, few of the activities will have to follow certain sequence so as to achieve the desired output from the implementation of the SWM project on a long term sustainable basis.

(i) Procurement and distribution of LLDP household-bins and PVC bags,
(ii) Procurements of bins for market areas and for street sweeping,
(iii) Procurements of PPE for street sweepers and distribution,
(iv) Generating awareness campaign among all the stakeholders,
(v) Initiating studies on market availability and investor participation.

(vi) Appointments of drivers and helpers for primary collection and secondary transportation vehicles and for landfill machineries,
(vii) Appointments of personnel for operation and maintenance of landfill site.
(viii) Procurements of vehicles for primary collection and secondary transportation,
(ix) Development and construction of sanitary landfill,
(x) Construction of other infrastructure facilities such as buildings, and garages with adequate provisions of water supply, electricity, sanitation, and other related facilities.
(xi) Procurement of machinery for landfill site,
(xii) Development, and construction of roads at landfill site,
(xiii) Construction of leachate tank and storm water drainage at SWM site,
(xiv) Construction of garages and workshop for transportation vehicles and landfill machineries,
(xv) All electrical installation at landfill site,
(xvi) Plantation of trees for buffer zone,

All the above activities will have to be put into operation within a period of 30 months. State Government and all the concerned agencies will have to make all out efforts to put all these in place within the specified time-frame. Any spill over period will have adverse effect on the economics of the project sustainability.

As mentioned in **Table 11.4** regarding implementation schedule of SWM activities in GSPA, some of the activities, as mentioned above, will have to be taken up simultaneously so as to complete the project within the prescribed time-frame of 30 months.

TABLE 11.4 IMPLEMENTATION SCHEDULE OF SWM ACTIVITIES IN GSPA

Sl. No.	Activities	Year – 1 (Quarters)				Year – 2 (Quarters)				Year – 3 (Quarters)	
		I	II	III	IV	I	II	III	IV	I	II
1.	Generating awareness campaign among all the stakeholders regarding SWM program										
2.	Procurement and distribution of LLDP household-bins and PVC bags, bins for market areas and for street sweeping, PPE for street sweepers and distribution.										
4.	Appointments of drivers and helpers for primary collection and secondary transportation vehicles and for landfill machineries,										
5.	Appointments of personnel for operation and maintenance of landfill site										
6.	Procurements of vehicles for primary collection and secondary transportation of waste.										
7.	Procurements of machinery for landfill site										
8.	Development of landfill site										
9.	Development and construction of inner roads.										
10.	Construction of retaining walls at landfill site.										
11.	Construction of leachate tank and storm water drainage at landfill site.										
12.	Installation of weigh bridge.										
13.	Construction of all buildings and related infrastructures with all facilities such as water supply, electricity, and other related facility.										
14.	Construction of garages and workshop for vehicles and landfill machineries.										

Sl. No.	Activities	Year – 1 (Quarters)				Year – 2 (Quarters)				Year – 3 (Quarters)	
		I	II	III	IV	I	II	III	IV	I	II
15.	All electrical installation in SWM site.										
16.	Plantation of trees for buffer zone.										

12. LEGAL ASPECTS

12.1 INTRODUCTION

193.Solid Waste Management practices can never reach the desired level of efficiency until the public participates and discharges its obligation religiously. The system therefore, can only be improved by modernizing the solid waste management system by urban local bodies and ensuring public participation through very serious motivational efforts and by providing adequate legislative support for improving SWM activities efficiency with punitive measures for defaulters.

12.2 PRESENT SCENARIO

206. Local bodies in the country are governed by various laws enacted by their respective State Legislatures. Many state laws governing urban local bodies do not have adequate provision for ensuring appropriate solid waste management systems with the result out dated systems continue affecting quality of life of the people. For improving solid waste management practices in urban areas it is necessary to incorporate suitable provisions in the state legislation to ensure public participation and providing for minimum level of solid waste management service.

207. Local laws also need to provide for punishment for on the spot for those who do not adhere to the directions given for maintaining appropriate solid waste management systems in the urban areas, giving adequate powers to local authorities to punish the offenders.

12.3 LEGISLATIONS ENFORCED IN MEGHALAYA

208. The Government of Meghalaya enacted many Acts for the protection of land and environment. Few of the Acts relevant to the SWM project in GSPA are highlighted as under:

12.3.1 MEGHALAYA TRANSFER OF LAND (REGULATION) ACT, 1971

209. The Meghalaya Transfer of Land (Regulation) Act, 1971 is applicable in the State that protects tribal land alienation. However, the act also has an exemption clause that states “Nothing contained in this Act shall apply to any transfer of land to , or in favor of, Government or Autonomous District Council.”

210. MLTRA specifies “No land in Meghalaya shall be transferred by a tribal to a non-tribal or by a non-tribal to another non-tribal expect with previous sanction of the competent authority. Provided the Government of Meghalaya is satisfied may, from time to time, by notification, prohibit any transfer of land within such area or areas as may be specified in the notification and there upon the competent authority shall not sanction any such transfer of land under the provision of this Act, within such area or areas.

12.3.2 THE MEGHALAYA TREE (PREVENTION) ACT, 1976

211. The act makes provisions for regulating the felling of trees for the purpose of protecting catchment area and soil from erosion and to preserve the special characteristics of hilly areas such as landscapes, vegetative cover and climate. Following are the salient features of the act in reference to the project:

i. **Felling of trees:** No person shall fell any tree without prior written permission from Divisional Forest Officer (DFO). The DFO shall not refuse the permission

if the tree is dead, diseased, over matured, wind fallen or has become dangerous to life and property.

ii. **Duration of granting permission:** The Act direct the DFO that duration of granting permission shall not be greater than 2 months from the date of the submission of the application.

12.3.3 MEGHALAYA FOREST AUTHORITY ACT, 1991

212. The Act directs the State Government to constitute an authority for the unified control of forest in the state. Under this Act, Meghalaya Forest Authority comprising the Chief Minister, Minister in Charge of Forest and Environment and the Chief Executive Members of the Autonomous District Councils of the state shall be formed. The authority shall advice the state government in preparation of forest plan and schemes, co-ordination and implementation of forest laws and other matters connected with the preservation of forest in the state.

12.3.4 THE MEGHALAYA PROTECTION OF CATCHMENT AREA ACT, 1992

213. The Act directs the state government to make provision for the protection of catchment areas (Catchment Area means an area where springs, streams, rivulets and water sources originated and serve as potential sources of perennial flow of water) with a view to preserve water. Following are the salient features of the Act in references to the project:

i. **Constitution of Meghalaya Catchment Area Advisory Board:** The Act directs the state government to constitute "Meghalaya Catchment Areas Advisory Board". The Advisory Board advises the state government for identification, delineation, preservation and protection of catchment areas.

ii. **Classification of Catchment Areas:** Under the Act, catchment areas are classified into critical catchment area (Critical Catchment Area means the area from where springs, streams, rivulets and water heads potential serve the water supply system of any village or town and the preservation of which is so vital for the life and health of the community) and non-critical catchment area (Non-critical Catchment Areas refers to all other catchment areas that are not identified as critical area).

iii. **Provision of Activities in Critical Catchment Areas:** Incase of critical catchment area, the Act prohibits within a distance not exceeding 200 meters from the periphery of area – felling of trees, destruction or clearing of grooves or bushes or any other vegetative covers, jhum cultivation, use of any insecticides or pesticides, quarrying of sand or stone, excavation of earth and construction of roads.

iv. **Prohibition of Activities in Non-critical Catchment Areas:** In case of non-critical areas, the Act prohibits above mentioned activities without permission from competent authority (Competent Authority refers to Special Secretary / Secretary of Forest and Environment Department), within a distance not exceeding 100 meters from the periphery area.

v. **Grant or Refusal of Permission:** Competent Authority grant or refuse permission considering the nature, period of activity and examining extent of damage likely to be caused by the proposed activity.

12.3.5 Meghalaya Municipal Act 1973

214. For making Shillong environment friendly and ensuring effective, Collection, transportation, treatment and disposal of the city waste it is necessary that Provisions under section 214 and subsection 4, section 216 of Meghalaya Municipal Act 1973 and section 46 of the byelaws need to be enforced. The above provisions are In respect of penalty for throwing waste on the places other than authorized by SMB Which varies from INR 20 to 25 for each offense, and is compounded for subsequent violation of the Act and the bye laws. To work as deterrent it is recommended the Penalty may increased substantially by making appropriate amendments and through rigorous enforcement for which SMB may take the assistance of the local Dorbars. outside the SMB, the local Dorbars themselves may impose such penalties as per customary laws and usage.

12.4 SOLID WASTE MANAGEMENT RULES TO BE FOLLOWED

215. There are important solid waste manage Rules, as mentioned below, enacted by the Ministry of Environment and Forests, Government of India to be followed by the States/Urban local bodies for their implementations. These, following Acts have been framed for the benefit of urban local bodies in the country so that these could be implemented by them following the proper procedure for their promulgation as by-laws of the urban local body. These are:

i. Municipal Solid Waste (Management and Handling) Rules, 2000- **Annexure-1**
ii. Bio-Medical Waste (Management and Handling) Rules, 1998 – **Annexure - 2**

216. Information on legal aspects is essential to enforce and maintain Environmental Sanitation. Following information is to be made in each ward/town/city and also to the public;

a. Municipal Act

b. Public Health Act

c. Penalties and enforcement

d. Administrative charges

e. Special service charges

f. Mobile Courts

g. Public Interest Litigation (PIL) cases

217. The information format for the above may be referred as given in the manual on “Municipal Solid Waste Management” published by the Ministry of Urban Development, Government of India.

12.5 ENVIRONMENTAL REGULATORY COMPLIANCE

218. The implementation of any sub-project proposed under Project Implementation and Urban Management Improvement in the North Eastern Region, ADB-TA-4779-IND (Pkg.-A) will be governed by the Environmental Acts, Rules, Policies, and Regulations of the Government of India and the respective state governments of the Northeast Region. These regulations impose restrictions on the activities to minimize/mitigate likely impacts

on the environment. The following are the environmental regulations applicable to PIUMI-NER-ADB-TA-4779-IND (Pkg.-A):

(i) The Water (Prevention and Control of Pollution) Act, 1974, amended 1988;

(ii) The Water (Prevention and Control of Pollution) Rules, 1975;

(iii) The Air (Prevention and Control of Pollution) Act 1981, amended 1987;

(iv) The Air (Prevention and Control of Pollution) Rules, 1982;

(v) The Environment (Protection) Act, 1986, amended 1991 and including the following Rules/Notification issued under this Act;

(vi) The Environment (Protection) Rules, 1986, including amendments;

(vii) The Municipal Solid Wastes (Management and Handling) Rules, 2000;

(viii) The Hazardous Wastes (Management and Handling) Rules, 1989;

(ix) The Bio-Medical Waste (Management and Handling) Rules, 1998;

(x) Noise Pollution (Regulation and Control) Rules, 2000;

(xi) Wild Life (Protection) Amendment Act, 2002;

(xii) Environmental Impact Assessment Notification, 2006;

(xiii) Environmental Standards of Central Pollution Control Board (CPCB);

(xiv) The Indian Wildlife (Protection) Act, 1972, amended 1993;

(xv) The Wildlife (Protection) Rules, 1995;

(xvi) The Indian Forest Act, 1927;

(xvii) Forest (Conservation) Act, 1980, amended 1988;

(xviii) Forest (Conservation) Rules, 1981 amended 1992 and 2003; and

(xix) Guidelines for Diversion of Forest Lands for Non-Forest Purpose under the Forest (Conservation) Act, 1980.

219. Any component included in project shall comply with the above environmental laws, standards, rules and requirements. Key standards include those related to drinking water quality, air quality, effluent discharge, leachate quality, and protected areas. Compliance is required in all stages of the project including design, construction, and operation and maintenance. Components relevant to this sub-project, which fall under the ambit of environmental regulations and mandatory requirement, are indicated in **Table 12.1**

TABLE 12.1: ENVIRONMENTAL REGULATORY COMPLIANCE FOR THE PROJECT

S. No	Component	Applicable Legislation	Compliance	Action Required
1	All components that require forest land acquisition	Forest (Conservation) Act, 1980 &and Wildlife Act, 1972	Approval of the Ministry of Environment and Forests, GoI	Identification of non-forest land and afforestation program need to be formulated
2.	Municipal Solid Waste Facility	Municipal Solid Waste Management and Handling Rules (SWMHR), 2000; Water (Prevention and Control of Pollution) Act, 1974 and/or the Air (Prevention and Control of Pollution) Act, 1981	Authorization from SPCB. No Objection Certificates (NOC), Certificates for Establishment (CFE) and Certificates for Operation (CFO).	Municipal Authority to receive proper authorization (CFE and CFO) from State Pollution Control Board (SPCB) for setting up waste processing and disposal facility including landfills.
			Renewal of CFO during operation	Based on the performance of the solid waste facility and its compliance with the discharge standards CFO will be renewed every year.

12.6 ENVIRONMENTAL COMPLIANCE

220. The new EIA Notification of 2006 of Government of India, which replaces the EIA Notification of 1994, requires environmental clearance for certain defined activities/projects. This Notification classifies the projects/activities that require environmental clearance (EC) into 'A' and 'B' categories depending on the impact potential and/or scale of project. For both category projects, prior environmental clearance is mandatory before any construction work, or preparation of land except for securing the land, is started on such project or activity. Clearance provisions are as follows:

a. Category 'A' projects require prior environmental clearance from the MoEF, Government of India[13];

b. Category 'B' projects require prior environmental clearance from the State Environment Impact Assessment Authority (SEIAA)[14]; and

c. This Notification provides that, any project or activity specified in Category 'B' will be treated as Category A, if located in whole or in part within 10 km from the boundary of (i) Protected Areas notified under the Wild Life (Protection)

[13] For Category A projects, based on the preliminary details provided by the project proponent as per Notification, the Expert Appraisal Committee (EAC) of MoEF, determine comprehensive TOR for EIA studies. This TOR will be finalized within 60 days. On the recommendation of the EAC based on EIA studies, MoEF provides the EC.

[14] The B category projects will be further divided by State Level EAC into B1 – that require EIA studies and B2 – no EIA studies. The State Level EAC will determine TOR for EIA studies for B1 projects within 60 days. On the recommendation of the State level EAC based on EIA studies, SEIAA provides the EC.

Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, (iv) inter-State boundaries and international boundaries. Also, in the case where a SEIAA does not exist, Category B project will be reclassified as Category A and reviewed by the MoEF.

221. Consequently, requiring Prior Environmental Clearance is solid waste facilities, otherwise referred to as Common Municipal Solid Waste Facilities (CMSWF). Common municipal solid waste management facilities qualify as Category B projects and are thus reviewed by the respective SEIAA. For solid waste facilities, the Government of India further ensures environmental safeguards through its Municipal Solid Waste Management and Handling Rules (SWMHR), 2000 as published under MoEF.

222. This project focuses only on solid waste components. Therefore the construction of a sanitary landfill site (solid waste facility) qualifies the project as a Category B under GoI law. The project is to be reviewed by the Nagaland SEIAA, as well as ensure environmental safeguards through its Municipal Solid Waste Management and Handling Rules (SWMHR), 2000 as published under MoEF.

223. These Rules issued under the Environment (Protection) Act, 1986 with the objective of regulating the management and handling of the municipal solid wastes is applicable to all municipal solid waste subprojects. The important provisions are:

a. Solid waste generated in a municipal area shall be managed, including segregation, collection, transportation, and disposal in accordance with the Rules;

b. The State Pollution Control Board will authorize waste processing and landfills;

c. Solid waste processing and landfills shall meet design and operation specifications/standards specified under the Rules. These include site and facility design specifications, output compost characteristics, pollution control and monitoring programs, including closure of landfill site and post-care.

224. At the state government level, solid waste subprojects require review by the respective State Pollution Control Board (SPCB). These subprojects are required to obtain the following clearances from SPCB: No Objection Certificates (NOC), Certificates for Establishment (CFE) and Certificates for Operation (CFO).

225. A location map of the solid waste and compost facility in Shillong is presented in **Figure 6.2.**The map clearly indicates the proposed site is not within or near sensitive and valuable ecosystems, including protected areas and forests. There are also no sensitive receptors occurring within 500 m of the site.

226. As per ADB Environmental Assessment Guidelines 2003, the Project Solid Waste Disposal Site falls under Category B project. As such, an Initial Environmental Examination (IEE) is required, as no significant adverse impact has been envisaged, as mentioned above.

13. ECONOMIC AND FINANCIAL ANALYSIS

13.1 BACKGROUND

227. The Shillong City has proposed a project to obtain financial support from Government of India/Government of Meghalaya for improvements to the existing Solid Waste Management (SWM) system in the city. As a part of a larger package of urban infrastructure development in selected cities of North Eastern Region (NER) States and as the magnitude of capital funds are expected to be very high, the Asian Development Bank (ADB) has been approached for funding the investment. After due process of initial procedures and deliberations, the Detailed Project Report (DPR) for the SWM system Project for Shillong Municipal Board (SMB) has been prepared as per the ADB Guidelines under the Project Implementation and Urban Management Improvement Unit (SIPMIU) in the North Eastern Region (NER).

13.2 SCOPE AND COST OF THE PROJECT

228. From the earlier Chapter on cost estimates, the scope of the project in terms of broad categories of components with estimated costs are summarized as given below:

	Components of SWM	**INR in million**
1.	Primary and secondary collection and transportation	26.77
2.	Development of sanitary landfill site with electrical equipment	40.98
3.	Other infrastructure facilities and others	8.85
	Total	**76.60**

229. Thus, the total capital investment of the proposed SWM project is INR 76.60 million

230. The estimated O & M cost is to INR 27.25 million. This constitutes 35.57% of the total cost of the project.

231. The project is designed to benefit estimated population of about 0. 164 million persons (32802 HHs), In SMB area and 0.328 million persons (61562 HHs) in Shillong Urban Agglomeration (SUA) area at the base year 2010-11. It is expected to benefit the GSP area in due course.

232. As a part of the DPR, an appraisal of the project has been carried out and prepared as per the ADB Guidelines to assess the viability, feasibility, sustainability and economic and financial cost and benefits of the project.

13.3 CONSTRUCTION/INSTALLATION PERIOD AND LIFE SPAN

233. It is given in the earlier Chapters of this DPR that the duration of construction period is 18 months and the expected life span/designed period of the project is 15 years. Base on these inputs, the capital cost is proportionately divided between the two years with INR 51.07 million for first 12 months and 25.53 million for next 6 months for calculating economic and financial streams.

13.4 ORGANIZATION OF THE CHAPTER

234. This Chapter is organized in the following order:

1. The conceptual and methodological issues of financial appraisal of the project consisting of Economic Analysis and Financial Analysis to assess the viability and feasibility of the proposed investment with the ADB loan.
2. The derivation of results of Economic and Financial analysis;
3. Sensitivity Analysis and Shifting Values to test the certainty of the values and risks involved with variations in costs and benefits.
4. A note on implications or relevance of Financial Operating Plan for SMB;
5. Implications of proposed ADB loan on annual budgets of Central Government and State Government of Mizoram;
6. Project implementation and managerial structure of the implementing and executing agencies or departments for the project
7. ADB Loan disbursement arrangement and funds flow process;
8. Accounts and auditing procedures to be followed for ADB fund utilization;
9. Project supervision, review and reporting procedures and arrangements; and
10. Summary with findings and policy recommendations.

13.5 SOURCE OF INFORMATION AND REFERENCES

235. For conceptual and methodological discussion, the main documents referred are :

(i) ADB *Guidelines for Financial Management and Analysis of Projects,* July, 2005,

(ii) ADB Handbook for Barrowers on the Financial Management and Analysis of Projects, 2006,

(iii) ADB and Guidelines for the Economic Analysis of Projects, 1997.

236. The references for statistical data are given at the respective places.

13.6 CONCEPTS AND NEED OF ECONOMIC AND FINANCIAL ANALYSIS

237. The “Economic Analysis” measures the effect of the project on the national economy.

238. The “financial analysis” of a project estimates the profit accruing to the project-operating entity or to the project participants.

239. The economic analysis of project is similar in form to financial analysis; both appraise the profit of an investment. For a project to be economically viable, it must be financially sustainable, as well as economically efficient.

240. If a project is not financially sustainable, economic benefits will not be realized.

241. Financial analysis and economic analysis are therefore two sides of the same coin and complementary.

242. Both types of analysis are conducted in monetary terms, the major difference lying in the definition of costs and benefits.

13.6.1 Economic Analysis

243. Economic analysis attempts to assess the overall impact of a project on improving the economic welfare of the citizens of the country/state/region concerned. It assesses a project in the context of the national economy, rather than for the project participants or the project entity that implements the project.

244. Economic analysis differs from the financial analysis in terms of both (i) the breadth of the identification and evaluation of inputs and outputs, and (ii) the measure of benefits and costs.

245. Economic analysis include all members of society, and measures the project's positive and negative impacts in terms of willingness to pay for units of increased consumption, and to accept compensation for foregone units of consumption. Willingness to pay and willingness to accept compensation are used rather than prices actually paid or received because many of the project impacts that are to be included in the economic analysis will not have price tags such as water supply and sanitation benefits. Thus, some form of non-market value must be estimated.

246. Shadow prices can be used in estimating the willingness to pay and willingness to accept compensation values in the face of these market absences and market imperfections.

13.6.2 Financial Analysis

247. In financial analysis all expenditure incurred under the project and revenues resulting from it are taken into account. This form of analysis is necessary to:

i. assess the degree to which a project will generate revenue sufficient to meet its financial obligations,

ii. assess the incentives for producers, and

iii. ensure demand or output forecasts on which the economic analysis is based are consistent with financial charges or available budget resources.

13.6.3 Steps is Financial Analysis

248. The ADB Guidelines specify the following steps in the financial analysis of the projects:

i. Preparing projects cost estimates;

ii. Forecasting incremental project net cash flows;

iii. Determining the appropriate discount rate (IRR);

iv. Calculating the present worth of cash inflows and outflows financial net present value (FNPV);

v. Calculating the financial internal rate of return (FIRR);

vi. Undertaking risk and sensitivity analysis and,

vii. Examining the implications of ADB loan on Central and State Government budgets before and after receipt of the loan;

249. Sensitivity Analysis (SA) should be applied to project items that are numerically large, or for which there is considerable uncertainty.

250. The results of the SA need to be summarized through a Sensitivity Indicator (SI) and in a Switching Value (SV).

251. The SI measures the % change in NPV or IRR to the % change (increase or decrease) in a selected variable such as Capital cost, O & M cost, economic or financial benefits. Higher the value of SI, higher the sensitivity to the selected variable. However, up to 10% is considered as an acceptance limit.

252. The SV is the ratio of % change in a variable (ie. Capital cost or O &M Cost) and % change in NPV or IRR. It explains the change or variation in a variable required for a project decision to switch or shift from acceptance to rejection. Obviously, the SV is a reciprocal of SI. The ADB Guidelines suggest a quantitative risk analysis incorporating different ranges for key variables for large projects and those close to the cut off rate.

253. Financial Sustainability: In this analysis, it is assumed that the implementing agency (i.e urban local body – ULB) will carry out reforms indicated as assumptions for financial projections. It examines whether the ULB has the financial capacity in the form of annual budget surpluses to absorb the annual O&M costs in its normal budgets during the life span period.

254. Financial Operating Plan (FOP) for ULB: In the FOP, projections are made to evaluate the ULBs fund/financial status for different scenarios.

255. FOP is based on a whole range of assumptions related to revenue and expenditures of the ULB.

256. Thus, the FOP is based on projections of cash flow streams of the ULB based on the regular municipal revenues, expenditures and applicability of surplus funds to support project sustainability.

257. Similarly, Financial Plans for Central and State Governments also need to be carried out to assess the financial capacity and impact of the proposed loan from ADB for the project.

13.6.4 Economic And Financial Viability Considerations

258. The proposed sub-projects will have to satisfy the following criteria:

i. The cost and benefit analysis for the individual sub-projects shall give a positive NPV and an EIRR equal or above the appropriate opportunity cost of capital estimated at the rate of 12%.

ii. If the NPV shows negative or the EIRR below 12%, additional qualitative analysis will be carried out.

iii. The estimated Weighted Average Cost of Capital (WACC) is 4.2%. Hence, the estimated FIRR should be more that the WACC with positive FNPV. The derivation is presented in the following **Table 13.1**.

259. Sub-projects to be funded should yield FIRR more than WACC rate, which is estimated as 4.2%. This is arrived at by taking the present London Inter Bank offered Rate (LIBOR) with additional charges totaling to the effective interest rate of 1.7% charged by ADB for its loans.

TABLE 13.1: CALCULATION OF WACC RATE

Interest Rate		INR million
Share of ADB (Loan) @1.7% interest	1.70%	0.912
Share of GOI @ 10% interest	10%	2.298
Total Interest		3.21
WACC (%)		4.20%

WACC = (Total Interest/ Total Capital Cost)

i. The sub-projects must be financially sustainable for O&M.

ii. For non-remunerative projects it must be demonstrated that funds for O&M are being budgeted.

iii. For sectors with partial or full-cost recovery, tariffs and other revenue sources should at least demonstrate capacity to cover O&M costs.

iv. Construction costs must be identified and contingencies calculated and the cost estimates shall be justified.

v. The financial health of the ULB (status of borrowing institution's capacity) making the investment shall be assessed; its debt servicing capacity shall be adequate.

13.7 METHODOLOGY - OVERVIEW

i. The cash flows for EIRR need to be discounted using the appropriate opportunity cost of capital (12%) and for FIRR, the discounting rate will be present rate of WACC (4.2%).

ii. The analysis includes calculation of the EIRR, FIRR with respective NPV values.

iii. The base year is 2010-11 and all amounts used in the models will be in the base year prices.

iv. The construction and installation period should also be decided as per the time schedule.. The period of analysis is taken as 15 years (life span) after investment becomes operational, without re-investment during this period; therefore the life span is assumed as 15 years.

v. Data used for sub-project analysis are actual and obtained from socio-economic indicators, surveys, interviews, focus groups, or actual on-site observations.

13.7.1 Estimating Economic Costs And Benefits

260. **Economic costs** are estimated by applying standard conversion factors and they include:

i. capital costs (including designing, planning and engineering costs, construction costs, etc.)

ii. operating and maintenance costs (O&M)

iii. contingencies, cost escalations and complementary actions necessary to achieve the expected benefits like costs of environment protection pollution control etc.

261. For facilities in ULB/Areas with existing services, the benefits from the investment will be established based on the direct use benefits (e.g. measured by the tariffs charged to customers) and the opportunity cost of not having access to these services (e.g. time savings, health benefits in the form of increased water consumption, productivity benefits and/or other benefits that apply in the Indian context).

262. The Economic Rate of Return (EIRR) is an Internal Rate of Return (IRR) of the sub-project when NPV (calculated based on economic prices) equals zero.

263. Sub-projects to be funded should yield an ERR equal to at least the appropriate opportunity cost of capital (12%).

13.7.2 The Cost-Effectiveness

264. The cost-effectiveness indicator is used to assess the burden of the investment costs on the income levels of households. It is the ratio of per capita capital cost and per capita income of the population (Per capita cost of the project/ per capita income).

13.8 Economic And Financial Analysis – Shillong SWM Project

13.8.1 Expected Economic, Social And Environmental Benefits

265. The SWM project for Shillong City is designed as an improvement to the existing SWM system to improve the environmental sanitation and hygiene condition in the SMB area in particular and expected beyond to cover SUA area in general. As an initial step for calculating economic, social and environment benefits, a list of possible sources are listed as given below:

i. **Access:** More households/ families with in core city as well as out side but with in GAPA will be given access to better quality of service through improvement in door to door collection, mechanical transportation, scientific treatment and disposal of waste with an element of cost recovery.

ii. **Coverage:** More households and non-domestic establishments will be covered in core area of Shillong City with the proposed Municipal body with 100 percent coverage and projected to extend to SUA area as well as GAPA in due course.

iii. **Improvement in quality of service:** Improvement in coverage and quantity, the quality of service will also improve with the improvement in the efficiency in collection, transportation and disposal as per the the SWM Rules, 2000..

iv. **Improvement in health conditions:** Savings in health care due to decrease in water/garbage/sanitation/pollution related diseases and improvement in hygiene practices.

13.8.2 Expected Environmental Costs And Benefits

266. In view of the overall improvement to the existing SWM system, it is shown in the earlier Chapter that:

i. There will not be any additional economic costs due to environmental effects like air, water, land pollution etc.

ii. There will be a minimum extent of damage to the green cover as the present project is only an improvement to the existing system within the land belonging to the government.

iii. There are no statutory compliance costs involved.

iv. Contingencies that are taken into account are only cost contingencies at the rate of 3%.

267. Hence, these environmental costs and benefits are equated to insignificant effects.

13.9 Economic And Financial Analysis – Improvement To Shillong SWM Project

13.9.1 Shillong City – Status

268. The governance scenario in Shillong is the most complex of all the capital cities in the NER of the country. There are multiple geographical and functional jurisdictions between State agencies and traditional/tribal institutions that have not been resolved till date. In pursuance of the Sixth Schedule of the Constitution, the whole of Meghalaya has been covered by District Councils in 1961 with powers to create institutions for local government. Apart from this, there is a hierarchy of political organizations performing a variety of judicial and administrative functions. But the most critical control is of land and other natural resources, their occupation and use. Also, the 73rd and 74th Constitutional Amendment Acts do not apply to these areas. While the SMB is able to exercise control in its own area in certain matters, there is still no clarity in the matter of jurisdiction in trade licenses and building regulation. As for the Greater Shillong area, the multiple jurisdiction conflict is between the State Government agencies and the traditional institutions. There have been attempts to incorporate the role of traditional institutions into municipal laws, but these were not successful. Also, elections to the ULBs have been held twice but no council of members could be formed.

269. The functional distribution of the urban services is also not very clear. For example, the responsibility for water supply to Shillong is divided between the PHED, the SMB, the Village Committees and the Durbars.

270. Within its area of operation, the SMB has responsibility for SWM and street lighting and has a partial role in water distribution.

271. These factors do influence significantly in designing the framework for economic and financial management of projects

13.10 ECONOMIC ANALYSIS

272. Project Beneficiaries of the proposed project on SWM for Shilling city will comprise households in SMB area for some components and SUA area for some components. It is envisaged that they will gain from the improved environmental sanitation, living conditions and amenity that a properly functioning solid waste collection and disposal system will provide. The households who are currently disposing off their solid waste will receive additional benefit from primary waste at their door steps.

273. The costs of capital works and annual Operation and Maintenance (O&M) for SWM project are calculated at the actual costs at current prices (2009).

13.10.1 VALUING ECONOMIC BENEFITS

274. The proposed SWM project would clearly improve the hygienic conditions, public health and living standards of the people residing in the Shillong city. The project has also enormous positive fallouts on the private and social spending pattern, particularly on health and family welfare.

275. The incidence of various diseases especially sanitation related is expected to reduce over the years leading to improved health and sanitary conditions and better living environment.

276. The location of the waste Compost Yard outside the town limits is expected to prevent the incidence of foul smell and other negative fallouts.

277. Out of many, some important and core economic benefits which are quantifiable are:

i. Cost savings in personal expenditure on health attributable to existing lack of hygiene (to individuals)

ii. Cost Savings from recovered labor days;

iii. Reduction in drainage cleaning cost incurred by the SMB due to throwing of garbage in drains

13.10.2 SAVINGS IN HEALTHCARE EXPENDITURE

278. The sources of information in this section are derived from TS 4348-IND, NEUD Project, Technical Report: SES, Methodology and Outcome. The required data on the above selected accrued benefits is obtained from the results of the base line sample survey of households for WTP used to arrive at the results with some limitations. For example, the respondents of the survey generally had difficulty in separating out the costs of treating diseases due to environmental sanitation from other diseases. With these types of constraints and assumptions, the required parameters have been derived.

279. The estimation of the annual savings in health expenditure of the population in Shillong city due to the investment on improvement in SWM system are presented in **Table 13.2**. The table gives important indicators such as average annual income by income categories like BPL, marginal, low, middle and high income groups, the share of expenditure on health etc. based on which annual savings in health expenditure has been derived. It is assumed that all the households in the city as well as the households outside the SMB area covering SUA and also GSPA benefit from the proposed SWM system but the benefit is assumed to be thinly spread. Hence, for the purpose of analysis,

it assumed that the HHs in SUA area would directly benefit. Since the benefit is thinly spread, it is further assumed that 20% of the HHs in SUA area is used and arrived the monitory benefit. With this assumption, the calculations are done and presented in the Table.

280. Row (6) gives the average savings of INR 29.49 million as monitory value of benefit.

TABLE 13.2: ESTIMATED SAVINGS IN HOUSEHOLD EXPENDITURE ON HEALTH

Sl. No.	Details	Unit	Income Category of HHs					All
			BPL	MP	LIG	MIG	HIG	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Average Annual HH income per year	INR	14,964	26,196	49,692	144,000	240,000	115,842
2	Annual expenditure on sanitaiton related diseases per HH (5% of Row 1)	INR	748	1,310	2,485	7,200	12,000	**9,580**
3	Annual Health exp. saved due to water related diseases (20% of item 2 above)	INR	150	262	497	1,440	2,400	**1,916**
4	Total number of HHs in SUA area	No.	3,429	7,776	17,730	19,115	13,512	**61,562**
5	No. of beneficiaries HHs in SUA (25% of total HHs)	No.	857	1,944	4,433	4,779	3,378	**15,391**
6	**Annual Savings in Health Expenditure (Row 3 x Row 5)**	**INR in M**	**0.13**	**0.51**	**2.20**	**6.88**	**8.11**	**29.49**

Source: Row 1: Derived from TA 4348-IND, NEUD Project, Technical Report: SES, Methodology and outcome.

13.10.3 SAVING DUE TO DECREASE IN NON WORKING DAYS

281. Another economic benefit to the community due to the investment on proposed SWM system would be the saving in expenditure due to expected decrease in number of non working days. In other words, increase in working days. Here also, we are expecting the benefit to be accrued to the HHs of SUA area. **Table 13.3** gives the estimated values of the variables. It is estimated that, on an average, there will be a saving of 4 working person days in a year due to improvement in health of the community with an average wage rate of INR 260.

282. On the basis of this value, the estimated annual saving due to increase in working days for 25% of HHs is arrived at and presented in row 7. The estimated average monetary value of saving due to this benefit is **INR 8.41** million.

TABLE 13.3: ESTIMATED ANNUAL SAVINGS DUE TO ADDITIONAL WORKING DAYS

Sl. No.	Details	Unit	Income Category of HHs					All
			BPL	MP	LIG	MIG	HIG	
1	Average Annual HH income	INR	14,964	26,196	49,692	144,000	240,000	115,842
2	Average No. of Non-Working days in a year due to health problem	Nos	9	1	4	3	3	**4**
3	Average income per working day	INR	41	72	136	395	658	**260**
4	Average Loss of Income	INR	369	72	544	1,185	1,974	**1,800**
5	Share of loss in income due to bad sanitation and related diseases (30% Row 4)	%	111	22	163	356	592	**540**
6	Total number of HHs in SUS area	No.	3,429	7,776	17,730	19,115	13,512	**61,562**
7	No. of beneficiary HHs (25% of total HHs)	INR	857	1,944	4,433	4,779	3,378	**15,391**
8	**Annual Savings due to gain in working days**	**INR in M**	**0.10-**	**0.04**	**0.72**	**1.70**	**2.00**	**8.41**

Source: Same as in Table: 1 above

13.10.4 SAVINGS IN CLEARING AND CLEANING OF DRAINS

283. The proposed investment on SWM system for Shillong city would also yield economic benefit not only to the community of SUA area but also the SMB in terms of financial savings due to clearing and cleaning of storm water drains where in the garbage is thrown in many parts of the city. When the proposed SWM project is implemented, the waste thrown in the drains will be collected on regular basis and converted into manure. On this assumption, the cost of manure thus generated will yield revenue of **INR 5.90** million. **Table 13.4** gives the details of calculations.

TABLE 13.4: SAVINGS DUE TO CLEANING OF DRAINS

Sl. No.	Details	Unit	
1	Waste generated per household (1.5 Kg x 365)	Kg	548
2	25% of Total House holds of SUA area	No.	15,391
3	Total waste of the households	Million Kg	8.43
4	Conversion of Manure (30% of Total waste (Row 3))	Million Kg	2.95
5	Cost of Manure (@ Rs. 2.00 per Kg)	INR	**5.90**

284. These three economic benefits expected from the capital investment and annual O &M costs on proposed SWM system are summarized and presented in **Table 13.5**.

285. The Table gives cost components (2010-11 rates), monitory values of expected economic benefits which are used to derive the net economic benefits, net present value, and EIRR.

286. It is to be stated that the economic benefits are arrived on iterative basis so as to achieve the EIRR greater than the stipulated rate of 12% and a positive NPV. The project areas, number of beneficiary HHs and the number of years of life span also are dictated by the above requirement.

287. By using the derived key parameters, the cost and benefit streams are arrived at for economic analysis to calculate the EIRR and ENPV. The economic analysis is presented in **Table 13.6.**

288. **The derived value of EIRR is 17.64% and the ENPV is non-negative with INR 23.91 million.**

289. **It implies that the investment on proposed SWM project in Shillong is economically viable.**

TABLE 13.5: SUMMARY OF ECONOMIC ANALYSIS: SWM FOR SHILLONG

Sl. No.	Details	Actuals (2010-11 rates)	Present Value discounted at 12% real rate
1	**Capital Investment Cost**	76.60	65.95
2	**Operation and Maintenance Cost**	27.25	147.96
3	**Total costs**	**103.85**	**213.91**
4	**Net Benefits**		
	i Savings in Healthcare Expenditure	29.49	160.12
	ii Savings due to decrease in number of working days	8.41	45.66
	iii Savings due to cleaning of drains	5.90	32.04
	Sub-Total:	**43.80**	**237.82**
5	Economic Internal Rate of Return	-	**17.64%**
6	Net Present Value (NPV)	-	**23.91**

290. Other positive externalities that cannot be quantified easily include benefits to the various industries and commercial establishments, general enhancement in urban environmental profile, employment opportunities created due to project implementation, solid waste re-use for plantation, horticulture farming and corresponding revenue, increase in property valuation etc. It is expected that the EIRR will be much higher than indicated above when all the aforementioned benefits are quantified.

TABLE 13.6: ECONOMIC ANALYSIS

Sl. No.	Year	Capital Cost	O&M	Total Cost	House hold expenditure on Health	Income due to Increase Working Days	Savings due to Drainage Cleaning	Total Economic Benefits (5+6+7)	Net Economic Benefits
	1	2	3	4	5	6	7	8	9
1	2009-10	51.07	-	51.07	-	-	-	-	(51.07)
2	2010-11	25.53	-	25.53	-	-	-	-	(25.53)
3	2011-12	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
4	2012-13	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
5	2013-14	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
6	2014-15	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
7	2015-16	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
8	2016-17	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55

Sl. No.	Year	Capital Cost	O&M	Total Cost	House hold expenditure on Health	Income due to Increase Working Days	Savings due to Drainage Cleaning	Total Economic Benefits (5+6+7)	Net Economic Benefits
	1	2	3	4	5	6	7	8	9
9	2017-18	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
10	2018-19	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
11	2019-20	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
12	2020-21	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
13	2021-22	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
14	2022-23	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
15	2023-24	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
16	2024-25	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
17	2025-26	-	27.25	27.25	29.49	8.41	5.90	43.80	16.55
								EIRR	17.64%
								NPV@ 12%	23.91

13.11 FINANCIAL ANALYSIS OF SWM PROJECT.

291. The Financial Analysis for the proposed project is done as per the estimated revenue streams from the SWM project.

292. SWM is considered as a revenue generating subproject. However, in the present circumstances of significant proportion of BPL and LIG households, the services like SWM system in urban areas still are not on the capacity of stand-alone projects.

13.11.1 REVENUE ASSUMPTIONS

293. Revenue from the SWM project are based on the following assumptions:

294. There will be revenue from

i. Sale of Recyclable Materials;
ii. Tipping Charges for waste collection;
iii. User Charges and
iv. .SWM tariff

13.11.2 REVENUE FROM SALE OF RECYCLABLE MATERIALS

295. Revenues from recyclable material are based on the present characteristics of SWM. The various sellable recyclable material found are glass, rubber, polythene, tin, metals etc. It is estimated in the earlier chapters that out of a total quantity of about 50557 tons per day waste generated, the proportion of recyclable waste would be about 35% of which expected saleable recycled waste is 45%. At the rate of INR 3000 per ton, the revenue to be generated per year is estimated as **INR 23.89** million. The calculations are given in **Table 13.7 (i).**

TABLE 13.7: ESTIMATION OF FINANCIAL BENEFITS

i).Revenue from Sale of Recyclable Materials		
1	Total Households of SUA Area (Year 2010-11)	61,562
2	Number of persons per households	5
3	Total population in SUA area	307,810
4	Waste generated per person per day (Kg)	0.45

5	Total quantity of waste generated per year) (Tons)	50557.79
6	Proportion of recyclable waste (35%)	17695.23
7	Saleable waste 45% of recyclable waste (Row6))	7962.85
8	Monetary value of recyclable waste (Rs. 3000 per ton) (INR million)	23888550
9	**Revenue from Recyclable waster per year (INR Million)**	**23.89**
ii). Revenue from Waste Collection – Tipping charges		
1	No. of Municipal Areas in SUA Area	5
2	Generation of waste (Tonnes Per Day)	40
3	Tipping charges per month (40 x 50 x 30) @ Rs. 50/- per ton per day	60000
4	**Tipping charges per year (INR 60000 x 12 = INR 720000)**	**0.72**
iii). Revenue from Conservancy Tax of Property Tax		
1	Total Households in S M B Area (2010-11)	61,562
2	Assessed households (75% of Total Households)	46,172
3	Proposed Average property tax per year	500
4	Conservancy Tax (3% of Proposed Average ARV per property tax per year)	15
5	**Total Revenue through Conservancy Tax per year (INR in Million) (Row 2 x Row 4)**	**0.69**
iv). Revenue from Collection of User Charges		
1	Total number of HHs in SMB Area (2010-11)	61,562
2	Number of taxable HHs for user charges (less 20% urban poor)	49,250
3	Number of HHs for user charges (75% of Row2)	36,937
4	Collection rate of user charges per month (INR)	30
5	**Revenue from user charges per year (INR in million)**	**13.3**

13.11.3 REVENUE FROM SALE OF MANURE

296. The other revenue source from SWM process is the tipping charges collected from transporters of garbage from collection points landfill site at the rate of INR 50 per ton. This works out to INR 0.72 million.

13.11.4 REVENUE FROM SWM TARIFF

297. Tariffs have been estimated based on the assumption that a significant share of O&M cost will be recovered by the SMB from HHs. It is assumed that in the base year, 75% of HHs will be assessed for property tax. Out of the property tax revenue, 3% is for conservancy service which works out INR 15 of expected property tax INR 500. Thus, the share of SWM service is expected annual property tax revenue is estimated and presented in **Table 13.7**. The estimated revenue per annum will be **INR 0.69** million.

13.11.5 REVENUE FROM USER CHARGES FROM RESIDENTS/ BUILDINGS.

298. In addition to conservancy tax on properties, there will be charges from individual households and commercial establishments for collecting waste from their premises by the SMB in its jurisdiction. It is assumed that on an average, INR 30 per month will be appropriate to charge for the service. From this source, it is estimated that an amount of **INR 13.3** million will be generated per year. The detailed calculations are given in **Table 13.7**.

13.11.6 FINANCIAL BENEFITS FROM ALL SOURCES

299. Based on the derivations arrived, the total annual financial benefits in the form of revenue proposed from all sources is **INR 38.60** million.

300. While arriving these revenue sources, care is taken that there will not be unnecessary additional financial burden on the people.

13.12 FINANCIAL ANALYSIS

301. The derived estimates of financial benefits are summarized and presented in **Table 13.8.**

TABLE 13.8: SUMMARY OF FINANCIAL ANALYSIS: SWM FOR SHILLONG

Sl. No.	Details	Actuals (2010-11 rates)	Present Value discounted at 4.2% real rate
1	**Capital Investment Cost**	76.60	65.95
2	**Operation and Maintenance Cost**	27.25	147.96
3	**Total costs**	**103.85**	**213.91**
4	**Net Benefits**		
	i Sale of Recyclable Materials	23.89	241.25
	ii Waste Collection	0.72	7.27
	iii Revenue from Tariff	0.69	6.97
	iv Collection of User Charges	13.30	134.31
	Sub-Total:	**38.60**	**389.80**
5	Financial Internal Rate of Return	-	**10.88%**
6	Net Present Value (NPV)	-	**42.09**

302. The FIRR is calculated based assumptions on the annual financial benefits totaling to **INR 10.88** million.

303. On the outflow side, the yearly O&M expenditure as well as the construction cost is taken into account. The total cost estimates for construction of SWM system is estimated as INR 76.60 million. For the analysis, the construction cost is proportionately spread over 18 months as per the construction schedule. The Financial analysis is presented in **Table 13.9**. The summary of analysis is presented in **Table 13.8**.

304. **The estimated FIRR is 10.88% with a positive FNPV of INR 42.09 million.**

305. **From the calculated parameters, it is found that the proposed investment is financially viable and feasible with the set of assumptions.**

TABLE 13.9: FINANCIAL ANALYSIS

Sl. No.	Year	Capital Cost	O&M	Total Cost	Sale from Recyclable Materials	Collection of Waste	Revenue from Tariff	Revenue from User Charges	Total Financial Benefits (5+6+7+8)	Net Financial Benefits
	1	2	3	4	5	6	7	8	9	10
1	2009-10	51.07	-	51.07	-	-	-	-	-	(51.07)
2	2010-11	25.53	-	25.53	-	-	-	-	-	(25.53)
3	2011-12	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
4	2012-13	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
5	2013-14	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
6	2014-15	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
7	2015-16	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
8	2016-17	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
9	2017-18	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
10	2018-19	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
11	2019-20	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
12	2020-21	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
13	2021-22	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350

Sl. No.	Year	Capital Cost	O&M	Total Cost	Sale from Recyclable Materials	Collection of Waste	Revenue from Tariff	Revenue from User Charges	Total Financial Benefits (5+6+7+8)	Net Financial Benefits
	1	2	3	4	5	6	7	8	9	10
14	2022-23	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
15	2023-24	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
16	2024-25	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
17	2025-26	-	27.25	27.25	23.89	0.720	0.69	13.30	38.60	11.350
									FIRR	10.88%
									NPV @ 4.2%	42.09

13.13 FINANCIAL OPERATING PLAN (FOP) FOR SHILLONG MUNICIPAL BOARD (SMB)

306. Once the SWM system is installed and ready for operation, the system is proposed to be handed over to the SMB for operation and implementation. It is also proposed that the installation process will be completed in two years and handed over to SMB the third year. In this context, the SMB has to be equipped with required financial capabilities. The necessary legal and legislative provisions have to be completed such that the SMB will effectively able to mobilize required financial resources. Hence, to give a broad view of the municipal finance of SMB and to check the sustainability of the different project components, a Financial Operating Plan (FOP) of SMB is prepared.

307. The forecast of the revenue and expenditure patterns of SMB has been taken up based on the assumption on property tax revision, introduction of rates and duties for services and improved expenditures on services based on O&M norms, trends based on increment to current expenses and major revenue sources. The revenue side of the heads of the municipal accounts are divided into revenue account and capital account for better understanding and for projection of capital investment and associated O&M. The forecast has been carried out for a medium term till of the year 2020-21.

308. **Table 13.10** gives the summary of all the assumptions made earlier and other related made for FOP preparation.

TABLE 13.10: KEY ASSUMPTIONS USED IN FOP FOR SMB

Sl. No.	Assumptions	Units	Quantity
1	**A. For General Data**		
2	Estimated Population in SMB area (2010-11)	Nos.	164012
3	Average HH Size	Nos.	5
4	Estimated total HHs area in SMB	Nos.	32802
5	Taxable properties	Nos.	22962
6	Revenue from Property Tax	INR	4.94
	B. For Property Tax		
7	Proposed Average property tax per building (2011-12)	INR	500
8	Implementation year	Year	2011-12

Sl. No.	Assumptions	Units	Quantity
9	**Tax Rate %**	**%**	**7**
10	Holding Tax	%	3
11	**Conservancy Tax**	**%**	**3**
12	Street Lighting tax	%	1
13	Annual Value revision	once in	5
14	% increase in ARV	%	25
15	Demand of property Tax per property(2011-12)	INR	215
16	Growth in Assessment	%	1.50

13.14 SUMMARY OF THE REVENUE AND CAPITAL ACCOUNTS

309. **Table 13.11** gives the summary of income and expenditure of SMB for the past three years from 2006-07 to 2008-09 as also the performance indicators. The table shows that the revenue account balance is a surplus and increasing for the most part of the period while the capital account balance shows a deficit. Partly, this is due to the shifting of a major part of the non-plan grants to current account. The operating ratios were on higher side in the beginning but gradually declined. A glaring and disquieting feature is in the share of establishment cost which is higher than the revenue receipts itself. It means that they were living beyond their means and transferring funds from other heads like state grants to pay salaries and other establishment expenditures. However, the trend is declining with very marginal proportion. There are many potential areas from where the revenues can easily be generated through internal sources itself. Above all the thrust should be on the efficient financial management.

13.14.1 PROJECTIONS WITHOUT NEW PROJECT INVESTMENTS

310. The projections are made assuming that the past trends will continue. The average annual compound growth rates were derived using the budgetary and financial data provided by the SMB. These growth rates were modified wherever necessary and used for the projections. On the revenue side, items such as rents, trade licenses, fee are linked to the growth of urban population.

TABLE 13.11: PRE-PROJECT STATUS-RECEIPTS/EXPENDITURE SUMMARY(INR million)

	2006-07	2007-08	2008-09
Fiscal health indicators			
Revenue account balance	15.22	20.02	24.64
Capital account balance	-0.53	-0.53	-0.53
Operating ratio	0.78	0.72	0.66
Debt repayment/ revenue receipts	0.0	0.0	0.0
Establishment cost/ revenue receipts	1.19	1.09	1.00

311. Special attention is focused on the property tax collections. Using the data provided on the number of assessments and assuming the coverage of assessed households will improve the tax demand and the collection and arrears position will follow the same trends, the revenue from property tax is projected. Similarly, the expenditure side items are also projected linking with population growth, State domestic product,

urbanization and other factors. The detailed status quo projections are as shown in Table 13.12.

13.14.2 PROJECTIONS WITH NEW PROJECT INVESTMENTS

312. Having examined the finances of SMB with status quo position, the implications of new SWM project investment is examined in the budgets of SMB and presented in **Table 13.13.**

313. Some important features of the projected financial pattern can be seen in the table. In addition to regular property tax revenue, a component of SWM tax of INR 1.23 million is added from the year 2011-12 which will increase to INR 1.35 million in 2016-17 to generate additional revenue to meet the proposed O & M expenditures. In addition, user charges from residential and commercial users for SWM have been added with effect from 2011-12. Grants from centre and state are added as they are meant for general purposes.

314. The summary parameters (fiscal Indicators) at the end of the period (2020-21) show sufficient revenue account balances, establishment cost declining to about 46 % and operating ratio also declining to 29%.

315. Though the results of projections are not very bright, there will be sufficient balances to absorb the expected additional financial commitments due to the new SWM project.

TABLE 13.12 PROJECTIONS OF SHILLONG MUNICIPAL BOARD FINANCES BEFORE NEW PROJECT INVESTMENT

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2016-17	2020-21
Opening Balance	**9.66**	**14.69**	**19.49**	**24.11**	**28.58**	**32.96**	**54.50**	**73.24**
Grand Total Revenue	**68.75**	**70.66**	**72.69**	**74.86**	**77.17**	**79.63**	**94.75**	**111.18**
Own Tax Revenue Receipts	**33.33**	**33.68**	**34.03**	**34.39**	**34.75**	**35.12**	**37.00**	**38.58**
SWM Tax in Property Tax								
Principal tax	14.46	14.62	14.79	14.95	15.12	15.29	16.16	16.89
Vehicle entry tax & car parking	18.87	19.06	19.25	19.44	19.64	19.83	20.84	21.69
Urban immovable property tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Own Nontax Receipts	**25.74**	**27.30**	**28.97**	**30.78**	**32.73**	**34.83**	**48.07**	**62.91**
Fees under the Act	0.74	0.75	0.75	0.76	0.77	0.78	0.82	0.85
Rent on land and stall	2.20	2.23	2.25	2.27	2.29	2.32	2.43	2.53
Receipts from market	18.64	20.14	21.75	23.50	25.38	27.41	40.31	54.87
Animal and carriage tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nontax receipts from water supply	1.23	1.24	1.26	1.27	1.29	1.30	1.38	1.44
Charges for solid waste management								
Conservancy	0.51	0.51	0.52	0.52	0.52	0.53	0.55	0.57
Service charges	1.02	1.03	1.04	1.05	1.06	1.07	1.13	1.17
Miscellaneous receipt	1.39	1.40	1.40	1.41	1.42	1.42	1.45	1.48
Loans	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Loans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Grants	**9.68**	**9.68**	**9.68**	**9.68**	**9.68**	**9.68**	**9.68**	**9.68**
Capital Grant for SWM (ADB)								
Total Capital Expenditure	**0.53**	**0.53**	**0.53**	**0.53**	**0.54**	**0.54**	**0.54**	**0.54**
Grant and contributions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2016-17	2020-21
Public works	0.53	0.53	0.53	0.53	0.54	0.54	0.54	0.54
Capital Expenditure on SWM (ADB)								
Revenue Expenditure	**53.53**	**50.64**	**48.05**	**45.74**	**43.67**	**41.83**	**35.25**	**32.24**
Establishment	39.66	36.72	34.08	31.71	29.60	27.70	20.86	17.64
Pay and Allowance	29.67	26.70	24.03	21.63	19.46	17.52	10.34	6.79
General administration	8.07	8.15	8.23	8.32	8.40	8.48	8.92	9.28
Gratuities	1.21	1.23	1.24	1.25	1.27	1.28	1.35	1.42
Board's Contribution to CPF	0.71	0.64	0.58	0.52	0.47	0.42	0.25	0.16
Operation and Maintenance	13.87	13.92	13.97	14.02	14.08	14.13	14.38	14.59
Collection charges	5.51	5.57	5.62	5.68	5.74	5.79	6.09	6.34
O&M due to SWM								
Light charges including street light	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.52
Water supply charges/Water Works	1.18	1.19	1.19	1.19	1.19	1.19	1.20	1.21
Drainage	3.47	3.50	3.54	3.57	3.61	3.64	3.83	3.99
Public health	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Conservancy	2.20	2.20	2.20	2.21	2.21	2.21	2.23	2.24
Maintenance of garden	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Law charges	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.08
Miscellaneous	1.07	1.09	1.12	1.14	1.16	1.18	1.30	1.40
Loans	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Grand Total Expenditure	**54.07**	**51.17**	**48.59**	**46.27**	**44.21**	**42.36**	**35.79**	**32.78**
Closing Balance	**14.69**	**19.49**	**24.11**	**28.58**	**32.96**	**37.27**	**58.96**	**78.40**
Repayment of loan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fiscal Indicators								
Revenue account balance	15.22	20.02	24.64	29.12	33.50	37.80	59.51	78.94
Capital account balance	-0.53	-0.53	-0.53	-0.53	-0.54	-0.54	-0.54	-0.54
Operating ratio	0.78	0.72	0.66	0.61	0.57	0.53	0.37	0.29
Debt repayment/ revenue receipts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Establishment cost/ revenue receipts	1.19	1.09	1.00	0.92	0.85	0.79	0.56	0.46

TABLE 13.13 PROJECTIONS OF SHILLONG MUNICIPAL BOARD FINANCES WITH NEW PROJECT INVESTMENT

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2016-17	2020-21
Opening Balance	**9.66**	**14.69**	**19.49**	**24.11**	**28.58**	**84.03**	**139.78**	**159.90**
Grand Total Revenue	**68.75**	**70.66**	**72.69**	**125.92**	**153.77**	**177.39**	**194.63**	**211.05**
Own Tax Revenue Receipts	**33.33**	**33.68**	**34.03**	**34.39**	**34.75**	**36.35**	**38.36**	**39.93**
SWM Tax in Property Tax						1.23	1.35	1.35
Principal tax	14.46	14.62	14.79	14.95	15.12	15.29	16.16	16.89
Vehicle entry tax & car parking	18.87	19.06	19.25	19.44	19.64	19.83	20.84	21.69
Urban immovable property tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Own Nontax Receipts	**25.74**	**27.30**	**28.97**	**30.78**	**32.73**	**54.76**	**69.99**	**84.84**
Fees under the Act	0.74	0.75	0.75	0.76	0.77	0.78	0.82	0.85
Rent on land and stall	2.20	2.23	2.25	2.27	2.29	2.32	2.43	2.53
Receipts from market	18.64	20.14	21.75	23.50	25.38	27.41	40.31	54.87
Animal and carriage tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2016-17	2020-21
Nontax receipts from water supply	1.23	1.24	1.26	1.27	1.29	1.30	1.38	1.44
Charges for solid waste management						19.93	21.92	21.92
Conservancy	0.51	0.51	0.52	0.52	0.52	0.53	0.55	0.57
Service charges	1.02	1.03	1.04	1.05	1.06	1.07	1.13	1.17
Miscellaneous receipt	1.39	1.40	1.40	1.41	1.42	1.42	1.45	1.48
Loans	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Loans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Grants	**9.68**	**9.68**	**9.68**	**60.75**	**86.28**	**86.28**	**86.28**	**86.28**
Capital Grant for SWM (ADB)				51.07	25.53			
Total Capital Expenditure	**0.53**	**0.53**	**0.53**	**51.60**	**26.07**	**0.54**	**0.54**	**0.54**
Grant and contributions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Public works	0.53	0.53	0.53	0.53	0.54	0.54	0.54	0.54
Capital Expenditure on SWM (ADB)				51.07	25.53			
Revenue Expenditure	**53.53**	**50.64**	**48.05**	**45.74**	**43.67**	**53.17**	**47.72**	**46.22**
Establishment	39.66	36.72	34.08	31.71	29.60	27.70	20.86	17.64
Pay and Allowance	29.67	26.70	24.03	21.63	19.46	17.52	10.34	6.79
General administration	8.07	8.15	8.23	8.32	8.40	8.48	8.92	9.28
Gratuities	1.21	1.23	1.24	1.25	1.27	1.28	1.35	1.42
Board's Contribution to CPF	0.71	0.64	0.58	0.52	0.47	0.42	0.25	0.16
Operation and Maintenance	13.87	13.92	13.97	14.02	14.08	14.13	14.38	14.59
Collection charges	5.51	5.57	5.62	5.68	5.74	5.79	6.09	6.34
O&M due to SWM						11.34	12.47	13.98
Light charges including street light	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.52
Water supply charges/Water Works	1.18	1.19	1.19	1.19	1.19	1.19	1.20	1.21
Drainage	3.47	3.50	3.54	3.57	3.61	3.64	3.83	3.99
Public health	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Conservancy	2.20	2.20	2.20	2.21	2.21	2.21	2.23	2.24
Maintenance of garden	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Law charges	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.08
Miscellaneous	1.07	1.09	1.12	1.14	1.16	1.18	1.30	1.40
Loans	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Grand Total Expenditure	**54.07**	**51.17**	**48.59**	**97.34**	**69.74**	**53.70**	**48.26**	**46.76**
Closing Balance	**14.69**	**19.49**	**24.11**	**28.58**	**84.03**	**123.69**	**146.37**	**164.29**
Repayment of loan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fiscal Indicators								
Revenue account balance	15.22	20.02	24.64	80.19	110.10	124.22	146.91	164.83
Capital account balance	-0.53	-0.53	-0.53	-51.60	-26.07	-0.54	-0.54	-0.54
Operating ratio	0.78	0.72	0.66	0.36	0.28	0.30	0.25	0.22
Debt repayment/ revenue receipts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Establishment cost/ revenue receipts	1.19	1.09	1.00	0.92	0.85	0.76	0.54	0.44

13.15 Overall Fiscal Impact

316. The overall impact of the proposed investment on the municipal budgets of SMB shows a deficit in capital account but overall, there will be sufficient revenue account balances even without state grants for SWM purpose to absorb the costs of new project in the annual budgets. This is subject to reforms and revisions in property tax and user

charges periodically, revenue collection level to be improved and tariffs are adjusted to recover at least the annual O&M costs.

13.16 Sensitivity Analysis

317. The sensitivity tests are to examine to what extent the estimated parameters of EIRR and FIRR are sensitive to any variations in costs or benefits. It is suggested that sensitivity test needs to be done for projects with large capital costs and those close to the cut off rate and a quantitative risk analysis incorporating different ranges for key variable is recommended. In the present context, the project is an improvement to the existing SWM system with a medium size of investment. However, we have attempted to see to what extent the project benefits are sensitive to the changes in costs.

318. An attempt is made to test with three scenarios:

i. 10% increase in capital cost,

ii. 10% increase in O &M cost , and

iii. 10% decrease in financial benefits.

319. **Table 13.14** gives the summary of sensitivity tests for Economic and Financial Analysis.

320. It can be seen from the Table that the sensitivity indicators (% change in NPV in relation to % change in cost) for increase in capital cost by 10 % and O & M cost by 10 % are 6.2 and 6.5 respectively which are below the limit of 10%. These are not on higher side implying that the project is not sensitive to increase up to 10% in investment cost or O &M cost. Thus, the proposed investment has lesser risk and gives reasonable certainty in achieving the required benefits.

Table 13.14: Sensitivity Analysis and Switching Values

	Economic		Financial	
Description	**EIRR**	**NPV @ 12%**	**FIRR**	**NPV @ 4.2%**
Base Calculation	17.64%	23.91	10.88%	42.09
Scenario 1				
Increase in Capital Cost (10%)	31.89%	127.25	22.31%	74.73
Scenario 2				
Increase in O&M Cost (10%)	14.25%	9.12	6.71%	14.57
Scenario 3				
Decrease in Benefits by 10%	12.03%	0.13	4.76%	3.11
Sensitivity Test				
10% increase in Capital Cost				
Sensitivity Indicator	43.20		7.80	
Switching Value	0.02		0.13	
10% increase in O&M				
Sensitivity Indicator	6.20		6.50	
Switching Value	0.16		0.15	

13.17 SWITCHING VALUES

321. Based on the sensitivity indicators, switching values have been calculated and given in **Table 13.14**. The switching value for increase in capital cost by 10% is INR 0.02 million and for increase in O & M cost by 10% is INR 0.16 million. These values indicate lesser risk in investment.

322. It is also to be noted that the sensitivity indicator and switching value are related (switching value = reciprocal of Sensitivity Indicator). The switching values for the selected critical variables (Capital Cost, O & M Cost and and Financial Benefits) have been calculated and presented in **Table 13.14**. The results obtained for various alternatives and options show that there is lesser risks with changes in costs

13.18 COST EFFECTIVENESS INDICATOR

323. To assess the impact or incidence of the proposed investment on SWM project in the city on the income levels of the people, cost effective indicator is used. It is the ratio of per HH capital cost of the project and per HH annual income. Smaller the ratio, better the cost effectiveness. It is suggested that the ratio be less than the hurdle rate of 10%.

324. For the present project, the derived value of cost effective indicator is 0.63%. It is many times lesser than the hurdle rate and also reasonably smaller implying that the proposed investment is not burdensome on the people of the city.

13.19 FUNDING PATTERN

325. The Capital investment on the proposed SWM Project will be based on the Funding Pattern specified as per the ADB guidelines. Based on the formula, the total capital cost will be shared by ADB, Government of India/State Government and SMB as given in **Table 13.15**.

326. The funding pattern for the project costing a total of INR 76.60 million is as follows:

i. The share of ADB is 70 percent as loan in total estimated cost which works out to INR 76.60 x 0.70 = INR 53.62 million.

ii. The remaining 30 percent is INR 22.98 million

iii. The share of GoI as grant is 90 percent of item (2) above, which works out to INR 22.98 x 0.90 = INR 20.68 million. The remaining 10% percent (INR 2.30 million) as loan to States.

iv. The terms of on-lending mobilization of 10 percent loan by State Government and its sharing or contribution pattern will be as decided by State Government acceptable to ADB.

327. The above sharing pattern is presented in **Table 13.15.**

TABLE 13.15: FUND SHARING PATTERN

Agency	Share of Agencies	
	%	INR million
Total Cost	100	76.60
ADB Loan	70	53.62
Balance	30	22.98
GoI Grant	90% of Balance	20.68
Share of State Government	10%	2.30
Total		**76.60**

13.20 IMPLICATIONS OF PROPOSED ADB LOAN ON CENTRAL AND STATE GOVERNMENT BUDGETS

328. While planning for new investment on urban infrastructure development like WSS and SWM, it is necessary to examine the financial feasibility and sustainability aspects of not only the fiscal management at the ULB level, but also the institutional arrangements of inter-governmental fiscal transfers as well as the fiscal capacities of the state and central governments. As discussed earlier, the ULBs in the NER depend a great deal on respective state governments to finance not only their capital expenditures but even their recurrent expenditures. Own revenue sources are grossly inadequate to finance new expenditures in view of their extremely limited resource-raising instruments.

329. The capacity of the state government to enhance the transfers to the lower tier depends on the fiscal health of the state government itself. Also, there should be adequate institutional arrangements that allow for the enhancement of the state -local transfers. In case the state level finances are not sufficient, the possibility of central government intervention needs to be examined. Thus, the financial feasibility and sustainability of the new investment needs to be examined by taking into account:

(i) the capacity of the respective state governments to enhance grants and transfers to the ULBs;

(ii) the institutional feasibility for such enhancement of state-local transfers;

(iii) the capacity of the centre to intervene and assist the state government to meet the additional liability, and

(iv) the adequacy of the centre-state transfer system for the purpose.

330. Under these circumstances, an attempt is made here to examine the impact of the loan from ADB on the finances of both Central and State Government of Meghalaya.

13.21 IMPACT ON CENTRAL GOVERNMENT BUDGETS

13.21.1 EXPENDITURE COMPONENT

331. The proposed new capital investment on WSS is expected to raise the expenditure of the Central government in at least three ways:

(i) sharing capital cost of 30 percent,

(ii) in the form of grant portion and

(iii) in the form of loan portion of the ADB loan

332. The loan would be part of the normal Central assistance to States although it is additional central assistance for state projects funded by external agencies. The loan component falls under the schematic portion of state plan schemes i.e. state plan loans carrying the same rate of interest and other terms of conditions. The revenue expenditure will increase by the new obligation of servicing the loan from ADB in the form of interest charges.

333. From the documents of Indian Public Finance Statistics, Government of India, New Delhi, it is found that the total capital expenditure of the Central government which was about INR 350 billion in 2001-02 went up to INR 666 billion by 2005-06.and is likely to touch INR 1 trillion by 2010-11.

334. The proposed loan from ADB for is INR 76.60 million constitutes a very insignificant share in the budgets of central government. Again, the annual repayment burden of loan and interest in terms of annuity over 20 years or so works out to less than 0.01 %. Thus, the new capital expenditure on SWM to SMB may not make any significant burden to the central government.

13.21.2 REVENUE COMPONENT

335. The total capital receipts of the centre from all sources work out to be over INR 1.13 trillion in 2001-02 doubled by 2005-06 and is expected to touch INR 4.0 trillion by 2010-11.

336. Going by these trends, the new capital expenditure of the present magnitude of total investment might not make much difference in the Central budget.

13.22 MEGHALAYA STATE FINANCES 2006-07 TO 2025-26 – TRENDS AND PRESENT STATUS (WITHOUT ADB LOAN)

13.22.1 REVENUE ACCOUNT

337. The state's revenue pattern shows a moderate growth rate during the reference period of 2006-07 to 2008-09. The share of total revenue receipts in annual total revenue is about 8% where as the transfer from the centre is about 56% which indicates that the State is heavily dependent on transfers from the centre. A small proportion of about 0.3% is being received as revenue from WSS under Social Services component. The share of recovery of loans (from all sources) per year continues to be about 0.5% of total receipts which may increase very marginally due to the receipts from SWM component. Hence, the impact of the ADB loan for SWM on State budget will be insignificant.

13.22.2 EXPENDITURE ACCOUNT

338. Similar to the growth pattern of revenue, the expenditure has also increased moderately. About 63 % constitutes as development expenditure. The expenditure on SWM as a part of sanitation is about 4% each under revenue account and capital account. There is no disbursements as grants to lower tier governments under non-development expenditure.

13.22.3 OVERALL FINANCIAL STATUS

339. Budgetary surplus or deficit in a backward state like Meghalaya does not necessarily reflect its financial strength or weakness. A state might be showing surplus by rendering administrative social and developmental services at a very low level or by not rendering certain services at all. This is true in the case of Meghalaya also. State financial

status. Though the state had a deficit during 2006-07 and 2007-08, the subsequent years has shown a surplus budget which is expected to grow.

13.22.4 STATUS QUO PROJECTIONS OF STATE FINANCES – 2008-09 TO 2025-26

340. The projections made before and after adding the ADB loan in the budgets of the State are presented in **Tables 9.16 and 9.17**.

341. From **Table 13.16,** it can be seen that left to the past trends, from the base-year of 2006-07 to 2025-26, total revenues are likely to grow up about three and half times and also total revenue expenditure is likely to grow nearly by same proportions. In the case of Capital Account, the capital receipts will grow by three and half times and the expenditures will increase by four and a half time during the reference period.

342. The summary fiscal indicators reveal that the state had surplus budgets all through the reference period. To the extent of about 5% and expected to continue the same trend. The source of surplus account is revenue account balances which reflect scope for absorbing any additional expenditure due to new projects like ADB loan for SWM.

13.22.5 PROJECTIONS OF STATE FINANCES WITH ADB LOAN AS INVESTMENTS

343. **Table 13.17** gives the projections of state finances for next 15 years till 2025-26 with proposed new investment on SWM. The table also gives the impact of annuity of loan repayment which will be about INR 0.12 million per year for a period of 20 years. The capital expenditure will go up by the entire new investment during the period 2010-11 to 2011-12. Capital receipts in the form of grants as also the loan from centre will go up but very marginally. As for the revenue receipts with respect to proposed SWM project, there will not be any direct revenue and hence it is treated as insignificant. However, it is likely that the revenues due to higher tax bases such as sales tax revenue might go up due to the improved infrastructure in the state and its likely positive impact on the state's GSDP.

13.22.6 OVERALL IMPACT

344. Comparing the two scenarios of State finances, we find that there will not be any significant impact on revenue or expenditure due to the new SWM project and can be concluded that the State will not be burdened with a loan component. In view of this, it can be easily conclude that it is feasible to finance the SWM for Shillong city with ADB funds.

TABLE 13.16: MEGHALAYA STATE FINANCE WITHOUT PROJECT INVESTMENT

Item			2006-07 (Accounts)	2007-08 (Revised)	2008-09 (Budget)	2009-10	2010-11	2011-12	2017-18	2023-24	2025-26
TOTAL REVENUE (I+II)			**21,422**	**32,418**	**37,029**	**39,991**	**43,192**	**46,647**	**74,009**	**117,423**	**136,958**
I.	**TAX REVENUE (A+B)**		7,519	8,612	10,488	11,328	12,234	13,211	20,957	33,248	38,778
	A.	**State's Own Tax Revenue**	3,048	3,319	3,846	4,155	4,487	4,845	7,683	12,186	14,213
II.	**NON-TAX REVENUE (C+D)**		13,903	23,806	26,541	28,663	30,958	33,436	53,052	84,175	98,180
	C.	**State's Own Non-Tax Revenue**	1,844	1,804	1,987	2,145	2,318	2,504	3,963	6,276	7,318
		of which Water Supply and Sanitation	4.9	6	6.6	7	8	9	15	23	27
	D.	**Grants from the Centre**	12,059	22,003	24,554	26,518	28,640	30,932	49,089	77,899	90,862
TOTAL EXPENDITURE (I+II+III)			**19,075**	**27,333**	**31,805**	**34,348**	**37,096**	**40,063**	**63,566**	**100,862**	**117,642**

Item			2006-07 (Accounts)	2007-08 (Revised)	2008-09 (Budget)	2009-10	2010-11	2011-12	2017-18	2023-24	2025-26
I.	DEVELOPMENTAL EXPENDITURE (A + B)		12,044	19,601	22,833	24,659	26,631	28,762	45,639	72,417	84,465
	A.	Social Services	6,143	9,419	10,830	11,696	12,630	13,640	21,645	34,344	40,059
		of which Water Supply and Sanitation	654	684	789	852	920	994	1,578	2,503	2,919
	B.	Economic Services	5,901	10,182	12,004	12,963	14,001	15,122	23,994	38,073	44,406
II	NON-DEVELOPMENTAL EXPENDITURE										
	(General services) (A to F)		7,031	7,732	8,972	9,689	10,465	11,301	17,927	28,445	33,177
III.	Grants-in-Aid and Contributions		-	-	-	-	-	-	-	-	-
TOTAL CAPITAL RECEIPTS			74,909	104,785	117,093	126,461	136,577	147,503	234,065	371,430	433,236
TOTAL CAPITAL RECEIPTS			3,222	4,394	4,210	4,546	4,910	5,303	8,414	13,352	15,574
(Includes Public Accounts on a net basis)*											
Loans and Advances from the Centre			30	86	87	94	102	110	173	272	317
	Loans *of which* SWM										
TOTAL CAPITAL EXPENDITURE			77,827	109,568	122,187	131,960	142,516	153,914	244,212	387,511	451,987
TOTAL CAPITAL EXPENDITURE			4,126	7,152	7,928	8,562	9,247	9,987	15,848	25,149	29,334
(Excluding Public Accounts)											
Total Capital Outlay			3,204	5,779	6,113	6,601	7,128	7,695	12,192	19,329	22,543
	Water Supply and Sanitation		923	1,494	1,463	1,580	1,706	1,842	2,922	4,636	5,408
Discharge of Internal Debt			569	1,244	1,507	1,627	1,757	1,897	3,010	4,777	5,571
Repayment of Loans to the Centre			294	211	188	204	220	238	375	591	689
	Loans for Special Schemes		7	7	7	7	8	9	15	23	27
	Others		9	8	-	-	-	-	-	-	-
Loans and Advances by State Governments			60	324	524	565	610	658	1,041	1,649	1,922
	SWM										
1	GRAND TOTAL - REVENUE		96,331	137,202	154,121	166,452	179,769	194,150	308,074	488,853	570,194
2	GRAND TOTAL - EXPENDITURE		96,902	136,900	153,992	166,308	179,612	193,977	307,778	488,373	569,629
FISCAL INDICATORS											
	A.	Surplus (+)/Deficit (-) on Capital Account	(904)	(2,758)	(3,718)	(4,016)	(4,337)	(4,684)	(7,434)	(11,797)	(13,760)
	B.	Surplus (+)/Deficit (-) on Revenue Account	2,347	5,085	5,224	5,643	6,096	6,584	10,443	16,561	19,316
	C.	Overall Surplus (+)/Deficit (-) (A+B)	1,443	2,327	1,506	1,627	1,759	1,900	3,009	4,764	5,556
	D.	Opening Balance	(1,752)	(572)	302	129	144	157	270	441	519
	E.	Closing Balance	(572)	302	129	144	157	173	296	480	565
	Gross State Domestic Products (At Current Prices)		67,427	72,147	77,197	82,601	88,383	94,570	141,924	212,989	243,851
	Overall Surplus or Deficit / GSDP		0.021	0.032	0.020	0.020	0.020	0.020	0.021	0.022	0.023
	Total Revenue Receipts/ GSDP		0.318	0.449	0.480	0.484	0.489	0.493	0.521	0.551	0.562
	Total Expenditure / GSDP		0.283	0.379	0.412	0.416	0.420	0.424	0.448	0.474	0.482
	Operating Ratio		1.006	0.998	0.999	0.999	0.999	0.999	0.999	0.999	0.999

TABLE 13.16: MEGHALAYA STATE FINANCE WITH PROJECT INVESTMENT

Item			2006-07 (Accounts)	2007-08 (Revised)	2008-09 (Budget)	2009-10	2010-11	2011-12	2017-18	2023-24	2025-26
TOTAL REVENUE (I+II)			21,422	32,418	37,029	39,991	43,192	46,647	74,009	117,423	136,958
I.	TAX REVENUE (A+B)		7,519	8,612	10,488	11,328	12,234	13,211	20,957	33,248	38,778

Item			2006-07 (Accounts)	2007-08 (Revised)	2008-09 (Budget)	2009-10	2010-11	2011-12	2017-18	2023-24	2025-26
	A.	State's Own Tax Revenue	3,048	3,319	3,846	4,155	4,487	4,845	7,683	12,186	14,213
II.	NON-TAX REVENUE (C+D)		13,903	23,806	26,541	28,663	30,958	33,436	53,052	84,175	98,180
	C.	State's Own Non-Tax Revenue	1,844	1,804	1,987	2,145	2,318	2,504	3,963	6,276	7,318
		of which Water Supply and Sanitation	4.9	6	6.6	7	8	9	15	23	27
	D.	Grants from the Centre	12,059	22,003	24,554	26,518	28,640	30,932	49,089	77,899	90,862
TOTAL EXPENDITURE (I+II+III)			**19,075**	**27,333**	**31,805**	**34,348**	**37,096**	**40,063**	**63,566**	**100,862**	**117,642**
I.	DEVELOPMENTAL EXPENDITURE (A + B)		12,044	19,601	22,833	24,659	26,631	28,762	45,639	72,417	84,465
	A.	Social Services	6,143	9,419	10,830	11,696	12,630	13,640	21,645	34,344	40,059
		of which Water Supply and Sanitation	654	684	789	852	920	994	1,578	2,503	2,919
	B.	Economic Services	5,901	10,182	12,004	12,963	14,001	15,122	23,994	38,073	44,406
II	NON-DEVELOPMENTAL EXPENDITURE										
	(General services) (A to F)		7,031	7,732	8,972	9,689	10,465	11,301	17,927	28,445	33,177
III.	Grants-in-Aid and Contributions		-	-	-	-	-	-	-	-	-
TOTAL CAPITAL RECEIPTS			**74,909**	**104,785**	**117,093**	**126,462**	**136,578**	**147,503**	**234,065**	**371,430**	**433,236**
TOTAL CAPITAL RECEIPTS			3,222	4,394	4,210	4,546	4,910	5,303	8,414	13,352	15,574
(Includes Public Accounts on a net basis)*											
Loans and Advances from the Centre			30	86	87	95	103	110	173	272	317
	Loans *of which* SWM					1.15	1.15				
TOTAL CAPITAL EXPENDITURE			**77,827**	**109,568**	**122,187**	**131,960**	**142,516**	**153,914**	**244,212**	**387,511**	**451,987**
TOTAL CAPITAL EXPENDITURE			4,126	7,152	7,928	8,562	9,247	9,987	15,848	25,149	29,334
(Excluding Public Accounts)											
Total Capital Outlay			3,204	5,779	6,113	6,601	7,128	7,695	12,192	19,329	22,543
	Water Supply and Sanitation		923	1,494	1,463	1,580	1,706	1,842	2,922	4,636	5,408
Discharge of Internal Debt			569	1,244	1,507	1,627	1,757	1,897	3,010	4,777	5,571
Repayment of Loans to the Centre			294	211	188	204	220	238	375	591	689
	Loans for Special Schemes		7	7	7	7	8	9	15	23	27
	Others		9	8	-	-	-	-	-	-	-
Loans and Advances by State Governments			60	324	524	565	610	658	1,041	1,649	1,922
	SWM		-	-	-	-	-	0.12	0.12	0.12	0.12
1	**GRAND TOTAL - REVENUE**		**96,331**	**137,202**	**154,121**	**166,453**	**179,770**	**194,150**	**308,074**	**488,853**	**570,194**
2	**GRAND TOTAL - EXPENDITURE**		**96,902**	**136,900**	**153,992**	**166,308**	**179,612**	**193,977**	**307,778**	**488,373**	**569,629**
FISCAL INDICATORS											
	A.	Surplus (+)/Deficit (-) on Capital Account	**(904)**	**(2,758)**	**(3,718)**	**(4,016)**	**(4,337)**	**(4,684)**	**(7,434)**	**(11,797)**	**(13,760)**
	B.	Surplus (+)/Deficit (-) on Revenue Account	**2,347**	**5,085**	**5,224**	**5,643**	**6,096**	**6,584**	**10,443**	**16,561**	**19,316**
	C.	Overall Surplus (+)/Deficit (-) (A+B)	**1,443**	**2,327**	**1,506**	**1,627**	**1,759**	**1,900**	**3,009**	**4,764**	**5,556**
	D.	Opening Balance	**(1,752)**	**(572)**	**302**	**129**	**145**	**158**	**270**	**441**	**519**
	E.	Closing Balance	**(572)**	**302**	**129**	**145**	**158**	**173**	**296**	**480**	**565**
	Gross State Domestic Products (At Current Prices)		**67,427**	**72,147**	**77,197**	**82,601**	**88,383**	**94,570**	**141,924**	**212,989**	**243,851**
	Overall Surplus or Deficit / GSDP		**0.021**	**0.032**	**0.020**	**0.020**	**0.020**	**0.020**	**0.021**	**0.022**	**0.023**
	Total Revenue Receipts/ GSDP		**0.318**	**0.449**	**0.480**	**0.484**	**0.489**	**0.493**	**0.521**	**0.551**	**0.562**
	Total Expenditure / GSDP		**0.283**	**0.379**	**0.412**	**0.416**	**0.420**	**0.424**	**0.448**	**0.474**	**0.482**

Item	2006-07 (Accounts)	2007-08 (Revised)	2008-09 (Budget)	2009-10	2010-11	2011-12	2017-18	2023-24	2025-26
Operating Ratio	1.006	0.998	0.999	0.999	0.999	0.999	0.999	0.999	0.999

13.23 PROJECT IMPLEMENTATION AGENCIES AND MANAGERIAL STRUCTURE

345. Implementation of the project at Shillong city involves the following arrangements at different levels:

346. At the Central Government level, Ministry of Urban Development will be the executing agency and will be responsible for coordination with ADB and the State Governments. A Central Level Steering Commission (CLSC).

347. At the state level, the Government of Meghalaya has designated Urban Affairs Department (UAD) as Nodal Agency. There is an Investment Program Empowered Committee (IPEC) of the senior officers to take necessary decisions and actions for monitoring and timely execution of the project. There is a State Level Executing Agency (SLEA) responsible for executing the part of the load approved for ADB funding.

348. At the project town/ city, there is a State Investment Program Management and Implementation Unit (SIPMIU) to execute the project at Shillong.

13.24 DISBURSEMENT ARRANGEMENTS

349. Loan Disbursement arrangements from central government to State government / SIPMIU would be in accordance with ADB's *Loan Disbursement Handbook (January 2001)* and *Interim* Guidelines *for Libor-Based Loan Products.*

350. The SIPMIU will prepare disbursement requests and keep the Bank informed about any changes in contracts. An Impress Account (IA) will be opened in a current account in a commercial bank by the SIPMIU, subject to the commitment by the State and the SIPMIU to adhere to the ADB procedures for operating IA. The Department of Expenditure, Ministry Finance, Government of India will pass on the rupee equivalent of ADB's IA advances directly to the commercial bank IA established by the SIPMIU.

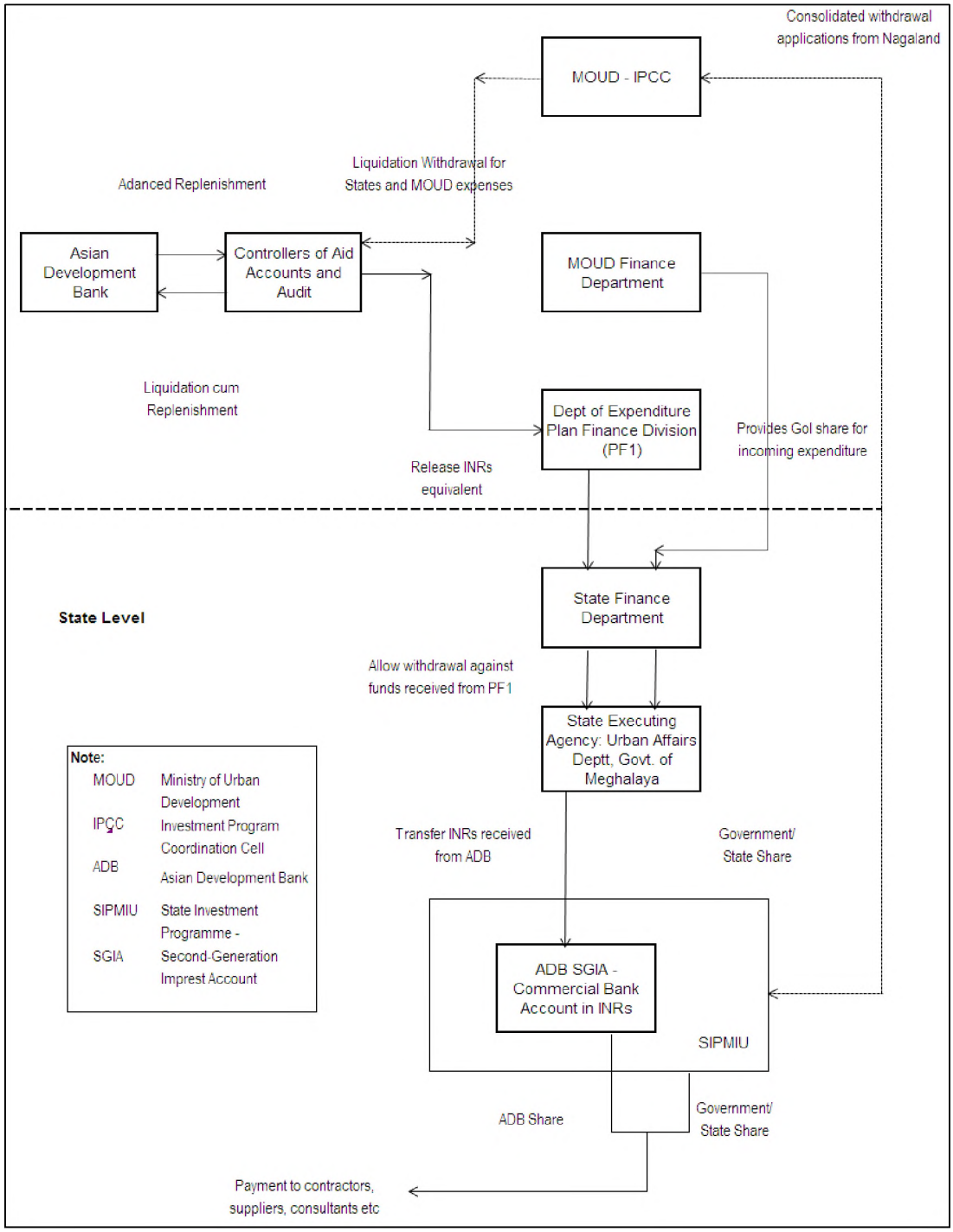
351. The GOI has to assure the ADB that all ADB disbursements for IA advance and/or replenishment will be passed on to the SIPMIU for deposit into the commercial bank IA within 30 days of receipt of such advance/replenishment from ADB. The SIPMIU will establish a separate account for consolidating the counterpart funds and the ADB funds.

352. The SIPMIU will draw the ADB portion of expenditure from the IA into the consolidated account to make consolidated payments for eligible Project expenditures.

353. The SIPMIU will warrant that funds in the IA will be used only to fund eligible expenditures in accordance with the terms of the Loan Agreement and to meet the immediate short-term disbursement needs of the investment program. The Statement of Expenditures (SOE) procedure will be adopted for reimbursing and liquidating the IA for eligible expenditures up to certain limit (not exceeding $50,000) per payment, except as ADB may agree during implementation.

354. The above proposed investment program funds flow is depicted in Flow Chart 1. The Chart gives the way funds will flow from ADB to final payment to the contractors, suppliers, consultants etc. This process is applicable for all the States in NER.

FLOW CHART – 1 : INVESTMENT PROGRAMME FUND FLOW CHART



Source: ADB 2006, Aide Memoire: Pre-Appraisal Mission – Proposed Multitranche Financing Facility India: NER Capital Cities Development Programme.

13.25 ACCOUNTS AND AUDIT

355. As per the ADB Guidelines, the SIPMIU will maintain separate project accounts in accordance with generally accepted accounting principles for all expenditures incurred on the investment program, whether funded out of loan proceeds or other sources. They will establish and maintain separate records for works, goods and services financed out of loan proceeds.

356. The GOI and the States will cause the detailed consolidated project accounts, as maintained by the SIPMIU to be audited by independent auditors, whose qualifications, experience and terms of reference are acceptable to ADB. The audited project accounts will be submitted to ADB within 9 months of the fiscal year. The annual audit report will include the audit of the IA and SOE procedure, and will specifically include a separate audit opinion on the use of loan proceeds in the operation of the IA, and compliance with SOE procedures. The SIPMIUs will be made aware of ADB's policy on delayed submission, and the requirements for the satisfactory and acceptable quality of the audited accounts.

13.26 PROJECT SUPERVISION, REVIEW AND REPORTING

357. State Government, through MoUD, will provide ADB with quarterly progress reports on project implementation, prepared by the SIPMIU. These progress reports will describe the progress of various contracts, details of any modifications required to the components, schedule, implementation arrangements, implementation of loan proceeds and work undertaken and to be undertaken during the next quarter. The reports will also provide summary financial accounts of the investment program, including expenditure during the quarter, year-to-date expenditure, and total expenditure to date. The State government will also submit to ADB, within three months of physical completion of the sub projects, a project completion report that will cover the details of project implementation, costs, monitoring and evaluation activities, and other information requested by ADB. MoUD will coordinate the production of the reports and ensure that they are produced and provided to ADB on time.

358. The SIPMIU will ensure that the Investment Program Performance Monitoring System (IPPMS) is established within 6 months of loan effectiveness. The IPPMS system will be developed in accordance with ADB's *Project Performance Management System* Handbook. It will track project implementation activities, target dates, expected inputs, impacts, outcomes and outputs, and assigned responsibilities including those for institutional and financial reforms.

359. Some tasks will be outsourced to external contractors, others will form part of the routine reporting of SIPMIU, and some will be sourced from community representatives selected to monitor and report on project activities.

360. The indicators to be monitored, which are illustrated in the design and monitoring framework, will be discussed and agreed by ADB, GOI, the state government and the ULBs during the loan inception mission. Within 6 months of loan effectiveness, the SIPMIU will conduct or ensure the conduct of initial baseline physical and socio economic surveys and submit a detailed implementation plan for benchmarking information and monitoring performance, subject to ADB's concurrence. The SIPMIU will submit annual reports to ADB through MoUD throughout project implementation.

361. Program performance will be monitored first by the SIPMIU, then by the State Steering Committees and then by the Central Steering Committee. A program inception mission will be fielded soon after loan approval. In addition to the Inception mission and

regular review missions held at not less than six monthly intervals, a mid term review (MTR) will be conducted 5 years from the implementation of the Investment Program. The regular reviews will include a summary of contracts awarded and costs versus estimates. The MTR will identify problems or weaknesses in implementation arrangements, and agree on the changes needed.

13.27 Main Findings

362. With the proposed capital investment of INR 76.60 million and estimated annual O &M cost of INR 27.25 million, the project is expected to benefit about 0.16 million persons and about 0.032 million households in Shillong Municipal Board area directly and about 0.31 persons in SUA area. The project will be constructed and installed in 18 months period and will be handed over to Shillong Municipal Board (SMB) for O & M which will be the implementing agency.

363. For economic and financial analysis, fifteen years is taken as life period after taking into consideration costs of land, civil works, machinery and equipment for the improvement of existing SWM system.

364. Three economic benefits are assumed for economic analysis and the estimated value of EIRR is arrived as 17.64% with the ENPV of INR 23.91 million.

365. Four financial benefits are assumed due to the investment and the estimated FIRR is 10.88% with FNPV of INR 42.09 million.

366. Standard sensitivity tests were undertaken by giving consideration to key variables, i.e, capital cost over run, O & M cost over run and decrease in project benefits. The derived Sensitivity indicators and Shifting Values for economic and financial analyses indicate that there are no risks in the investment on the project up to 10% increases in capital and O & M costs as well as 10% decrease in benefits. Hence the investment on the project is reliable with no risks.

367. From the analysis of Financial Operating Flan (FOP) for SMB it is found that the proposed investment and annual O &M costs could be absorbed by the SMB and sustainable subject to the assumptions made on implementation of prescribed taxation and consumer charges for SWM system by the SMB.

13.28 Recommendations

368. Based on the results and findings, the following recommendations are suggested:

369. The proposed investment on the improvement to the SWM system may be financed by ADB and Government of India/Government of Meghalaya loan/grant.

370. The State government and SMB need to attempt municipal reforms, implement the suggested taxes and to give effect to taxation and consumer charges for SWM service with effect from the base year i.e, 2011-2012. .

ANNEXURE 1

MUNICIPAL SOLID WASTE (MANAGEMENT AND HANDLING)

SMEC INDIA

ANNEXURE 1

MUNICIPAL SOLID WASTES (MANAGEMENT AND HANDLING)
MINISTRY OF ENVIRONMENT AND FORESTS
NOTIFICATION
NEW DELHI, THE 25TH SEPTEMBER, 2000

S.O. 908(E).- Whereas the draft of the Municipal Solid Wastes (Management and Handling) Rules, 1999 were published under the notification of the Government of India in the Ministry of Environment and Forests number S.O. 783(E), dated, the 27th September, 1999 in the Gazette of India, Part II, Section 3, Sub-section (ii) of the same date inviting objections and suggestions from the persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which the copies of the Gazette containing the said notification are made available to the public;

And whereas copies of the said Gazette were made available to the public on the 5th October, 1999;

And whereas the objections and suggestions received from the public in respect of the said draft rules have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by section 3, 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules to regulate the management and handling of the municipal solid wastes, namely:-

1. SHORT TITLE AND COMMENCEMENT.--

1. These rules may be called the Municipal Solid Wastes (Management and Handling) Rules, 2000.

2. Save as otherwise provided in these rules, they shall come into force on the date of their publication in the Official Gazette.

2. APPLICATION -- These rules shall apply to every municipal authority responsible for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes.

3. RESPONSIBILITY OF MUNICIPAL AUTHORITY

1. Every municipal authority shall, within the territorial area of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.

2. The municipal authority or an operator of a facility shall make an application in **Form-I,** for grant of authorization for setting up waste processing and disposal facility including landfills from the State Board or the Committee in order to comply with the implementation programme laid down in **Schedule I**.

3. The municipal authority shall comply with these rules as per the implementation schedule laid down in **Schedule I.**

4. THE MUNICIPAL AUTHORITY SHALL FURNISH ITS ANNUAL REPORT IN FORM-II,-

a. to the Secretary-incharge of the Department of Urban Development of the concerned State or as the case may be of the Union territory, in case of a metropolitan city; or

b. to the District Magistrate or the Deputy Commissioner concerned in case of all other towns and cities, with a copy to the State Board or the Committee on or before the 30th day of June every year.

5. RESPONSIBILITY OF THE STATE GOVERNMENT AND THE UNION TERRITORY ADMINISTRATIONS.--

(1) The Secretary-incharge of the Department of Urban Development of the concerned State or the Union territory, as the case may be, shall have the overall responsibility for the enforcement of the provisions of these rules in the metropolitan cities.

(2) The District Magistrate or the Deputy Commissioner of the concerned district shall have the overall responsibility for the enforcement of the provisions of these rules within the territorial limits of their jurisdiction.

6. RESPONSIBILITY OF THE CENTRAL POLLUTION CONTROL BOARD AND THE STATE BOARD OR THE COMMITTEES

1. The State Board or the Committee shall monitor the compliance of the standards regarding ground water, ambient air, leachate quality and the compost quality including incineration standards as specified under **Schedules II, III** and **IV**.

2. The State Board or the Committee, after the receipt of application from the municipal authority or the operator of a facility in **Form I,** for grant of authorization for setting up waste processing and disposal facility including landfills, shall examine the proposal taking into consideration the views of other agencies like the State Urban Development Department, the Town and Country Planning Department, Air Port or Air Base Authority, the Ground Water Board or any such other agency prior to issuing the authorization.

3. The State Board or the Committee shall issue the authorization in **Form-III** to the municipal authority or an operator of a facility within forty-five days stipulating compliance criteria and standards as specified in **Schedules II, III** and **IV** including such other conditions, as may be necessary.

4. The authorization shall be valid for a given period and after the validity is over, a fresh authorization shall be required.

5. The Central Pollution Control Board shall co-ordinate with the State Boards and the Committees with particular reference to implementation and review of standards and guidelines and compilation of monitoring data.

7. MANAGEMENT OF MUNICIPAL SOLID WASTES

1. Any municipal solid waste generated in a city or a town, shall be managed and handled in accordance with the compliance criteria and the procedure laid down in **Schedule-II**.

2. The waste processing and disposal facilities to be set up by the municipal authority on their own or through an operator of a facility shall meet the specifications and standards as specified in **Schedules III** and **IV.**

8. ANNUAL REPORTS

1. The State Boards and the Committees shall prepare and submit to the Central Pollution Control Board an annual report with regard to the implementation of these rules by the 15th of September every year in **Form-IV**.

2. The Central Pollution Control Board shall prepare the consolidated annual review report on management of municipal solid wastes and forward it to the Central Government alongwith its recommendations before the 15th of December every year.

9. ACCIDENT REPORTING

When an accident occurs at any municipal solid wastes collection, segregation, storage, processing, treatment and dispoosal facility or landfill site or during the transportation of such wastes, the municipal authority shall forthwith report the accident in **Form-V** to the Secretary in-charge of the Urban Development Department in metropolitan cities, and to District Collector or Deputy Commissioner in all other cases.

Schedule I
[see rules4(2) and (3)]
Implementation Schedule

Serial No.	Compliance Criteria	Schedule
1.	Setting up of waste processing and disposal facilities	By 31.12.2003 or earlier
2.	Monitoring the performance of waste processing and disposal facilities	Once in six months
3.	Improvement of existing landfill sites as per provisions of these rules	By 31.12.2001 or earlier
4.	Identification of landfill sites for future use and making site (s) ready for operation	By 31.12.2002 or earlier

Schedule -II
[see rules 6(1) and (3), 7(1)]
Management of Municipal Solid Wastes

S. No	Parameters	Compliance criteria
1.	**Collection of municipal solid wastes**	1. Littering of municipal solid waste shall be prohibited in cities, towns and in urban areas notified by the State Governments. To prohibit littering and facilitate compliance, the following steps shall be taken by the municipal authority, namely :- i. Organising house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and scheduling by using bell ringing of musical vehicle (without exceeding permissible noise levels);

		ii. Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and commercial areas; iii. Wastes from slaughter houses, meat and fish markets, fruits and vegetable markets, which are biodegradable in nature, shall be managed to make use of such wastes; iv. Bio-medical wastes and industrial wastes shall not be mixed with municipal solid wastes and such wastes shall follow the rules separately specified for the purpose; v. Collected waste from residential and other areas shall be transferred to community bin by hand-driven containerised carts or other small vehicles; vi. Horticlutural and construction or demolition wastes or debris shall be separately collected and disposed off following proper norms. Similarly, wastes generated at dairies shall be regulated in accordance with the State laws; vii. Waste (garbage, dry leaves) shall not be burnt; viii. Stray animals shall not be allowed to move around waste storage facilities or at any other place in the city or town and shall be managed in accordance with the State laws. 2. The municipal authority shall notify waste collection schedule and the likely method to be adopted for public benefit in a city or town. 3. It shall be the responsibility of generator of wastes to avoid littering and ensure delivery of wastes in accordance with the collection and segregation system to be notified by the municipal authority as per para 1(2) of this Schedule.
2.	**Segregation of municipal solid wastes**	In order to encourage the citizens, municipal authority shall organise awareness programmes for segregation of wastes and shall promote recycling or reuse of segregated materials. The municipal authority shall undertake phased programme to ensure community participation in waste segregation. For this purpose, regular meetings at quarterly intervals shall be arranged by the municipal authorities with representatives of local resident welfare associations and non-governmental organizations.
3.	**Storage of municipal solid wastes**	Municipal authorities shall establish and maintain storage facilities in such a manner as they do not create unhygienic and insanitary conditions around it. Following criteria shall be taken into account while establishing and maintaining storage facilities, namely :- i. Storage facilities shall be created and established by taking into account quantities of waste generation in a given area and the population densities. A storage facility shall be so placed that it is accessible to users; ii. Storage facilities to be set up by municipal authorities or any other agency shall be so designed that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user-friendly; iii. Storage facilities or 'bins' shall have 'easy to operate' design for handling, transfer and transportation of waste.

		Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black; iv. Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers.
4.	**Transportation of municipal solid wastes**	Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The following criteria shall be met, namely:- i. The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing; ii. Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided.
5.	**Processing of municipal solid wastes**	Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill. Following criteria shall be adopted, namely:- (i) The biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes. It shall be ensured that compost or any other end product shall comply with standards as specified in Schedule-IV; ii. Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can also be used for processing wastes in specific cases. Municipal authority or the operator of a facility wishing to use other state-of-the-art technologies shall approach the Central Pollution Control Board to get the standards laid down before applying for grant of authorisation.
6.	**Disposal of municipal solid wastes**	Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land-filling shall be done following proper norms. Landfill sites shall meet the specifications as given in Schedule –III.

Schedule III
[see rules 6(1) and (3), 7(2)]
Specifications for Landfill Sites

Site Selection

1. In areas falling under the jurisdiction of 'Development Authorities' it shall be the responsibility of such Development Authorities to identify the landfill sites and hand over the sites to the concerned municipal authority for development, operation and maintenance. Elsewhere, this responsibility shall lie with the concerned municipal authority.

2. Selection of landfill sites shall be based on examination of environmental issues. The Department of Urban Development of the State or the Union territory shall co-ordinate with the concerned organisations for obtaining the necessary approvals and clearances.

3. The landfill site shall be planned and designed with proper documentation of a phased construction plan as well as a closure plan.

4. The landfill sites shall be selected to make use of nearby wastes processing facility. Otherwise, wastes processing facility shall be planned as an integral part of the landfill site.

5. The existing landfill sites which continue to be used for more than five years, shall be improved in accordance of the specifications given in this Schedule.

6. Biomedical wastes shall be disposed off in accordance with the Bio-medical Wastes (Management and Handling) Rules, 1998 and hazardous wastes shall be managed in accordance with the Hazardous Wastes (Management and Handling) Rules, 1989, as amended from time to time.

7. The landfill site shall be large enough to last for 20-25 years.

8. The landfill site shall be away from habitation clusters, forest areas, water bodies monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.

9. A buffer zone of no-development shall be maintained around landfill site and shall be incorporated in the Town Planning Department's land-use plans.

10. Landfill site shall be away from airport including airbase. Necessary approval of airport or airbase authorities prior to the setting up of the landfill site shall be obtained in cases where the site is to be located within 20 km of an airport or airbase.

Facilities at the Site

11. Landfill site shall be fenced or hedged and provided with proper gate to monitor incoming vehicles or other modes of transportation.

12. The landfill site shall be well protected to prevent entry of unauthorised persons and stray animals.

13. Approach and other internal roads for free movement of vehicles and other machinery shall exist at the landfill site.

14. The landfill site shall have wastes inspection facility to monitor wastes brought in for landfill, office facility for record keeping and shelter for keeping equipment and machinery including pollution monitoring equipments.

15. Provisions like weigh bridge to measure quantity of waste brought at landfill site, fire protection equipments and other facilities as may be required shall be provided.

16. Utilities such as drinking water (preferably bathing facilities for workers) and lighting arrangements for easy landfill operations when carried out in night hours shall be provided.

17. Safety provisions including health inspections of workers at landfill site shall be periodically made.

Specifications for land filling

18. Wastes subjected to land filling shall be compacted in thin layers using landfill compactors to achieve high density of the wastes. In high rainfall areas where heavy compactors cannot be used alternative measures shall be adopted.

19. Wastes shall be covered immediately or at the end of each working day with minimum 10 cm of soil, inert debris or construction material till such time waste processing facilities for composting or recycling or energy recovery are set up as per Schedule I.

20. Prior to the commencement of monsoon season, an intermediate cover of 40-65 cm thickness of soil shall be placed on the landfill with proper compaction and grading to prevent infiltration during monsoon. Proper drainage berms shall be constructed to divert run-off away from the active cell of the landfill.

21. After completion of landfill, a final cover shall be designed to minimize infiltration and erosion. The final cover shall meet the following specifications, namely :--

    a. The final cover shall have a barrier soil layer comprising of 60 cms of clay or amended soil with permeability coefficient less that 1×10^{-7} cm/sec.

    b. On top of the barrier soil layer there shall be a drainage layer of 15 cm.

    c. On top of the drainage layer there shall be a vegetative layer of 45 cm to support natural plant growth and to minimize erosion.

Pollution prevention

22. In order to prevent pollution problems from landfill operations, the following provisions shall be made, namely:-

    a. Diversion of storm water drains to minimize leachate generation and prevent pollution of surface water and also for avoiding flooding and creation of marshy conditions;

    b. Construction of a non-permeable lining system at the base and walls of waste disposal area. For landfill receiving residues of waste processing facilities or mixed waste or waste having contamination of hazardous materials (such as aerosols, bleaches, polishes, batteries, waste oils, paint products and pesticides) minimum liner specifications shall be a composite barrier having 1.5 mm high density polyethylene (HDPE) geomembrane, or equivalent, overlying 90 cm of soil (clay or amended soil) having permeability coefficient not greater than 1×10^{-7} cm/sec. The highest level of water table shall be at least two meter below the base of clay or amended soil barrier layer;

c. Provisions for management of leachates collection and treatment shall be made. The treated leachates shall meet the standards specified in Schedule- IV;

d. Prevention of run-off from landfill area entering any stream, river, lake or pond.

Water Quality Monitoring

23. Before establishing any landfill site, baseline data of ground water quality in the area shall be collected and kept in record for future reference. The ground water quality within 50 metres of the periphery of landfill site shall be periodically monitored to ensure that the ground water is not contaminated beyond acceptable limit as decided by the Ground Water Board or the State Board or the Committee. Such monitoring shall be carried out to cover different seasons in a year that is, summer, monsoon and post-monsoon period.

24. Usage of groundwater in and around landfill sites for any purpose (including drinking and irrigation) is to be considered after ensuring its quality. The following specifications for drinking water quality shall apply for monitoring purpose, namely :-

S.No.	Parameters	IS 10500: 1991 Desirable limit (mg/l except for pH)
1.	Arsenic	0.05
2.	Cadmium	0.01
3	Chromium	0.05
4.	Copper	0.05
5.	Cyanide	0.05
6.	Lead	0.05
7.	Mercury	0.001
8.	Nickel	-
9.	Nitrate as NO_3	45.0
10	PH	6.5-8.5
11.	Iron	0.3
12.	Total hardness (as $CaCO_3$)	300.0
13.	Chlorides	250
14.	Dissolved solids	500
15.	Phenolic compounds (as C_6H_5OH)	0.001
16.	Zinc	5.0
17.	Sulphate (as SO_4)	200

Ambient Air Quality Monitoring

25. Installation of landfill gas control system including gas collection system shall be made at landfill site to minimize odour generation, prevent off-site migration of gases and to protect vegetation planted on the rehabilitated landfill surface.

26. The concentration of methane gas generated at landfill site shall not exceed 25 per cent of the lower explosive limit (LEL).

27. The landfill gas from the collection facility at a landfill site shall be utilized for either direct thermal applications or power generation, as per viability. Otherwise, landfill gas shall be burnt (flared) and shall not be allowed to directly escape to the atmosphere or for illegal tapping. Passive venting shall be allowed if its utiliztion or flaring is not possible.

28. Ambient air quality at the landfill site and at the vicinity shall be monitored to meet the following specified standards, namely :-

S.No.	Parameters	Acceptable levels
(i)	Sulphur dioxide	120
(ii)	Suspended Particulate Matter	500
(iii)	Methane	Not to exceed 25 per cent of the lower explosive limit (equivalent to 650 mg/m^3)
(iv)	Ammonia daily average	
	(Sample duration 24 hrs)	0.4 mg/m^3 (400
(v)	Carbon monoxide	1 hour average : 2 mg/m^3 8 hour average : 1 mg/m^3

29. The ambient air quality monitoring shall be carried out by the concerned authority as per the following schedule, namely:-

(a) Six times in a year for cities having population of more than fifty lakhs;

(b) Four times in a year for cities having population between ten and fifty lakhs;

(c) Two times in a year for town or cities having population between one and ten lakhs.

Plantation at Landfill Site

30. A vegetative cover shall be provided over the completed site in accordance with the and following specifications, namely:-

(a) Selection of locally adopted non-edible perennial plants that are resistant to drought and extreme temperatures shall be allowed to grow;

(b) The plants grown be such that their roots do not penetrate more than 30 cms. This condition shall apply till the landfill is stabilised;

(c) Selected plants shall have ability to thrive on low-nutrient soil with minimum nutrient addition;

(d) Plantation to be made in sufficient density to minimize soil erosion.

Closure of Landfill Site and Post-care

31. The post-closure care of landfill site shall be conducted for at least fifteen years and long term monitoring or care plan shall consist of the following, namely :-

(a) Maintaining the integrity and effectiveness of final cover, making repairs and preventing run-on and run-off from eroding or otherwise damaging the final cover;

(b) Monitoring leachate collection system in accordance with the requirement;

(c) Monitoring of ground water in accordance with requirements and maintaining ground water quality;

(d) Maintaining and operating the landfill gas collection system to meet the standards.

32. Use of closed landfill sites after fifteen years of post-closure monitoring can be considered for human settlement or otherwise only after ensuring that gaseous and leachate analysis comply with the specified standards.

Special provisions for hilly areas

33. Cities and towns located on hills shall have location-specific methods evolved for final disposal of solid wastes by the municipal authority with the approval of the concerned State Board or the Committee. The municipal authority shall set up processing facilities for utilization of biodegradable organic wastes. The inert and non-biodegradable waste shall be used for building roads or filling-up of appropriate areas on hills. Because of constraints in finding adequate land in hilly areas, wastes not suitable for road-laying or filling up shall be disposed of in specially designed landfills.

Schedule IV
[see rules 6(1) and (3), 7(2)]
Standards for Composting, Treated Leachates and Incineration

1. The waste processing or disposal facilities shall include composting, incineration, pelletisation, energy recovery or any other facility based on state-of-the-art technology duly approved by the Central Pollution Control Board

2. In case of engagement of private agency by the municipal authority, a specific agreement between the municipal authority and the private agency shall be made particularly, for supply of solid waste and other relevant terms and conditions.

3. In order to prevent pollution problems from compost plant and other processing facilities, the following shall be complied with, namely :-

   i. The incoming wastes at site shall be maintained prior to further processing. To the extent possible, the waste storage area should be covered. If, such storage is done in an open area, it shall be provided with impermeable base with facility for collection of leachate and surface water run-off into lined drains leading to a leachate treatment and disposal facility;

   ii. Necessary precautions shall be taken to minimise nuisance of odour, flies, rodents, bird menace and fire hazard;

   iii. In case of breakdown or maintenance of plant, waste intake shall be stopped and arrangements be worked out for diversion of wastes to the landfill site;

   iv. Pre-process and post-process rejects shall be removed from the processing facility on regular basis and shall not be allowed to pile at the site. Recyclables shall be routed through appropriate vendors. The non-recyclables shall be sent for well designed landfill site(s).

   v. In case of compost plant, the windrow area shall be provided with impermeable base. Such a base shall be made of concrete or compacted clay, 50 cm thick, having permeability coefficient less than 10^{-7} cm/sec. The base shall be provided with 1 to 2 per cent slope and circled by lined drains for collection of leachate or surface run-off;

   vi. Ambient air quality monitoring shall be regularly carried out particularly for checking odour nuisance at down-wind direction on the boundary of processing plant.

Ambient air quality monitoring shall be regularly carried out particularly for checking odour nuisance at down-wind direction

Parameters	**Concentration not to exceed * (mg/kg dry basis , except pH value and C/N ratio)**
Arsenic	10.00
Cadmium	5.00
Chromium	50.00
Copper	300.00

Lead	100.00
Mercury	0.15
Nickel	50.00
Zinc	1000.00
C/N ratio	20-40
PH	5.5-8.5

* Compost (final product) exceeding the above stated concentration limits shall not be used for food crops. However, it may be utilized for purposes other than growing food crops.

4. The disposal of treated leachates shall follow the following standards, namely:-

S.No	Parameter	Standards (Mode of Disposal)		
		Inland surface water	Public sewers	Land disposal
1.	Suspended solids, mg/l, max	100	600	200
2.	Dissolved solids (inorganic) mg/l, max.	2100	2100	2100
3	PH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Ammonical nitrogen (as N), mg/l, max.	50	50	-
5	Total Kjeldahl nitrogen (as N), mg/l, max.	100	-	-
6	Biochemical oxygen demand (3 days at 27^0 C) max.(mg/l)	30	350	100
7	Chemical oxygen demand, mg/l, max.	250	-	-
8	Arsenic (as As), mg/l, max	0.2	0.2	0.2
9	Mercury (as Hg), mg/l, max	0.01	0.01	-
10	Lead (as Pb), mg/l, max	0.1	1.0	-
11	Cadmium (as Cd), mg/l, max	2.0	1.0	-
12	Total Chromium (as Cr), mg/l, max.	2.0	2.0	-
13	Copper (as Cu), mg/l, max.	3.0	3.0	-
14	Zinc (as Zn), mg/l, max.	5.0	15	-

15	Nickel (as Ni), mg/l, max	3.0	3.0	-
16	Cyanide (as CN), mg/l, max.	0.2	2.0	0.2
17	Chloride (as Cl), mg/l, max.	1000	1000	600
18	Fluoride (as F), mg/l, max	2.0	1.5	-
19	Phenolic compounds (as C_6H_5OH) mg/l, max.	1.0	5.0	-

Note : While discharging treated leachates into inland surface waters, quantity of leachates being discharged and the quantity of dilution water available in the receiving water body shall be given due consideration.

The incinerators shall meet the following operating and emission standards, namely:-

A. Operating Standards

(1) The combustion efficiency (CE) shall be at least 99.00%.

(2) The combustion efficiency is computed as follows :

$$C.E. = \frac{\%CO_2}{\%CO_2 + \%CO} \times 100$$

1. Emission Standards

Parameters	Concentration mg/Nm^3 at (12% CO_2 correction)
(1) Particulate matter	150
(2) Nitrogen Oxides	450
(3) HCl	50

(4) Minimum stack height shall be 30 metres above ground.

(5) Volatile organic compounds in ash shall not be more than 0.01%.

Note:

1. Suitably designed pollution control devices shall be installed or retrofitted with the incinerator to achieve the above emission limits, if necessary.
2. astes to be incinerated shall not be chemically treated with any chlorinated disinfectants
3. Chlorinated plastics shall not be incinerated.
4. Toxic metals in incineration ash shall be limited within the regulatory quantities as specified in the Hazardous Wastes (Management and Handling) Rules, 1989 as amended from time to time.
5. Only low sulphur fuel like l.d.o., l.s.h.s or Diesel shall be used as fuel in the incinerator.

Form –I
[see rules 4(2) & 6(2)]
Application for obtaining authorization

To,
The Member Secretary

1.	Name of the municipal authority/Name of the agency appointed by the municipal authority	:	
2.	Correspondence address Telephone No. Fax No.	:	
3.	Nodal Officer & designation(Officer authorised by the municipal authority or agency responsible for operation of processing or disposal facility)	:	
4.	Authorization applied for (Please tick mark)	:	(a) Setting up & operation of waste processing facility (b)Setting up & operation of disposal facility
5.	Detailed proposal of waste processing/disposal facility (to be attached) to include	:	
5.1	**Processing of Waste** i. Location of site ii. Name of waste processing technology iii. Details of processing technology iv. Quanitty of waste to be processed per day v. Site clearance (from local authority) vi. Details of agreement between municipal authority and operating agency vii. Utilization programme for waste processed (Product utilization) viii. Methodology for disposal of waste processing rejects (quantity and quality) ix. Measures to be taken for prevention and control of environmental pollution x. Investment on Project and expected returns xi. Measures to be taken for safety of workers working in the plant	:	
5.2	**Disposal of Waste** i. Number of sites indentified	:	

	ii. Layout maps of site iii. Quantity of waste to be disposed per day iv. Nature and composition of waste v. Details of methodology or criteria followed for site selection vi. Details of existing site under operation vii. Methodology and operational details of landfilling viii. Measures taken to check enviornmental pollution		

Date	Signature of Nodal Officer

Form - II

[See rule 4(4)]

Format of Annual Report to be submitted by the Municipal Authority

i. Name of City/Town:……
ii. Population ……
iii. Name of municipal body:…… and Address
……
……

Telephone No. : ……

Fax : ……

iv. Name of Incharge dealing with municipal solid wastes ……
…… with designation
……

1. Quantity and composition of solid wastes

(i) Total quantity of wastes generated per day

(ii) Total quantity of wastes collected per day

(iii)Total quantity of wastes processed for :

a. Composting: ……
b. Vermiculture: ……
c. Pellets: ……
d. Others, if any, please specify ……

(iv) Total quantity of waste disposed by landfilling: ……

a. no. of landfill sites used : ……
b. Area used: ……
c. Whether Weigh bridge facilities available : Yes/No
d. Whether area is fenced : Yes/No
e. Lighting facility on site : Yes/No
f. Whether equipment like Bulldozer, Compacters etc.available. (Please specify) :----------
---------- ----------
g. Total Manpower available on site: ----------
h. Whether covering is done on daily basis : Yes/No
i. Whether covering material is used and whether it is adequately available : ----------
----
j. Provisions for gas venting provided : Available (Yes/No) /Not available
k. Provision for leachate collection : Provisions made/ Provisions not made

2. Storage facilities

(i) Area covered for collection of wastes : ----------

(ii) no. of houses covered : ----------

(iii) Whether house-to-house collection is practiced (if yes, whether done by Municipality or through Private : ----------

Agency or Non-Governmental Organisation)

(iv) Bins : ----------
Specifications Existing Proposed (Shape & Size) Numbers for future
----

a. RCC Bins (Capacity) :

b. Trolleys (Capacity) :

(c) Containers (Capacity) :

d. Dumper Placers :

e. Others, please specify :

(v)Whether all bins/collection spots are attended for daily lifting of garbage : Yes/No

(vi)Whether lifting of garbage from dustbins is manual or mechanical i.e. for example by using of front-end loaders (Please tick mark) : Manual/Loader/Others, please specify

3. Transportation

	Existing number	Actually Required/Proposed
(i) Truck :		
(ii) Truck-Tipper :		
(iii) Tractor-Trailer :		
(iv) Refuse-collector :		
(v) Dumper-placers :		
(vi) Animal Cart :		
(vii) Tricycle :		
(viii) Others (please specify) :		

4. Whether any proposal has been made to improve solid wastes management practices

5. Are any efforts made to call for private firms etc. to attempt for processing of waste utilising technologies like :

	Waste Utilisation Technology	Proposals	Steps taken (Quantity to be processed)
i. Composting :			
ii. Vermiculture :			

iii. Pelletisation :
iv. Others if any, Please specify :

6. What provisions are available and how these are implemented to check unhygienic operations of :

i. Dairy related activities :

ii. Slaughter houses and unauthorised slaughtering :

iii. Malba (cnstruction debris) lifting :

iv. Encroachment in Parks, Footpaths etc. :

7. How many slums are identified and whether these are provided with sanitation facilities :

Are municipal magistrates appointed for Taking penal action : Yes/No

[If yes, how many cases registered & settled during last three years (give year-wise details)]

9. Hospital waste management

i. How many Hospitals/Clinics under the control of the Corporation:

ii. What methods are followed for disposal of bio-medical wastes?

iii. Do you have any proposal for setting up of common treatment facility for disposal of bio-medical wastes :

iv. How many private Nursing Homes, Clinics etc. are operating in the city/town and what steps have been taken to check disposal of their wastes :

Signature of Municipal Commissioner

Dated :

Form –III
[See-rule 6(2)]
Format for Issue of Authorisation

File No.: _____

Date:_____

To,
_____
_____
_____

Ref: Your application number _____dt. _____

The _____State Pollution Control Board/Pollution Control Committee after examining the proposal hereby authorises_____having their administrative office at _____to set up and operate waste processing/waste disposal facility at_____on the terms and conditions (including the standards to comply) attached to this authorization letter.

1. The validity of this authorization is till_____. After the validity, renewal of authorization is to be sought.

2. The _____State Pollution Control Board/Pollution Control Committees may, at any time, revoke any of the conditions applicable under the authorization and shall communicate the same in writing.

3. Any violation of the provision of the Municipal Solid Wastes (Managemeant and Handling) Rules, 2000 will attract the penal provision of the Environment (Protection) Act, 1986 (29 of1986).

(Member Secretary)
State Pollution Control Board/
Pollution Control Committee

Date :

Place :

Form - IV
[see rule 8(1)]

Format of Annual Review Report to be submitted by the State Pollution Control Board/Committees to the Central Pollution Control Board

To,

The Chairman,
Central Pollution Control Board,
(Ministry of Environment and Forests)
Government of India,
'Parivesh Bhawan', East Arjun Nagar,
DELHI- 110 0032.

1.	Name of the State/Union territory	:	
2.	Name & address of the State Pollution Control	:	
3.	Board/Pollution Control Committee Number of municipal authorities responsible for management of municipal solid wastes in the State/Union territory under these rules	:	
4.	A Summary Statement on progress made by municipal authorities in respect of implementation of Schedule I [rule 4(3)]	:	Please attach as Annexure-I
5.	A Summary Statement on progress made by municipal authorities in respect of implementation of Schedule II [rules 6(1) and (3), 7(1)]	:	Please attach as Annexure-II
6.	A Summary Statement on progress made by municipal authorities in respect of implementation of Schedule III [rules 6(1) and (3), 7(2)]	:	Please attach as Annexure-III
7.	A summary statement on progress made by municipal authorities in respect of implementation of Schedule IV [rules 6(1) and (3), 7(2)]		Please attach as Annexure-IV
Date: _____ Place : _____			Chairman or the Member Secretary State Pollution Control Board/ Pollution Control Committee

Form - V
[see rule 9]
Accident reporting

1.	Date and time of accident	:	
2.	Sequence of events leading to accident	:	
3.	The waste involved in accident	:	
4.	Assessment of the effects of the accidents on human health and the environment	:	
5.	Emergency measures taken	:	
6.	Steps taken to alleviate the effects of accidents	:	
7.	Steps taken to prevent the recurrence of such an accident	:	

Date : ……	Signature : ……
Place : ……	Designation : ……

V. Rajagopalan, Jt. Secy.
[F.No.17-2/95-HSMD]

ANNEXURE 2

BIO-MEDICAL WASTE (MANAGEMENT AND HANDLING) RULES 1998

SMEC INDIA

ANNEXURE - 2

BIO-MEDICAL WASTE (MANAGEMENT AND HANDLING) RULES, 1998

MINISTRY OF ENVIRONMENT & FORESTS

NOTIFICATION

New Delhi, 20th July, 1998

S.O. 630 (E).-Whereas a notification in exercise of the powers conferred by Sections 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986) was published in the Gazette vide S.O. 746 (E) dated 16 October, 1997 inviting objections from the public within 60 days from the date of the publication of the said notification on the Bio-Medical Waste (Management and Handling) Rules, 1998 and whereas all objections received were duly considered

Now, therefore, in exercise of the powers conferred by section 6, 8 and 25 of the Environment (Protection) Act, 1986 the Central Government hereby notifies the rules for the management and handling of bio-medical waste.

1. SHORT TITLE AND COMMENCEMENT

(1) These rules may be called the Bio-Medical Waste (Management and Handling) Rules, 1998.

(2) They shall come into force on the date of their publication in the official Gazette.

2. APPLICATION:

These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form.

3. DEFINITIONS: In these rules unless the context otherwise requires:-

(1) **"Act"** means the Environment (Protection) Act, 1986 (29 of 1986);

(2) **"Animal House"** means a place where animals are reared/kept for experiments or testing purposes;

(3) **"Authorisation"** means permission granted by the prescribed authority for the generation, collection, reception, storage, transportation, treatment, disposal and/or any other form of handling of bio-medical waste in accordance with these rules and any guidelines issued by the Central Government.

(4) **"Authorised person"** means an occupier or operator authorised by the prescribed authority to generate, collect, receive, store, transport, treat, dispose and/or handle bio-medical waste in accordance with these rules and any guidelines issued by the Central Government;

(5) **"Bio-medical waste"** means any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals, and including categories mentioned in Schedule I;

(6) **"Biologicals"** means any preparation made from organisms or micro-organisms or product of metabolism and biochemical reactions intended for use in the diagnosis, immunisation or the treatment of human beings or animals or in research activities pertaining thereto;

(7) **"Bio-medical waste treatment facility"** means any facility wherein treatment. disposal of bio-medical waste or processes incidental to such treatment or disposal is carried out;

(8) **"Occupier"** in relation to any institution generating bio-medical waste, which includes a hospital, nursing home, clinic dispensary, veterinary institution, animal house, pathological laboratory, blood bank by whatever name called, means a person who has control over that institution and/or its premises;

(9) **"Operator of a bio-medical waste facility"** means a person who owns or controls or operates a facility for the collection, reception, storage, transport, treatment, disposal or any other form of handling of bio-medical waste;

(10) **"Schedule"** means schedule appended to these rules;

4. DUTY OF OCCUPIER:

It shall be the duty of every occupier of an institution generating bio-medical waste which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank by whatever name called to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment.

5. TREATMENT AND DISPOSAL

(1) Bio-medical waste shall be treated and disposed of in accordance with Schedule I, and in compliance with the standards prescribed in Schedule V.

(2) Every occupier, where required, shall set up in accordance with the time-schedule in Schedule VI, requisite bio-medical waste treatment facilities like incinerator, autoclave, microwave system for the treatment of waste, or, ensure requisite treatment of waste at a common waste treatment facility or any other waste treatment facility.

6. SEGREGATION. PACKAGING. TRANSPORTATION AND STORAGE

(1) Bio-medical waste shall not be mixed with other wastes.

(2) Bio-medical waste shall be segregated into containers/bags at the point of generation in accordance with Schedule II prior to its storage, transportation, treatment and disposal. The containers shall be labeled according to Schedule III.

(3) If a container is transported from the premises where bio-medical waste is generated to any waste treatment facility outside the premises, the container shall, apart from the label prescribed in Schedule III, also carry information prescribed in Schedule IV.

(4) Notwithstanding anything contained in the Motor Vehicles Act, 1988, or rules thereunder, untreated biomedical waste shall be transported only in such vehicle as may be authorized for the purpose by the competent authority as specified by the government.

(5) No untreated bio-medical waste shall be kept stored beyond a period of 48 hours Provided that if for any reason it becomes necessary to store the waste beyond such period, the authorized person must take permission of the prescribed authority and take measures to ensure that the waste does not adversely affect human health and the environment.

7. PRESCRIBED AUTHORITY

(1) The Government of every State and Union Territory shall establish a prescribed authority with such members as may be specified for granting authorization and implementing these rules. If the prescribed authority comprises of more than one member, a chairperson for the authority shall be designated.

(2) The prescribed authority for the State or Union Territory shall be appointed within one month of the coming into force of these rules.

(3) The prescribed authority shall function under the supervision and control of the respective Government of the State or Union Territory.

(4) The prescribed authority shall on receipt of Form 1 make such enquiry as it deems fit and if it is satisfied that the applicant possesses the necessary capacity to handle bio-medical waste in accordance with these rules, grant or renew an authorization as the case may be.

(5) An authorization shall be granted for a period of three years, including an initial trial period of one year from the date of issue. Thereafter, an application shall be made by the occupier/operator for renewal. All such subsequent authorization shall be for a period of three years. A provisional authorization will be granted for the trial period, to enable the occupier/operator to demonstrate the capacity of the facility.

(6) The prescribed authority may after giving reasonable opportunity of being heard to the applicant and for reasons thereof to be recorded in writing, refuse to grant or renew authorization.

(7) Every application for authorisation shall be disposed of by the prescribed authority within ninety days from the date of receipt of the application.

(8) The prescribed authority may cancel or suspend an authorisation, if for reasons, to be recorded in writing, the occupier/operator has failed to comply with any provision of the Act or these rules :

Provided that no authorisation shall be cancelled or suspended without giving a reasonable opportunity to the occupier/operator of being heard.

8. AUTHORISATION

(1) Every occupier of an institution generating, collecting, receiving, storing, transporting, treating, disposing and/or handling bio-medical waste in any other manner, except such occupier of clinics, dispensaries, pathological laboratories, blood banks providing treatment/service to less than 1000 (one thousand) patients per month, shall make an application in Form 1 to the prescribed authority for grant of authorisation.

(2) Every operator of a bio-medical waste facility shall make an application in Form 1 to the prescribed authority for grant of authorisation.

(3) Every application in Form 1 for grant of authorisation shall be accompanied by a fee as may be prescribed by the Government of the State or Union Territory.

9. ADVISORY COMMITTEE

The Government of every State/Union Territory shall constitute an advisory committee. The committee will include experts in the field of medical and health, animal husbandry and veterinary sciences, environmental management, municipal administration, and any other related department or organisation including non-governmental organisations. The State Pollution Control Board/Pollution Control Committee shall be represented. As and when required, the committee shall advise the Government of the State/Union Territory and the prescribed authority about matters related to the implementation of these rules.

10. ANNUAL REPORT

Every occupier/operator shall submit an annual report to the prescribed authority in Form 11 by 31 January every year, to include information about the categories and quantities of bio-medical wastes handled during the preceding year. The prescribed authority shall send this information in a compiled form to the Central Pollution Control Board by 31 March every year.

11. MAINTENANCE OF RECORDS

(1) Every authorised person shall maintain records related to the generation, collection, reception, storage, transporation, treatment, disposal and/or any form of handling of bio-medical waste in accordance with these rules and any guidelines issued.

(2) All records shall be subject to inspection and verification by the prescribed authority at any time.

12. ACCIDENT REPORTING

When any accident occurs at any institution or facility or any other site where bio-medical waste is handled or during transportation of such waste, the authorised person shall report the accident in Form III to the prescribed authority forthwith.

13. APPEAL

Any person aggrieved by an order made by the prescribed authority under these rules may, within thirty days from the date on which the order is communicated to him, prefer an appeal to such authority as the Government of State/Union Territory may think fit to constitute:

Provided that the authority may entertain the appeal after the expiry of the said period of thirty days if it is satisfied that the appellant was prevented by sufficient cause from filing the appeal in time.

SCHEDULE I

(See Rule 5)

CATEGORIES OF BIO-MEDICAL WASTE

Option	Waste Category	Treatment & Disposal
Category No. I	**Human Anatomical Waste** (human tissues, organs, body parts)	incineration@/deep burial*
Category No. 2	**Animal Waste** (animal tissues, organs, body parts carcasses, bleeding parts, fluid, incineration@/deep burial* blood and experimental animals used in research, waste generated by veterinary hospitals colleges, discharge from hospitals, animal houses)	incineration@/deep burial*
Category No 3	**Microbiology & Biotechnology Waste** (wastes from laboratory cultures, stocks or specimens of micro- local autoclaving/micro-organisms live or attenuated vaccines, human and animal cell waving/incineration@ culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)	Local autoclaving/ microwaving/ incineration@
Category No 4	**Waste sharps** (needles, syringes, scalpels, blades, glass, etc. that may cause disinfection (chemical treat- puncture and cuts. This includes both used and unused sharps)	Disinfection (chemical treatment@@/auto claving/micro- waving and mutilation/ shredding"
Category No 5	**Discarded Medicines and Cytotoxic drugs** (wastes comprising of outdated, contaminated and discarded medicines)	incineration@/destruct ion and medicines) drugs disposal in secured landfills
Category No 6	**Solid Waste** (Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material incineration@ contaminated with blood)	incineration@/ autoclaving/microwaving

Option	Waste Category	Treatment & Disposal
Category No. 7	**Solid Waste** (wastes generated from disposable items other than the waste shaprs disinfection by chemical such as tubings, catheters, intravenous sets etc).	Disinfection by chemical treatment@@ autoclaving/ microwaving and mutilation/ shredding##
Category No. 8	**Liquid Waste** (waste generated from laboratory and washing, cleaning, house- disinfection by chemical keeping and disinfecting activities)	Disinfection by chemical treatment@@ and discharge into drains.
Category No. 9	**Incineration Ash** (ash from incineration of any bio-medical waste)	disposal in municipal landfill
Category No. 10	**Chemical Waste** (chemicals used in production of biologicals, chemicals used in chemical treatment@@ and disinfection, as insecticides, etc.)	discharge into drains for liquids and secured landfill for solids

— @@ Chemicals treatment using at least 1% hypochlorite solution or any other equivalent chemical reagent. It must be ensured that chemical treatment ensures disinfection.

Multilation/shredding must be such so as to prevent unauthorised reuse.

@ There will be no chemical pretreatment before incineration. Chlorinated plastics shall not be incinerated.

* Deep burial shall be an option available only in towns with population less than five lakhs and in rural areas.

SCHEDULE II

(see Rule 6)

COLOUR CODING AND TYPE OF CONTAINER FOR DISPOSAL OF BIO-MEDICAL WASTES

Colour Conding	Type of Container	Waste Category	Treatment options as per Schedule I
Yellow	Plastic bag	Cat. 1, Cat. 2, and Cat. 3, Cat. 6	Incineration/deep burial
Red	Disinfected container/plastic bag	Cat. 3, Cat. 6, Cat.7	Autoclaving/Microwaving/ Chemical Treatment
Blue/White translucent	Plastic bag/puncture proof	Cat. 4, Cat. 7	Container Autoclaving/Microwaving/ Chemical Treatment and destruction/shredding
Black	Plastic bag	Cat. 5 and Cat. 9 and Cat. 10(solid)	Disposal in secured landfill

Notes:

1. Colour coding of waste categories with multiple treatment options as defined in Schedule I, shall be selected depending on treatment option chosen, which shall be as specified in Schedule I.

2. Waste collection bags for waste types needing incineration shall not be made of chlorinated plastics.

3. Categories 8 and 10 (liquid) do not require containers/bags.

4. Category 3 if disinfected locally need not be put in containers/bags.

SCHEDULE III

(see Rule 6)

LABEL FOR BIO-MEDICAL WASTE CONTAINERS/BAGS

HANDLE WITH CARE

Note : Lable shall be non-washable and prominently visible.

SCHEDULE IV

(see Rule 6)

LABEL FOR TRANSPORT OF BIO-MEDICAL WASTE CONTAINERS/BAGS

Day …….. Month ……..

Year ……..

Date of generation ……

Waste category No ……..

Waste class

Waste description

Sender's Name & Address	**Receiver's Name & Address**
Phone No ……..	Phone No ……..
Telex No ….	Telex No ……..
Fax No ……..	Fax No ……..
Contact Person ……..	Contact Person ……..

In case of emergency please contact

Name & Address :

Phone No.

Note :

Label shall be non-washable and prominently visible.

SCHEDULE V

(see Rule 5 and Schedule 1)

STANDARDS FOR TREATMENT AND DISPOSAL OF BIO-MEDICAL WASTES

STANDARDS FOR INCINERATORS:

All incinerators shall meet the following operating and emission standards

A. Operating Standards

1. Combustion efficiency (CE) shall be at least 99.00%.

2. The Combustion efficiency is computed as follows:

$$C.E. = \frac{\%C02}{\%C02 + \%\ CO} \times 100$$

3. The temperature of the primary chamber shall be 800 ± 50 deg. C°.

4. The secondary chamber gas residence time shall be at least I (one) second at 1050 ± 50 C°, with minimum 3% Oxygen in the stack gas.

B. Emission Standards

Parameters		Concentration mg/Nm3 at (12% CO2 correction)
(1)	Particulate matter	150
(2)	Nitrogen Oxides	450
(3)	HCl	50

(4) Minimum stack height shall be 30 metres above ground

(5) Volatile organic compounds in ash shall not be more than 0.01%

Note :

- Suitably designed pollution control devices should be installed/retrofitted with the incinerator to achieve the above emission limits, if necessary.
- Wastes to be incinerated shall not be chemically treated with any chlorinated disinfectants.
- Chlorinated plastics shall not be incinerated.
- Toxic metals in incineration ash shall be limited within the regulatory quantities as defined under the Hazardous Waste (Management and Handling Rules,) 1989.
- Only low sulphur fuel like L.D.0dLS.H.S.1Diesel shall be used as fuel in the incinerator.

STANDARDS FOR WASTE AUTOCLAVING:

The autoclave should be dedicated for the purposes of disinfecting and treating bio-medical waste,

(I) When operating a gravity flow autoclave, medical waste shall be subjected to:

(i) a temperature of not less than 121 C' and pressure of 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or

(ii) a temperature of not less than 135 C° and a pressure of 31 psi for an autoclave residence time of not less than 45 minutes; or

(iii) a temperature of not less than 149 C° and a pressure of 52 psi for an autoclave residence time of not less than 30 minutes.

(II) When operating a vacuum autoclave, medical waste shall be subjected to a minimum of one pre-vacuum pulse to purge the autoclave of all air. The waste shall be subjected to the following:

(i) a temperature of not less than 121 C° and pressure of 15 psi per an autoclave residence time of not less than 45 minutes; or

(ii) a temperature of not less than 135 C° and a pressure of 31 psi for an autoclave residence time of not less than 30 minutes;

(III) Medical waste shall not be considered properly treated unless the time, temperature and pressure indicators indicate that the required time, temperature and pressure were reached during the autoclave process. If for any reasons, time temperature or pressure indicator indicates that the required temperature, pressure or residence time was not reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and residence time were achieved.

(IV) Recording of operational parameters

Each autoclave shall have graphic or computer recording devices which will automatically and continuously monitor and record dates, time of day, load identification number and operating parameters throughout the entire length of the autoclave cycle.

(V) Validation test

Spore testing:

The autoclave should completely and consistently kill the approved biological indicator at the maximum design capacity of each autoclave unit. Biological indicator for autoclave shall be Bacillus stearothermophilus spores using vials or spore Strips; with at least 1X104 spores per millilitre. Under no circumstances will an autoclave have minimum operating parameters less than a residence time of 30 minutes, regardless of temperature and pressure, a temperature less than 121 C° or a pressure less than 15 psi.

(VI) Routine Test

A chemical indicator strip/tape the changes colour when a certain temperature is reached can be used to verify that a specific temperature has been achieved. It may be necessary to use more than one strip over the waste package at different location to ensure that the inner content of the package has been adequately autoclaved

STANDARD FOR LIQUID WASTE:

The effluent generated from the hospital should conform to the following limits

PARAMETERS	PERMISSIBLE LIMITS
PH	63-9.0
Susponded solids	100 mg/l
Oil and grease	10 mg/l
BOD	30 mg/l
COD	250 mg/l
Bio-assay test	90% survival of fish after 96 hours in 100% effluent.

these limits are applicable to those, hospitals which are either connected with sewers without terminal sewage treatment plant or not connected to public sewers. For discharge into public sewers with terminal facilities, the general standards as notified under the Environment (Protection) Act, 1986 shall be applicable.

STANDARDS OF MICROWAVING

1 Microwave treatment shall not be used for cytotoxic, hazardous or radioactive wastes, contaminated animal car casses, body parts and large metal items.

2. The microwave system shall comply with the efficacy test/routine tests and a performance guarantee may be provided by the supplier before operation of the limit.

3. The microwave should completely and consistently kill the bacteria and other pathogenic organisms that is ensured by approved biological indicator at the maximum design capacity of each microwave unit. Biological indicators for microwave shall be Bacillus Subtilis spores using vials or spore strips with at least 1 x 101 spores per milliliter.

STANDARDS FOR DEEP BURIAL

1. A pit or trench should he dug about 2 meters deep. It should be half filled with waste, then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil.

2. It must be ensured that animals do not have any access to burial sites. Covers of galvanised iron/wire meshes may be used.

3. On each occasion, when wastes are added to the pit, a layer of 10 em of soil shall be added to cover the wastes.

4. Burial must be performed under close and dedicated supervision.

5. The deep burial site should be relatively impermeable and no shallow well should be close to the site.

6. The pits should be distant from habitation, and sited so as to ensure that no contamination occurs of any surface water or ground water. The area should not be prone to flooding or erosion.

7. The location of the deep burial site will be authorised by the prescribed authority.

8. The institution shall maintain a record of all pits for deep burial.

SCHEDULE VI

(see Rule 5)

SCHEDULE FOR WASTE TREATMENT FACILITIES LIKE INCINERATOR/ AUTOCLAVE/ MICROWAVE SYSTEM

A	Hospitals and nursing homes in towns with population of 30 lakhs and above	by 31st December, 1999 or earlier
B.	Hospitals and nursing homes in towns with population of below 30 lakhs,	
	(a) with 500 beds and above	by 31st December, 1999 or earlier
	(b) with 200 beds and above but less than 500 beds	by 31st December, 2000 or earlier
	(c) with 50 beds and above but less than 200 beds	by 31st December, 2001 or earlier
	(d) with less than 50 beds	by 31st December, 2002 or earlier
C	All other institutions generating bio-medical waste not included in A and B above	by 31st December, 2002 or earlier

FORM I

(see rule

APPLICATION FOR AUTHORISATION

(To be submitted in duplicate.)

To
The Prescribed Authority
(Name of the State Govt/UT Administration)
Address.

1. Particulars of Applicant

(i) Name of the Applicant

(In block letters & in full)

(iii) Name of the Institution:

Address:

Tele No., Fax No. Telex No.

2. Activity for which authorisation is sought:

(i) Generation

(ii) Collection

(iii) Reception

(iv) Storage

(v) Transportation

(vi) Treatment

(vii) Disposal

(viii) Any other form of handling

3. Please state whether applying for resh authorisation or for renewal:
(In case of renewal previous authorisation-number and date)

4.

(i) Address of the institution handling bio-medical wastes:

(ii) Address of the place of the treatment facility:

(iii) Address of the place of disposal of the waste:

5.

(i) Mode of transportation (in any) of bio-medical waste:

(ii) Mode(s) of treatment:

6. Brief description of method of treatment and disposal (attach details):

7. (i) Category (see Schedule 1) of waste to be handled

(ii) Quantity of waste (category-wise) to be handled per month

8. **Declaration**

I do hereby declare that the statements made and information given above are true to the best of my knowledge and belief and that I have not concealed any information.

I do also hereby undertake to provide any further information sought by the prescribed authority in relation to these rules and to fulfill any conditions stipulated by the prescribed authority.

Date : Signature of the Applicant

Place : Designation of the Applicant

FORM II

(see rule 10)

ANNUALREPORT

(To be submitted to the prescribed authority by 31 January every year).

1 Particulars of the applicant:

(i) Name of the authorised person (occupier/operator):

(ii) Name of the institution:

Address
Tel. No
Telex No.
Fax No.

2. Categories of waste generated and quantity on a monthly average basis:

3. Brief details of the treatment facility:

In case of off-site facility:

(i) Name of the operator

(ii) Name and address of the facility:

Tel. No., Telex No., Fax No.

4. Category-wise quantity of waste treated:

5. Mode of treatment with details:

6. Any other information:

7. Certified that the above report is for the period from……

……

Date …… Signature ……

Place…… Designation……

FORM III

(see Rule 12)

ACCIDENT REPORTING

1. Date and time of accident:
2. Sequence of events leading to accident
3. The waste involved in accident.
4. Assessment of the effects of the accidents on human health and the environment.
5. Emergency measures taken
6. Steps taken to alleviate the effects of accidents
7. Steps taken to prevent the recurrence of such an accident

Date …… Signature ……

Place…… Designation……

[F.No.23-2/96-HSMD]
VIJAY SHARMA, Jt.Secy.

ANNEXURE 3

OPERATIONAL GUIDELINES FOR LANDFILL SITE

SMEC INDIA

Annexure 3

OPERATIONAL GUIDELINES FOR LAND FILL SITE

1. CONSTRUCTION OF LAND FILL SITE

(1) Land fill site is the engineering method of disposal of waste on land. As such land fills are required to protect the environment by spreading waste into thin layers and compact them into smallest practical volume and by the end of the day it is covered with a layer of soil of at least10- 15cm spread and then compacted.

2. CELL

(2) Cell is the building block of the sanitary land fill. To build cell, waste is spread over in layers maximum 60 cm or less and compacted in thin layers not exceeding 15cm. The compacted waste and the soil together form the cell. It consists of several layers of compost on a slope of 4:1 and enclosed on all sides.

(3) The length of the cell is decided based on the assessment of the daily waste arrival to the site while width is fixed on the requirement of movement of the waste vehicles and compactors and for unloading of waste trucks. The width of the cell or the working face should be as narrow as possible but wide enough for the movement of vehicles to ensure better compaction and to reduce daily cover material requirement.

(4) Hence it should be 10- 15 meters. A series of cells that adjoin each other make a lift

(5) There is no hard and fast rule for the height of the cells but for waste of 100 tons and less it could be 60 -120 cm, the requirement for the cover for the cell is worked out in the ratio of 1 to 8 of the waste.

(6) The entire land fill site is to be divided into yearly cell which is to be divided into daily cells. The detailed Plan of the entire land fill site and that of the daily cell and the manner in which the waste will be spread and compacted is prepared and included in the volume 2 of DPR Drawing No SMEC/1199/DPR/SIPMIU/DRW/SWM/59

3. EQUIPMENT MOVEMENT

(7) Solid waste should be dumped at the toe of the working face by the tipper trucks and pushed up the slope. For reasons of safety the inter distance between truck and the crawler tractor and the compactor should be at least 3 meter.

4. WASTE COMPACTION.

(8) A high degree of compaction extends the life of land fill, reduces cover material and long term land requirement, reduces litter problems and results in other environmental benefits. Good compaction is achieved by operating the compactor up and down the working face between three to five times on 30 to 60 cm layers of waste until no further compaction occurs. The top deck of the cell must also be compacted by running the compactor across the top keeping at level as possible

5. CELL COVER

(9) Cover soil must be placed over exposed waste at the close of each day's operation.

(10) The amount of soil required may vary with the type of the soil. However the thickness of the compacted soil should not be less than 10cm.

5.1 COVER SOIL

(11) Excavation of soil for cover material should only be made from the areas at the site designated as "borrow areas". The operator/ Supervisor is required to instruct as to when to begin on excavation of new borrow and when to stop excavation in an existing area.

5.2 PLACEMENT OF COVER

(12) Use of soil for daily, intermediate or final cover should be placed in the following manner.

(13) While using the compactor, cover soil should be pushed up the slope and feathered it out as evenly as possible. The tracks of the equipment should not be allowed to spin as it traverses the compacted slope. This action will tear up the waste and it may be necessary to compact the waste again in order to reapply the cover material. While constructing a cell in the slope in open area, the side slopes require soil cover also. These side slopes should be maintained in 4:1 to 2:1.

5.3 DAILY COVER

(14) All waste must be covered at the end of the day to protect against vectors, orders and debris leaving the landfill. This requirement may be filled by the use of landfill tarps and/ or soil. When using tarps for daily cover of the current waste slope ensure all waste is covered and the tarps have been overlapped.

(15) When using soil as daily cover at least 10-15cm of compacted soil must cover the slopes and the top deck by the close of business each day. In some cases, more soil than the minimum amount may be required so that after compaction, the slope layer and top deck will have adequate cover material. For example, loose soils such as sand and silt may drop into voids in the waste. For this reason, proper compaction is essential to minimize the amount of daily cover soil required.

5.4 INTERMEDIATE COVER

(16) The top and side surfaces of a completed cell that is not to be covered within 180 days by another cell may be exposed to weather and truck traffic. These surfaces should be covered with a layer of at least 30cm of compacted soil. This intermediate cover should be thick enough to prevent erosion of the cover by wind, water and traffic. If wastes become exposed, water can enter, and odours and gases may escape from the cells.

5.5 FINAL COVER

(17) When filling has reached the final planned grade, a final cover of compacted soil should be placed. The operating staff will advise the depth of final cover to use for all completed sections of fill.--. This cover is necessary to allow light traffic and minor settlement to occur without exposing any waste. The final cover will also help keep the rain from

seeping into the waste. Details are given in Volume 2 of DPR Drawing No. SMEC/1199/DPR/SIPMIU/DRW/SWM/60

6. CLEANUP OF COMPLETED AREA

a. Prior to Final Cover

Prior to placement of final cover material, the completed area should be cleared of all debris. Any objects protruding through the daily or intermediate cover should be pulled out and the hole filled. Large cracks or holes in the surface should be filled with cover material.

b. Final Cover Placement

Place final cover material on completed areas at the thickness specified by filling plans, Site Supervisors, or Engineering staff. Use methods indicated in "Cover Soil" as above

c. Planting and Landscaping

Completed areas should be landscaped according to landscaping plans provided by the concerned Authorities responsible for operation and maintenance of land fill.

7. MAINTENANCE OF COMPLETED AREAS

a. Landscaping

All grass, shrubs, and tree areas should be cultivated and watered as specified. by the Municipalities or Authority responsible for operation and maintenance Regular schedules for cultivation and watering should be determined and maintained.

b. Inspection of Completed Areas

The Engineering staff should inspect completed areas of the landfill once each month for signs of cracks and depressions due to settlement.

c. Cracks and Depressions

The entire land fill site area should be fenced to ensure that all other movement and activities that are required for operating the land fill is only permitted in the area.

(18) The operational vehicles like the tipper trucks and the compactors have easy access through the roads and the ramps made for the purpose. These need to be maintained by ensuring that no water gets accumulated and there is no depression or pot holes and wherever they appear should be filled up Cracks and depressions should be filled with compacted soil as soon as they are discovered. Their maintenance is important for operational reasons and the responsibility vests with the land fill operator

8. LEACHATE

(19) Landfill leachate is liquid that moves through or drains from a landfill. This liquid may either exist already in the landfill, or it may be created after rainwater mixes with the chemical waste. Modern landfills are often designed to prevent liquid from leaching out and entering the environment; however, if not properly managed, the leachate is at risk for mixing with ground water near the site, which can have dire effects.

8.1 SOURCES OF LEACHATE

(20) Sources of leachate are

a. Rainfall

b. Ground water

c. Consolidation

d. Initial Moisture Storage

e. Reaction associated with decomposition of waste

(21) The most common source of landfill leachate is rainwater filtering down through the landfill. Landfill leachate may be virtually harmless or dangerously toxic, depending upon the characteristics of the material in the landfill. Typically, landfill leachate has high concentrations of nitrogen, iron, organic carbon, manganese, chloride and phenols. Other chemicals including pesticides, solvents and heavy metals may also be present. In the past, this usually toxic soup was allowed to slowly leak away into the nearby environment, eventually mixing with the local ground system. However in case of the designed land fill sites which receive mostly the inert material and the rejects from the compost plants this may not be significant.

(22) Modern landfill sites require that the landfill leachate be collected and treated. Since there is no method to ensure that rainwater cannot enter the landfill site, landfill sites must now have an impermeable layer at the bottom. The landfill leachate that collects at the bottom must be monitored and treated if required. This liquid can be treated in a similar manner to sewage, and the treated water can then be safely released into the environment.

8.2 MINIMISING LEACHATE GENERATION

(23) A sanitary landfill is a step by step construction activity involving daily layering, compacting, soil covering of refuse into cells, and routing surface runoff away from waste cells. The space wherein the refuse would be placed should not be subject to seasonally high groundwater levels or to periodic flooding. The site preparation and land filling operation must be designed to minimize contact of surface runoff and percolating rainwater with the refuse. This requires diversion of up gradient surface drainage away from the landfill operational area, sloping of the cells to avoid ponding of waters on top of them, and compaction of refuse and daily soil cover as each cell is being constructed so that infiltration potential is minimized.

(24) Soil used for lining, interim cover, and final cover should be wetted with water (usually from a water tank truck) to reach optimum moisture (about 50%) so that good compaction can be obtained. Final soil cover needs to be sloped (2-3%) to avoid ponding of waters on top of the refuse filled area and to minimize infiltration. Grass is planted in the final soil cover to limit erosion.

8.3 LEACHATE MANAGEMENT

(25) At sites where potentially useable groundwater exists in unconfined layers, any rain and surface runoff waters which percolate through the refuse and become contaminated leachate need to be collected. The leachate collection system typically consists of a network of perforated plastic pipe within a gravel bed which is placed over the landfill liner. The

perforations holes need to be small enough that the encasement stones do not enter the pipes. The gravel bed may be protected from clogging by a geotextile liner. Leachate pipes need to be selected to withstand the compression forces of the waste deposit and equipment operating at the landfill. Slopes of the pipe should never transition from a steeper upstream slope to a shallower downstream slope; otherwise sediment could collect at the transition point and lead to clogging. The landfill liner and the leachate collection network need to be properly sloped (about 2% slope) to enable gravity flow of contaminated waters to treatment ponds.

8.4 LEACHATE CONTROL

(26) Leachate control is ensured for the land fill site by having the following arrangement in place

a. Drainage all around the land fill site to ensure that surface flow is arrested and minimum rain water enters the land fill. Leachate grows when it comes in contact with the moisture.

b. Land fill is constructed in such a way that there is 4:1 slope and there is no water retention

c. Capacity of the leachate tank is adequate to meet the peak demand of leachate generation

d. The liner is laid in such away that ensures no seepage of water. This can be checked by installing a lysimeter under a portion of the land fill. lysimeter is geo-synthetic membrane which will collect any leakage from under the liner test area and direct it to tank to measure and for analysis. If excessive leakage is detected liner material can be modified in the areas of land fill or for the entire site.

e. The waste is compacted and the soil cover is laid and compacted daily even the side slopes have the compacted soil cover.

f. Leachate is collected in the horizontal perforated pipes in both x and y direction and is laid inside a trench with gravel at the back

g. The network of pipes is connected to the drain which ultimately meets the leachate tank where it is treated and could be re-circulated or drained off.

h. In order to ensure that there is no obstruction caused to the flow of the leachate in the pipes the same should be flushed with water periodically with a hose

i. The drainage channel which is expected to carry the leachate to the leachate tank for treatment should also be kept free from any soil, waste or any other matter causing obstruction to the flow. This is to ensure that there is no over flow and leachate does not spill over to the ground surface.

9. LAND FILL GAS CONTROL

10. Landfill gas (LFG) is formed as a natural by product of the anaerobic decomposition of wastes in landfills. Typically, LFG is composed of about 50% methane, 45% carbon dioxide, and 5% of other gases including hydrogen sulphides and volatile organic compounds. .LFG is thought to be released from six months to two years after waste is placed in the land fill. Methane is a potent greenhouse gas (GHG), with 21 times the global

warming potential of carbon dioxide. Estimates indicate that about 13% of methane emissions released to the atmosphere in 2000 were from landfills.

11. .LFG can contribute to malodour and present health and safety hazards if it is not well controlled. To recover its energy value and minimize its pollutant effects, many landfill sites have installed LFG recovery and utilization systems. Recovery of 100% of the generated gas is generally considered infeasible due to the permeability of wastes and recovery systems in efficiencies as well as installation timing.

9.1 LFG COLLECTION SYSTEM

10. The two common ways to recover LFG are vertical extraction wells and horizontal collectors. The standard and most commonly used is the vertical extraction well. The well is drilled into the landfill at spacing typically ranging from 45 to 90 m .Two to 8 inch diameter pipes (typically PVC or HDPE) are placed in the holes, which are backfilled with 1-inch diameter, or larger, stones.

11. Horizontal extraction collectors or trenches may be installed instead of/or in combination with vertical wells to collect LFG. They consist of excavated trenches (similar to a pipeline trench) which are backfilled with permeable gravel. Perforated, slotted, or alternating diameters of pipe are installed in the trench. Horizontal extraction collectors are less expensive than vertical extraction wells and are particularly suitable for installation in active filling areas.

12. The LFG collection system should be used in concert with good leachate management practices. Leachate accumulation within the refuse can dramatically impact the rate of LFG recovery because liquid in the extraction well and collection trenches effectively restricts their ability to collect and convey LFG.

13. Field experiences indicate that horizontal extraction collectors are more suitable for compared to vertical extraction wells. The main purpose of using the horizontal extraction well is the very high leachate level in India landfills. In this DPR horizontal pipes have been suggested.

9.2 PRODUCING OF LANDFILL GAS

14. Three processes – bacterial decomposition, volatilization and chemical reactions – form landfill gas.

a. **Bacterial decomposition:** Most landfill gas is produced by bacterial decomposition, which occurs when organic waste is broken down by bacteria naturally present in the waste and in the soil used to cover the landfill. Organic wastes include food, garden waste, street sweepings, textiles and wood and paper products. Bacteria decomposed organic waste in four phases, and the composition of the gas changes during each phase. The paragraphs below provide detailed information about the four phases of bacterial decomposition and the gases produced during each phase.

b. **Volatilization:** Landfill gases can be created when certain wastes, particularly organic compounds, change from a liquid or a solid into vapour. The process is known as volatilization. Non –methane organic compounds or NMOCs in landfill gas may be the result of volatilization of certain chemicals disposed of in the landfill.

c. **Chemical reactions:** Landfill gas, including NMOCs, can be created by the reactions of certain chemicals present in waste. For example, if chlorine bleach and ammonia come in contact with each other within the landfill, a harmful gas is produced.

9.3 THE FOUR PHASES OF BACTERIAL DECOMPOSITION OF LANDFILL WASTE

15. Bacteria decompose landfill waste in four phases. The composition of the gas produced changes with each of the four phases of decomposition Landfills often accept waste over a 20 to 30 year period, so waste in a landfill may be undergoing several phases of decomposition at once. This means that older waste in one area might be in a different phase of decomposition than more recently buried waste in another area.

a. **Phase I:** During the first phase of decomposition, aerobic bacteria-bacteria that live only in the presence of oxygen consume oxygen while breaking down the long molecular chains of complex carbohydrates, proteins and liquids that comprise organic waste. The primary by product of this process is carbon dioxide. Nitrogen content is high at the beginning of this phase, but declines as the landfill moves through the four phases. Phase I continues until available oxygen is depleted. phase I decomposition can last for days or months, depending on how much oxygen is present when the waste is disposed of in the landfill. Oxygen levels will vary according to factors such as how loose or compressed the waste was when it was buried.

b. **Phase II:** decomposition starts after the oxygen in the landfill has been used up. Using an anaerobic process (a process that does not require oxygen), bacteria convert compounds created by aerobic bacteria into acetic, lactic and formic acids and alcohols such as methanol and ethanol. The landfill becomes highly acidic. As the acids mix with the moisture present in the landfill, they cause certain nutrients to dissolve, making nitrogen and phosphorus available to the increasingly diverse species of bacteria in the landfill. The gaseous by products of these processes are carbon dioxide and hydrogen. If the landfill is disturbed or if oxygen is somehow introduced into the landfill, microbial processes will return to Phase I.

c. **Phase III:** decomposition starts when certain kinds of anaerobic bacteria consume the organic acids produced in Phase II and form acetate, an organic acid. This process causes the landfill to become a more neutral environment in which methane-producing bacteria begin to establish themselves. Methane-and acid producing bacteria have a symbolic, or mutually beneficial, relationship. Acid-producing bacteria create compounds for the methanogenic bacteria to consume. Methanogenic bacteria consume the carbon dioxide and acetate, too much of which would be toxic to the acid-producing bacteria.

d. **Phase IV:** decomposition begins when both the composition and production rates of landfill gas remain relatively constant. Phase IV landfill gas usually contains approximately 45% to 60% methane by volume, 40% to 60% carbon dioxide, and 2% to 9% other gases, such as sulphides. Gas is produced at a stable rate in Phase IV, typically for about 20 years; however, gas will continue to be emitted for 50 or more years after the waste is placed in the landfill Gas production might last longer, for example, if greater amounts of organics are present in the waste, such as at a landfill receiving higher than average amounts of domestic animal waste.

9.4 LANDFILL GAS MOVEMENT

16. Once gases are produced under the landfill surface, they generally move away from the landfill. Gases tend to expand and fill the available space, so that they move, or "migrate", through the limited pore spaces within the refuse and soils covering of the landfill. The natural tendency of landfill gases that are lighter than air, such as methane, is to move upward, usually through the landfill surface. Upward movement of landfill gas can be inhibited by densely compacted waste or landfill cover material (e.g., by daily soil cover and caps). When upward movement is inhibited, the gas tends to migrate horizontally to other areas within the landfill or to areas outside the landfill, where it can resume its upward path. Basically, the gases follow the path of least resistance. Some gases, such as carbon dioxide are denser than air and will collect in subsurface areas., such as utility corridors. Three main factors influence the migration of landfill gases: diffusion (concentration), pressure and permeability.

a. **Diffusion (concentration):** Diffusion describes a gas's natural tendency to reach a uniform concentration in a given space, whether it is a room or the earth atmosphere. Gases in a landfill move from areas of high gas concentrations to areas with lower gas concentrations. Because gas concentrations are generally high in the landfill than in the surrounding areas, landfill gases diffuse out of the landfill to the surrounding areas with lower gas concentrations.

b. **Pressure:** Gases accumulating in a landfill create areas of high pressure in which gas movement is restricted by compacted refuse or soil covers and areas of low pressure in which gas movement is restricted by compacted refuse or soil covers and areas of low pressure in which gas movement is unrestricted. The variation in pressure throughout the landfill results in gases moving from areas of high pressure to areas of low pressure. Movement of gases from areas of high pressure to areas of lower pressure is known as convection. As more gases are generated, the pressure in the landfill increases, usually causing sub-surface pressures in the landfill to be higher than either the atmosphere pressure or indoor air pressure. When pressure in the landfill is higher, gases tend to move to ambient or indoor air.

c. **Permeability:** – Gases will also migrate according to where the pathways of least resistance occur. Permeability is a measure of how well gases and liquids flow through connected spaces or pores in refuse and soils. Dry, sandy soils are highly permeable (many connected pore spaces), while moist clay tends to be much less permeable (fewer connected pore spaces). Gases tend to move through areas of high permeability (e.g. areas of sand or gravel) rather than through areas of low permeability (e.g., areas of clay or silt). Landfill covers are often made of low-permeability soils, such as clay. Gases in a covered landfill, therefore, may be more likely to move horizontally than vertically.

9.5 FACTORS AFFECTING LANDFILL GAS PRODUCTION

a. **Waste Composition:** The more organic waste present in a landfill, the more landfill gas is produced by bacterial decomposition. Some types of organics waste contain nutrients, such as sodium, potassium, calcium and magnesium, that help bacteria thrive. When these nutrients are present, landfill gas production increases. Alternatively, some wastes contain compounds that harm bacteria, causing less gas to be produced. For example, methane-producing bacteria can be inhibitive when waste has high salt concentrations.

b. **Oxygen in the Landfill:** Only when oxygen is used up will bacteria begin to produce methane. The more oxygen present in a landfill, the longer aerobic bacteria can decompose waste in Phase I. If waste is loosely buried or frequently disturbed more oxygen is available, so that oxygen-dependent bacteria live longer and produce carbon dioxide and water for longer periods. If the waste is highly compacted, however, methane production will begin earlier as the aerobic bacteria are replaced by methane-producing anaerobic bacteria in Phase III. Methane gas starts to be produced by the anaerobic bacteria only when the oxygen in the landfill is used up by the aerobic bacteria; therefore, any oxygen remaining in the landfill will slow methane production. Barometric high will tend to introduce atmospheric oxygen into surface soils in shallow portions of a landfill, possibly altering bacterial activity. In this scenario, waste in Phase IV, for example, might briefly revert to Phase I until all the oxygen is used up again.

c. **Moisture Content:** The presence of a certain amount of water in a landfill increases gas production because moisture encourages bacterial growth and transports nutrients and bacteria to all areas within a landfill. A moisture content of 40% or higher, based on wet weight of waste, promotes maximum gas production (e.g., in a capped landfill). Waste compaction slows gas production because it increases the density of the landfill contents, decreasing the rate at which water can infiltrate the waste. The rate of gas production is higher if heavy rainfall and/ or permeable landfill covers introduce additional water into a landfill.

d. **Temperature:** Warm temperature increases bacterial activity, which in turn increases the rate of landfill gas production. Colder temperatures inhibit bacterial activity, which in turn increases the rate of landfill gas production. Typically, bacterial activity drops off dramatically below 21°C . Weather changes have a far greater effect on gas production in shallow landfills. This is because the bacteria are not as insulated against temperature changes as compared to deep landfills where a thick layer of soil covers the waste. A capped landfill usually maintains a stable temperature, maximizing gas production. Bacterial activity releases heat, stabilizing the temperature of a landfill between 25° C and 45° C, although temperatures up to 70°C have been noted. Temperature increases also promote volatilization and chemical reactions.

e. **Age of Refuse:** More recently buried waste will produce more gas than older waste. Landfills usually produce appreciable amounts of gas within 1 to 3 years. Peak gas production usually occurs 5 to 7 years after wastes are dumped. Almost all gas is produced within 20 years after waste is dumped; however, small quantities of gas may continue to be emitted from a landfill for 50 or more years. A low-methane yield scenario, however, estimates that slowly decomposing waste will produce methane after 5 years and continue emitting gas over a 40 year period. Different portions of the landfill might be in different phases of the decomposition process at the same time, depending on when the waste was originally placed in each area. The amount of organic material in the waste is an important factor in how long gas production lasts.

9.6 IMPACT OF THE LANDFILL GAS

17. People may be exposed to landfill gases either at the landfill or in their communities. Landfill gases may migrate from the landfill either above or below ground. Gases can move through the landfill surface to the ambient air. Once in the air, the landfill gases can be carried to the community with wind. Odours from day to day landfill activities are indicative of

gases moving above ground. Gases may also move through the soil underground and enter homes or utility corridors on or adjacent to the landfill. The levels of gases that migrate from a landfill and to which people are exposed are dependent on many factors, as described in Chapter Two. Landfill gas collection and control systems have the greatest impact on gas migration and exposures. If a collection or control system is in place and operating properly, migration and exposures should be minimal.

18. The following conditions must be met for landfill gas to pose an explosion hazard :

a. **Gas production:** A landfill must be producing gas, and this gas must contain chemicals that are present at explosive levels.

b. **Gas migrations:** The gas must be able to migrate from the landfill. Underground pipes or natural subsurface geology may provide migration pathways for landfill gas.

c. **Gas collection in a confined space:** The gas must collect in a confined space to a concentration at which it could potentially explode. A concentration at which a gas has the potential to explode is defined in terms of its lower and upper explosive limits (LEL and UEL) as defined.

9.7 LOWER AND UPPER EXPLOSIVE LIMITS (LEL AND UEL)

19. The concentration level at which gas has the potential to explode is called the explosive limit. The potential of a gas to explode is determined by its lower explosive limit (LEL) and upper explosive limit (UEL). The LEL and UEL are measures of the percentage of a gas in the air by volume. At concentrations below its LEL and above its UEL, a gas is not explosive. However, an explosion hazard may exist if a gas is present in the air between the LEL and UEL and an ignition source is present.

9.8 TYPES OF GASES WHICH CAN POSE AN EXPLOSION HAZARD

20. Methane is the constituent of landfill gas that is likely to pose the greatest explosion hazard. Methane is explosive between its LEL of 5% by volume and its UEL of 15% by volume. Because methane concentrations within the landfill are typically 50% (much higher than its UEL), methane is unlikely to explode within the landfill boundaries. As methane migrates and is diluted, however, the methane gas mixture may be at explosive levels. Also oxygen is a key component for creating an explosion, but the biological processes that produce methane require an anaerobic, or oxygen-depleted, environment. At the surface of the landfill, enough oxygen is present to support an explosion, but the methane gas usually diffuses into the ambient air to concentrations below 5% LEL. In order to pose an explosion hazard, methane must migrate from the landfill and to be present between its LEL and UEL.

9.9 OTHER LANDFILL GASES

21. Other landfill gas constituents (e.g. ammonia, hydrogen sulphide and NMOCs) are flammable. However, because they are unlikely to be present at concentrations above their LELs, they rarely pose explosion hazards as individual gases. For example, benzene (an NMOC that may be found in landfill gas) is explosive between LEL of 1.2% and its UEL of 7.8%. However, benzene concentrations in landfill gas are very unlikely to reach these levels. If benzene were detected in landfill gas at a concentration of 2 ppb (or 0.0000002% of the air by volume), then benzene would have to collect in a closed space at a concentration 6 million times greater than the concentration found in the landfill gas to cause an explosion hazard.

Table 1: Potential Explosion Hazards from Common Landfill Gas Components

Component	Potential to Pose an Explosion Hazard
Methane	Methane is highly explosive when mixed with air at a volume between its LEL of 5% and its UEL of 15%. At concentrations below 5% and above 15%, methane is not explosive. At some landfills, methane can be produced at sufficient quantities to collect in the landfill or nearby structures at explosive levels.
Carbon dioxide	Carbon dioxide is not flammable or explosive
Nitrogen dioxide	Nitrogen dioxide is not flammable or explosive
Oxygen	Oxygen is not flammable, but is necessary to support explosions.
Ammonia	Ammonia is flammable. Its LEL is 15% and its UEL is 28%. However, ammonia is unlikely to collect at a concentration high enough to pose an explosion hazards.
NMOCs	Potential explosion hazards vary by chemical. For example, the LEL of benzene is 1.2% and its UEL is 7.8%. However, benzene and other NMOCs alone are unlikely to collect at concentrations high enough to pose explosion hazards.
Hydrogen sulphide	Hydrogen sulphide is flammable. Its LEL is 4% and its UEL is 44%. However, in most landfills, hydrogen sulphide is unlikely to collect at a concentration high enough to pose an explosion hazards.

Table 2: Assessment of explosion hazard.

Landfill Gas Explosion Hazard Checklist	
1	**Is the landfill producing gas and if so, how much?**
	Because methane and carbon dioxide are the main components of landfill gas and these chemicals are both odourless and colourless, monitoring data are necessary to answer this question.
2.	**Is a landfill gas collection system in place?**
	Landfill gas collection systems reduce levels of gas migrating from the landfill to surrounding areas.
3.	**Is gas migrating from the landfill?**
	Off-site monitoring data may be necessary to answer this question.

4.	**If gas is migrating from the landfill and reaching structures, are there places for gas to collect?**
	Uncontrolled gases escaping from a landfill may migrate to structures on the landfill itself or in the surrounding area. However, the further a structure is from the landfill, the less likely it is that gases are migrating to it at concentrations great enough to pose an explosion threat. The most common places for gases to collect are basements, crawl spaces, or buried utility entry ports. Homes with basements, especially those with pipes or cracks in the basement that would allow gas to enter, are more likely to collect. Gases.
5.	**Is gas collecting at concentrations that are high enough to pose an explosion hazard?**
	Monitoring data are needed to answer this question. Caution should be used in selecting sampling equipment to ensure that an ignition source is not introduced into the area.
6.	**Is there an ignition source?**
	Gases can be ignited by many different sources, such as a furnace in the ba or a light on a gas stove. Other sources may include candles, matches, cigarettes, or a spark. Because there are so many ignition sources, it is safest to assume that the potential for an ignition source is always present.

9.10 PRESENCE OF ODOURS

22. People in communities near landfills are often concerned about odours emitted from landfills. They say that these odours are a source of undesirable health effects or symptoms, such as headaches and nausea. At low level concentrations- typically associated with landfill gas – it is unclear whether it is the consultant itself or its odours that trigger a response. Typically, these effects fade when the odour can no longer be detected. Landfill gas odours are produced by bacterial or chemical processes and can emanate from both active and closed landfills. These odours can migrate to the surrounding community. Potential sources of landfill odours include sulphides, ammonia, and certain NMOCs, if present at concentrations that are high enough. Landfill odours may also be produced by the disposal of certain types of wastes, such as manures and fermented grains.

a. **Odour Control:** Landfill operators controlled sulphide releases and odours by adding lime as a short-term solution and by installing a fabric landfill liner, a gas collection system, and a flaring system as the long term solution.

b. Local health departments may produce and distribute a newsletter to educate community members about landfill odours and what was being done to reduce them.

c. Hydrogen sulphide concentrations to be measured with monitoring devices located in areas where exposure might occur, such as nearby residential homes and retail areas.

d. At concentrations greater than 100 ppb for 15 minutes, landfill operators would take immediate action to reduce emissions.

e. At concentrations greater than 100 ppb for 2 hours, medical personnel would be notified that sensitive individuals (e.g. children, elderly, or asthmatics) might be affected.

f. At concentrations greater than 500 ppb for 2 hours, sensitive individuals would be advised to stay indoors or leave the area.

23. At concentrations greater than 5,000 ppb for 30 minutes, all residents would be advised to leave the area. The land fill for which the DPR has been prepared is away from the habitation and only a few houses are scattered and may not be a cause for concern. However it needs to be monitored on a regular basis. The land fill site operator may outsource monitoring of air ambient quality either to State pollution Control Board or to any other Agency .approved by the said board.

9.11 LANDFILL GAS COLLECTION

24. Landfill gas can be collected by either a passive or an active collection system. A typical collection system, either passive or active, is composed of a series of gas collection wells placed throughout the landfill. The number and spacing of the wells depend on landfill-specific characteristics, such as waste volume, density, depth and area. As gas is generated in the landfill, the collection wells offer preferred pathways for gas migration. Most collection systems are designed with a degree of redundancy to ensure continued operation and protect against system failure. Redundancy in a system may include extra gas collection wells in case one well fails. The system-specific components for passive and active gas collection systems are discussed below.

9.11.1 Passive Gas Collection Systems

a. Passive gas collection systems use existing variations in landfill pressure and gas concentrations to vent landfill gas into the atmosphere or a control system. Passive collection systems can be installed during active operation of a landfill or after closure. Passive systems use collection wells, to collect landfill gas. The collection wells are typically constructed of perforated or slotted plastic and are installed vertically throughout the landfill to depths ranging from 50% to 90% of the waste thickness. If groundwater is encountered within the waste, wells end at the groundwater table. Vertical wells are typically installed after the landfill, or a portion of a landfill, has been closed. A passive collection system may also include horizontal wells located below the ground surface to serve as conduits for gas movement within the landfill. Horizontal wells may be appropriate for landfills that need to recover gas promptly (e.g. landfills with subsurface gas migration problems), for deep landfills, or for active landfills. Sometimes, the collection wells vent directly to the atmosphere. Often the collection wells convey the gas to treatment or control systems (e.g., flares).

b. The efficiency of a passive collection system partly depends on how well the gas is contained within the landfill. Gas containment can be controlled and altered by the landfill collection system design. Gas can be contained by using liners on the top, sides, and bottom of the landfill. An impermeable liner (e.g., clay or geosynthetic membranes) will trap landfill gas and can be used to create preferred gas migration pathways. For example, installing an impermeable barrier at the top of a landfill will limit uncontrolled venting to the atmosphere by causing the gas to vent through collection wells rather than the cover.

c. The efficiency of a passive collection system also depends on environmental conditions, which may or may not be controlled by the system design. When the pressure in the landfill is inadequate to push the gas to the venting device or control device, passive systems fail to remove landfill gas effectively. High barometric pressure, as discussed above, sometimes results in outside air entering the landfill through passive vents that are not routing gas to control devices. For these reasons, passive collection systems are not considered reliable enough for use in areas with a high risk of gas migration, especially where methane can collect to explosive levels in buildings and confined spaces.

d. It is fairly common for landfills to flare gas due to odour concerns, for example, even if not the landfill is not subject to regulatory requirements. Passive gas collection systems may be used to comply with the NSPS/EG only at landfills where cells are lined in accordance with Subtitle D of RCRA to prevent gas migration.

9.11.2 Active Gas Collection Systems

a. Well-designed active collection systems are considered the most effective means of landfill gas collection. Active gas collection systems include vertical and horizontal gas collection wells similar to passive collection systems. Unlike the gas collection wells in a passive system, however wells in the active system should have valves to regulate gas flow and to serve as a sampling port. Sampling allows the system operator to measure gas generation, composition and pressure.

b. Active gas collection systems include vacuums or pumps to move gas out of the landfill and piping that connects the collection wells to the vacuum. Vacuums or pumps pull gas from the landfill by creating low pressure within the gas collection wells. The low pressure in the wells creates a preferred migration pathway for the landfill gas. The size, type and number of vacuums required in an active system to pull the gas from the landfill depend on the amount of gas being produced. With information about landfill gas generation, composition and pressure, a landfill operator can assess gas production and distribution changes and modify the pumping system and collection well valves to most efficiently run an active gas collection system. The system design should account for future gas management needs, such as those associated with landfill expansion. The DPR suggests passive LFG collection system for the reasons of ease in construction and maintenance.

9.12 METHODS TO TREAT LANDFILL GAS

25. Some passive gas collection systems simply vent landfill gas to the atmosphere without any treatment before release. This may be appropriate if only a small quantity of gas is produced and no people live or work nearby. More commonly, however, the collected landfill gas is controlled and treated to reduce potential safety and health hazards. Common methods to treat landfill gas include combustion and non-combustion technologies, as well as odour control technologies.

26. **Combustion:** Combustion is the most common technique for controlling and treating landfill gas. Combustion technologies such as flares, incinerators, boilers, gas turbines, and internal combustion engines thermally destroy the compounds in landfill gas. Over 98% destruction of organic compounds is typically achieved. Methane is converted to carbon

dioxide, resulting in a large greenhouse gas impact reduction. Combustion or flaring is most efficient when the landfill gas contains at least 20% methane by volume. At this methane concentration, the landfill gas will readily form a combustible mixture with ambient air, so that only an ignition source is needed for operation. At landfills with less than 20% methane by volume, supplemental fuel (e.g., natural gas) is required to operate flares, greatly increasing operating costs. When combustion is used, two different types of flares can be chosen: open or enclosed flares.

27. **Open flame flares:** (e.g., candle or pipe flares), the simplest flaring technology, consist of a pipe through which the gas is pumped, a pilot light to spark the gas, and a means to regulate the gas flow. The simplicity of the design and operation of an open flame flare is an advantage of this technology. Disadvantages include inefficient combustion, aesthetic complaints, and monitoring difficulties. Sometimes, open flame flares are partially covered to hide the flame from view and improve monitoring accuracy.

28. Enclosed flame flares are more complex and expensive than open flame flares. Nevertheless, most flares designed today are enclosed, because this design eliminates some of the disadvantages associated with open flame flares. Enclosed flame flares consist of multiple burners enclosed within fire-resistant walls that extend above the flame. Unlike open flame flares, the amount of gas and air entering an enclosed flame flare can be controlled, making combustion more reliable and more efficient.

29. Other enclosed combustion technologies such as boilers, process heaters, gas turbines, and internal combustion engines can be used not only to efficiently destroy organic compounds in landfill gas, but also to generate useful energy or electricity, as described later in this chapter.

30. **Noncombustion:**– Non combustion technologies were developed in the 1990s as an alternative to combustion, which produces compounds that contribute to smog, including nitrogen oxides, sulphur oxide, carbon monoxides, and particulate matter. Non-combustion technology if used; the landfill gas must first undergo pre-treatment to remove impurities such as water, NMOCs and carbon dioxide. Numerous pre treatment methods are available to address the impurities of concern for a specific landfill. After pre-treatment, the purified landfill gas is treated by non combustion technology options.

31. Energy recovery technologies use landfill gas to produce energy directly. Currently, the phosphoric acid fuel cell (PAFC) is the only commercially available non combustion energy recovery technology. Other types of fuel cells (molten carbonate, solid oxide and solid polymer) are still under development. The PAFC system consists of landfill gas collection and pre-treatment, a fuel cell processing system, fuel cell stacks, and a power conditioning system. Several chemical reactions occur within this system to create water, electricity, and heat and waste gases. The waste gases are destroyed in a flare.

32. Gas to product conversion technologies focus on converting landfill gas into commercial products, such as compressed natural gas, methanol, purified carbon dioxide and methane, or liquefied natural gas. The processes used to produce each of these products vary, but each includes landfill gas collection, pre-treatment and chemical reactions and/ or purification techniques. Some of the processes use flares to destroy gaseous wastes.

33. **Odour Control Technologies:** – Odour control technologies prevent odour-causing gases from leaving the landfill. Installing a landfill cover will prevent odours from newly deposited waste or from gases produced during bacterial decomposition. Covering a landfill

daily with soil can help reduce odours from newly deposited wastes. More extensive covers are installed at landfill closure to prevent moisture from infiltrating the refuse and encouraging bacterial growth and decomposition. Vegetative growth on the landfill cover also reduces odours. Flaring is another technique that can eliminate landfill gas odours by thermally destroying the odour causing gases. Venting landfill gas through a filter is another technology used to reduce odours. Landfill gas is collected and vented through a filter of bacterial slime. As long as oxygen is present, bacteria will decompose landfill gas under aerobic conditions, producing carbon dioxide and water. See the example below of odour controls used at a landfill in California.

9.13 SOME FACTORS IMPORTANT FOR LANDFILL GAS RECOVERY

34. Landfill gas recovery systems cite the following factors as guidelines important feasible landfill gas recovery projects. However, new technologies are becoming available that have allowed successful projects at smaller landfills. For example, smaller landfills can generate enough gas to heat an on site greenhouse or to use a micro turbine to generate a small amount of electricity. Various central and state government's incentives (e.g., grants, loans, renewable energy purchase requirements) can also enhance the economic feasibility of landfill gas recovery projects. However economic viability of such proposals may have to satisfy the following

a. The amount of waste in place at a landfill is greater than approximately 1 million tons.

b. The waste is greater than 10meters deep and is stable enough for well installation.

c. The landfill area is greater than 15ha.

d. The landfill is composed of refuse that can generate large quantities of landfill gas composed of 35% or more of methane. An industry guideline states that gas recovery is economically viable at landfills with gas generation rates of nearly 30,000cum per day.

e. If a landfill is still open, active landfill operation will continue for several more years.

f. If a landfill is already closed, a short time (no more than a few years) has elapsed since closure.

g. The climate is conducive to gas production (very cold or very dry climates can inhibit gas production).

h. The energy user is located nearby or in an area accessible to the landfill

ANNEXURE 4

NOTIFICATION

ANNEXURE 4

GOVERNMENT OF MEGHALAYA
FORESTS & ENVIRIONMENT DEPARTMENT

NOTIFICATION

FOR. 76/99/16 Dated Shillong the 25th February 2000.

The Governor of Meghalaya is pleased to extend the lease granted to the Shillong Municipality by the Government of Assam, vide their order No. 2391-G-S-8 dated 19-05-1938, for 18 acres of land in Riat Khwan Forest Compartment No. 4 for the purpose of trenching ground of Municipal waste, and which has been in perpetual use till date for the said purpose, on the following conditions :

1) That the lease is regularised and extended for the period from 1956 to 2026 (Seventy years).
2) That the Shillong Municipality will pay Land Rent of Rs. 90/- per annum, which may be revised by the Government of Meghalaya, at any point of time.
3) That the area shall be used exclusively for dumping of garbage and management of waste.
4) That out of this allocated area, 11 acres can be used for setting of aerobic compost plant which will help in disposal of accumulated waste.
5) That the Municipality will construct an internal fire line to isolate the adjoining forests.
6) That the Municipality will demarcate the area by constructing proper fencing.
7) That the Municipality will not sublet the project plant or sub-lease the area allocated to any other organisation or individual.
8) That the Municipality will not fell or damage any tree standing in area.
9) That the Municipality shall not pose any further encumberance on the forest due to establishment and or running of the project.
10) That the Municipality and its staff shall observe the rules and acts applicable to the forests in Meghalaya.

Principal Secretary
Forests & Environment Department

FOR. 76/99/16-A **Dated Shillong the 25th February 2000.**

Copy Forwarded To

1. The Principal Chief Conservator of Forests, Meghalaya Shillong for his information and necessary action
2. The Chief Executive Officer, Shillong Municipal Board for his information and necessary action
3. The Chief Conservator of Forests (Territorial) / Conservator of Forests (Territorial) Khasi & Jaintia Hills / Divisional Forest Officer (Territorial) Khasi Hills Division for their information and necessary action.

By Orders etc.

Agrawal

Under Secretary to the Government of Meghalaya
Forests & Environment Department

ANNEXURE 5

LAND POSSESSION CERTIFICATE

SMEC INDIA

ANNEXURE 5

LAND POSSESSION CERTIFICATE

This is to certify that an area of 18 acres in the Riat Khwan Reserve Forest, Compartment No. 4 has been allotted to the Shillong Municipality on lease for the period 1938 - 2026. The Municipality is allowed to implement the solid waste management scheme on 11 acres out of this holding without sub-letting or sub leasing it to any other private agency.

Principal Secretary
Forests & Environment Department

ANNEXURE 6

GEOTECHNICAL INVESTIGATION REPORT OF LANDFILL SITE AT MAWIONG

SMEC INDIA

R E P O R T

O N

GEOTECHNICAL INVESTIGATIONS IN GREATER SHILLONG PLANNING AREA FOR ABD TA 4779 - IND,

PREPARED BY

ESS FOUNDATION PVT.LTD.
BARTHAKUR MILL ROAD , ULUBARI,
GUWAHATI - 781007
DIAL NO : 0361 - 2525404, 94351-10953

1.0 INTRODUCTION

Sub - Soil Investigation was carried out at Mawiong,Shilong to find out the engineering properties of soil and to determine the depth of foundation and safe bearing capacity.

1.01 This report consists of field investigation and laboratory analysis along with the rational interpretation of test results and recommendation regarding the safe bearing capacity

1.02 All the field investigations and laboratory analysis were conducted as per relevant I.S. Code of practice for soil testing

2.0 FIELD INVESTIGATION

2.01 Field investigation was started on 25.02.2009 and completed on 28.02.2009

Field investigation consists of Auger boring with the help of outer casing and inner boring tube upto a maximum depth of 16.5 m

2.02 STANDARD PENETRATION TEST (S.P.T.)

The S.P.T were conducted by using standard split spoon sampler as per IS: 2131. Number of blows required to drive the sampler for first 15cm is neglected and the blows for the next 30cm is considered and expressed in

2.03 DISTURBED / UNDISTURBED SAMPLES

Disturbed and undisturbed samples were collected during the process of boring and were sealed for testing. The samples were sent to laboratory for testing as immediately as possible to avoid loss of moisture etc.

2.04 GROUND WATER LEVEL

The ground water level has been shown in bore hole log enclosed herewith.

3.0 LABORATORY TEST

Selected soil samples were analysed in the laboratory as per I.S: 2720 and the following tests were conducted and corresponding results of the tests have been furnished in the tabular form.

The following tests were conducted.

I) Natural Moisture Content

ii) Specific gravity

iii) Bulk density and Dry density

iv) Shear Strength

v) Grain Size analysis

vi) Atterberg Limits

4.1 BEARING CAPACITY OF THE FOUNDATION

Based on Standard Penetration Resistance value

$q_s = ((q (N_q-1) s_q d_q i_q + 0.5 B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W') / F) \times 10\ t / m^2$

Where

N_q, N_γ = Bearing capacity factors

s_q, s_γ = Shape factors

For square footing $s_q = 1.2$ $s_\gamma = 1$

B = Width dia of foundation in cm

$d_q = d_\gamma$ = Depth factors = 1.00 for $\phi < 10^0$

= $1 + 0.1 (D_f / B) \times \text{sqrt} (N_\phi)$ for $\phi > 10^0$

ϕ = Angle of shearing resistance of soil in degrees

$N_\phi = \tan^2 (45^0 + \phi / 2)$

D_f = Depth of foundation in cm

$N_\phi = \tan^2 (45^0 + \phi / 2) = 1$

i_q = Inclination factors = $(1- (\alpha / 90))^2$

i_γ = Inclination factor = $(1- (\alpha / \phi))^2$

α = Inclination of the load to the vertical in degrees

q = Effective surcharge at the base level of foundation in kgf / cm^2

γ = Bulk unit weight of foundation soil in kgf / cm^3

W' = Water table correction factor

F = Factor of safety

4.2 **FROM C-Ø VALUE :**

For bearing capacity of the following formula has been adopted as per I.S: 6403 - 1981.

q_s = $((q (N_q-1) s_q d_q i_q + 0.5 B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W') / F) \times 10$ t / m^2 (whenC=0)

q_s = $\{(C\ 5.14\ S_c\ d_c\ i_c)/F\} \times 10$ t/m^2 (When $\phi = 0$)

Where

C = Cohesion in Kgf/cm^2

S_c = Shape factor

For square $S_c = 1.3$

d_c = Depth Factor = $1+ 0.2 (D_f/B) \times \text{sqrt.} (N_\phi)$

ic = iq = Inclinition Factors = $\{1 -(\alpha /90)\}^2$

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JOB NO. : EFPL/2008-2009/804 DIAL NO : 0361 - 2525404, 95351-10953

PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

Calculation of Bearing capacity

Based on Standard Penetration Resistance value

For BH.NO - 1

At depth D_f = 150 cm

Average N -value = (48 + 78 + 100) / 3 = 75.33 Say N=75

For N = 75.00 ϕ = 45.83° ϕ_{cor} = 45.83° Say 45°

For ϕ = 45^{o} N_q = 34.87 N_γ = 271.74

S_q = 1.2 S_γ = 0.80

$d_q = d_\gamma$ = $1+0.1\,(150/200)\,x\tan(45+45/2)$ = 1.18

α = 0° $i_\gamma = i_q$ = 1.00

γ = 0.002 Kgf/cm^2

γ' = 0.001 Kgf /cm^2

q = 0.001 x 150 = 0.15 kgf/cm^2

W' = 0.5

F = 2.5

q_s = {(0.15x(34.87-1) x1.20 x1.18 x1.00+0.50 x 200 x0.002 x 271.74 x 0.8 x 1.18 x1.00 x 0.50)/2.5} x 10

= 216.34 t/m^2

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Calculation of Bearing capacity

From Shear Test Results

For BH.NO - 1

ϕ = 40° ϕ_{cor} = 40°

For ϕ = 40° N_q = 64.20 N_γ = 109.42

S_q = 1.2 S_γ = 0.80

$d_q = d_\gamma$ = $1+0.1\,(150/200)\,x\tan(45+40/2)$ = 1.16

α = 0° $i_\gamma = i_q$ = 1.00

γ = 0.002 Kgf/cm^2

γ' = 0.001 Kgf /cm^2

q = 0.001 x 150 = 0.15 kgf/cm^2

W' = 0.5

F = 2.5

q_s = {(0.15x(64.2-1) x1.20 x1.16 x1.00+0.50 x 200 x0.002 x 109.42 x 0.8 x 1.16 x1.00 x 0.50)/2.5} x 10

= 93.40 t/m^2

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For BH.NO - 6

At depth D_f = 300 cm $\phi = 0^\circ$

C = 0.29

d_c = 1+ 0.2 (300/200)x $\tan^2 45^\circ$ = 1.30

S_c = 1.30

q_s = {(0.29 X 5.14 X 1.30 X 1.30 X 1.00)/2.5} x 10 t/m^2

= 10.08 t/m^2

NET SAFE BEARING CAPACITY (t/m^2) AT VARIOUS DEPTHS

Bore Hole No.	Depth (m)	From N-Value	From C-Ø value
1	1.5	216.34	93.40
	2.0	267.18	115.78
	2.5	321.88	140.78
	3.0	380.43	229.50
2	1.5	260.74	93.40
	2.0	321.13	115.78
	2.5	386.06	140.78
	3.0	455.53	195.04
3	1.5	216.34	93.40
	2.0	267.18	115.78
	2.5	321.88	140.78
	3.0	380.43	229.50

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PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

NET SAFE BEARING CAPACITY (t/m^2) AT VARIOUS DEPTHS

Bore Hole No.	Depth (m)	From N-Value	From C-Ø value
4	1.5	181.94	109.22
	2.0	225.21	136.22
	2.5	269.68	164.02
	3.0	319.26	195.04
5	1.5	181.94	80.14
	2.0	225.21	99.56
	2.5	269.68	120.30
	3.0	319.26	166.35
6	1.5	-	-
	2.0	-	-
	2.5	-	-
	3.0	14.76	10.08

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RECOMMENDATION

From field and laboratory investigations, the following recommendations have been made for the purpose of design of foundation at the site.

A. For bore hole locations 1,2,3,4 & 5

1. Type of foundation : R.C.C Shallow foundation

2. Recommended Net safe bearing capacity:15.00 t/m^2 (considering jointed Rock)

3. Depth of Foundation :150 cm

B. For bore hole location 6

1. Type of foundation : R.C.C Shallow foundation

2. Net safe bearing capacity: 10.0 t/m^2

3. Depth of Foundation : 300 cm

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N - VALUE CORRECTION

Depth (m)	Bore Hole No.1		Bore Hole No.2		Bore Hole No. 3	
	Observed N - value	Corrected N - value	Observed N - value	Corrected N - value	Observed N - value	Corrected N - value
1.5	48	45	55	50	45	42
3.0	78	60	88	67	93	70
4.5	100	69	100	69	88	62
6.0	109	70	109	70	97	63
7.5	110	67	108	66	110	67
9.0	109	64	120	69	Refusal	69
10.5	112	63	121	67	-	-
12.0	122	65	129	69	-	-
13.5	120	62	Refusal	69	-	-
15.0	Refusal	60	-	-	-	-
16.5	Refusal	59	-	-	-	-

Depth (m)	Bore Hole No.4		Bore Hole No. 5		Bore Hole No. 6	
	Observed N - value	Corrected N - value	Observed N - value	Corrected N - value	Observed N - value	Corrected N - value
1.5	53	49	50	46	-	-
3.0	82	63	75	58	-	-
4.5	70	51	97	67	8	8
6.0	83	55	115	74	67	46
7.5	92	57	128	77	103	63
9.0	130	74	Refusal	74	-	-
10.5	110	62	-	-	-	-
12.0	Refusal	65	-	-	-	-
13.5	Refusal	67	-	-	-	-

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PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

Type of Boring : Auger Drilling

Ground Elevation: EGL

BORE HOLE NO. 01

Date Started : 25.02.2009

Date Completed : 25.02.2009

DESCRIPTION OF STRATA	DEPTH (m)	STRATA	SAMPLE COLLECTED D/S	SAMPLE COLLECTED U/S	GROUND WATER LEVEL	S.P.T V/S DEPTH (20 40 60 80)	N - VALUE
Little brown soil mixed with weathered rock	1.0		1.5	Undisturbed sample could not be taken.	G.W.L. ± 0.0		48
	2.0						
Weathered rock mixed with quartzite rock	3.0		3.0				78
	4.0		4.5				100
	5.0						
	6.0		6.0				109
	7.0		7.5				110
Quartzite rock	8.0						
	9.0		9.0				109
	10.0		10.5				112
Weathered rock	11.0						
	12.0		12.0				122
	13.0		13.5				120
Quartzite rock	14.0						
	15.0		15.0				Refusal
	16.0		16.5				Refusal

D/S = Disturbed Sample U/S = Undisturbed Sample S.P.T. = Standard Penetration Test

SOIL & FOUNDATION CONSULTANT. Depth of Sampler = 0.45 m

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JOB NO. EFPL/2008-2009/804

PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

Type of Boring : Auger Drilling

Ground Elevation: EGL

BORE HOLE NO. 02

Date Started : 25.02.2009

Date Completed : 26.02.2009

DESCRIPTION OF STRATA	DEPTH (m)	STRATA	SAMPLE COLLECTED D/S	SAMPLE COLLECTED U/S	GROUND WATER LEVEL	S.P.T V/S DEPTH (20 40 60 80)	N - VALUE
Soil mixed with quartzite rock	1.0		1.5	Undisturbed sample could not be taken.	G.W.L. ± 0.0		55
Weathered stone	2.0						
Quartzite stone mixed with little lime stone.	3.0		3.0				88
	4.0		4.5				100
Quartzite stone	5.0						
Weathered rock mixed with quartzite rock	6.0		6.0				109
	7.0		7.5				108
	8.0						
	9.0		9.0				120
Quartzite rock	10.0		10.5				121
	11.0						
	12.0		12.0				129
	13.0		13.5				Refusal

D/S = Disturbed Sample U/S = Undisturbed Sample S.P.T. = Standard Penetration Test

SOIL & FOUNDATION CONSULTANT.

Depth of Sampler = 0.45 m

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JOB NO. EFPL/2008-2009/804

PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

Type of Boring : Auger Drilling

Ground Elevation: EGL

BORE HOLE NO. 03

Date Started : 27.02.2009

Date Completed : 27.02.2009

DESCRIPTION OF STRATA	DEPTH (m)	STRATA	SAMPLE COLLECTED D/S	SAMPLE COLLECTED U/S	GROUND WATER LEVEL	S.P.T V/S DEPTH (20 40 60 80)	N - VALUE
Brown soil with weathered rock.	1.0		1.5	Undisturbed sample could not be taken.	G.W.L. ± 0.0		45
	2.0						
Quartzite rock	3.0		3.0				93
	4.0		4.5				88
	5.0						
	6.0		6.0				97
Quartzite rock of different layer	7.0		7.5				110
	8.0						
	9.0		9.0				Refusal

D/S = Disturbed Sample U/S = Undisturbed Sample S.P.T. = Standard Penetration Test

SOIL & FOUNDATION CONSULTANT.

Depth of Sampler = 0.45 m

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PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

Type of Boring : Auger Drilling

Ground Elevation: EGL

BORE HOLE NO. 04

Date Started : 27.02.2009

Date Completed : 28.02.2009

DESCRIPTION OF STRATA	DEPTH (m)	STRATA	SAMPLE COLLECTED D/S	SAMPLE COLLECTED U/S	GROUND WATER LEVEL	S.P.T V/S DEPTH (20 40 60 80)	N - VALUE
Little brown soil mixed with sedimulutation rock	1.0		1.5	Undisturbed sample could not be taken.	G.W.L. ± 0.0		53
	2.0						
	3.0		3.0				82
	4.0						
			4.5				70
	5.0						
Quartzite rock	6.0		6.0				83
	7.0						
			7.5				92
	8.0						
	9.0		9.0				130
	10.0						
			10.5				110
	11.0						
	12.0		12.0				Refusal
	13.0						
			13.5				Refusal

D/S = Disturbed Sample U/S = Undisturbed Sample S.P.T. = Standard Penetration Test

SOIL & FOUNDATION CONSULTANT. Depth of Sampler = 0.45 m

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JOB NO. EFPL/2008-2009/804

PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

Type of Boring : Auger Drilling

Ground Elevation: EGL

BORE HOLE NO. 05

Date Started : 28.02.2009

Date Completed : 28.02.2009

DESCRIPTION OF STRATA	DEPTH (m)	STRATA	SAMPLE COLLECTED D/S	SAMPLE COLLECTED U/S	GROUND WATER LEVEL	S.P.T V/S DEPTH (20 40 60 80)	N - VALUE
Little soil with weathered rock.	1.0						
			1.5				50
	2.0						
	3.0		3.0				75
Weathered rock mixed with quartzite rock							
	4.0						
			4.5				97
	5.0						
	6.0		6.0	Undisturbed sample could not be taken.	G.W.L. ± 0.0		115
	7.0						
Quartzite rock			7.5				126
	8.0						
	9.0		9.0				Refusal

D/S = Disturbed Sample U/S = Undisturbed Sample S.P.T. = Standard Penetration Test

SOIL & FOUNDATION CONSULTANT.

Depth of Sampler = 0.45 m

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PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

Type of Boring : Auger Drilling — **BORE HOLE NO. 06** — Date Started : 28.02.2009

Ground Elevation: EGL — Date Completed : 28.02.2009

DESCRIPTION OF STRATA	DEPTH (m)	STRATA	SAMPLE COLLECTED D/S	SAMPLE COLLECTED U/S	GROUND WATER LEVEL	S.P.T V/S DEPTH (20 40 60 80)	N - VALUE
Garbage (Debris)	1.0		1.5		G.W.L. ± 0.0		-
	2.0						
Silty clay grey in colour	3.0		3.0	3.5			7
	4.0		4.5				8
	5.0						
Weathered rock	6.0		6.0				67
	7.0		7.5				103
	8.0						

D/S = Disturbed Sample U/S = Undisturbed Sample S.P.T. = Standard Penetration Test

SOIL & FOUNDATION CONSULTANT. Depth of Sampler = 0.45 m

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PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

PHYSICAL PROPERTIES

Bore Hole No.	Depth (m)	Moisture Content (%)	Specific gravity	Bulk Density (gm/cc)	Dry Density (gm/cc)	Void Ratio
1	1.5	15.16	2.67	-	-	-
	3.0	24.20	2.69	-	-	-
	4.5	10.67	2.66	-	-	-
	6.0	5.97	2.66	-	-	-
	7.5	7.12	2.67	-	-	-
	9.0	9.07	2.68	-	-	-
	10.5	7.91	2.66	-	-	-
	12.0	3.56	2.67	-	-	-
	13.5	6.33	2.68	-	-	-
	15.0	7.13	2.68	-	-	-
	16.5	8.01	2.68	-	-	-
2	1.5	16.44	2.67	-	-	-
	3.0	5.56	2.69	-	-	-
	4.5	4.19	2.66	-	-	-
	6.0	5.43	2.66	-	-	-
	7.5	9.35	2.67	-	-	-
	9.0	5.01	2.68	-	-	-
	10.5	6.55	2.66	-	-	-
	12.0	4.21	2.67	-	-	-
	13.5	6.52	2.68	-	-	-
3	1.5	14.63	2.67	-	-	-
	3.0	23.94	2.69	-	-	-
	4.5	9.03	2.66	-	-	-
	6.0	7.18	2.66	-	-	-
	7.5	6.65	2.67	-	-	-
	9.0	6.71	2.68	-	-	-

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PHYSICAL PROPERTIES

Bore Hole No.	Depth (m)	Moisture Content (%)	Specific gravity	Bulk Density (gm/cc)	Dry Density (gm/cc)	Void Ratio
4	1.5	15.46	2.67	-	-	-
	3.0	6.88	2.69	-	-	-
	4.5	4.45	2.66	-	-	-
	6.0	5.47	2.66	-	-	-
	7.5	9.17	2.67	-	-	-
	9.0	9.18	2.68	-	-	-
	10.5	8.54	2.66	-	-	-
	12.0	4.25	2.67	-	-	-
	13.5	8.14	2.68	-	-	-
5	1.5	17.43	2.67	-	-	-
	3.0	23.59	2.69	-	-	-
	4.5	8.72	2.66	-	-	-
	6.0	7.75	2.66	-	-	-
	7.5	6.36	2.67	-	-	-
	9.0	7.40	2.68	-	-	-
6	1.5	15.18	2.67	-	-	-
	3.0	12.77	2.69	-	-	-
	3.5	13.65	2.69	1.80	1.58	0.70
	4.5	5.38	2.66	-	-	-
	6.0	5.58	2.66	-	-	-
	7.5	10.60	2.67	-	-	-

*N.B.: The Bulk Density, Dry Density & Void Ratio can not be worked out due to undisturbed samples are not availaable.

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CHEMICAL ANALYSIS
at G.L - 0.50m

Sample No	P^H	Sulphate (mg/1)	Clorides (mg/1)
1	6.6	72	87
2	6.7	76	84
3	6.9	79	85
4	6.8	77	88
5	6.8	79	87
6	6.9	78	86

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SHEAR TEST RESULTS

BoreHole No.	Depth (m)	Unconfined		Direct shear test	
		C (kgf/cm^2)	ϕ°	C (kgf/cm^2)	ϕ°
1	1.5	-	-	-	40°
	3.0	-	-	-	42°
	4.5	-	-	-	44°
	6.0	-	-	-	42°
	9.0				41°
	10.5	-	-	-	43°
	12.0	-	-	-	44°
	15.0	-	-	-	44°
2	1.5	-	-	-	40°
	3.0	-	-	-	41°
	4.5	-	-	-	42°
	6.0	-	-	-	44°
	7.5				44°
	10.5	-	-	-	44°
	12.0	-	-	-	44°
3	1.5	-	-	-	40°
	3.0	-	-	-	42°
	4.5	-	-	-	43°
	6.0	-	-	-	44°
	7.5	-	-	-	44°

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SHEAR TEST RESULTS

BoreHole No.	Depth (m)	Unconfined		Direct shear test	
		C (kgf/cm^2)	ϕ°	C (kgf/cm^2)	ϕ°
4	1.5	-	-	-	41°
	3.0	-	-	-	41°
	4.5	-	-	-	43°
	7.5	-	-	-	43°
	10.5	-	-	-	44°
	12.0	-	-	-	43°
5	1.5	-	-	-	39°
	3.0	-	-	-	40°
	6.0	-	-	-	42°
	7.5				42°
	9.0	-	-	-	44°
6	3.5	0.29	-	-	-
	4.5	-	-	-	42°
	7.5	-	-	-	43°

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GRAIN SIZE ANALYSIS

Bore Hole No.	Depth (m)	Silt & Clay (%)	Fine Sand (%)	Medium Sand (%)	Coarse Sand (%)	Gravel (%)
1	1.5	11.00	5.00	3.00	5.0	76.0
	3.0	9.00	4.00	3.00	6.0	78.0
	4.5	8.00	1.00	4.00	5.0	82.0
	6.0	9.00	4.00	3.00	4.0	80.0
	7.5	7.00	2.00	3.00	5.0	83.0
	9.0	5.00	4.00	5.00	9.0	77.0
	10.5	6.00	3.00	4.00	8.0	79.0
	12.0	5.00	5.00	3.00	6.0	81.0
	13.5	4.00	6.00	4.00	7.0	79.0
	15.0	3.00	4.00	6.00	5.0	82.0
	16.5	1.00	2.00	3.00	5.0	89.0
2	1.5	9.00	3.00	4.00	5.0	79.0
	3.0	8.00	4.00	3.00	4.0	81.0
	4.5	5.00	4.00	5.00	9.0	77.0
	6.0	6.00	3.00	4.00	8.0	79.0
	7.5	5.00	2.00	3.00	5.0	85.0
	9.0	3.00	2.00	5.00	8.0	82.0
	10.5	3.00	4.00	2.00	4.0	87.0
	12.0	4.00	3.00	3.00	6.0	84.0
	13.5	2.00	1.00	2.00	5.0	90.0
3	1.5	11.00	3.00	4.00	5.0	77.0
	3.0	4.00	3.00	3.00	6.0	84.0
	4.5	4.00	2.00	5.00	7.0	82.0
	6.0	3.00	4.00	2.00	4.0	87.0
	7.5	5.00	2.00	3.00	5.0	85.0
	9.0	2.00	1.00	2.00	5.0	90.0

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PROJECT : Geotechnical Investigations in Greater Shillong Planning Area for ADB TA 4779-IND

GRAIN SIZE ANALYSIS

Bore Hole No.	Depth (m)	Silt & Clay (%)	Fine Sand (%)	Medium Sand (%)	Coarse Sand (%)	Gravel (%)
4	1.5	12.00	2.00	3.00	5.0	78.0
	3.0	4.00	3.00	2.00	4.0	83.0
	4.5	3.00	3.00	5.00	4.0	85.0
	6.0	4.00	1.00	4.00	5.0	86.0
	7.5	2.00	1.00	3.00	4.0	90.0
	9.0	3.00	2.00	4.00	2.0	89.0
	10.5	2.00	1.00	2.00	4.0	91.0
	12.0	4.00	1.00	3.00	3.0	89.0
	13.5	2.00	2.00	2.00	4.0	90.0
5	1.5	9.00	3.00	4.00	12.0	72.0
	3.0	4.00	1.00	4.00	5.0	86.0
	4.5	4.00	2.00	5.00	7.0	82.0
	6.0	2.00	1.00	2.00	4.0	91.0
	7.5	3.00	4.00	2.00	4.0	87.0
	9.0	2.00	1.00	2.00	3.0	92.0
6	1.5	-	-	-	-	-
	3.0	62.00	9.00	4.00	15.0	10.0
	4.5	4.00	2.00	5.00	7.0	82.0
	6.0	3.00	4.00	2.00	4.0	87.0
	7.5	2.00	1.00	2.00	3.0	92.0

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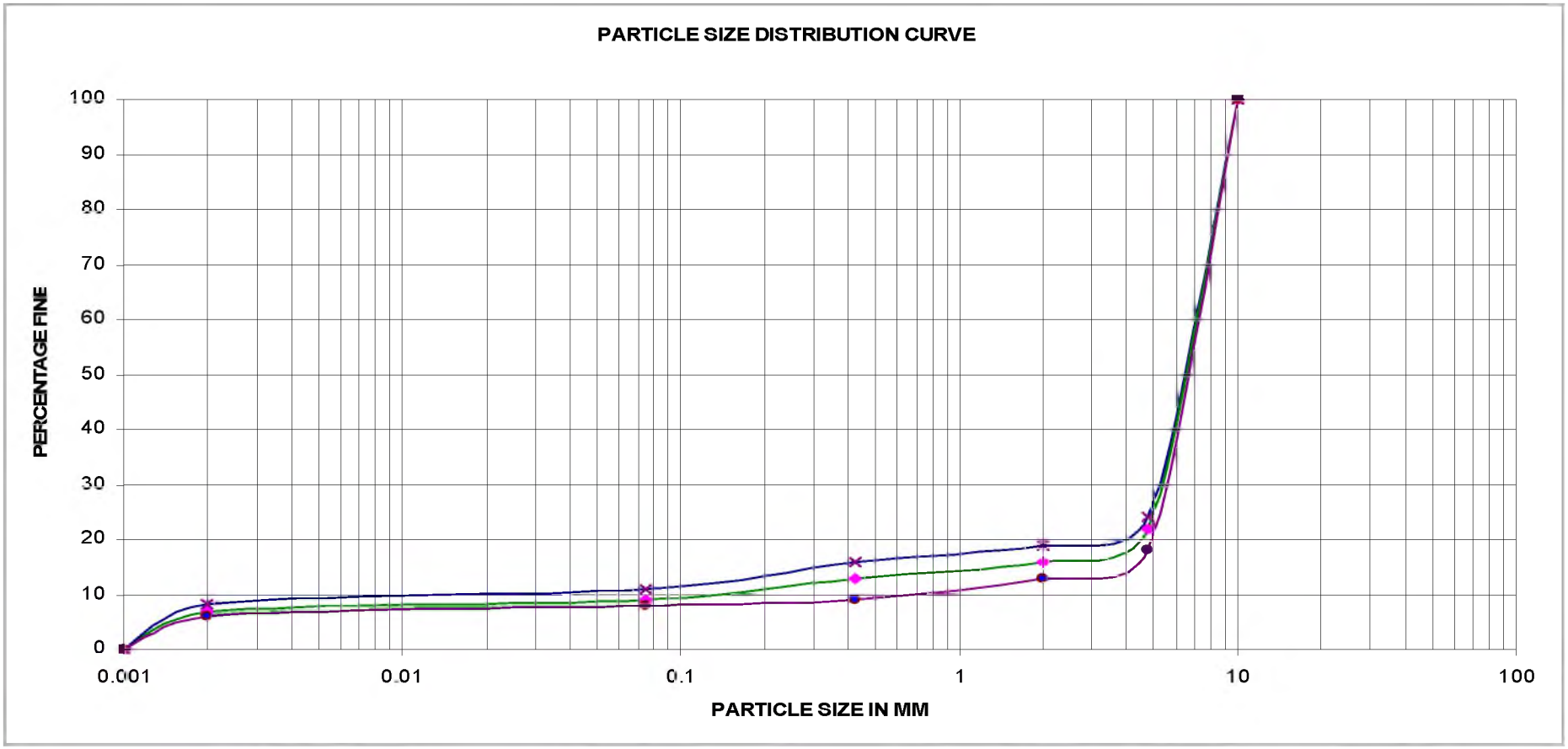
PROJECT : Geo Technical Survey in Shillong City.



CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
1	1.5	x
	3.0	◇
	4.5	⊗

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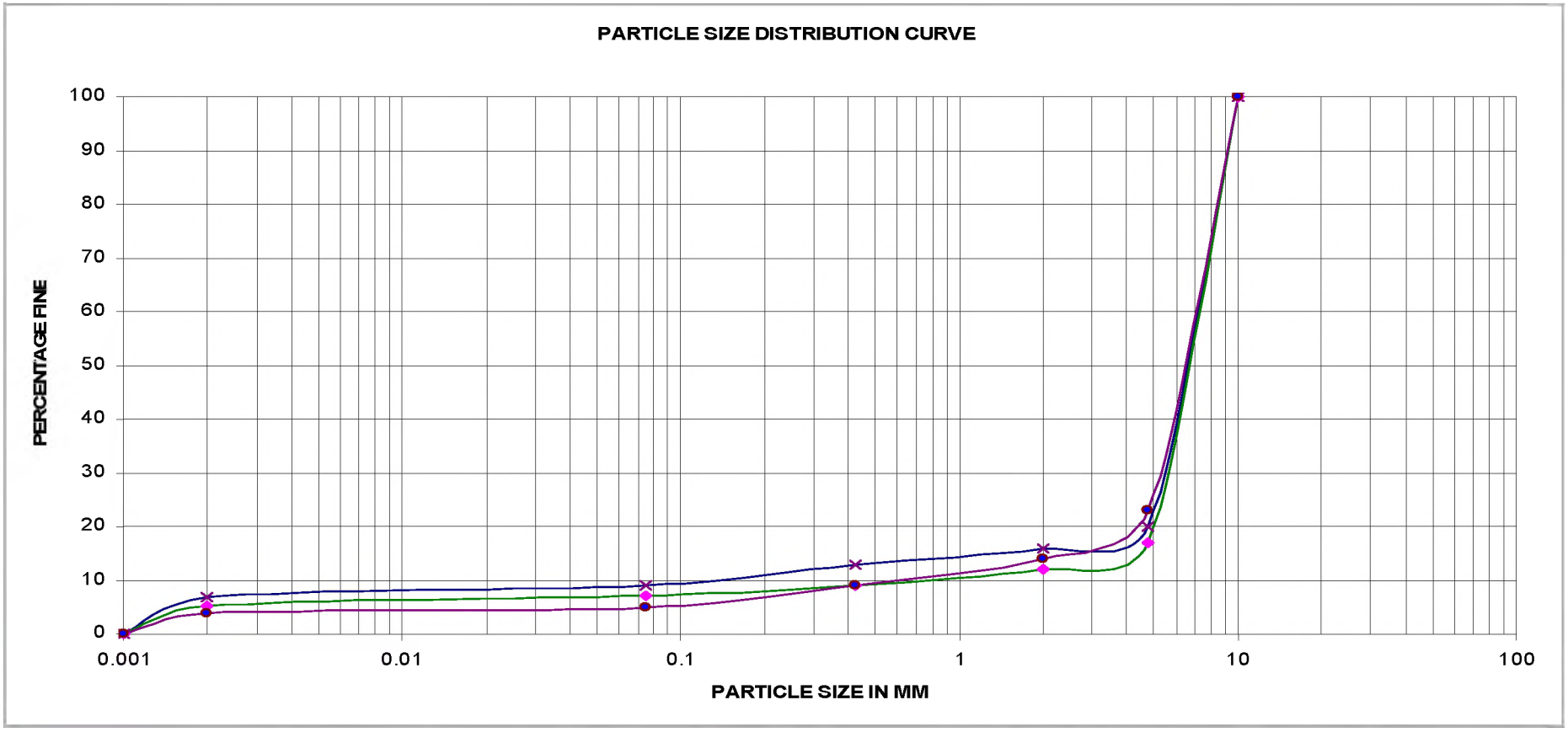

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
1	6.0	x
	7.5	◇
	9.0	⊗

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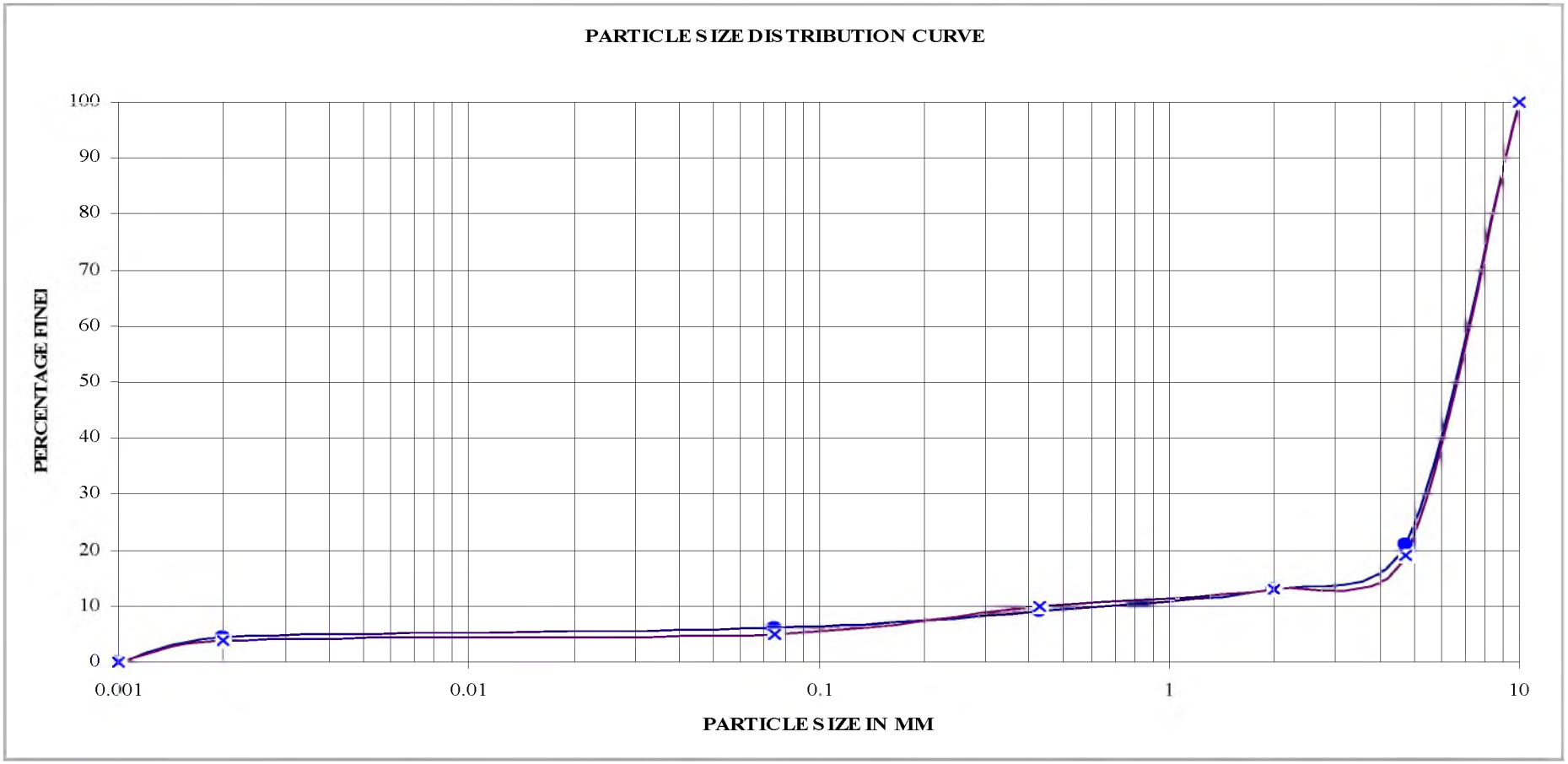

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
1	10.5	x
	12.0	◇

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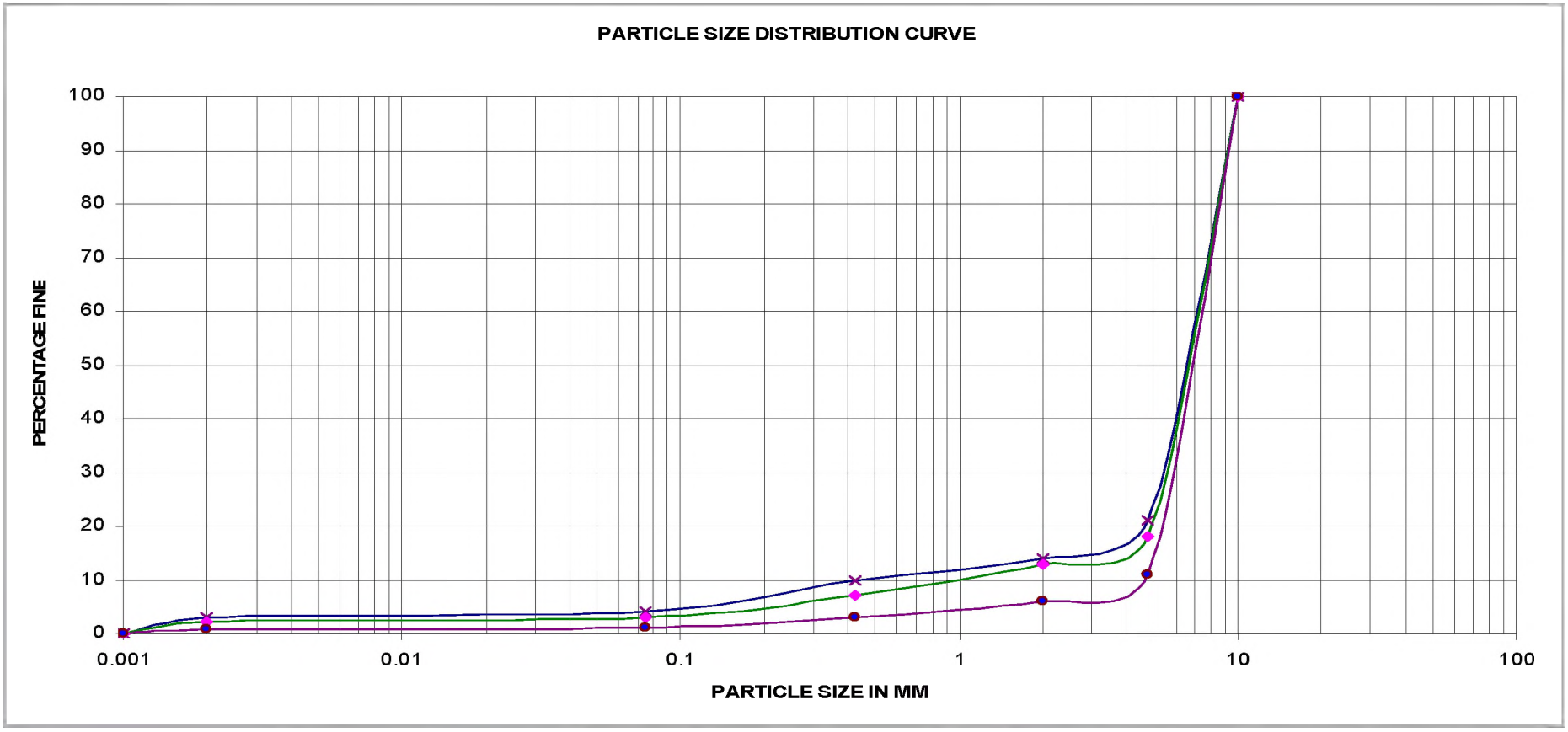

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
1	13.5	x
	15.0	◇
	16.5	⊗

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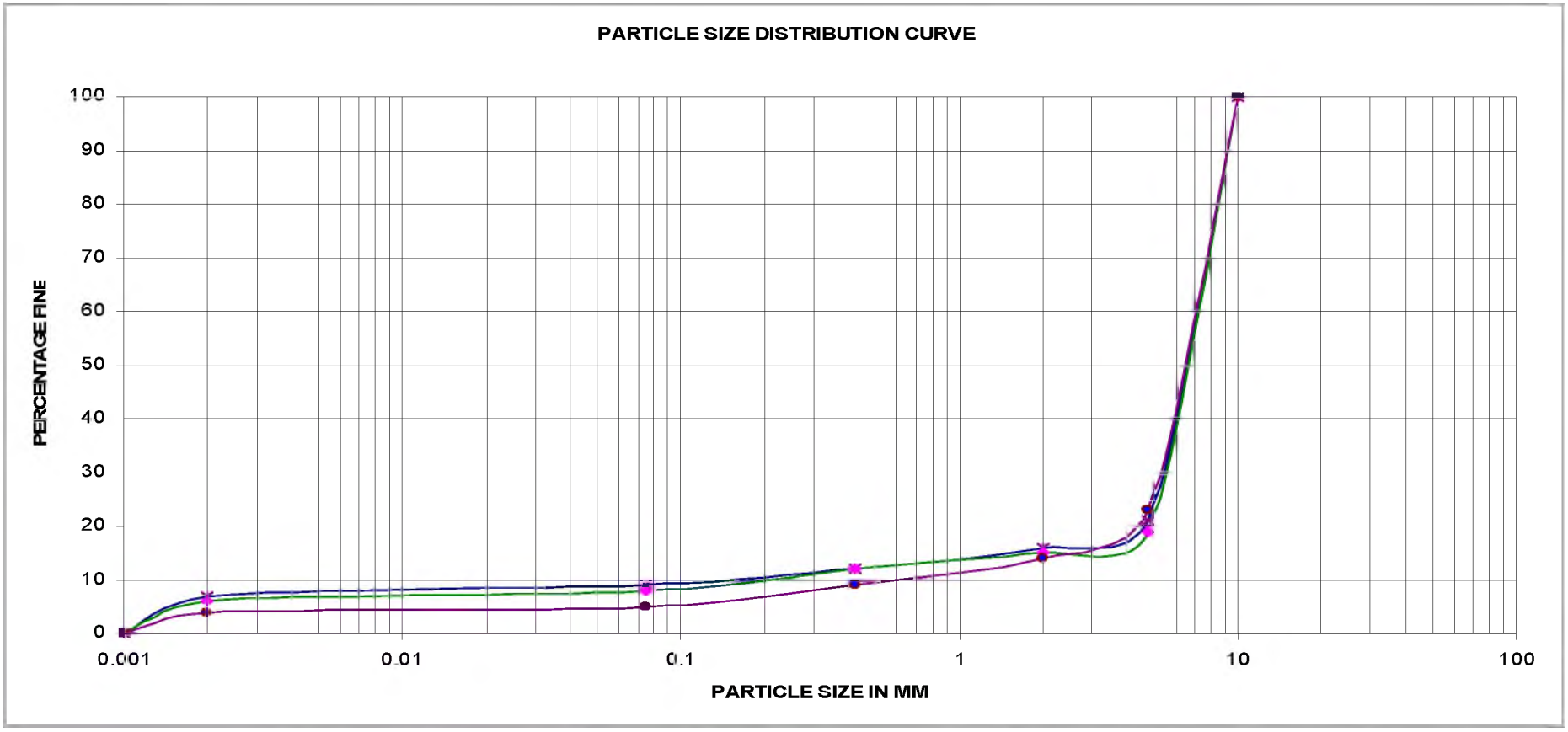

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
2	1.5	x
	3.0	◇
	4.5	⊗

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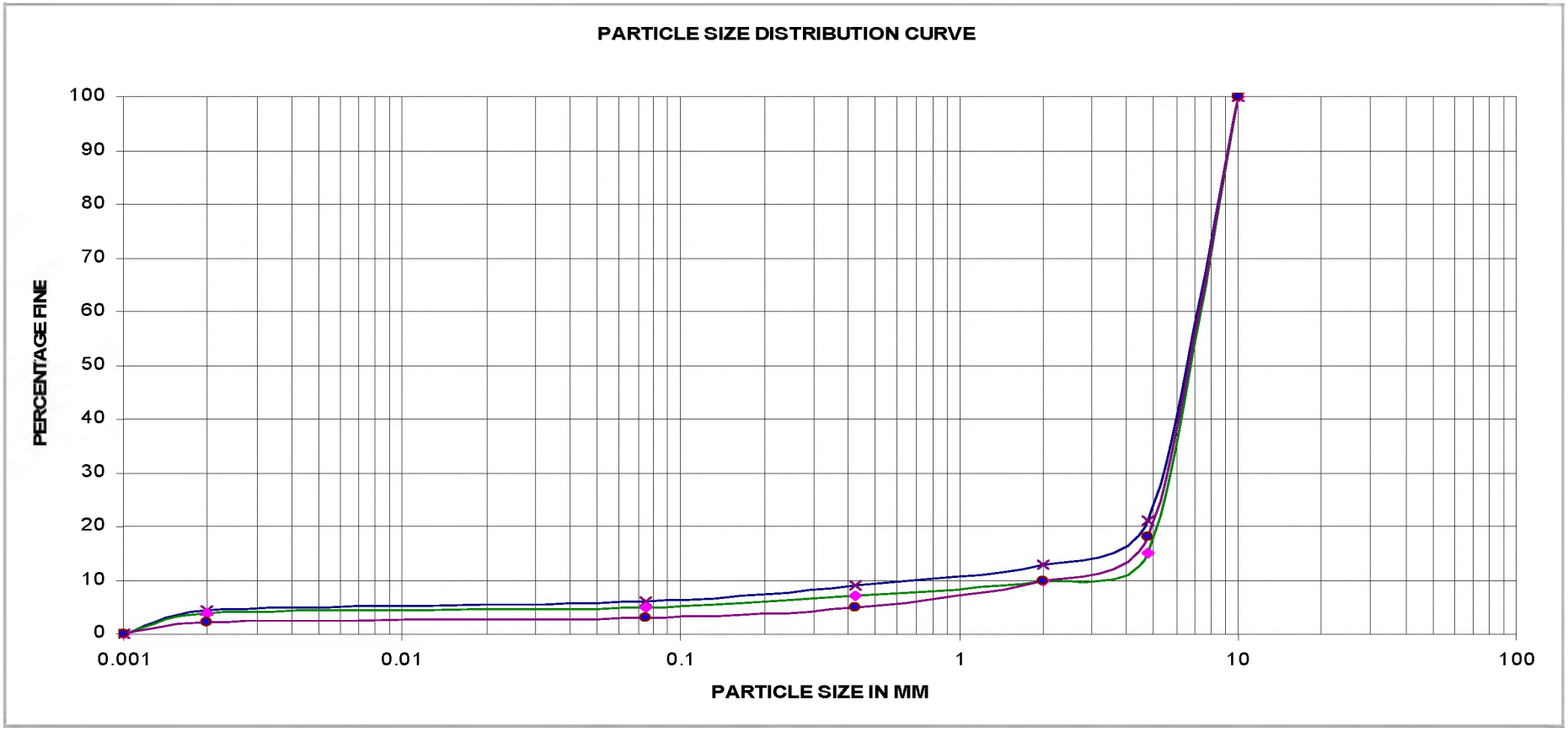

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
2	6.0	x
	7.5	◇
	9.0	⊗

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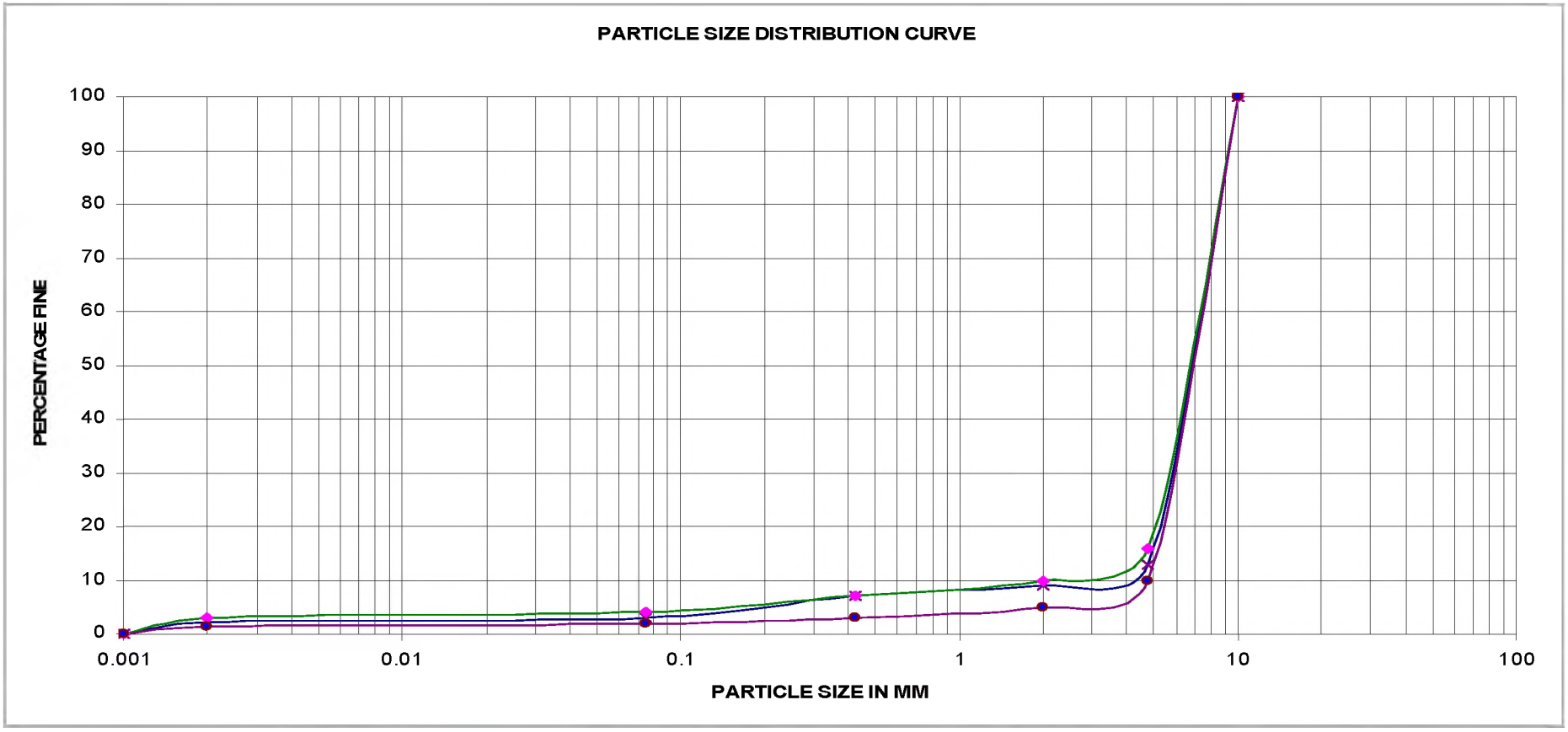

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
2	10.5	x
	12.0	◇
	13.5	⊗

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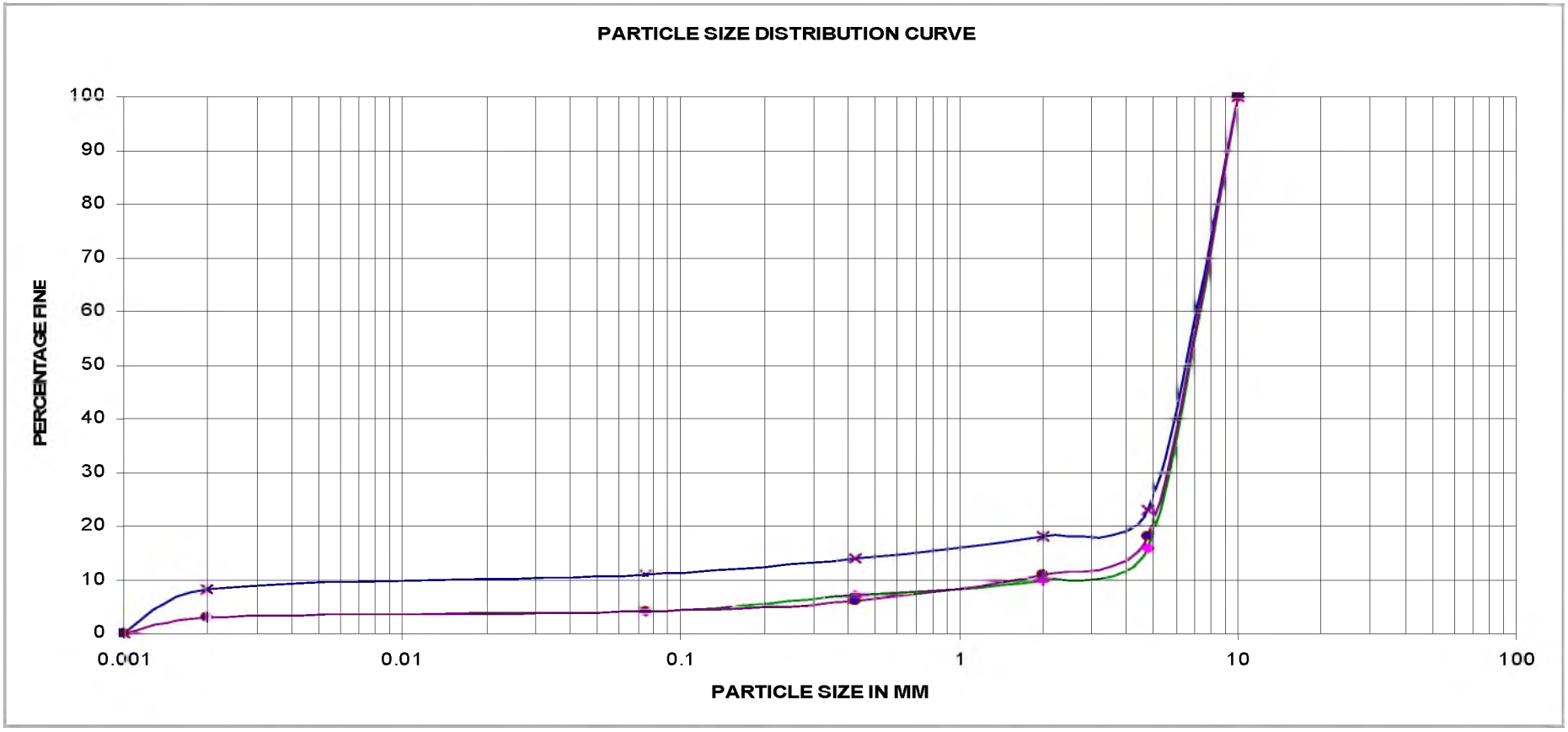

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
3	1.5	x
	3.0	◇
	4.5	⊗

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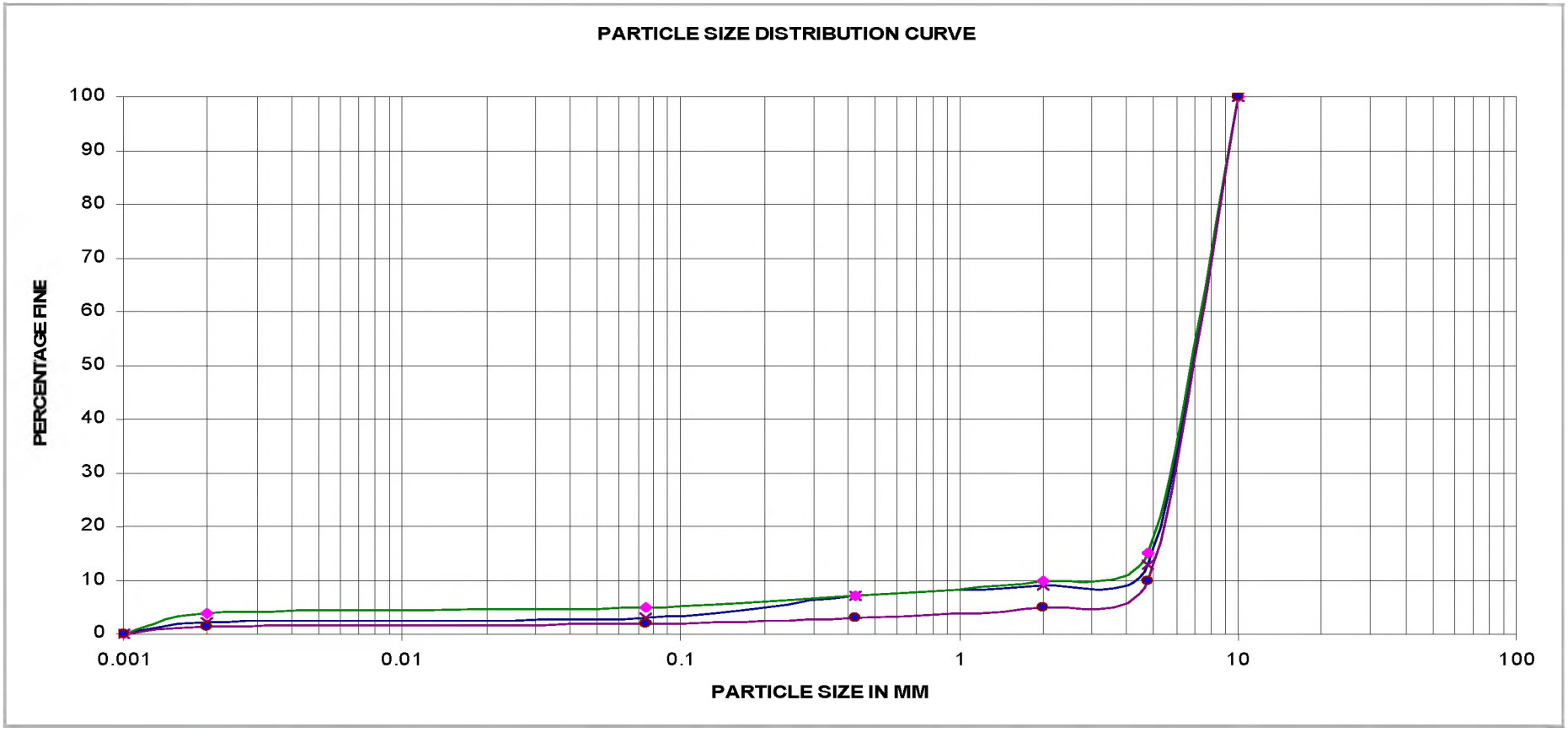

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
3	6.0	x
	7.5	◇
	9.0	⊗

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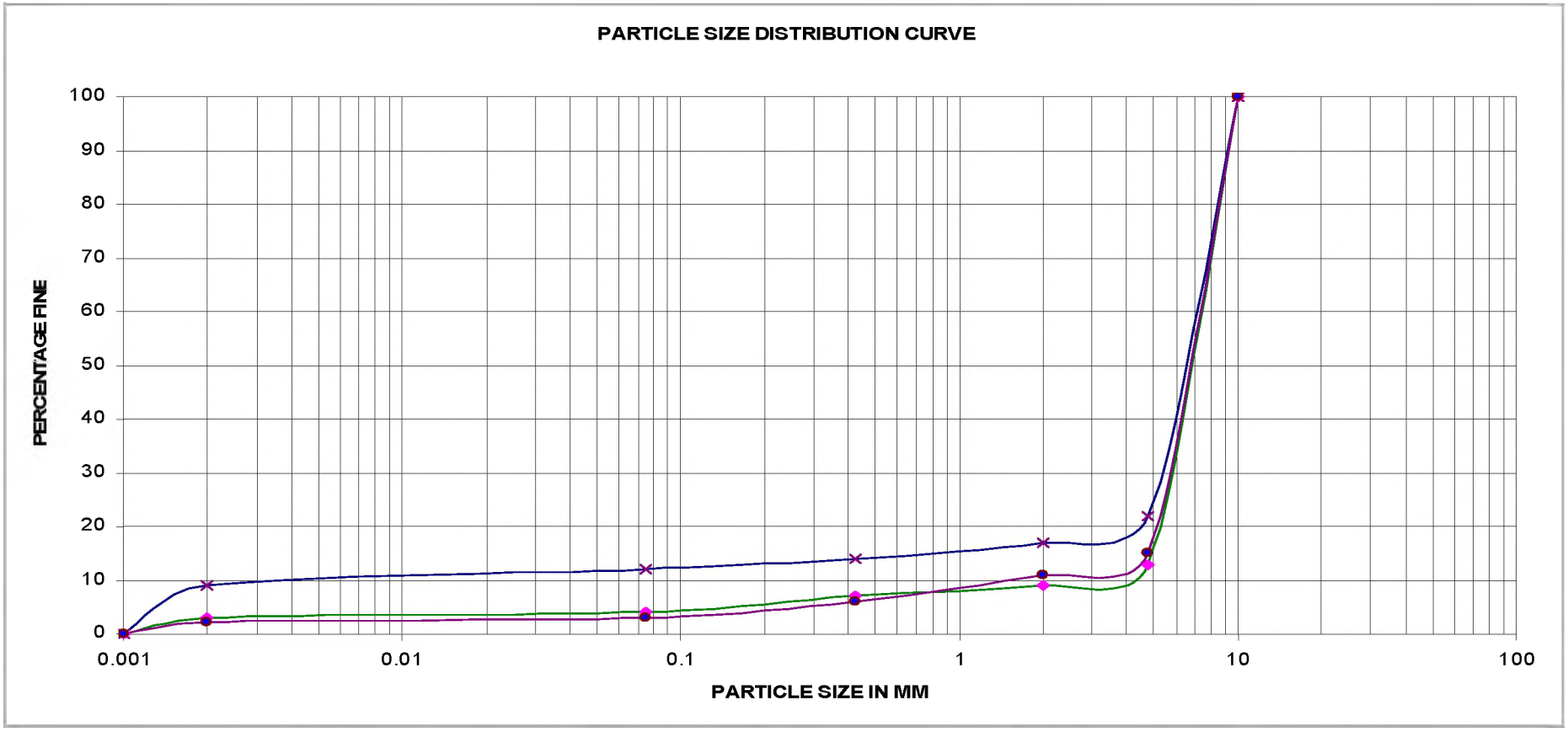

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
4	1.5	x
	3.0	◇
	4.5	⊗

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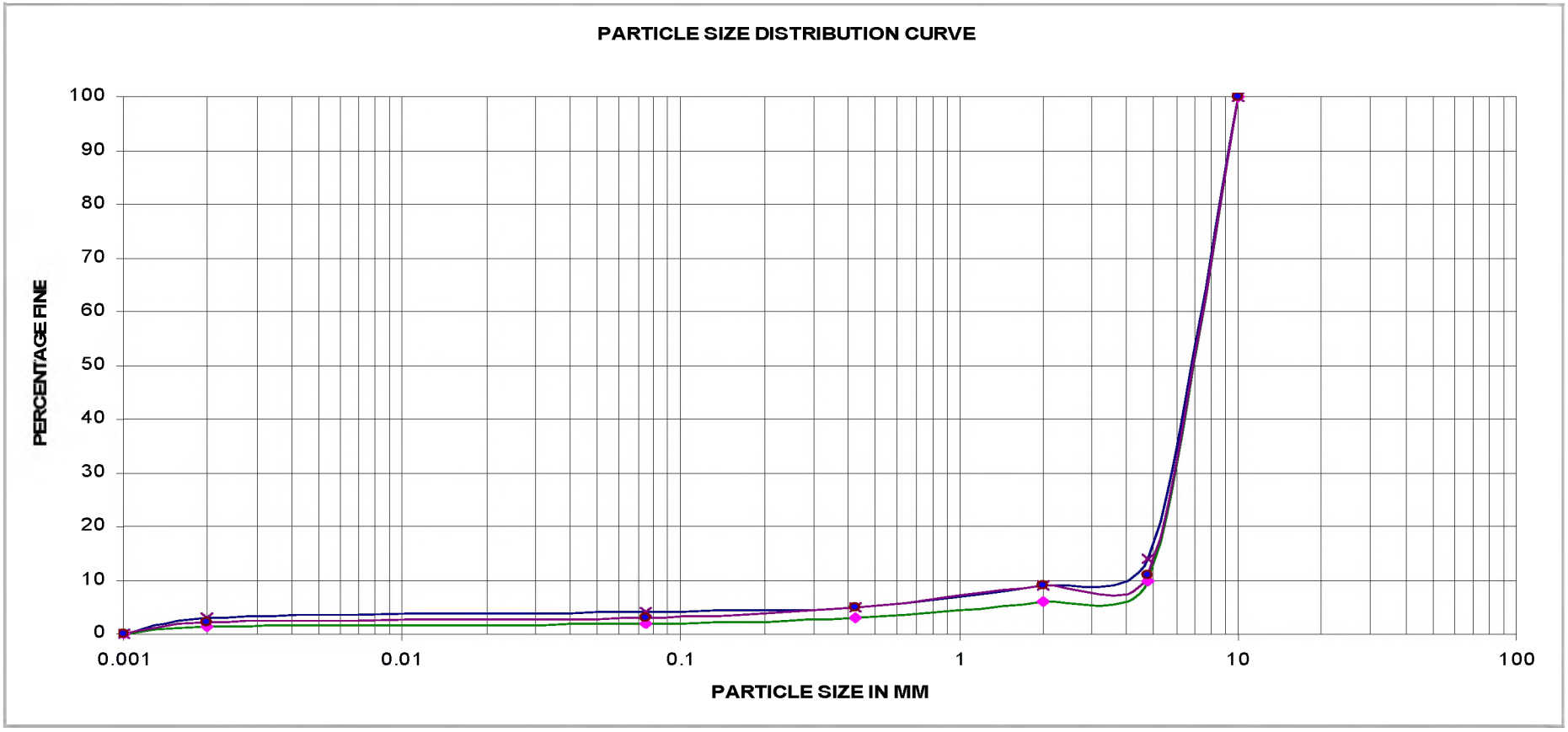

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
4	6.0	x
	7.5	◇
	9.0	⊗

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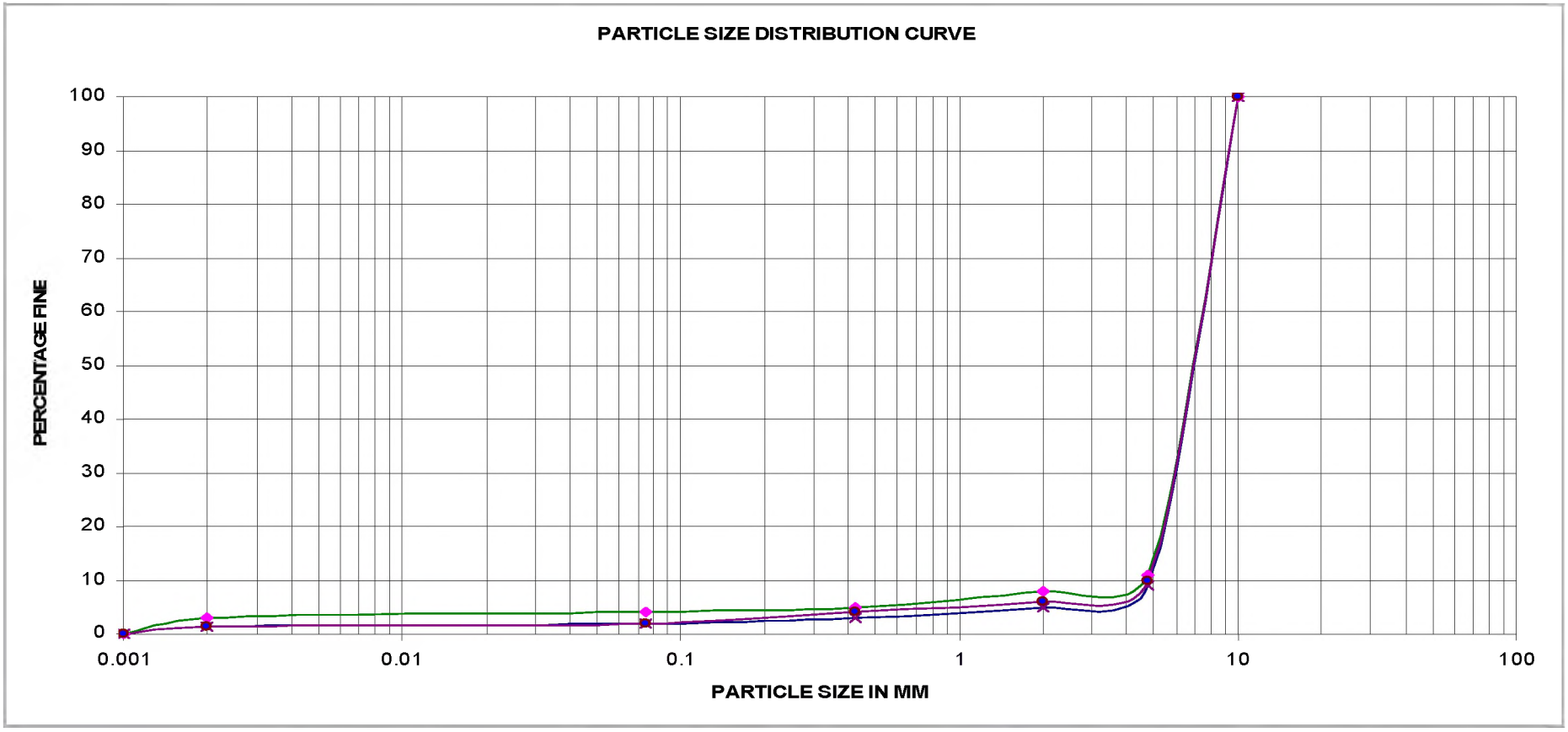

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
4	10.5	x
	12.0	◇
	13.5	⊗

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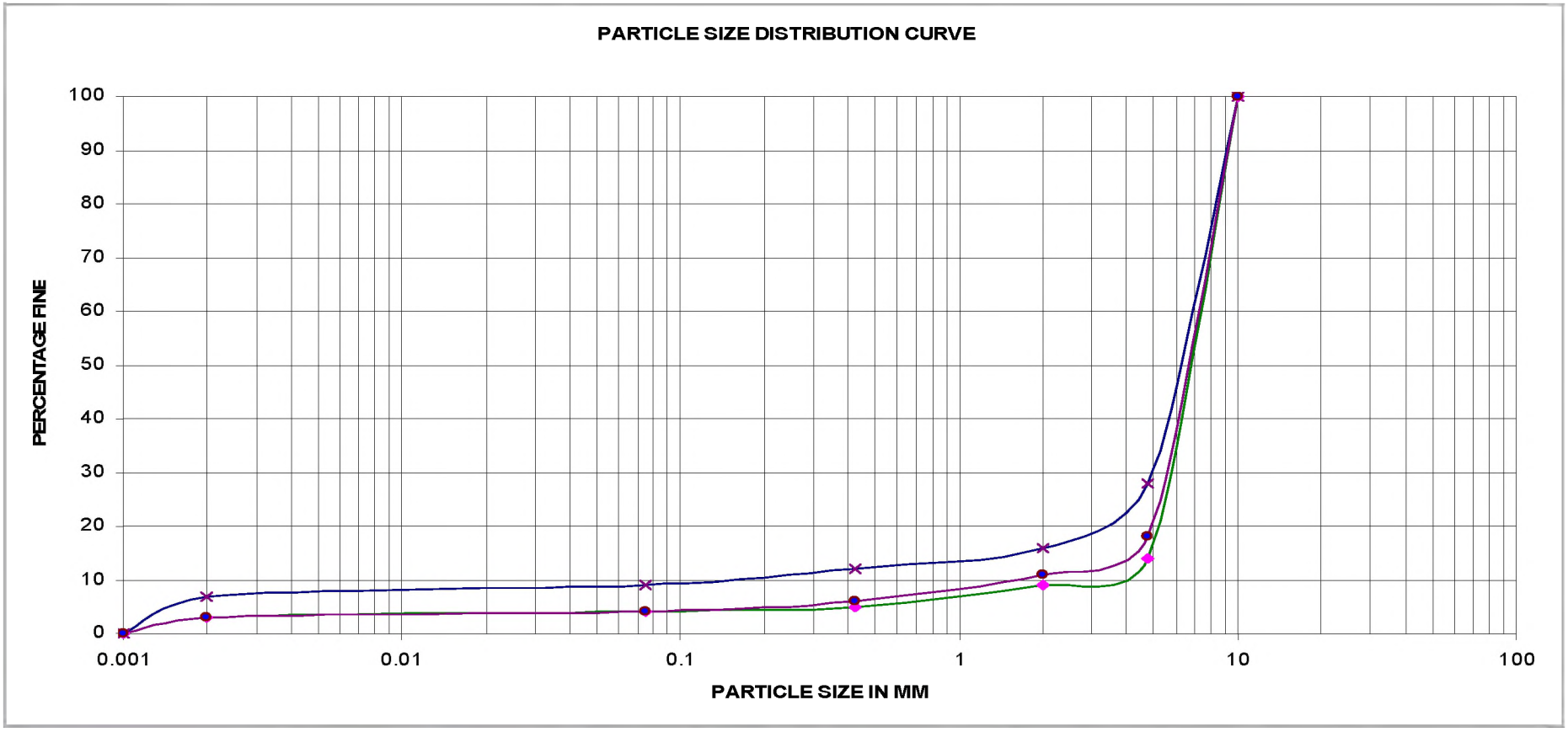

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
5	1.5	x
	3.0	◇
	4.5	⊗

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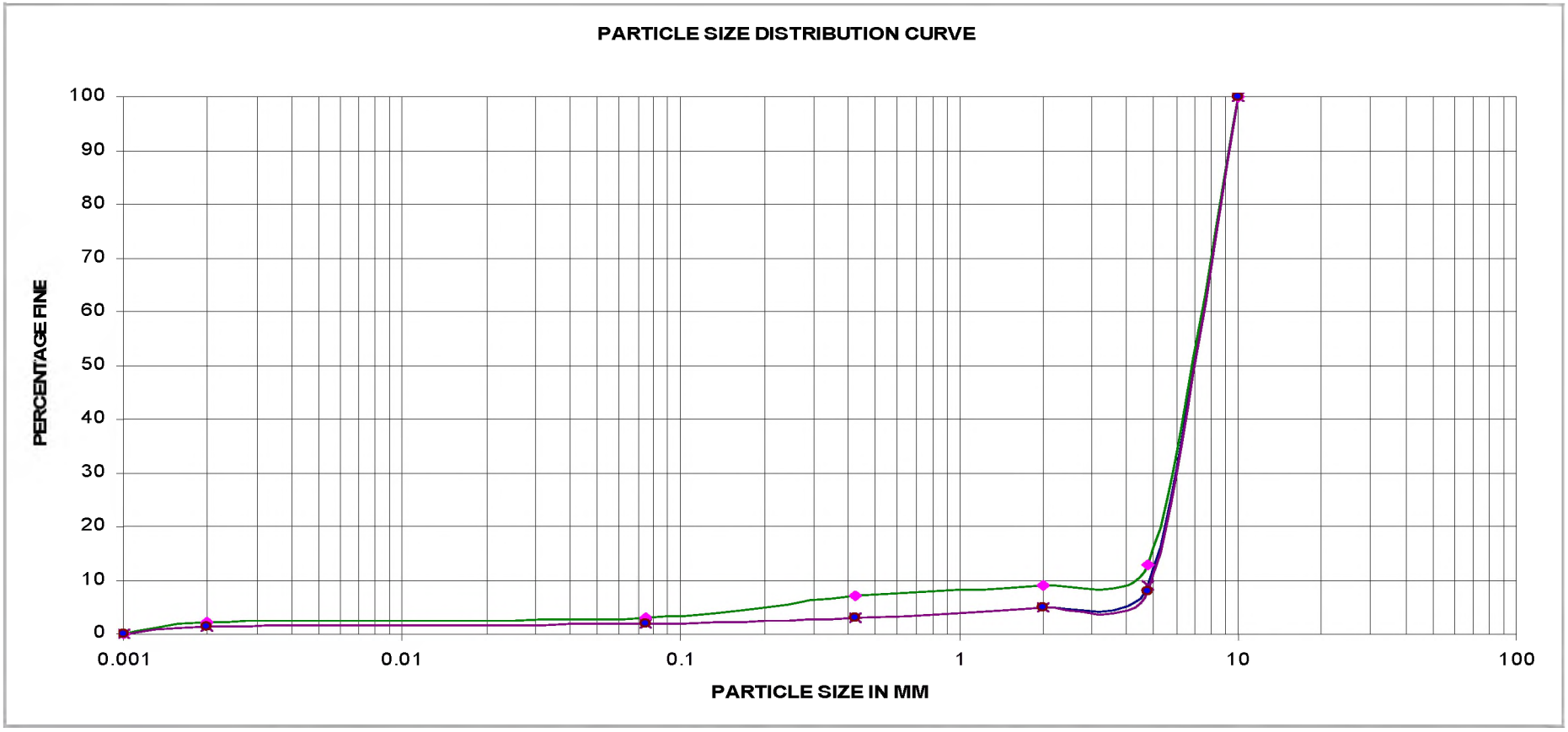

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
5	6.0	x
	7.5	◇
	9.0	⊗

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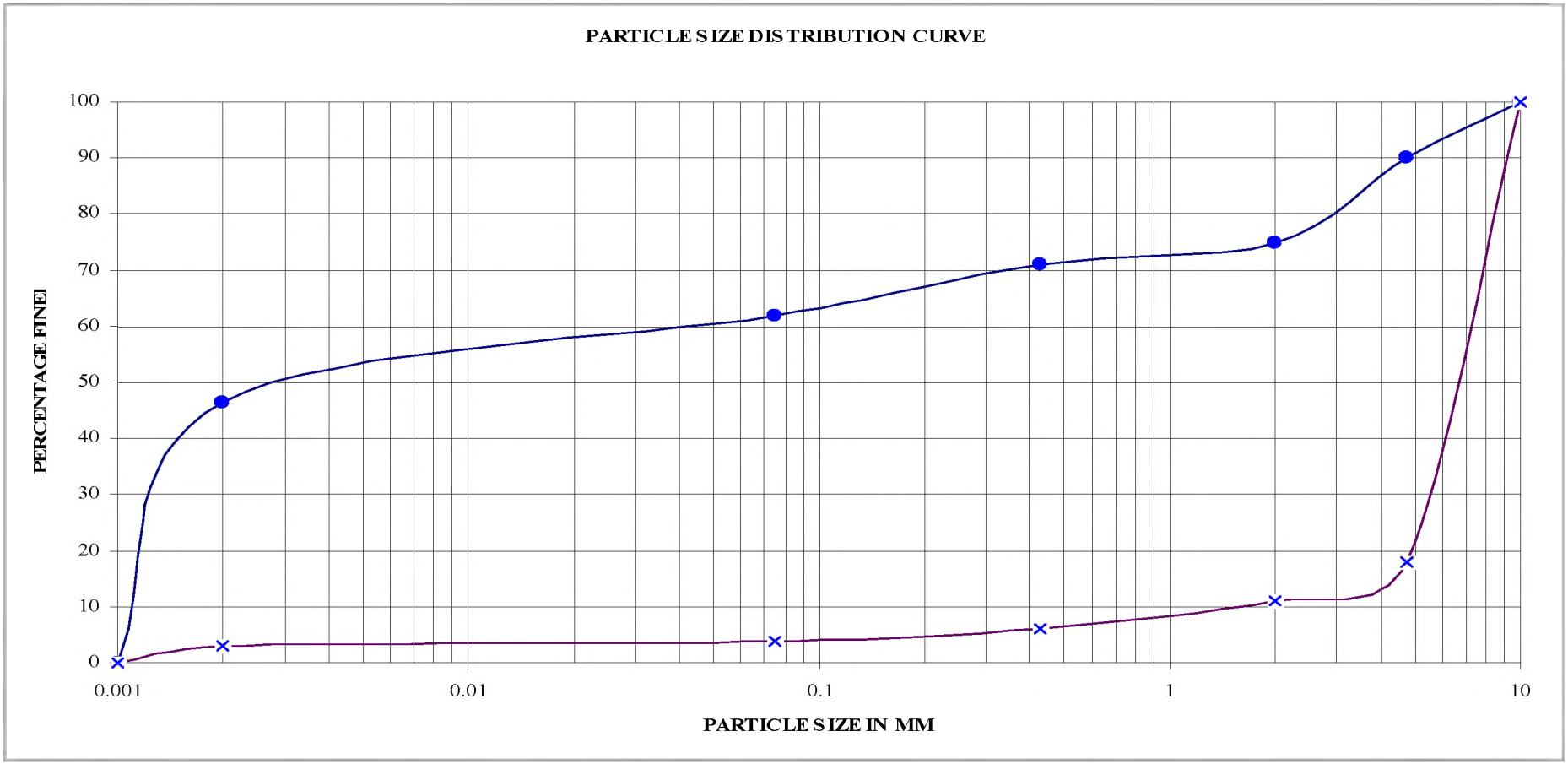

CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
6	3.0	x
	4.5	◇

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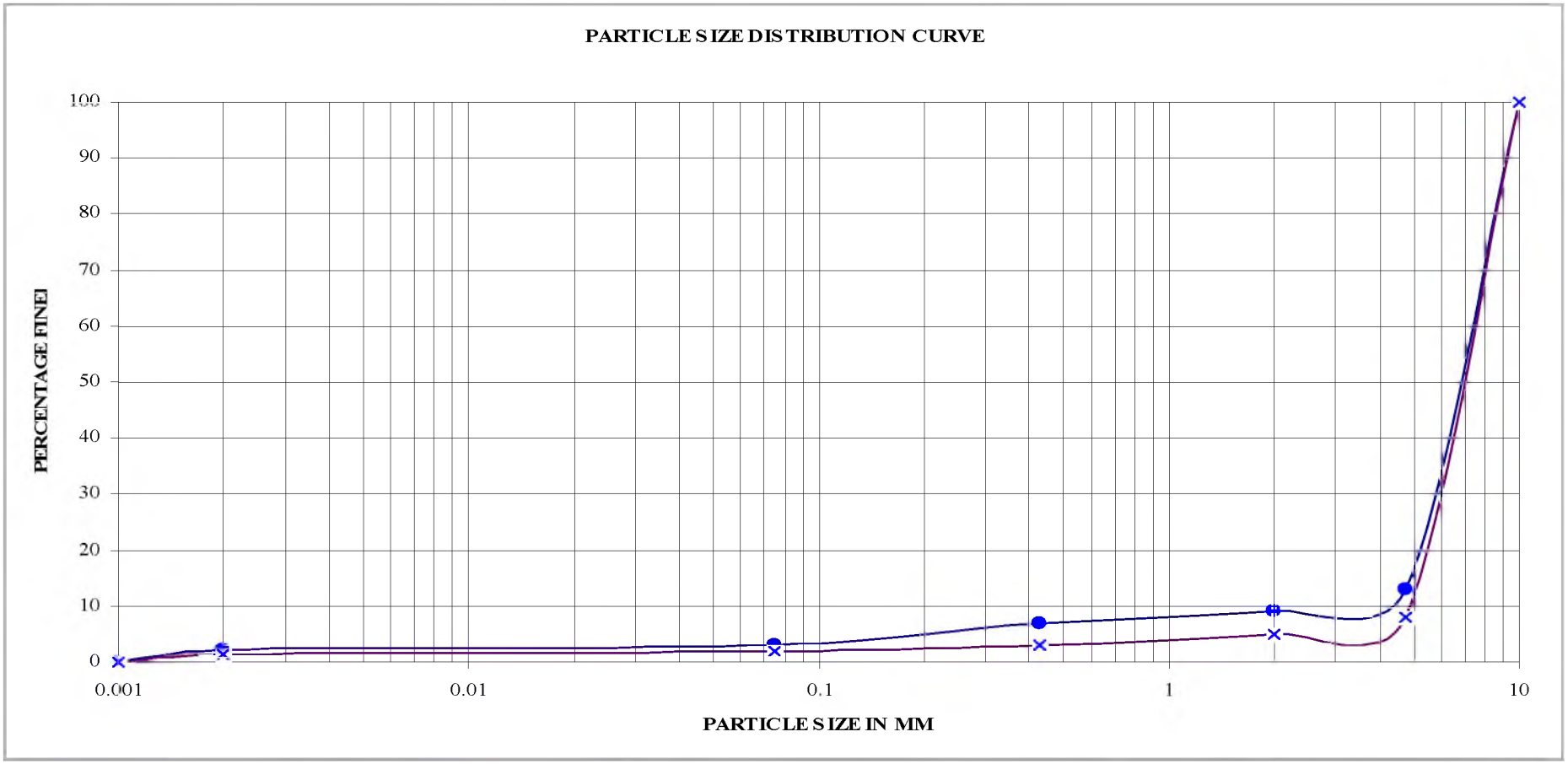


CLAY & SILT | FINE SAND | MEDIUM SAND | C.SAND | GRAVEL | COBBLE

B.H.No.	Depth (m)	Index
6	6.0	x
	7.5	◇

ANNEXURE 7

SOIL INVESTIGATION REPORT OF LANDFILL SITE AT MAWIONG

SMEC INDIA

Annexure - 7

SOIL ANALYSIS FOR THE PROJECT OF SOLID WASTE MANAGEMENT (CONSTRUCTION OF SANITARY LANDFILL SITE AT MAWIONG)

1. The sanitary landfill site of Mawiong area consist mainly of feldspathic quartzite. It is the Shillong Group of metamorphic rocks of Precambrian age. The rocks are highly jointed. The mineral content of the rocks are mostly quartz, feldsper and very less amount of mica. The rocks are also partially weathered. The rocks are permeable in nature due to the presence of joints, fractures and weathering effect. During rainy season water may percolate from the SWM site through joints and fractures and may pollute the soil, nearby streams, lakes and ground water of this area. The soil cover of the area is very thin and silty clay in nature. But in nearby areas of the SWM site thick beds of lateritic clayey soil is available at a distance of 3 km towards Barapani.

2. To make the SWM site into an impervious one we have to add 10 % of Bentonite alongwith the silty clay to laminate the area. For this purpose the following three soil samples had been collected from three different locations of Shillong area for Laboratory analysis.

1. Lateritic soil sample from Mawiong which is only 3.5 km away from SWM site.
2. Soil sample from SWM site of Mawiong.
3. Soil sample from Smit area which is about 25 km away from the SWM site.

3. The following laboratory tests were conducted on the above mentioned samples.

They are –

1) Gradation test,
2) Liquid limit and Plastic limit,
3) Standard proctor test
4) Permeability test

4. The summary of the results of laboratory analysis are given below:

Summary of results

Sample No	Test No	Name of test	Result
1	i	Proctor test	
	a	Virgin soil	MDD= 1.69gm/cc OMC = 21%
	b	with 10% Bentonite by weight	MDD= 1.70gm/cc OMC = 23.4%
	ii	Gradation	% silt and clay (Passing .075mm sieve) =80%
	iii	Plasticity	LL=58% PL=35% PI= 23%
	iv	Permeability (Coeff of Permeability) K=	
	a	Virgin soil	$K=9.20 \times 10^{-8}$ cm/sec
	b	with 10% Bentonite by weight	$K=2.85 \times 10^{-8}$ cm/sec

2	i	Proctor test	
	a	Virgin soil	MDD= 1.66gm/cc OMC =13.5%
	b	with 10% Bentonite by weight	MDD= 1.67gm/cc OMC = 15.8%
	ii	Gradation	% silt and clay (Passing .075mm sieve) =18%
	iii	Plasticity	LL=Non Plastic PL=Non Plastic
	iv	Permeability (Coeff of Permeability) K=	
	a	Virgin soil	K=1.80x10^{-4} cm/sec
	b	with 10% Bentonite by weight	K=2.07x10^{-6} cm/sec
3	i	Proctor test	
	a	Virgin soil	MDD= 1.66gm/cc OMC = 16%
	b	with 10% Bentonite by weight	MDD= 1.70gm/cc OMC =17%
	ii	Gradation	% silt and clay (Passing .075mm sieve) =35%
	iii	Plasticity	LL=Non Plastic PL=Non Plastic
	iv	Permeability (Coeff of Permeability) K=	
	a	Virgin soil	K=1.30x10^{-5} cm/sec
	b	with 10% Bentonite by weight	K=9.41x10^{-8} cm/sec

5. From the study of the laboratory analysis of the above mentioned samples it appears that the sample No.1 which is collected from Mawiong area (3.5 km away) site is suitable for laminating the SWM site. The lateritic silty clay soil after amended with 10 % Bentonite the coefficient of permeability result is K = 2.85 x 10 $^{-8}$ cm/Sec. which will be suitable for SWM site as an impervious layer.

6. The basic requirement of the compacted clay liner is that it should have permeability below prespecified limit (10 $^{-7}$ cm/sec.) and that this should be maintained during the design life of landfill. For this purpose sample No.1 is recommended which is available nearby areas with admix of 10 % Bentonite.

The detailed results of laboratory analysis are given as under:-

Sample1 Reddish silty clay (virgin soil)

Name of test : 1. Determination of MDD & OMC (Standard Proctor test)

Proctor test result (IS:2720-VII)

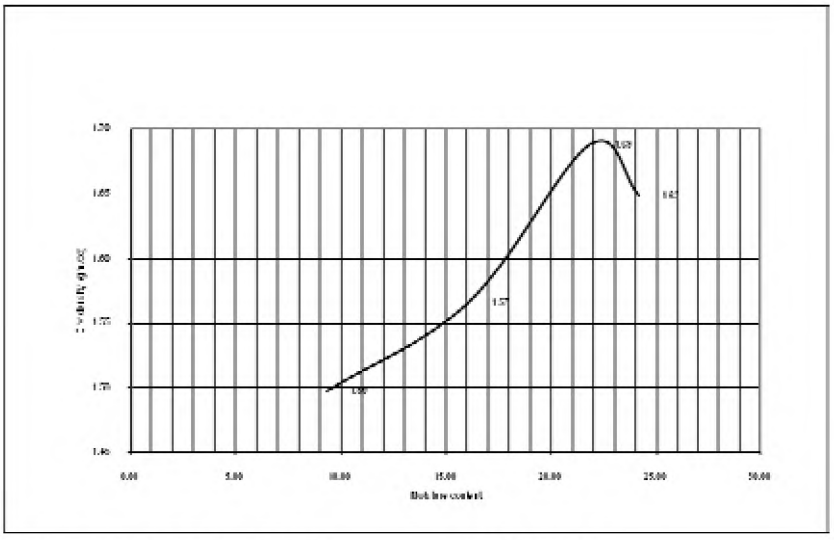
1 Size of mould = 10 cm dia x 12.73 cm height
2 Capacity of mould = 1000 cc
3 Rammer = 2.6 Kg x 310mm
4 No of layer = 3
5 Blows per layer = 25

(a) *Density determination*

		Test No	1	2	3	4
1	Mass of mould + soil	(gm)	3630	3810	4050	4040
2	Mass of empty mould	(gm)	1993	1993	1993	1993
3	Mass of compacted soil	(gm)	1637	1817	2057	2047
4	Bulk density	(gm/cc)	1.64	1.82	2.06	2.05
5	Dry density	(gm/cc)	1.50	1.57	1.69	1.65

(b) *Moisture content determination*

1	Container No		A2	A7	N1	N6
2	Mass of cont + wet soil	gm	48.87	51.64	56.62	60.45
3	Mass of cont + dry soil	gm	45.92	46.2	48.44	51.23
4	Mass of water present	gm	2.95	5.44	8.18	9.22
5	Mass of emptycontainer	gm	14.19	12.36	11.04	13.07
6	Mass of dry soil	gm	31.73	33.84	37.4	38.16
7	Moisture content	%	9.30	16.08	21.87	24.16



Maximum dry density (MDD) = 1.69gm/cc
Optimum moisture content (OMC) =21.0 %

2 Gradation test
Silt and Clay = 80%
3 Liquid limit = 58%
Plastic limit = 35%

Sample1 Reddish silty clay (with 10% Bentonite by weight)

Name of test : 1. Determination of MDD & OMC (Standard Proctor test)

Proctor test result (IS:2720-VII)

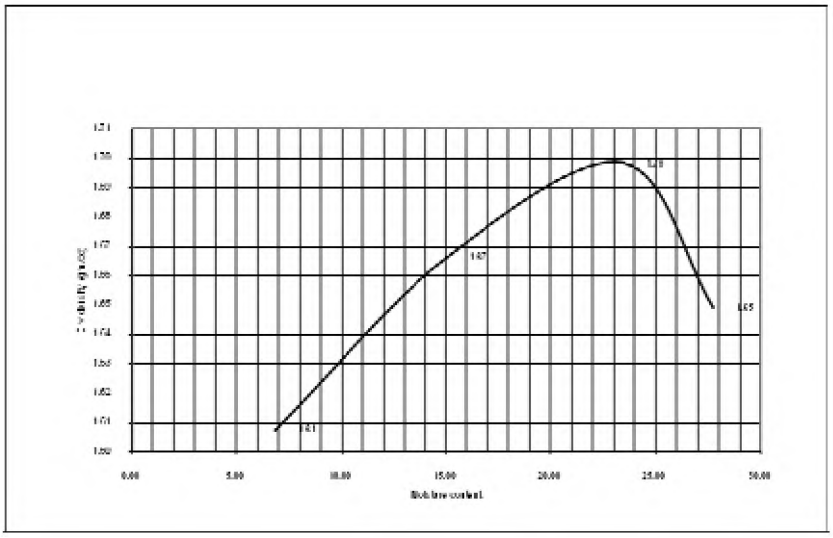
1	Size of mould	=	10 cm dia x 12.73 cm height
2	Capacity of mould	=	1000cc
3	Rammer	=	2.6 Kg x 310mm
4	No of layer	=	3
5	Blows per layer	=	25

(a) *Density determination*

		Test No	1	2	3	4
1	Mass of mould + soil	(gm)	3710	3910	4090	4100
2	Mass of empty mould	(gm)	1993	1993	1993	1993
3	Mass of compacted soil	(gm)	1717	1917	2097	2107
4	Bulk density	(gm/cc)	1.72	1.92	2.10	2.11
5	Dry density	(gm/cc)	1.61	1.67	1.70	1.65

(b)*Moisture content determination*

1	Container No		N5	N6	N1	N6
2	Mass of cont + wet soil	gm	41.35	42.6	50.12	53.89
3	Mass of cont + dry soil	gm	39.54	38.61	43.1	45.3
4	Mass of water present	gm	1.81	3.99	7.02	8.59
5	Mass of emptycontainer	gm	12.97	12.1	13.2	14.36
6	Mass of dry soil	gm	26.57	26.51	29.9	30.94
7	Moisture content	%	6.81	15.05	23.48	27.76



Maximum dry density (MDD) = 1.70gm/cc

Optimum moisture content (OMC) =23.4 %

4 Name of test : Falling head Permeability test

Sample1. **(Virgin soil)**			
Length of soil sample L= .		12.73	cm
Diameter of soil sample =		10	cm
Area of soil sample,A =		78.5	sqcm
Area of stand pipe, a =		0.44	sqcm
Initial head h1 =		100	cm
Final head h2 =		85	cm
Time =	35 hrs	126000	sec
Coefficient of permeability , K=(2.303aL/At) log h1/h2			
K=	**9.20×10^{-8}**	**cm/sec**	

Sample1. (**with 10% Bentonite by weight**)			
Length of soil sample L= .		12.73	cm
Diameter of soil sample =		10	cm
Area of soil sample,A =		78.5	sqcm
Area of stand pipe, a =		0.44	sqcm
Initial head h1 =		90	cm
Final head h2 =		84	cm
Time =	48 hrs	172800	sec
Coefficient of permeability , K=(2.303aL/At) log h1/h2			
K=	**2.85×10^{-8}**	**cm/sec**	

Sample2 (virgin soil)

Name of test : **1. Determination of MDD & OMC (Standard Proctor)**

Proctor test result (IS:2720-VII)

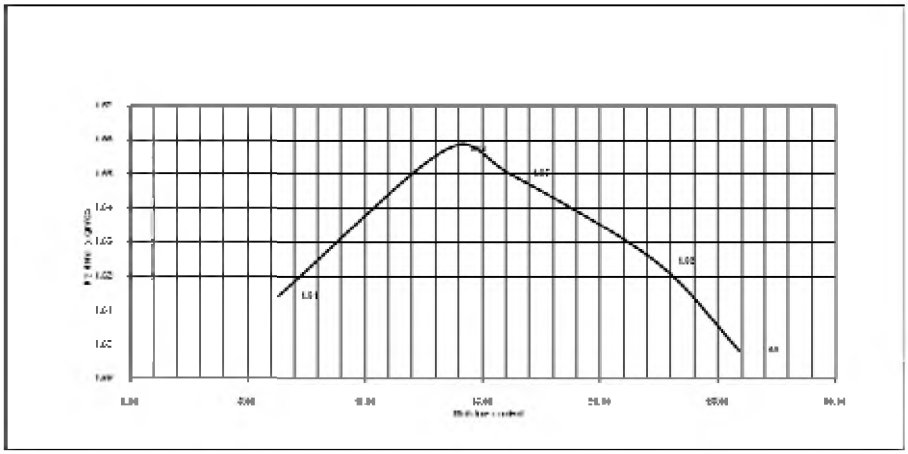
1 Size of mould = 10 cm dia x 12.73 cm height
2 Capacity of mould = 1000cc
3 Rammer= 2.6 Kg x 310mm
4 No of layer = 3
5 Blows per layer 25

(a) *Density determination*

		Test No	1	2	3	4	5
1	Mass of mould + soil		3710	3874	3910	3980	4005
2	Mass of empty mould	(gm)	1993	1993	1993	1993	1993
3	Mass of compacted soil	(gm)	1717	1881	1917	1987	2012
4	Bulk density	(gm/cc)	1.72	1.88	1.92	1.99	2.01
5	Dry density	(gm/cc)	1.61	1.66	1.65	1.62	1.60

(b) *Moisture content determination*

1	Container No		5	4	8	9	10
2	Mass of cont + wet soil	gm	64.17	56.2	64.43	61.56	75.03
3	Mass of cont + dry soil	gm	61.25	51.15	57.36	52.23	62.84
4	Mass of water present	gm	2.92	5.05	7.07	9.33	12.19
5	Mass of emptycontainer	gm	15.29	13.73	13.63	10.43	15.75
6	Mass of dry soil	gm	45.96	37.42	43.73	41.8	47.09
7	Moisture content	%	6.35	13.50	16.17	22.32	25.89



Maximum dry density (MDD) = 1.66 gm/cc
Optimum moisture content (OMC)
=13.50%

2 Gradation
Silt and clay =18%
3 Liquid limit = Non Plastic
Plastic limit = Non Plastic

Sample2 (with 10% Bentonite by weight)

Name of test : **1. Determination of MDD & OMC (Standard Proctor)**

Proctor test result (IS:2720-VII)

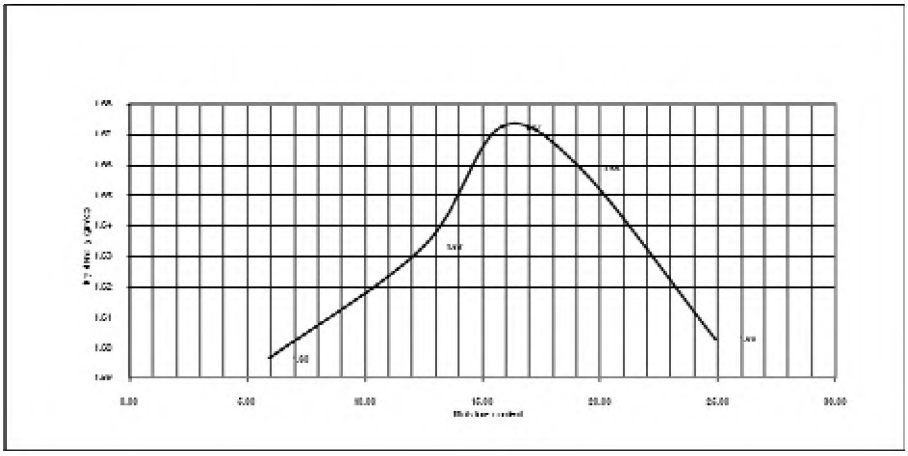
1 Size of mould = 10 cm dia x 12.73 cm height
2 Capacity of mould = 1000cc
3 Rammer= 2.6 Kg x 310mm
4 No of layer= 3
5 Blows per layer= 25

(a) *Density determination*

		Test No	1	2	3	4	5
1	Mass of mould + soil		3684	3830	3930	3970	3995
2	Mass of empty mould	(gm)	1993	1993	1993	1993	1993
3	Mass of compacted soil	(gm)	1691	1837	1937	1977	2002
4	Bulk density	(gm/cc)	1.69	1.84	1.94	1.98	2.00
5	Dry density	(gm/cc)	1.60	1.63	1.67	1.66	1.60

(b) *Moisture content determination*

1	Container No		B2	B7	B3	B11	B13
2	Mass of cont + wet soil	gm	54.23	43.02	51.88	45.19	37.3
3	Mass of cont + dry soil	gm	51.98	39.65	47.1	40.36	32.54
4	Mass of water present	gm	2.25	3.37	4.78	4.83	4.76
5	Mass of emptycontainer	gm	14.06	12.63	16.89	15.19	13.43
6	Mass of dry soil	gm	37.92	27.02	30.21	25.17	19.11
7	Moisture content	%	5.93	12.47	15.82	19.19	24.91



Maximum dry density (MDD) = 1.67 gm/cc
Optimum moisture content (OMC)=15.80%

2 Gradation
Silt and clay =18%
3 Liquid limit = Non Plastic
Plastic limit = Non Plastic

4 Name of test : Falling head Permeability test

Sample2. **(Virgin soil)**				
Length of soil sample L= .			12.73	cm
Diameter of soil sample =			10	cm
Area of soil sample,A =			78.5	sqcm
Area of stand pipe, a =			0.44	sqcm
Initial head h1 =			100	cm
Final head h2 =			10	cm
Time =	0.25	hrs= 15 min	900	sec
Coefficient of permeability , K=(2.303aL/At) log h1/h2				
K=	**$1.8x10^{-4}$**		**cm/sec**	

Sample2. (**with 10% Bentonite by weight**)				
Length of soil sample L= .			12.73	cm
Diameter of soil sample =			10	cm
Area of soil sample,A =			78.5	sqcm
Area of stand pipe, a =			0.44	sqcm
Initial head h1 =			85	cm
Final head h2 =			69	cm
Time =	2	hrs	7200	sec
Coefficient of permeability , K=(2.303aL/At) log h1/h2				
K=	**$2.07x10^{-6}$**		**cm/sec**	

Sample3 (virgin soil)

Name of test : 1 Determination of MDD & OMC (Standard Proctor)

Proctor test result (IS:2720-VII)

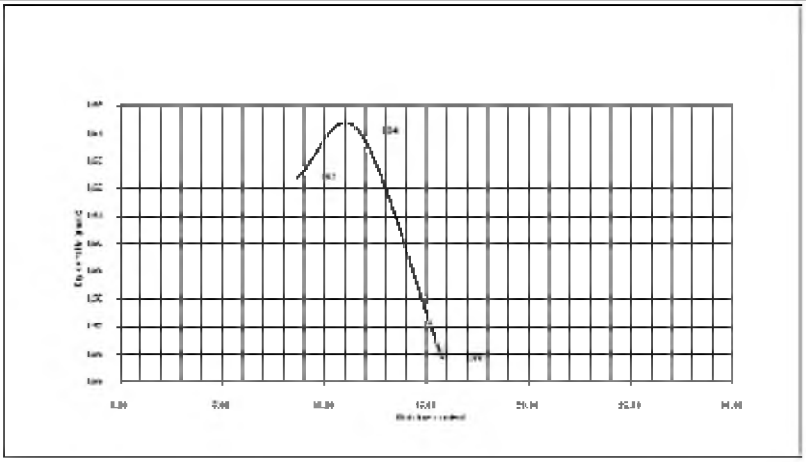
1	Size of mould =	10 cm dia x 12.73 cm height
2	Capacity of mould=	1000 cc
3	Rammer=	2.6 Kg x 310mm
4	No of layer=	3
5	Blows per layer=	25

(a) *Density determination*

		Test No	1	2	3
1	Mass of mould + soil	(gm)	3757	3825	3798
2	Mass of empty mould	(gm)	1993	1993	1993
3	Mass of compacted soil	(gm)	1764	1832	1805
4	Bulk density	(gm/cc)	1.76	1.83	1.81
5	Dry density	(gm/cc)	1.62	1.64	1.56

(b) *Moisture content determination*

1	Container No		4	2	8
2	Mass of cont + wet soil	gm	66	73.71	67.44
3	Mass of cont + dry soil	gm	61.74	67.3	59.78
4	Mass of water present	gm	4.26	6.41	7.66
5	Mass of emptycontainer	gm	12.36	12.27	11.35
6	Mass of dry soil	gm	49.38	55.03	48.43
7	Moisture content	%	8.63	11.65	15.82



Maximum dry density (MDD) = 1.66 gm/cc

Optimum moisture content (OMC) =16.0 %

2 Gradation

Silt and clay = 35%

3 Liquid limit = Non Plastic

Plastic limit = Non Plastic

Sample3 : (with 10% Bentonite by weight)

Name of test : **1 Determination of MDD & OMC (Standard Proctor)**

Proctor test result (IS:2720-VII)

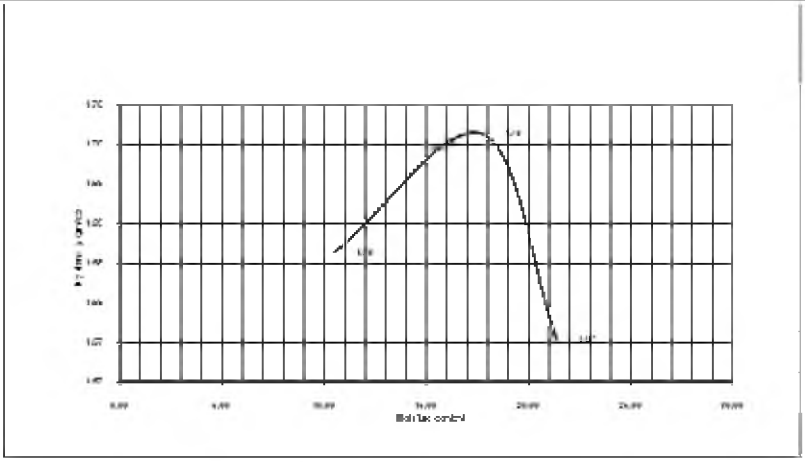
1 Size of mould = 10 cm dia x 12.73 cm height
2 Capacity of mould = 1000 cc
3 Rammer= 2.6 Kg x 310mm
4 No of layer= 3
5 Blows per layer= 25

(a) *Density determination*

		Test No	1	2	3
1	Mass of mould + soil	(gm)	3850	3990	4020
2	Mass of empty mould	(gm)	1993	1993	1993
3	Mass of compacted soil	(gm)	1857	1997	2027
4	Bulk density	(gm/cc)	1.86	2.00	2.03
5	Dry density	(gm/cc)	1.68	1.70	1.67

(b) *Moisture content determination*

1	Container No		C1	C5	C3
2	Mass of cont + wet soil	gm	35.3	40.39	37.85
3	Mass of cont + dry soil	gm	33.2	36.23	33.56
4	Mass of water present	gm	2.1	4.16	4.29
5	Mass of emptycontainer	gm	13.1	12.76	13.46
6	Mass of dry soil	gm	20.1	23.47	20.1
7	Moisture content	%	10.45	17.72	21.34



Maximum dry density (MDD) = 1.70 gm/cc
Optimum moisture content (OMC) =17.0 %

4. Name of test : Falling head Permeability test

Sample3. **(Virgin soil)**			
Length of soil sample L= .		12.73	cm
Diameter of soil sample =		10	cm
Area of soil sample,A =		78.5	sqcm
Area of stand pipe, a =		0.44	sqcm
Initial head h1 =		91	cm
Final head h2 =		47	cm
Time =	1 hrs	3600	sec
Coefficient of permeability , K=(2.303aL/At) log h1/h2			
K=	**1.30×10^{-5}**	**cm/sec**	

Sample3. (**with 10% Bentonite by weight**)			
Length of soil sample L= .		12.73	cm
Diameter of soil sample =		10	cm
Area of soil sample,A =		78.5	sqcm
Area of stand pipe, a =		0.44	sqcm
Initial head h1 =		83	cm
Final head h2 =		68	cm
Time =	42 hrs	151200	sec
Coefficient of permeability , K=(2.303aL/At) log h1/h2			
K=	**9.41×10^{-8}**	**cm/sec**	

PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)

DRAFT FINAL DPR- SOLID WASTE MANAGEMENT PROJECT IN GREATER SHILLONG PLANNING AREA

ASIAN DEVELOPMENT BANK TA-4779-IND

VOLUME-II
DRAWINGS

JUNE - 2009

SMEC INDIA

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DRAWING INDEX

SL. No.	DRAWING NO.	TITLE
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2	SMEC/1199/DPR/SIPMIU/DRW/SWM/2	MAP SHOWING SHILLONG AGGLOMERATION BOUNDARY
3	SMEC/1199/DPR/SIPMIU/DRW/SWM/3	MAP SHOWING PROPOSED LANDFILL SITE AND EXISTING COMPOST PLANT
4	SMEC/1199/DPR/SIPMIU/DRW/SWM/4	LAYOUT PLAN OF PROPOSED SANITARY LANDFILL SITE & EXISTING COMPOST PLANT WITH OTHER INFRASTRUCUTRAL FACLITIES
5	SMEC/1199/DPR/SIPMIU/DRW/SWM/5	LAYOUT OF LEACHATE COLLECTION PIPES AND SECTION OF SANITARY LANDFILL
6	SMEC/1199/DPR/SIPMIU/DRW/SWM/6	PLAN OF SECURITY GUARD ROOM
7	SMEC/1199/DPR/SIPMIU/DRW/SWM/7	SECTION AT A–A OF SECURITY GUARD ROOM
8	SMEC/1199/DPR/SIPMIU/DRW/SWM/8	SECTION AT B–B OF SECURITY GUARD ROOM
9	SMEC/1199/DPR/SIPMIU/DRW/SWM/9	SIDE ELEVATION OF SECURITY GUARD ROOM
10	SMEC/1199/DPR/SIPMIU/DRW/SWM/10	FRONT ELEVATION OF SECURITY GUARD ROOM
11	SMEC/1199/DPR/SIPMIU/DRW/SWM/11	FOUNDATION DETAILS OF SECURITY GUARD ROOM
12	SMEC/1199/DPR/SIPMIU/DRW/SWM/12	TRUSS DETAILS OF SECURITY GUARD ROOM
13	SMEC/1199/DPR/SIPMIU/DRW/SWM/13	PLAN, ELEVATION AND SECTION OF REST HOUSE
14	SMEC/1199/DPR/SIPMIU/DRW/SWM/14	SECTION OF REST HOUSE
15	SMEC/1199/DPR/SIPMIU/DRW/SWM/15	SIDE ELEVATION OF REST HOUSE
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17	SMEC/1199/DPR/SIPMIU/DRW/SWM/17	FOUNDATION DETAILS OF REST HOUSE
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19	SMEC/1199/DPR/SIPMIU/DRW/SWM/19	PLAN & SECTION FOR 30 M.T. FULLY ELECTRONIC CONCRETE DECK WEIGHBRIDGE
20	SMEC/1199/DPR/SIPMIU/DRW/SWM/20	PLAN, SECTION & ELEVATION OF WEIGHBRIDGE OPERATOR ROOM
21	SMEC/1199/DPR/SIPMIU/DRW/SWM/21	SECTION OF WEIGHBRIDGE OPERATOR ROOM
22	SMEC/1199/DPR/SIPMIU/DRW/SWM/22	SIDE ELEVATION OF WEIGHBRIDGE OPERATOR ROOM
23	SMEC/1199/DPR/SIPMIU/DRW/SWM/23	FRONT ELEVATION OF WEIGHBRIDGE OPERATOR ROOM
24	SMEC/1199/DPR/SIPMIU/DRW/SWM/24	FOUNDATION DETAILS OF WEIGHBRIDGE OPERATOR ROOM
25	SMEC/1199/DPR/SIPMIU/DRW/SWM/25	PLAN & SECTION OF GARAGE FOR PRIMARY COLLECTION
26	SMEC/1199/DPR/SIPMIU/DRW/SWM/26	SECTION OF GARAGE FOR PRIMARY COLLECTION
27	SMEC/1199/DPR/SIPMIU/DRW/SWM/27	FOUNDATION DETAILS OF GARAGE PRIMARY COLLECTION
28	SMEC/1199/DPR/SIPMIU/DRW/SWM/28	PLAN AND SECTION OF GARAGE FOR SECONDARY TRANSPORTATION VEHICLES
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32	SMEC/1199/DPR/SIPMIU/DRW/SWM/32	TRUSS DETAILS FOR SECONDARY TRANSPORTATION VEHICLES
33	SMEC/1199/DPR/SIPMIU/DRW/SWM/33	LAYOUT PLAN OF GROUND LEVEL RESERVOIR
34	SMEC/1199/DPR/SIPMIU/DRW/SWM/34	PLAN OF LEATCHATE TREATMENT PLANT
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36	SMEC/1199/DPR/SIPMIU/DRW/SWM/36	PLAN & SECTION OF SEPTIC TANK FOR 25 USERS
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41	SMEC/1199/DPR/SIPMIU/DRW/SWM/41	PROPOSED TRANSFER POINTS

CLIENT: ADB Asian Development Bank

CONSULTANT:
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GUWAHATI,PIN-781001,
TEL-0361-2633661FAX-0361-2631482

PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)

DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA

DRAWING SUB-TITLE: TABLE OF CONTENTS

DATE: JUNE - 2009

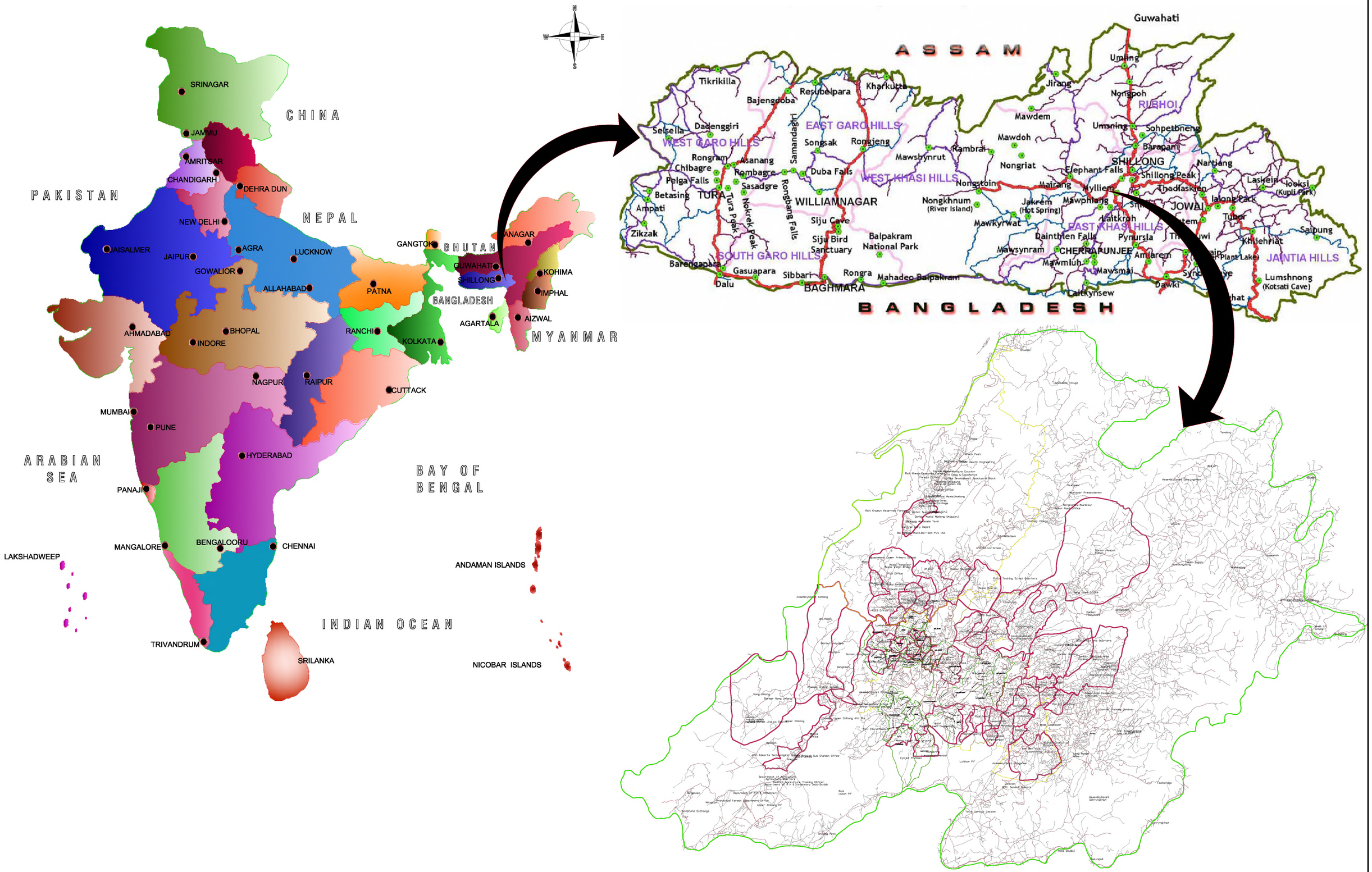
ALL DIMENSIONS ARE IN MM

SCALE:NTS

SHEET SIZE: A3

Detailed Project Report (Draft Final)

SMEC	1199	DPR	SIPMIU	DRW	SWM	TOC



CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** LOCATION MAP OF SHILLONG **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE:A2** *Detailed Project Report (Draft Final)*

SMEC	1199	DPR	SIPMIU	DRW	SWM	1

LEGENDS

TOWN BOUNDARY:----------

SINGLE ROAD:----------

DOUBLE ROAD:----------

TOWN AGGLOMERATION BOUNDARY:---

WARD BOUNDARY:----------

N

W E

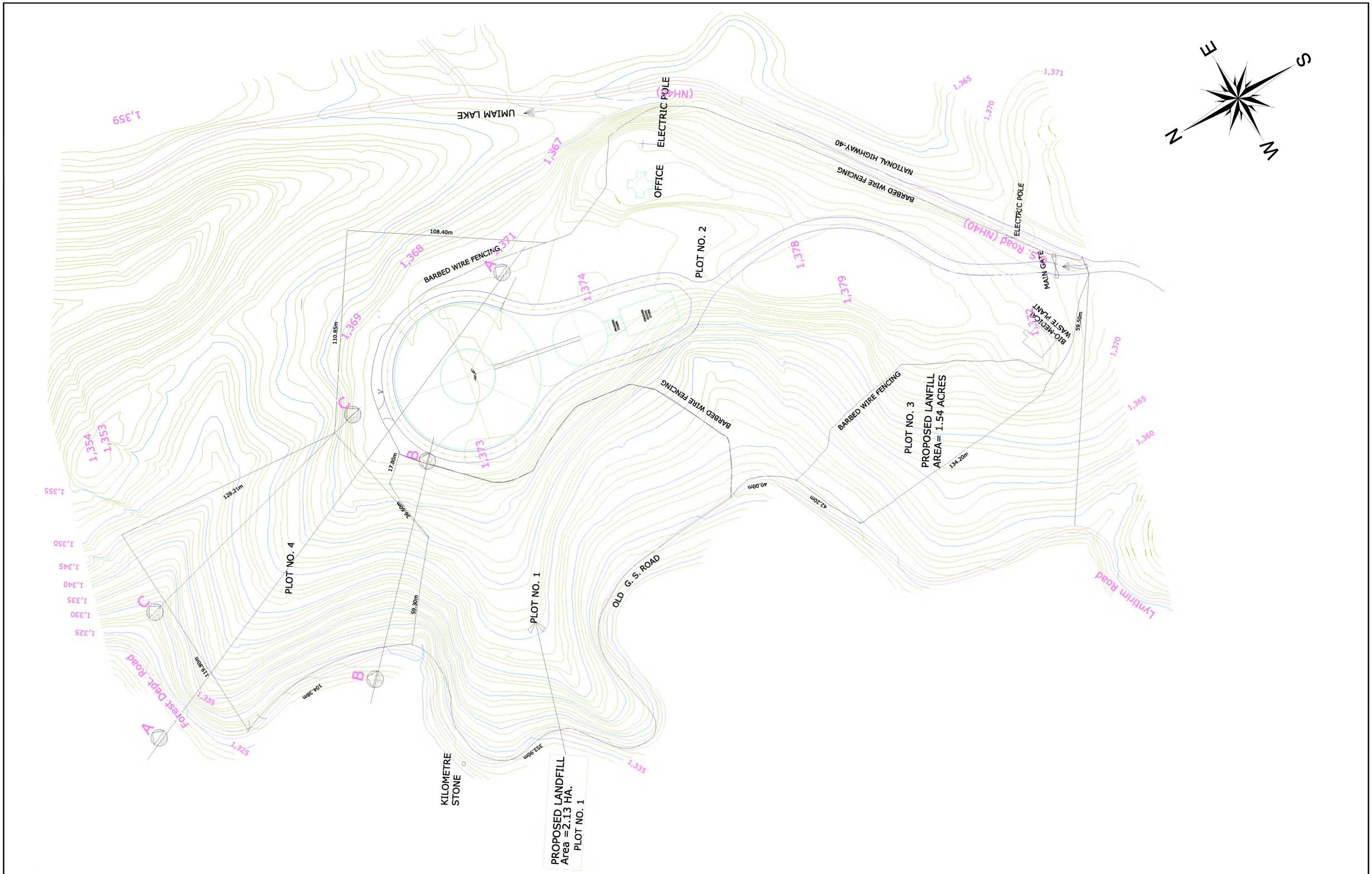
S

BOUNDARY INDEX

1. SHILLONG MUNICIPAL BOUNDARY
2. CANTONMENT BOUNDARY
3. MAWLAI:
4. NONGTHYMMAI
5. MADANRYTING
6. PYNTHORUMKHRAH
7. NONGMENSONG

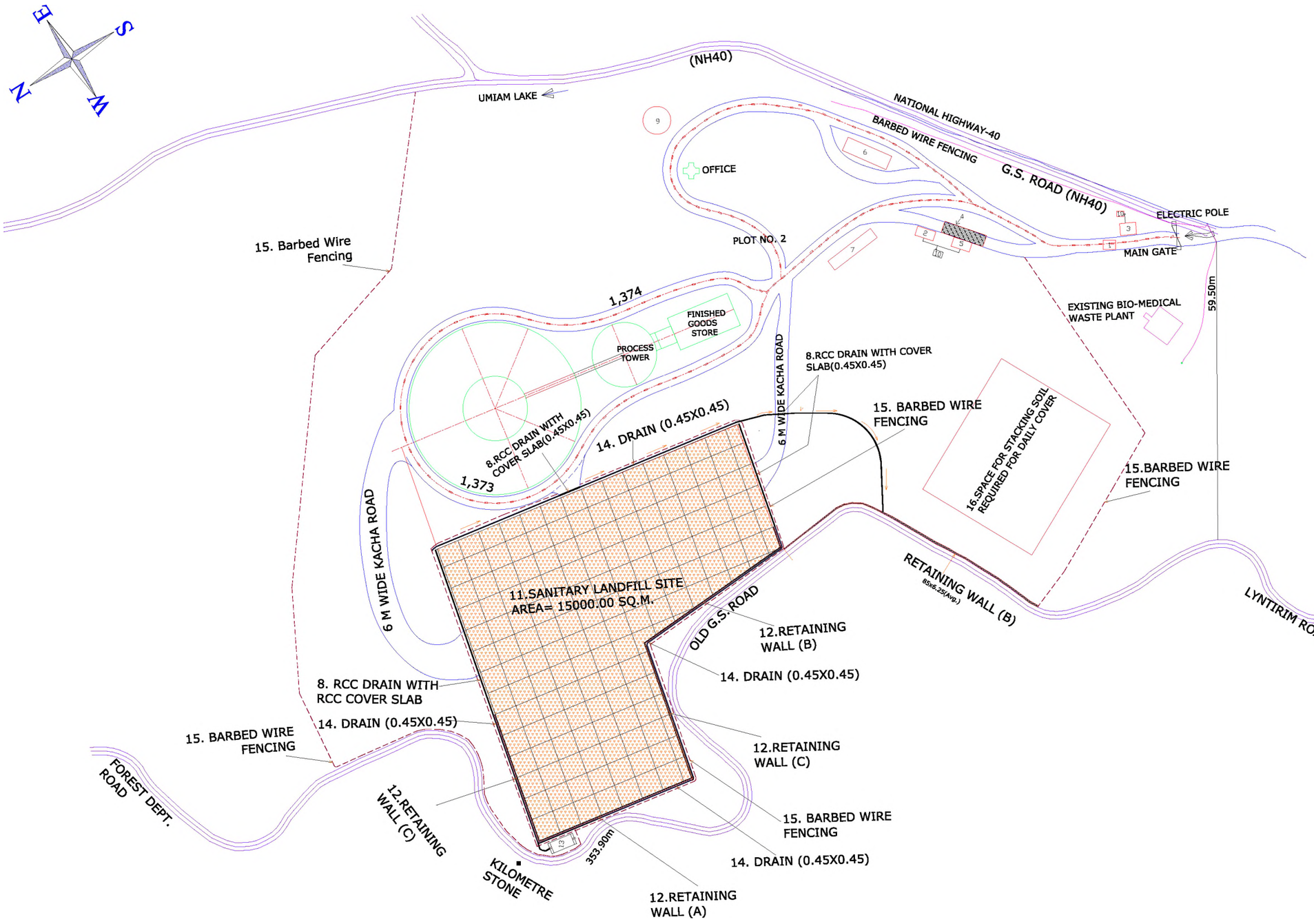
CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** MAP SHOWING SHILLONG AGGLOMERATION BOUNDARY **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE:A2**	*Detailed Project Report (Draft Final)*

SMEC	1199	DPR	SIPMIU	DRW	SWM	2



CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** MAP SHOWING PROPOSED LANDFILL SITE PLOT NO-1 MAIWIONG, SHILLONG **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE:A2**	*Detailed Project Report (Draft Final)*

SMEC	1199	DPR	SIPMIU	DRW	SWM	3



LEGEND

* ROAD =
* RETAINING WALL
* DRAIN LINE =
* JUNCTION BOX =

NO.	DESCRIPTION	QTY.	SIZE (METRE)
1	INTERNAL ROAD	1	1000
2	OPERATOR'S REST ROOM	1	10.04X8.69X3
3	SECURITY HOUSE	1	6 x 4.5 x 3.2
4	CONCRETE DECK WEIGHBRIDGE	1	7.5 x 3 x 1.925
5	WEIGHT BRIDGE CONTROL ROOM	1	4 x 3 x 3.2
6	GARAGE FOR PRIMARY COLLECTION VEHICLE	1	35 x 15 x 5
7	GARAGE FOR SECONDARY TRANSPORTATION VEHICLES & WORKSHOP WITH STORE	1	24 x 7 x 5
8	RCC DRAIN WITH RCC COVER SLABS	4	10 x .45 x .45
9	GROUND LEVEL RESERVOIR	1	7.5 Dia x 3ht.
10	SEPTIC TANK (25 USERS)	2	3.4 x 1.25
11	SANITARY LANDFILL AREA	1	15000 sq.m
12	RETAINING WALL (STONE MASONRY) (A)	1	75 x 9 HT.
	(B)	1	85 x 6.25(Avg)
	(C)	1	125 x 7.75(Avg)
13	LEACHATE TANK	1	10 x 5 x 2
14	DRAIN	2	490 x 0.45 x 0.45
15	BARBED WIRE FENCING	980	1.8 m ht.
16	SPACE FOR STACKING EARTH FOR DAILY COVERAGE	1	4000 SQM.

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TEL-0361-2633661 FAX-0361-2631482

PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)

DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA

DRAWING SUB-TITLE: LAYOUT PLAN OF PROPOSED SANITARY LANDFILL SITE AND EXISTING COMPOST PLANT WITH OTHER INFRASTRUCTURAL FACILITIES

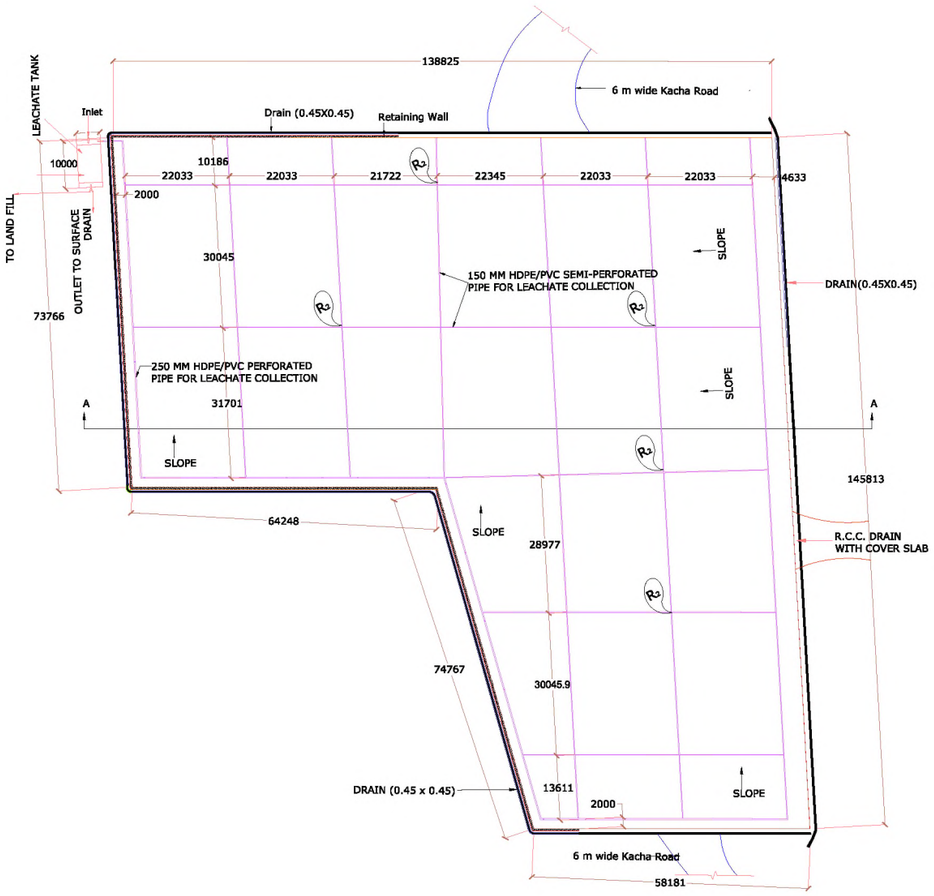
DATE: JUNE - 2009

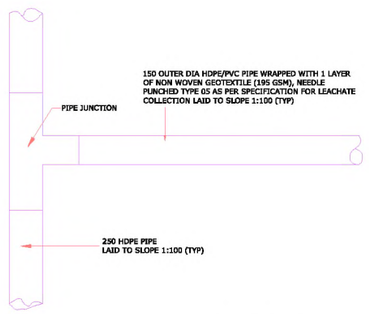
SCALE:NTS

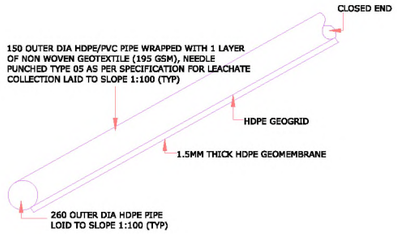
SHEET SIZE: A2

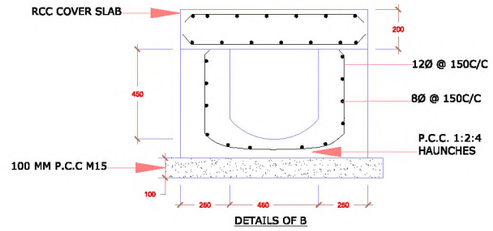
Detailed Project Report (Draft Final)

SMEC	1199	DPR	SIPMIU	DRW	SWM	4

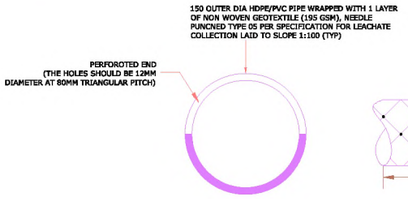


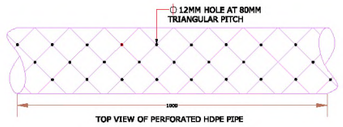




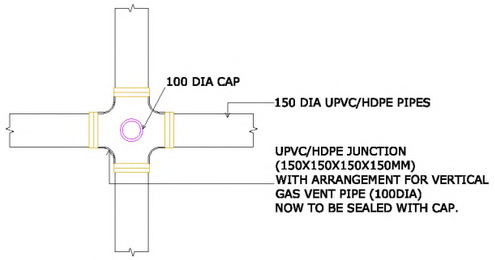


DETAILS OF B

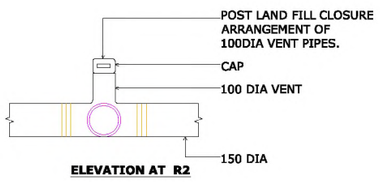




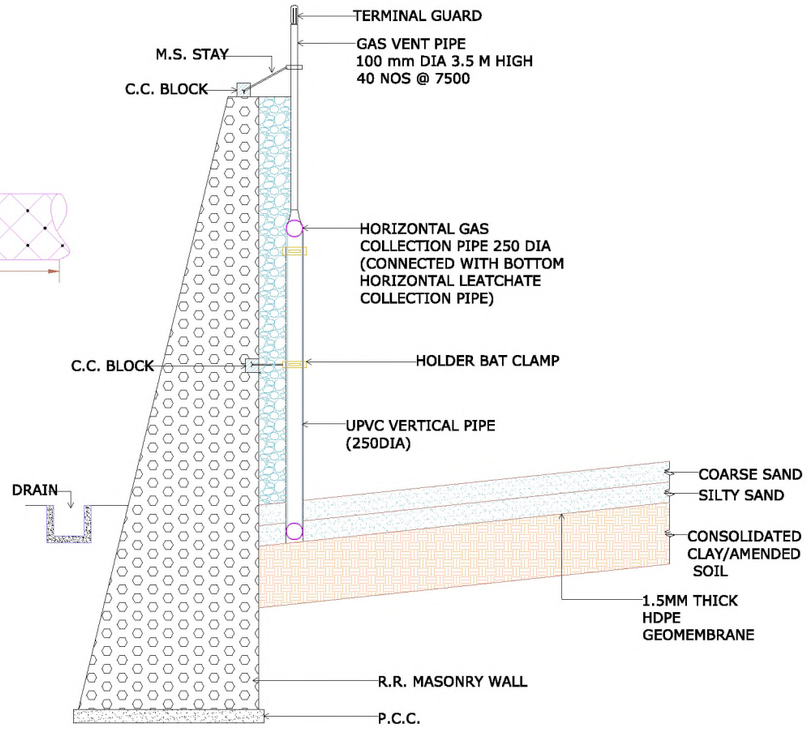
TOP VIEW OF PERFORATED HDPE PIPE



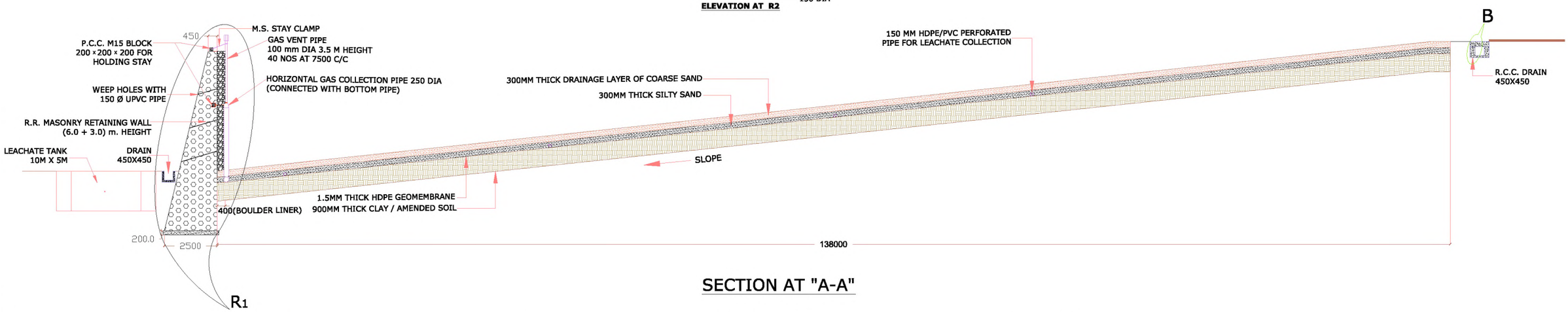
DETAILS AT R2



ELEVATION AT R2

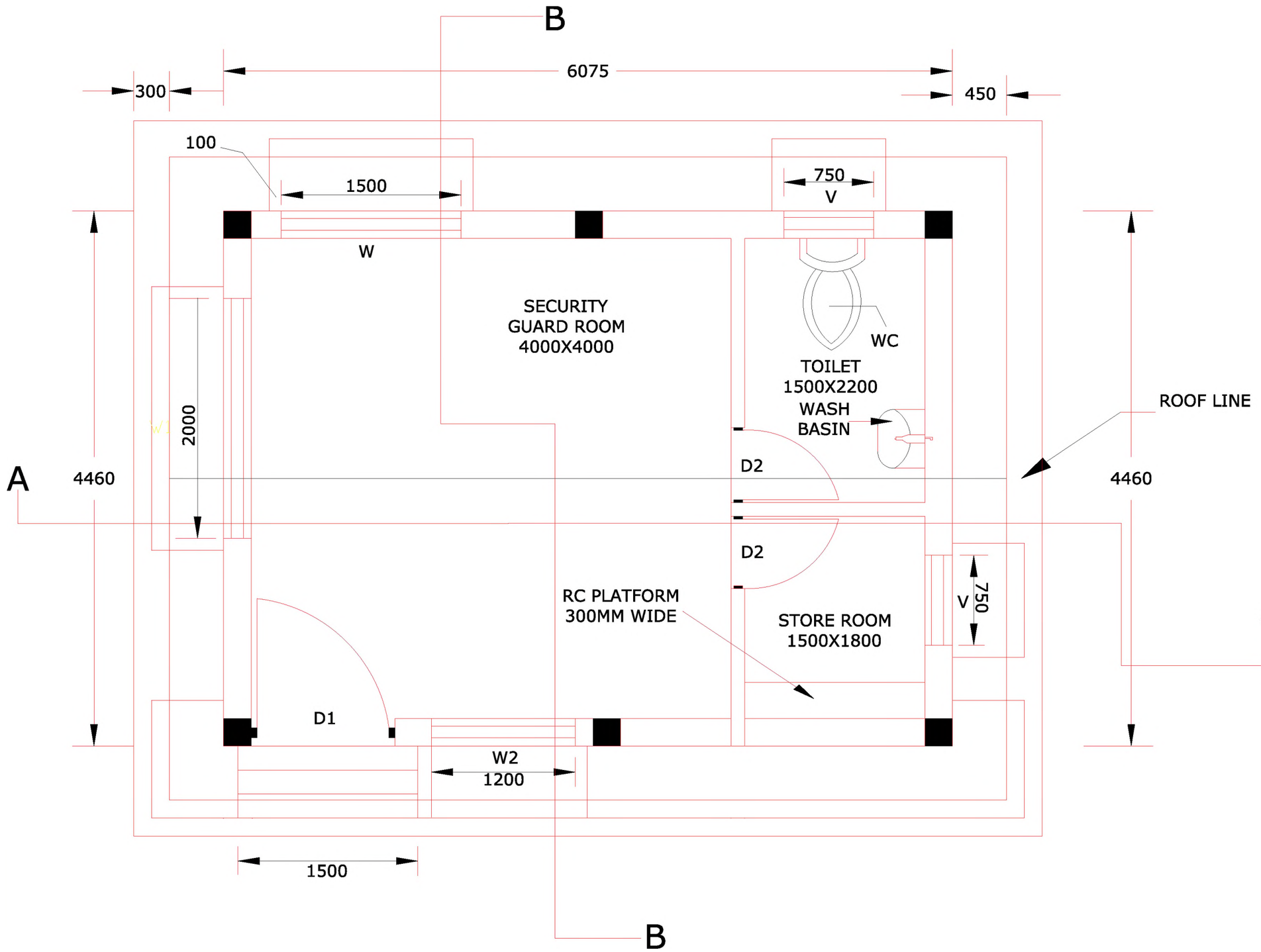


DETAILS AT R1



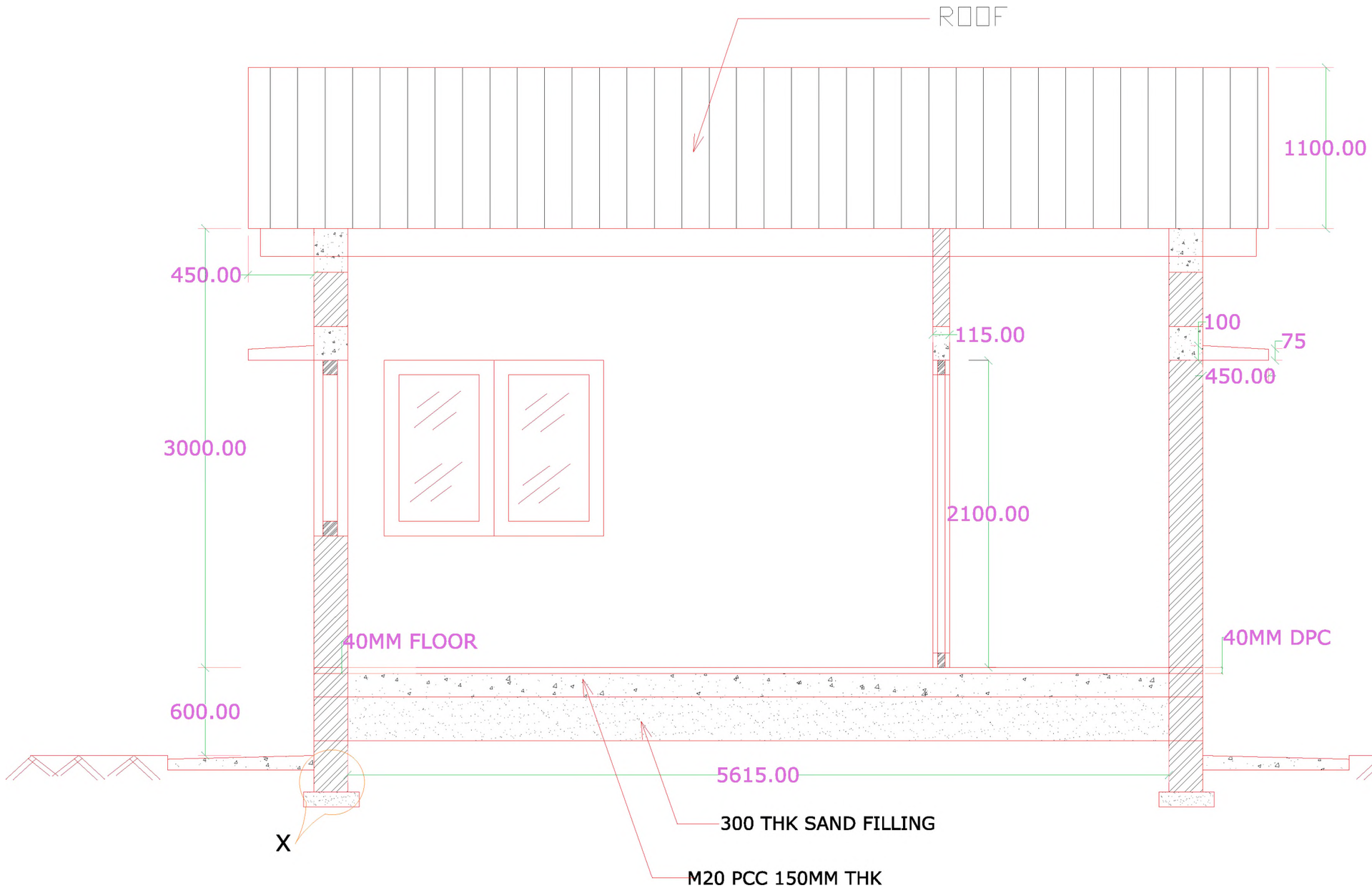
SECTION AT "A-A"

CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	**DRAWING SUB-TITLE:** LAYOUT OF LEACHATE COLLECTION PIPES & SECTION OF SANITARY LANDFILL	**SCALE:NTS**	***Detailed Project Report (Draft Final)***	
			DATE: JUNE - 2009	**ALL DIMENSIONS ARE IN MM**	**SHEET SIZE: A3**	SMEC 1199 DPR SIPMIU DRW SWM 5	



CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001. TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	DRAWING SUB-TITLE: PLAN OF SECURITY GUARD ROOM ALL DIMENSIONS ARE IN MM	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*

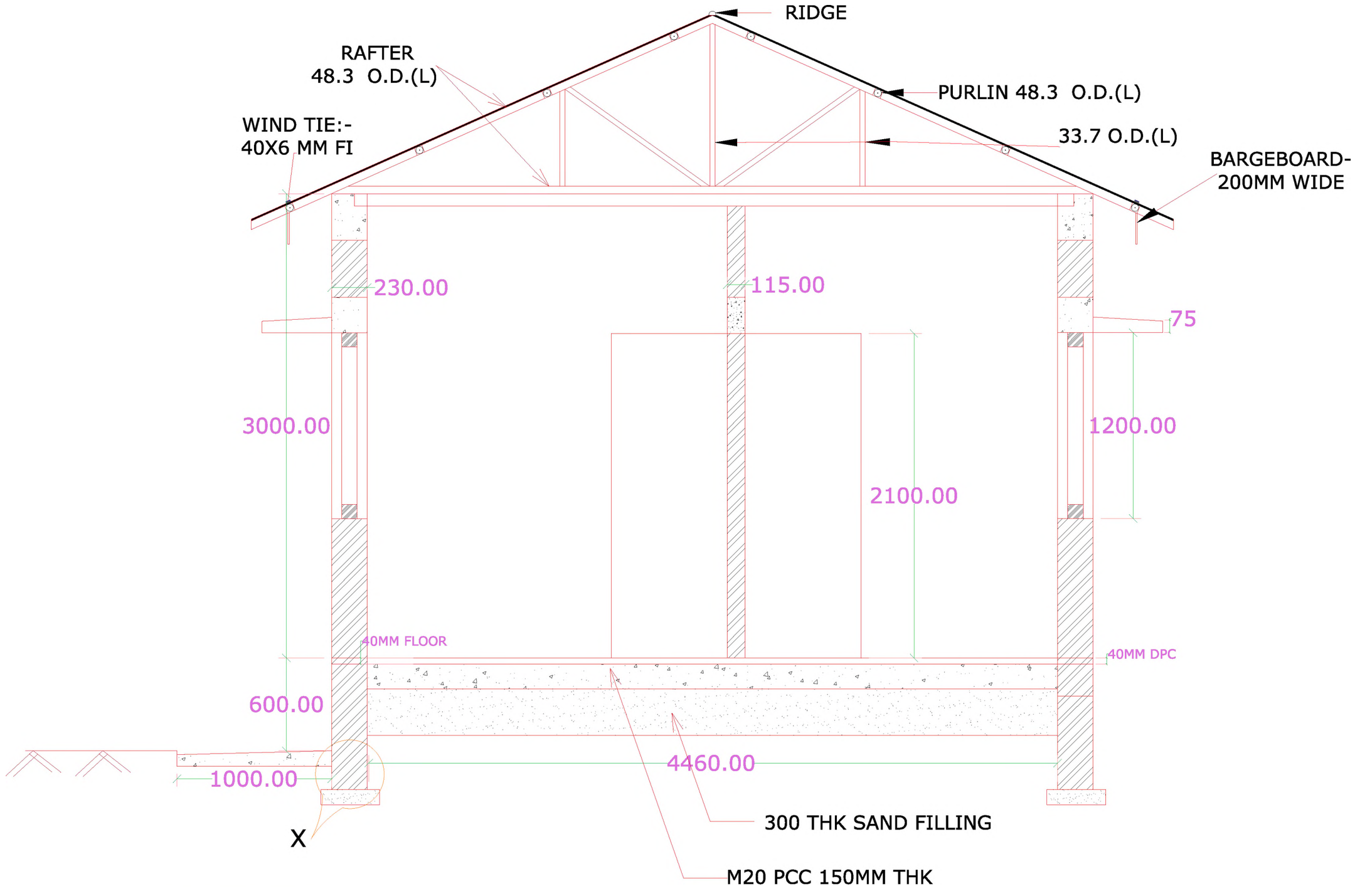
SMEC	1199	DPR	SIPMIU	DRW	SWM	6



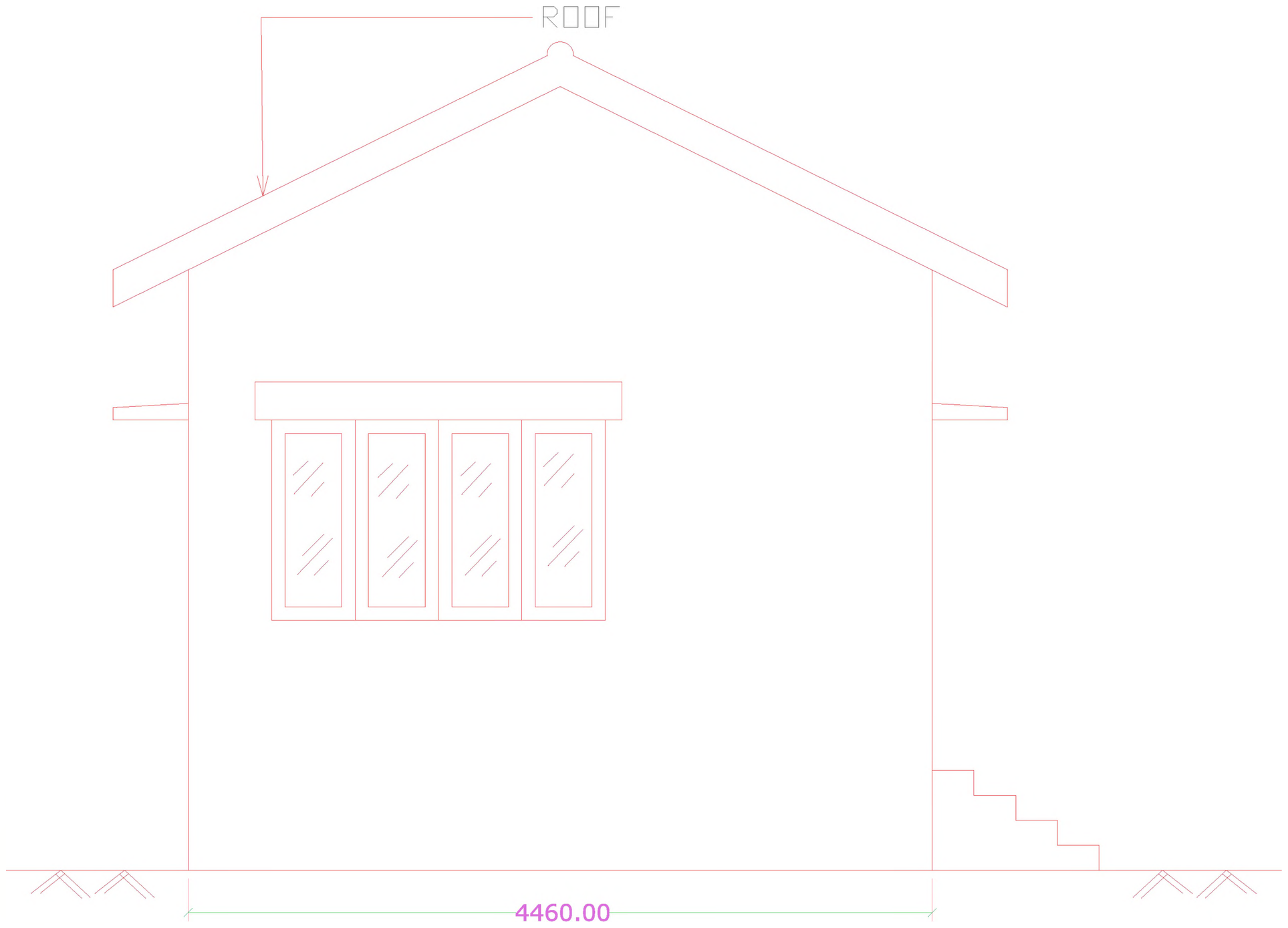
SECTION AT A-A

CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS: GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** SECTION AT 'A-A' OF SECURITY GUARD ROOM **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

SMEC	1199	DPR	SIPMIU	DRW	SWM	7

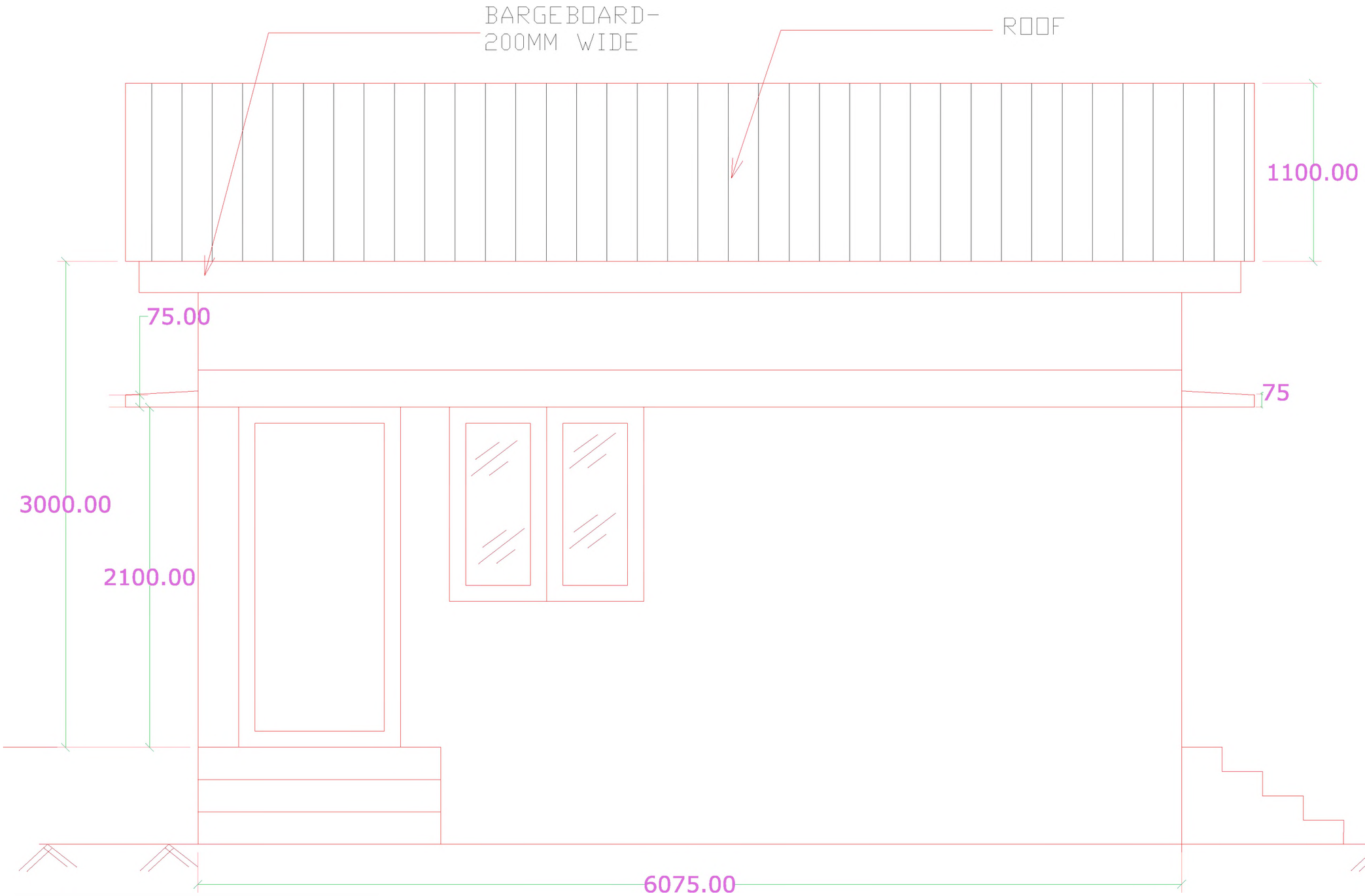


CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001. TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	DRAWING SUB-TITLE: SECTION AT 'B-B' OF SECURITY GUARD ROOM ALL DIMENSIONS ARE IN MM	SCALE:NTS SHEET SIZE:A3 *Detailed Project Report (Draft Final)* SMEC | 1199 | DPR | SIPMIU | DRW | SWM | 8



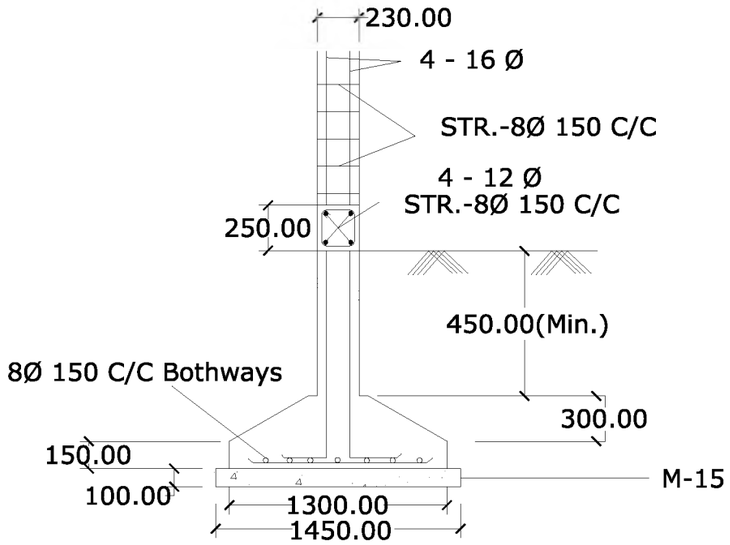
CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC **SMEC INDIA PVT. LTD.** BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** **PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)**	**DRAWING TITLE:** **GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA** **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** SIDE ELEVATION OF SECURITY GUARD ROOM **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

SMEC	1199	DPR	SIPMIU	DRW	SWM	9

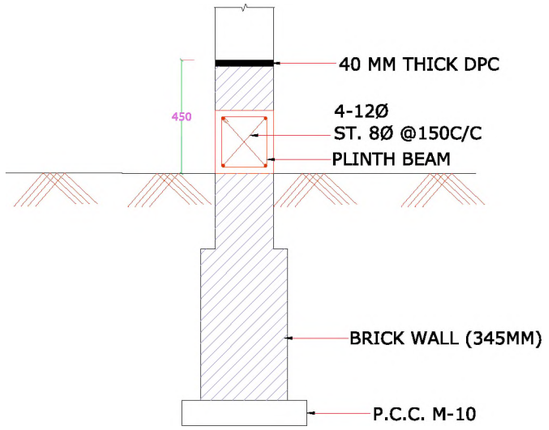


CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001. TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** FRONT ELEVATION OF SECURITY GUARD ROOM **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

SMEC	1199	DPR	SIPMIU	DRW	SWM	10

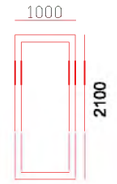
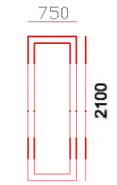
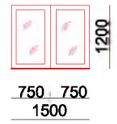
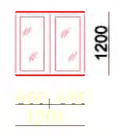


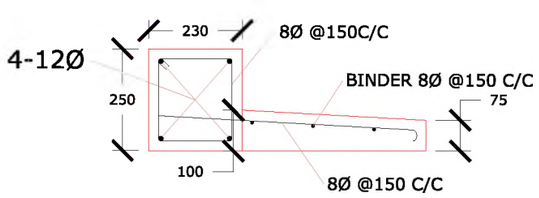
FOOTING DETAILS



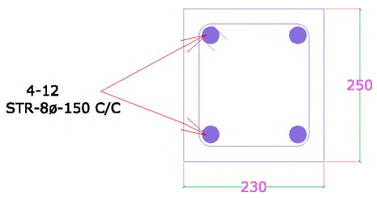
DETAILS AT X
SECTION OF FOUNDATION OF BRICK WALLS

SCHEDULE OF OPENINGS

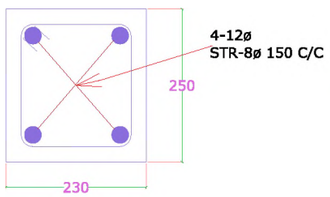
SCHEDULE	STRUCTURAL OPENINGS (W X H)	VIEW	REMARK
D1	1000X2100		SINGLE LEAF - WOODEN DOOR
D2	750X2100		SINGLE LEAF - WOODEN DOOR
W	1500 X1200		-STEEL WINDOW. - 4 MM THICK CLEAR GLASS -TWO OPENABLE SIDE HUNG SHUTTERS
W1	2000 X1200		-STEEL WINDOW. - 4 MM THICK CLEAR GLASS -FOUR OPENABLE SIDE HUNG SHUTTERS
W2	1500 X 2100		-STEEL WINDOW. - 4 mm THICK CLEAR GLASS -TWO OPENABLE SIDE HUNG SHUTTERS
V	750 X 600		- GLAZED STEEL VENTILATOR - 4MM THICK GLASS - CENTRE HUNG



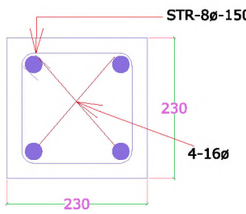
LINTEL DETAILS WITH CHAJJA



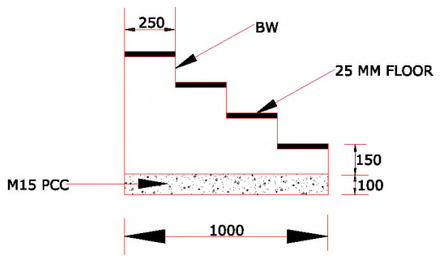
SECTION OF PLINTH BEAM



SECTION OF LINTEL AND ROOF BEAM

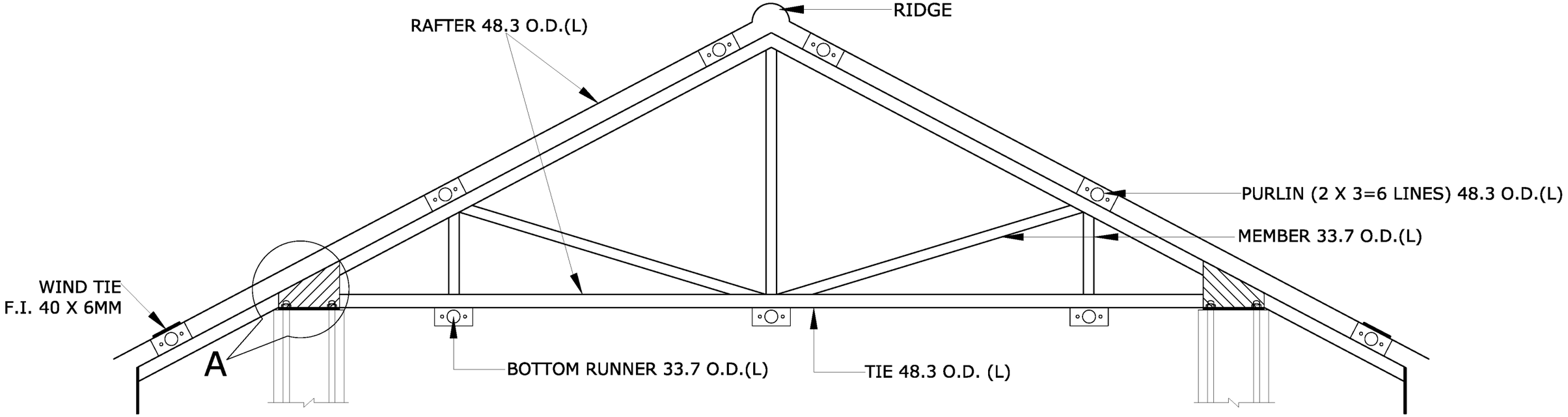


COLUMN SECTION



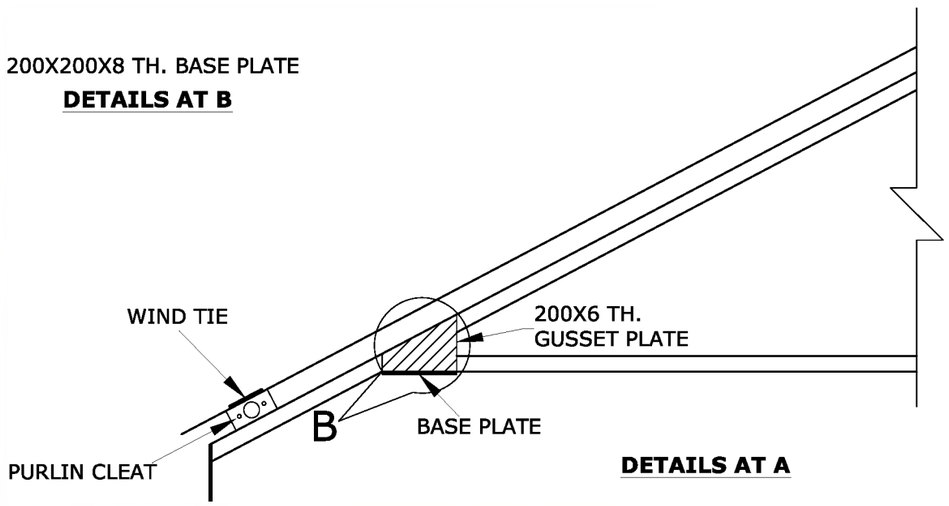
STEP DETAILS (11500X1000X600)

CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001. TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	DRAWING SUB-TITLE: FOUNDATION DETAILS OF SECURITY GUARD ROOM	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SMEC 1199 DPR SIPMIU DRW SWM 11	



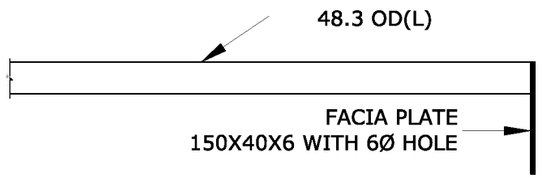
200X200X8 TH. BASE PLATE

DETAILS AT B

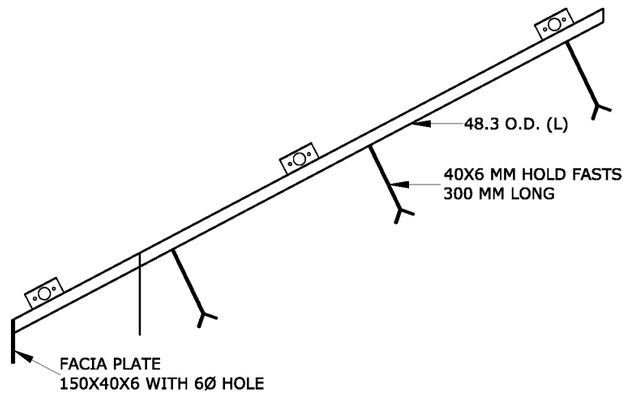


DETAILS AT A

PURLIN CLEAT: 125X60X6 TH.
BOTTOM RUNNER CLEAT: 125X60X6 TH.



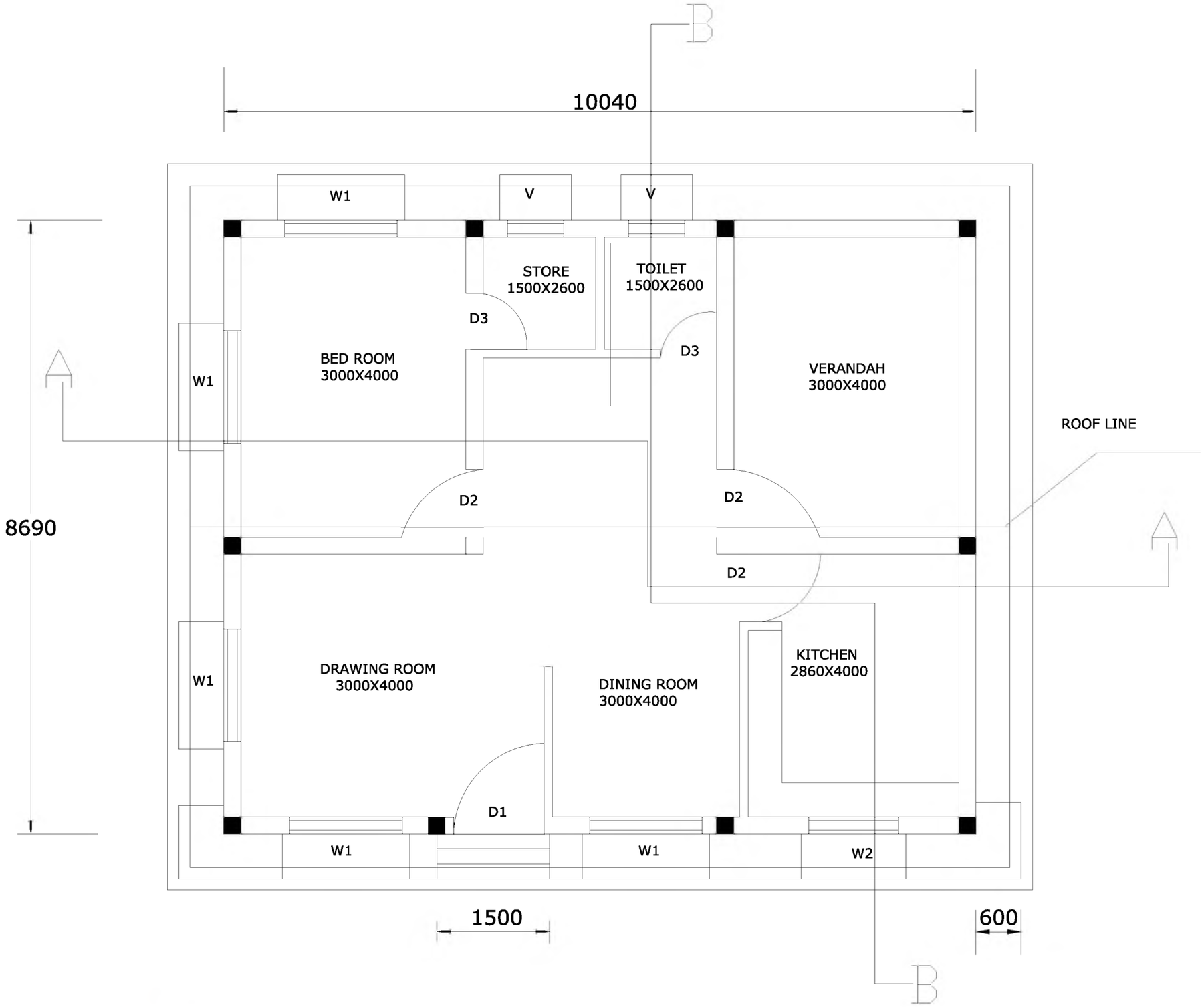
END PURLIN



GABLE RAFTER

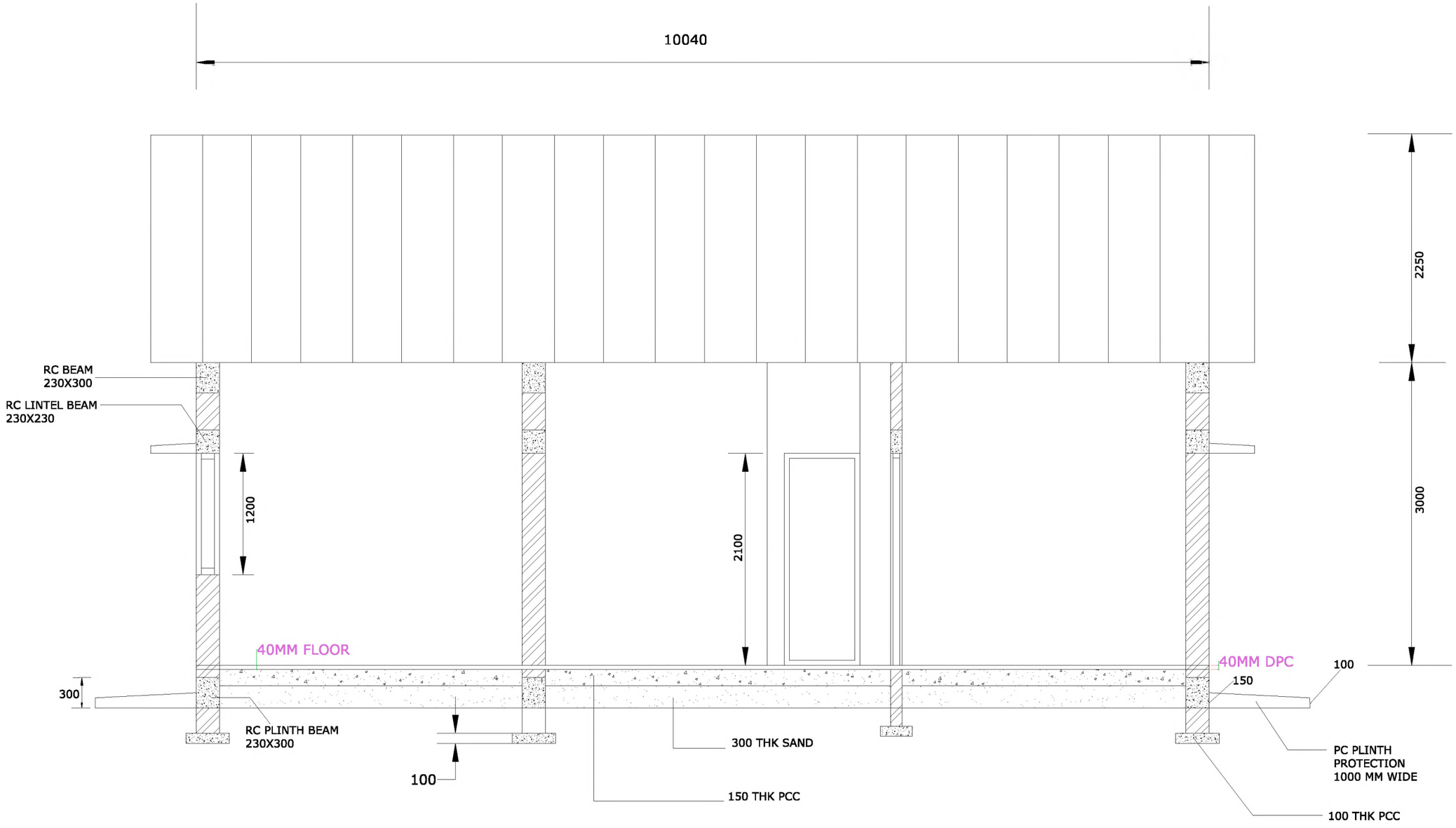
CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	DRAWING SUB-TITLE: TRUSS DETAILS OF SECURITY GUARD ROOM ALL DIMENSIONS ARE IN MM	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*

SMEC	1199	DPR	SIPMIU	DRW	SWM	12



CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	**DRAWING SUB-TITLE:** PLAN ELEVATION AND SECTION OF REST HOUSE ALL DIMENSIONS ARE IN MM	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

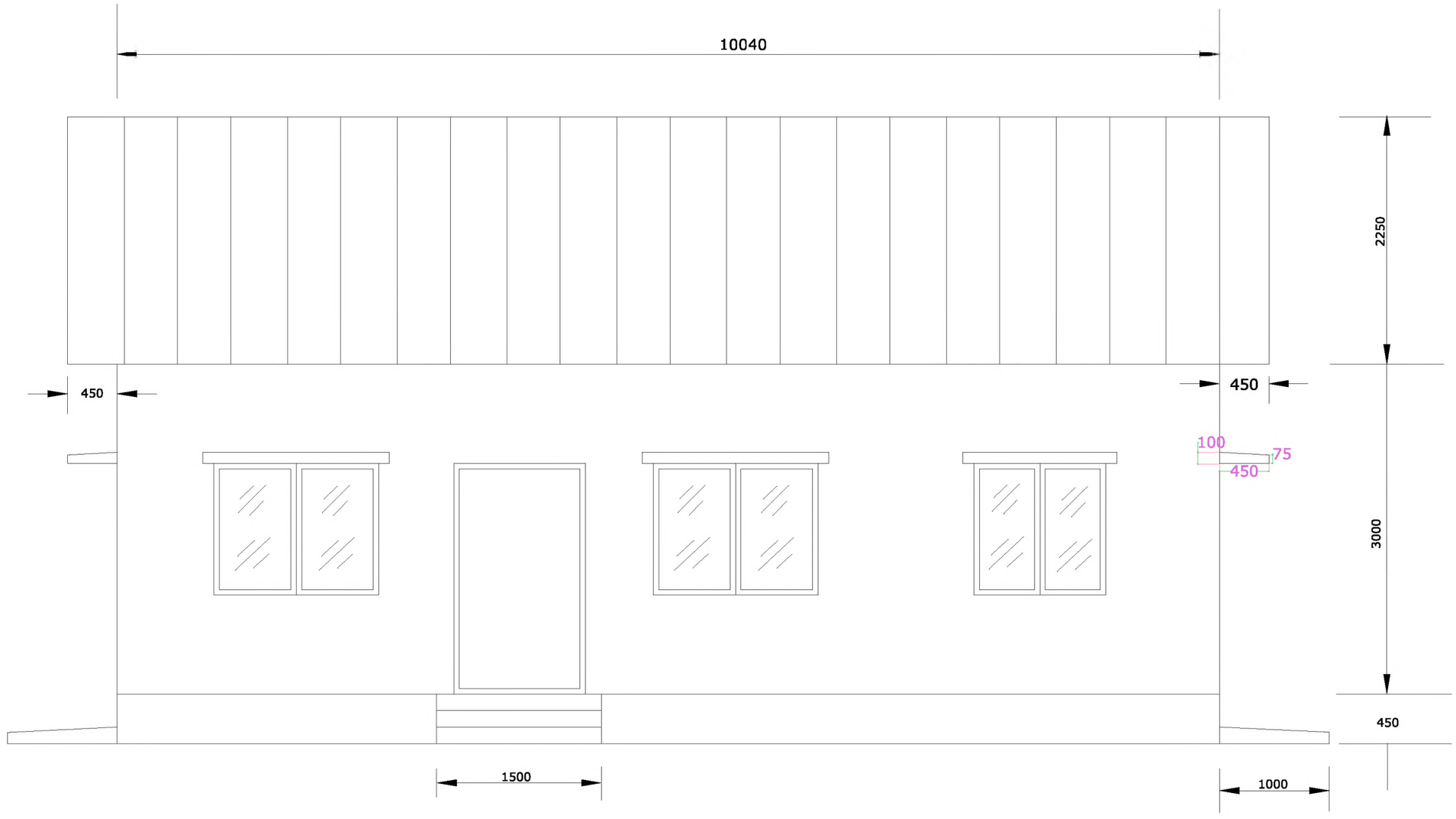
SMEC	1199	DPR	SIPMIU	DRW	SWM	13



CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	DRAWING SUB-TITLE: SECTION OF REST HOUSE ALL DIMENSIONS ARE IN MM	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*

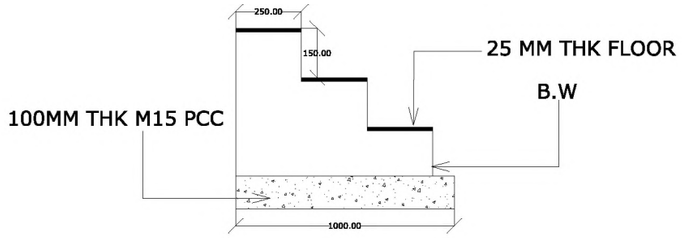
SMEC	1199	DPR	SIPMIU	DRW	SWM	14

CLIENT: Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI, PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	DRAWING SUB-TITLE: SIDE ELEVATION OF REST HOUSE	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SMEC 1199 DPR SIPMIU DRW SWM 15	

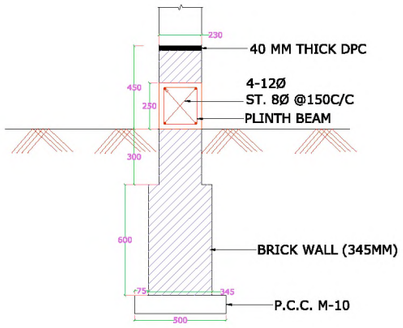


CLIENT: Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	DRAWING SUB-TITLE: FRONT ELEVATION OF REST HOUSE ALL DIMENSIONS ARE IN MM	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*

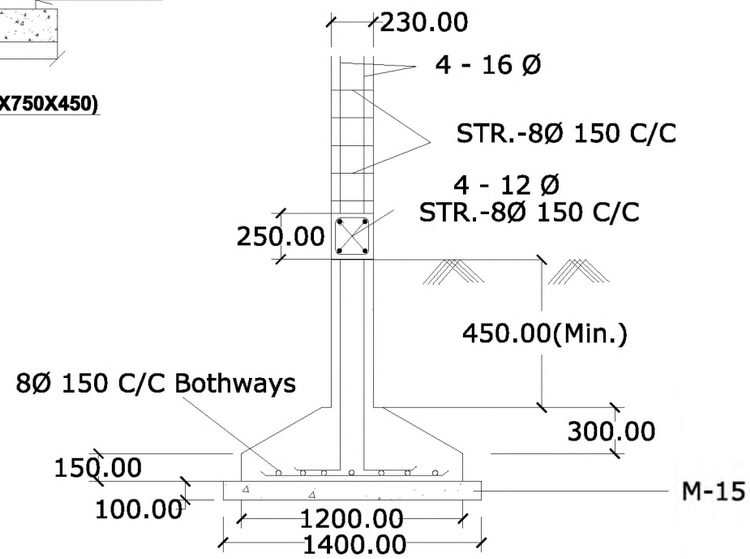
SMEC	1199	DPR	SIPMIU	DRW	SWM	16



STEP DETAILS (1000X750X450)

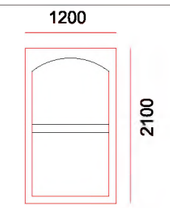
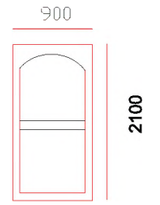
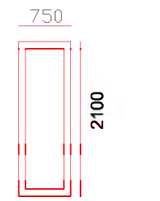
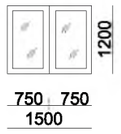
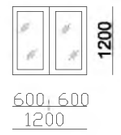


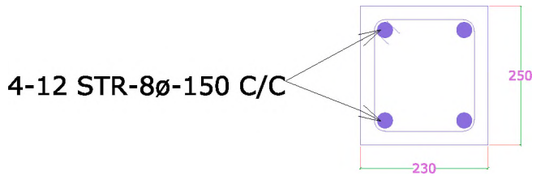
SECTION OF FOUNDATION OF BRICK WALLS



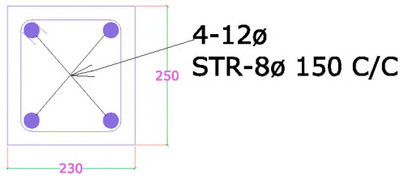
FOOTING DETAILS

SCHEDULE OF OPENINGS

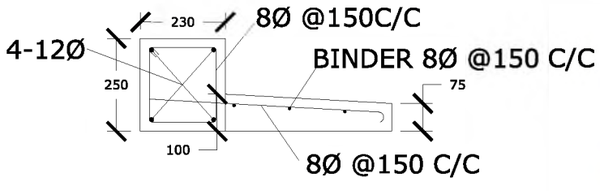
SCHEDULE	STRUCTURAL OPENINGS (W X H)	VIEW	REMARK
D			SINGLE LEAF - WOODEN DOOR
D2	1200X2100		SINGLE LEAF - WOODEN DOOR
D3	750X2100		SINGLE LEAF - WOODEN DOOR
W1	1500 X 2100		-STEEL WINDOW. - 4 MM THICK CLEAR GLASS -TWO OPENABLE SIDE HUNG SHUTTERS
W2	1500 X 2100		-STEEL WINDOW. - 4 mm THICK CLEAR GLASS -TWO OPENABLE SIDE HUNG SHUTTERS
V	750 X 600		- GLAZED STEEL VENTILATOR - 4MM THICK GLASS - CENTRE HUNG



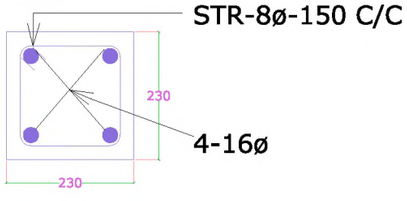
SECTION OF PLINTH BEAM



SECTION OF LINTEL & ROOF BEAM

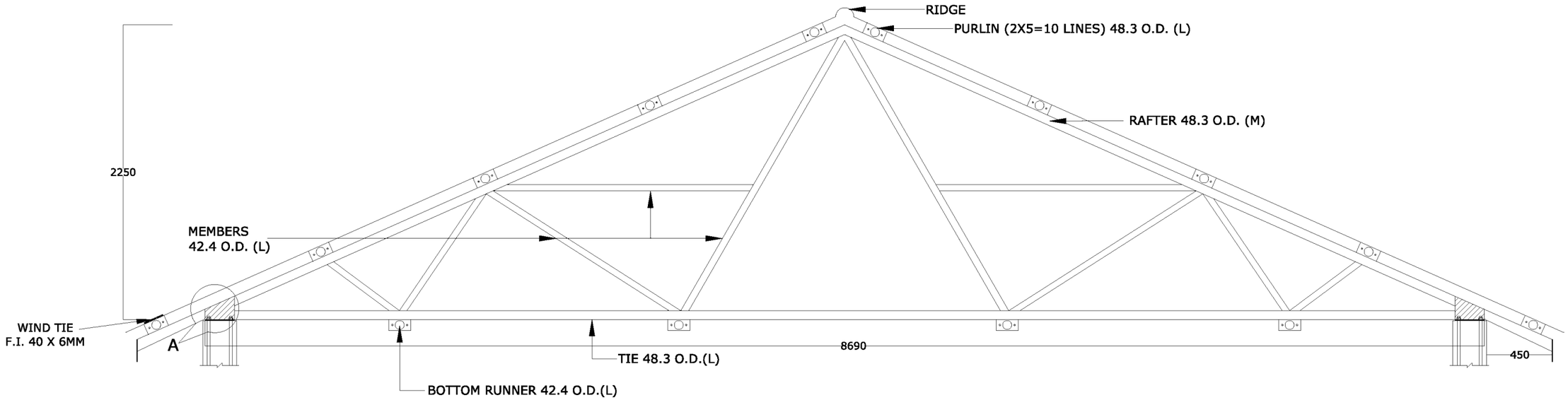


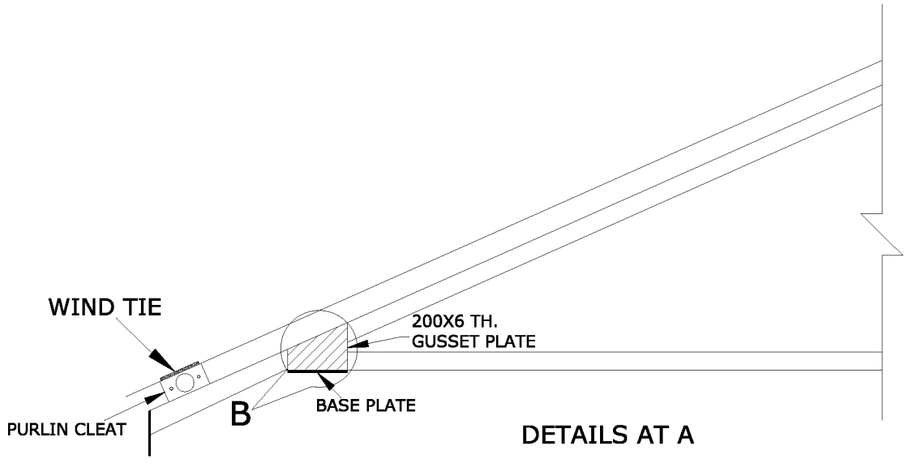
LINTEL DETAILS WITH CHAJJA



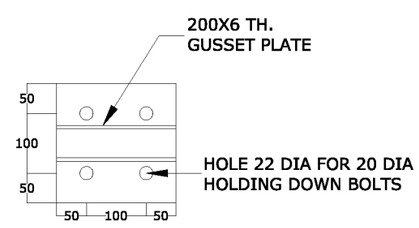
COLUMN SECTION

CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI, PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	DRAWING SUB-TITLE: FOUNDATION DETAILS OF REST HOUSE	SCALE:NTS SHEET SIZE:A3	*Detailed Project Report (Draft Final)*
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SMEC 1199 DPR SIPMIU DRW SWM	17



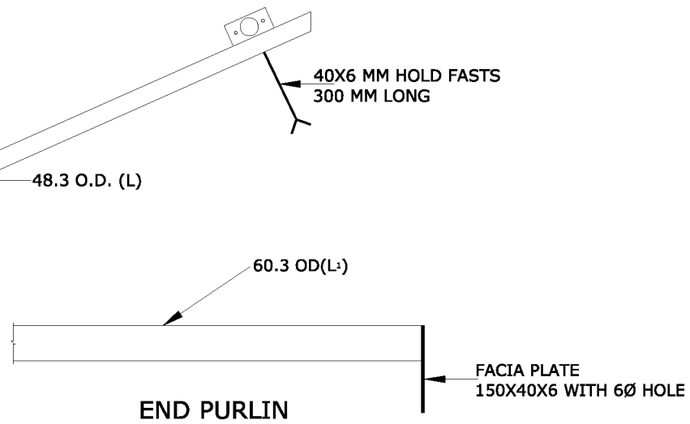


DETAILS AT A

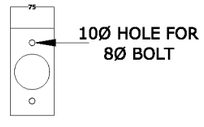


200X200X8 TH. BASE PLATE
DETAILS AT B

GABLE RAFTER



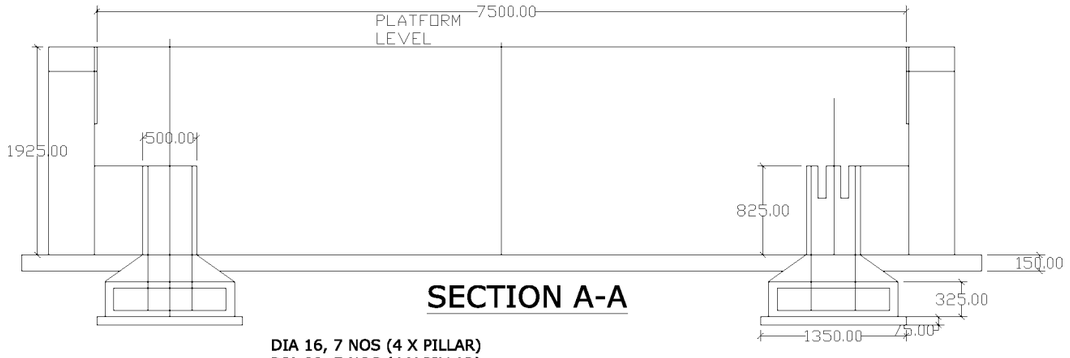
END PURLIN



PURLIN CLEAT: 150X75X6 TH.
BOTTOM RUNNER CLEAT: 150X60X6 TH.

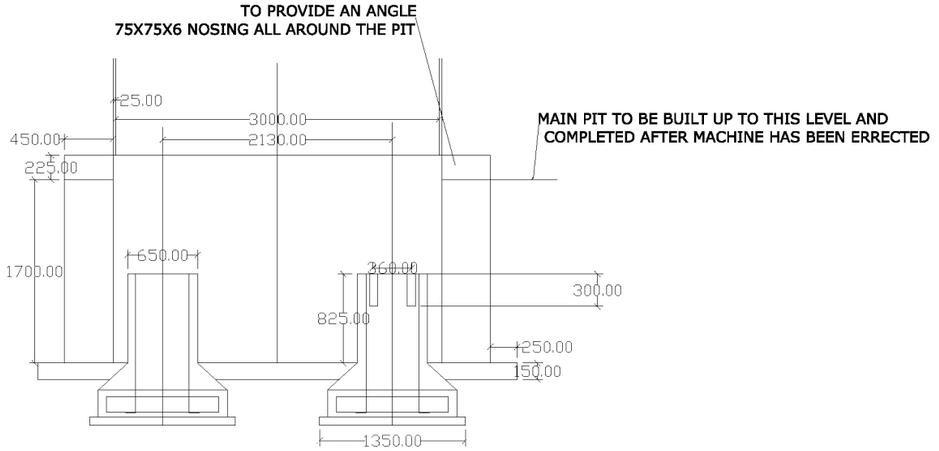
CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	DRAWING SUB-TITLE: STRUCTURAL DETAILS OF TUBULAR TRUSSES & PURLINS OF REST HOUSE	SCALE:NTS	*Detailed Project Report (Draft Final)*
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SHEET SIZE: A3	

SMEC	1199	DPR	SIPMIU	DRW	SWM	18

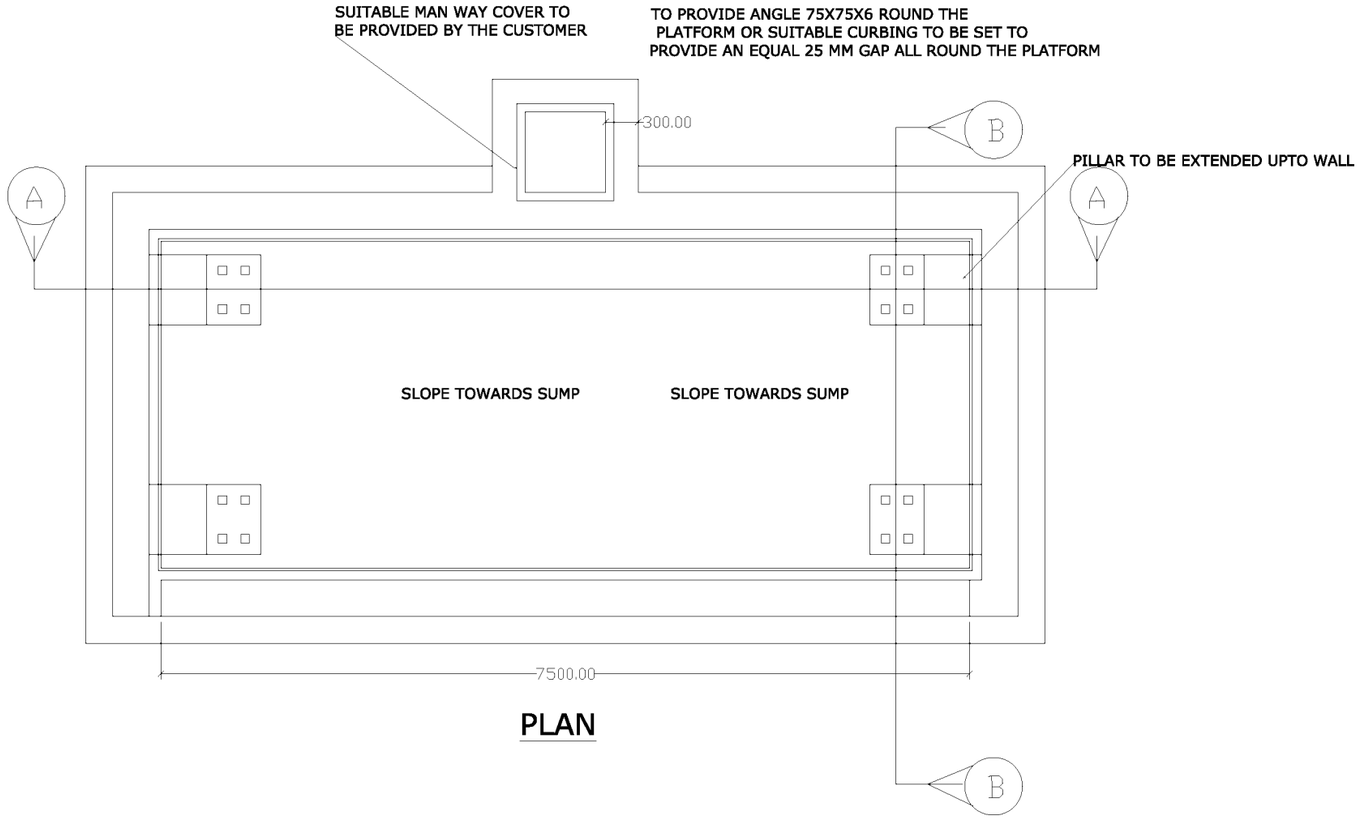


SECTION A-A

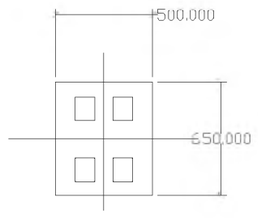
DIA 16, 7 NOS (4 X PILLAR)
DIA 08, 5 NOS (4 X PILLAR)
DIA 16, 8 NOS (4 X PILLAR)



SECTION B-B



PLAN



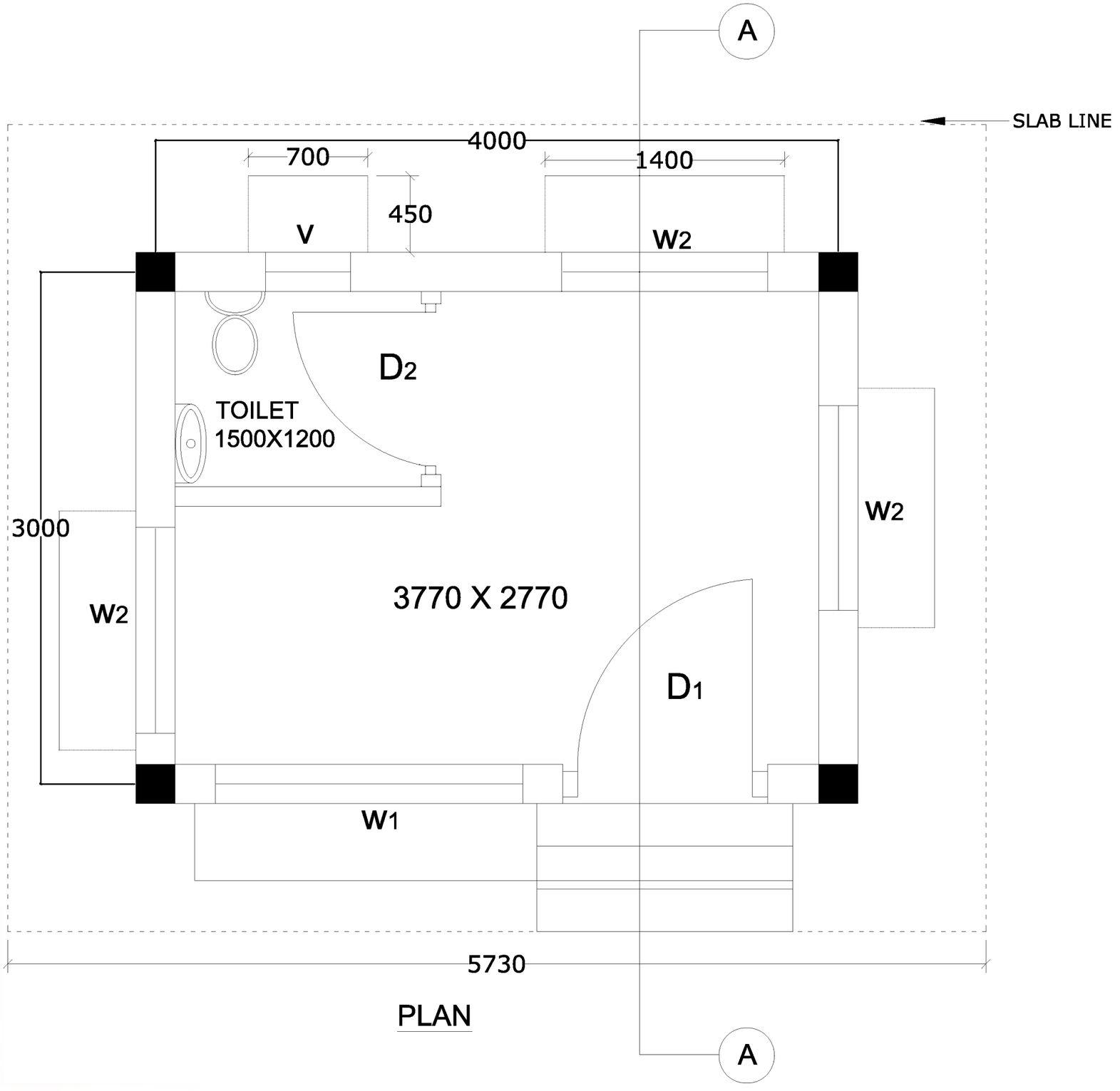
REFERENCE STANDARDS:

1)	CONCRETE AND ITS CONSTRUCTION	IS:456
2)	CEMENT	IS:269
3)	AGGREGATE	IS:383
4)	REINFORCEMENT BARS	IS:1786
5)	ASSEMBLY OF REINFORCEMENT BARS	IS:2502
6)	SKIRTING ANGLES	IS:808
7)	CONDUIT PIPES	IS:1161

NOTES:

1) ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS UNLESS MENTIONED I.
2) EL 0.000 DENOTES GROUND LEVEL (REFERENCE LEVEL)
3) CONCRETE TO BE OF GRADE M200 ACC. TO IS:456
4) SOIL BEARING CAPACITY OF 10 TONS/SQM IS ASSUMED AT FOUNDATION LEVEL.
5) GROUND WATER TABLE IS ASSUMED TO BE BELOW FOUNDATION LEVEL.
6) ADEQUATE RUBBLE SOLING TO BE DONE BELOW P.C.C SQUIRTING IS REQUIRED.
7) MAXIMUM CONCRETE COVER TO MAIN REINFORCEMENT TO BE AS FOLLOWS. RAFT---25MM & WALLS---15MM
8) ADEQUATE CONCRETE TEST CUBES TO BE TAKEN AND TESTED FOR STRENGTH PER IS:456
9) REINFORCEMENT ARE NOT TO BE WELDED TO EACH OTHER FOR RETAINING PURPOSE.BUT TO BE TIED TOGETHER ONLY.
10) CLEAR FOUNDTION BOLT POCKETS TO BE ENSURED WHILE PLACING REINFORCEMENT BARS

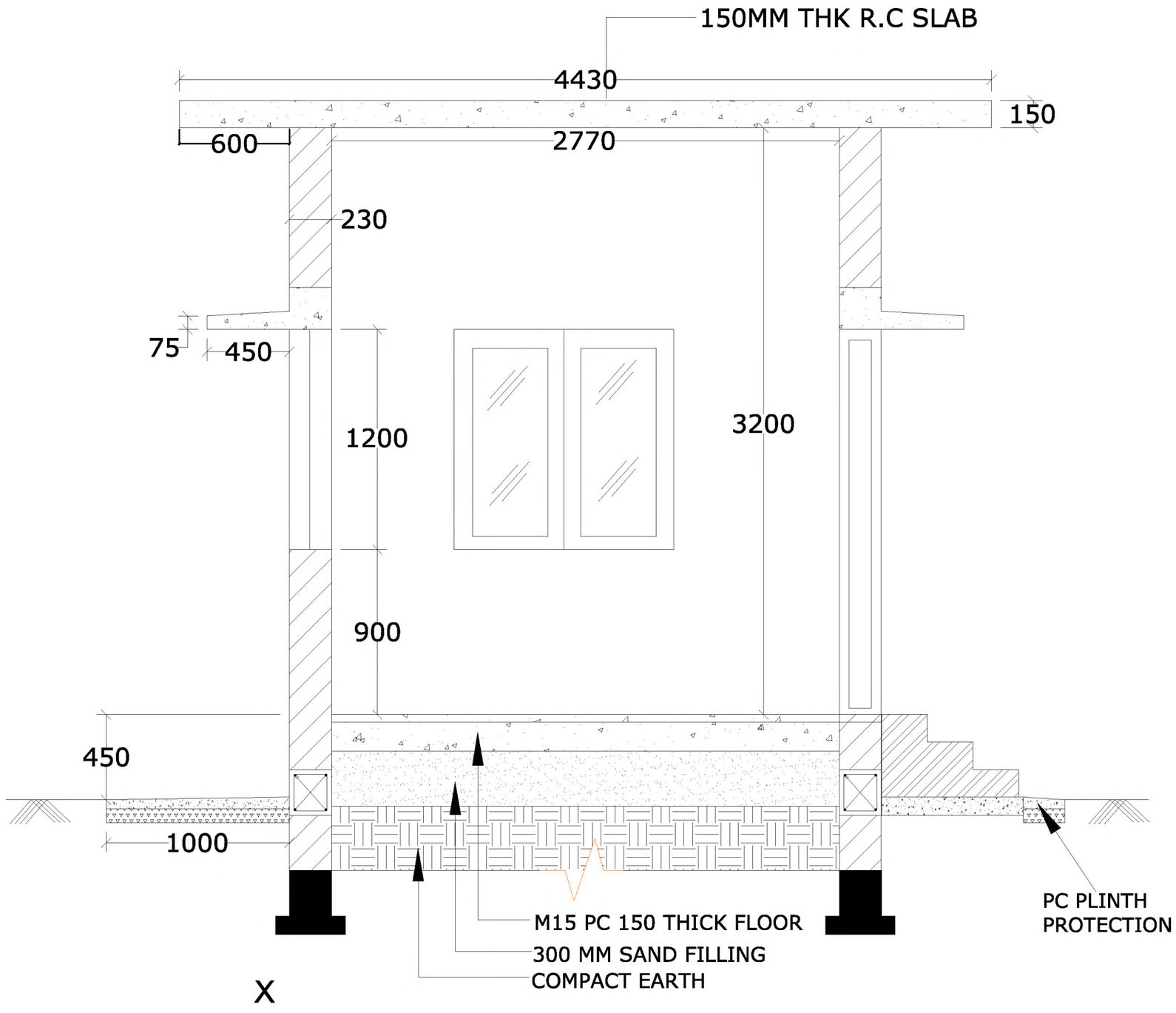
CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	DRAWING SUB-TITLE: PLAN & SECTION FOR 30 M.T. FULLY ELECTRONIC CONCRETE DECK WEIGHBRIDGE	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SMEC | 1199 | DPR | SIPMIU | DRW | SWM | 19	



PLAN

CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	DRAWING SUB-TITLE: PLAN SECTION AND ELEVATION OF WEIGH-BRIDGE OPERATOR ROOM ALL DIMENSIONS ARE IN MM	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*

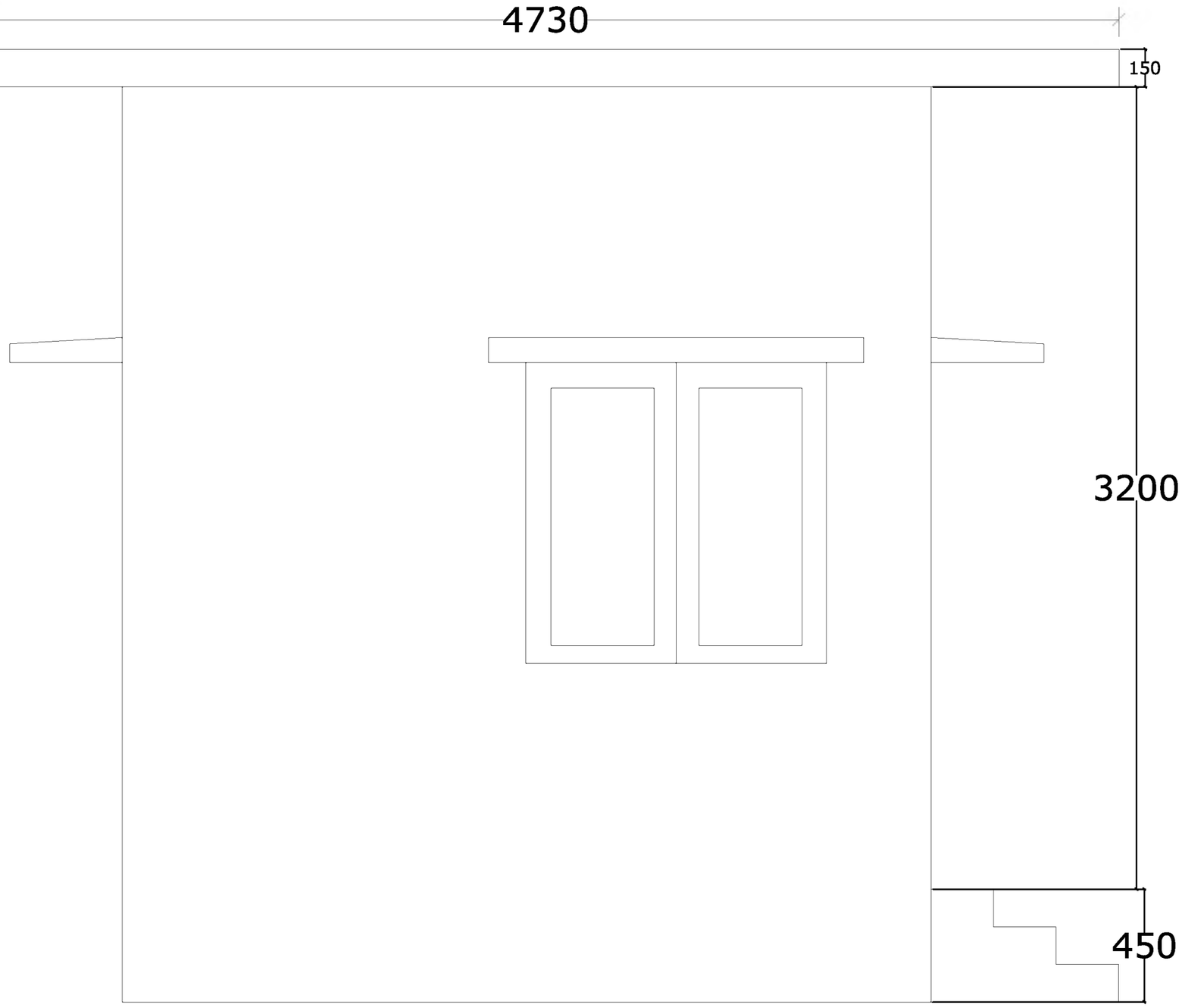
SMEC	1199	DPR	SIPMIU	DRW	SWM	20



SECTION AT A-A

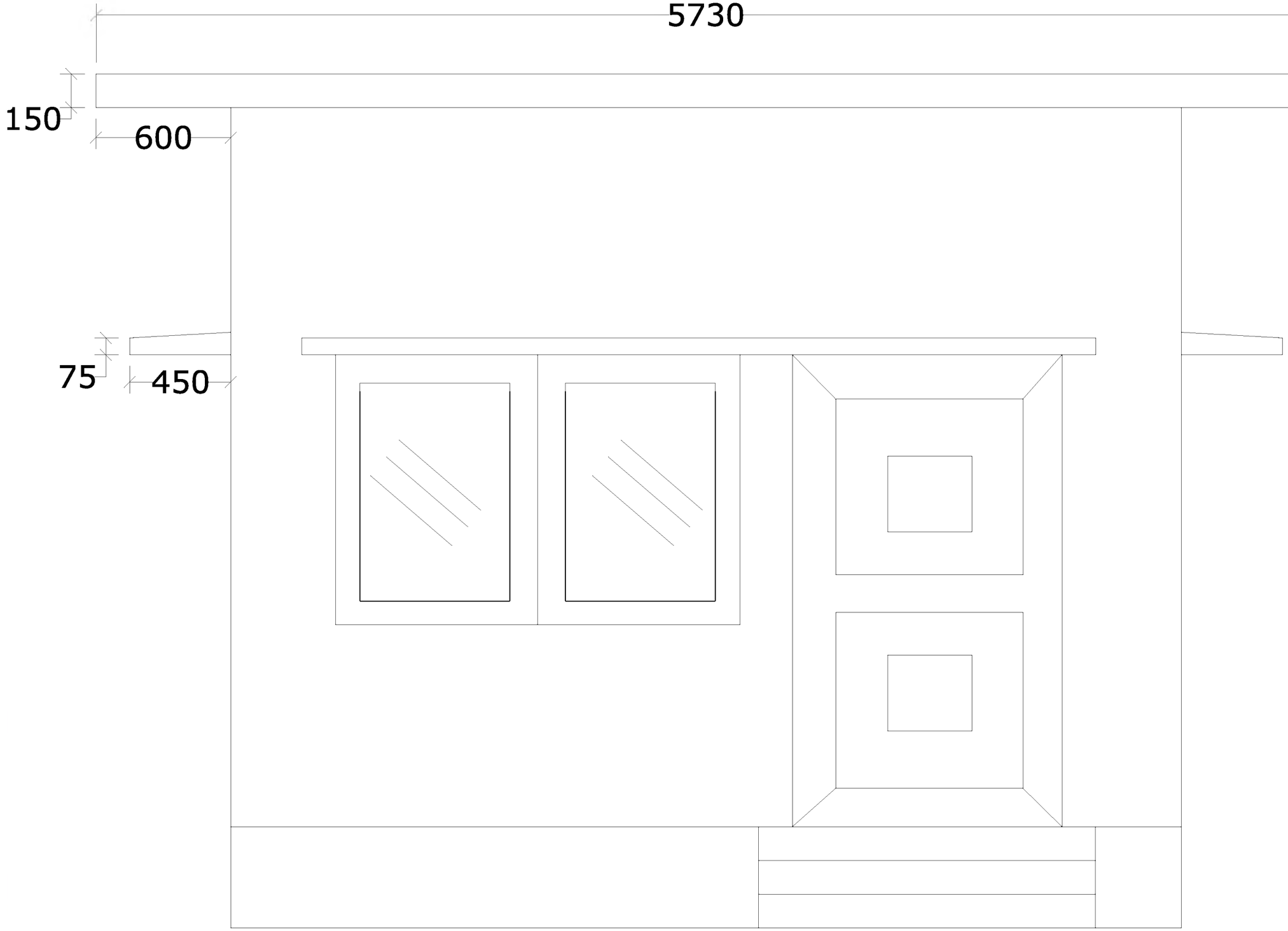
CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	DRAWING SUB-TITLE: SECTION OF WEIGHBRIDGE OPERATOR ROOM ALL DIMENSIONS ARE IN MM	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*

SMEC	1199	DPR	SIPMIU	DRW	SWM	21



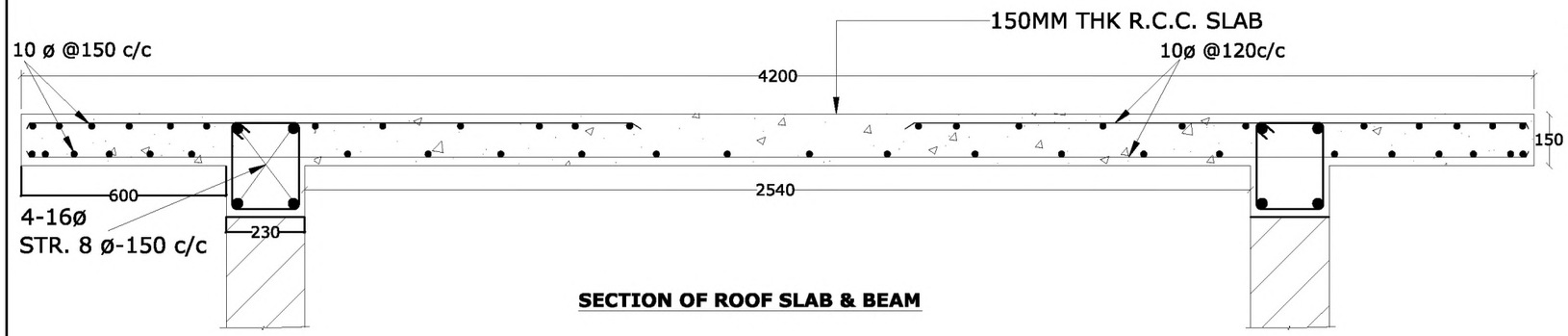
CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	**DRAWING SUB-TITLE:** SIDE ELEVATION OF WEIGHBRIDGE OPERATOR ROOM	**SCALE:NTS**	***Detailed Project Report (Draft Final)***
			DATE: JUNE - 2009	**ALL DIMENSIONS ARE IN MM**	**SHEET SIZE: A3**	

SMEC	1199	DPR	SIPMIU	DRW	SWM	22

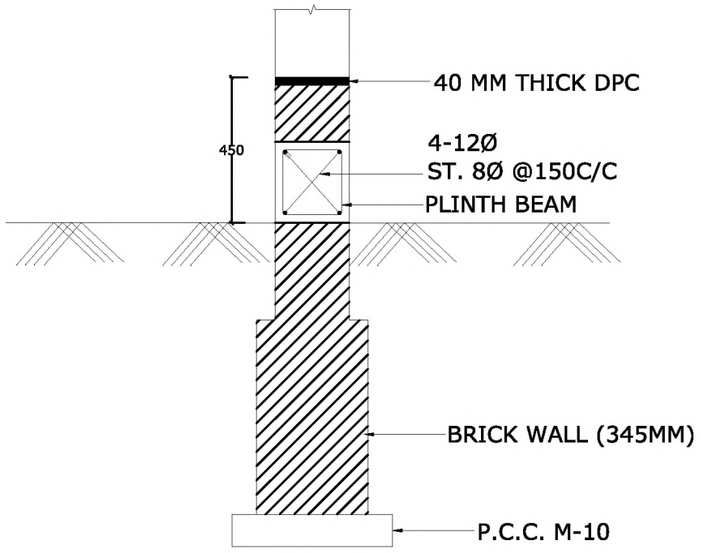


CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** FRONT ELEVATION OF WEIGHBRIDGE OPERATOR ROOM **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

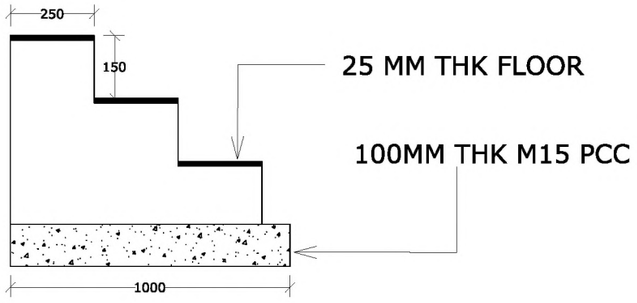
SMEC	1199	DPR	SIPMIU	DRW	SWM	23



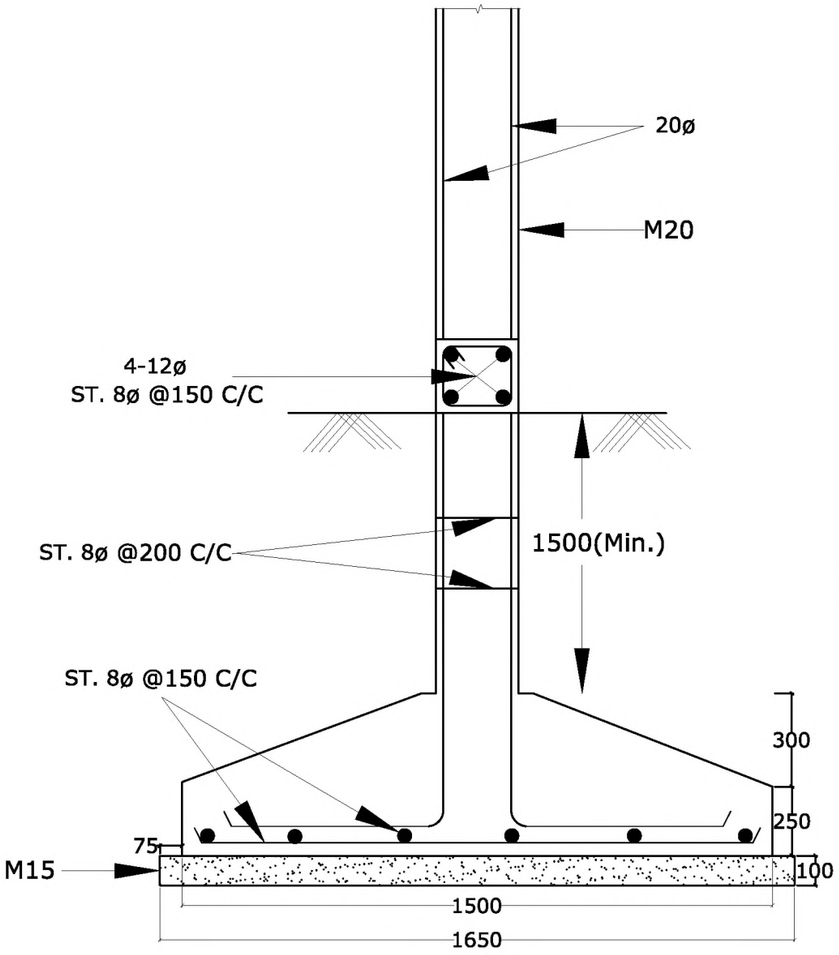
SECTION OF ROOF SLAB & BEAM



DETAILS AT X
SECTION OF FOUNDATION OF BRICK WALLS



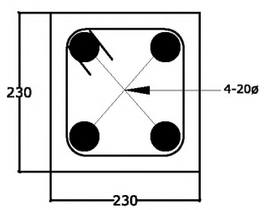
STEP DETAILS (1000X750X450)



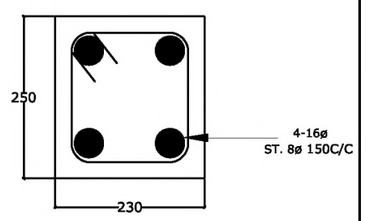
FOOTING DETAILS

SCHEDULE OF OPENINGS

SCHEDULE	STRUCTURAL OPENINGS (W X H)	VIEW	REMARK
D1	1200 X 2100	2100 / 1200	SINGLE LEAF - WOODEN DOOR
D2	1000 X 2100	2100 / 1000	SINGLE LEAF- WOODEN DOOR
W1	1800X 1200	1200 / 900, 900 / 1800	-STEEL WINDOW. - 4 mm THICK CLEAR GLASS -TWO OPENABLE SIDE HUNG SHUTTERS
W 2	2000 X 1200	1200 / 600 600 / 1200	-STEEL WINDOW. - 4 mm THICK CLEAR GLASS -TWO OPENABLE SIDE HUNG SHUTTERS
V	500 X 350	350 / 500	- GLAZED STEEL VENTILATOR - 4MM THICK GLASS - CENTRE HUNG



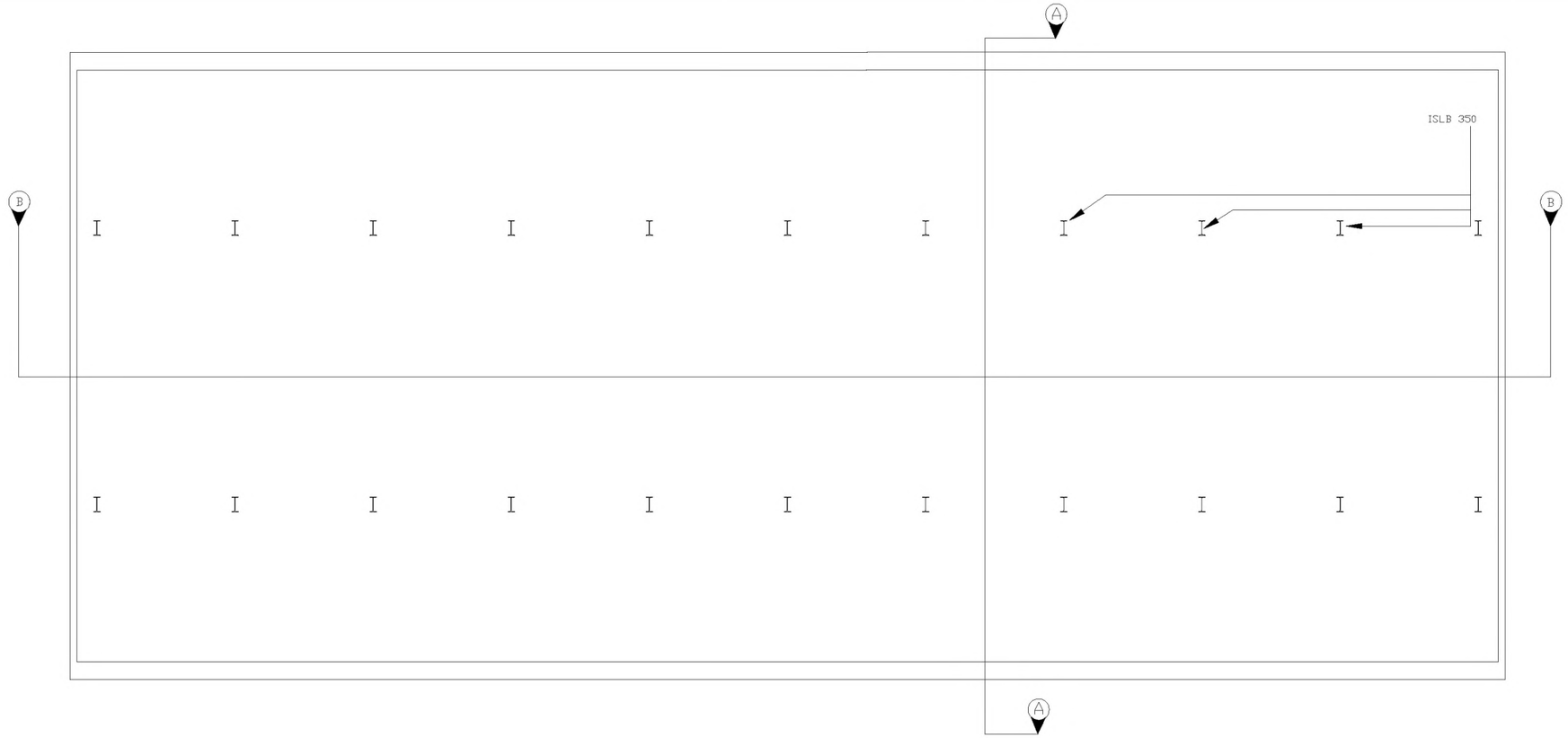
SECTION OF COLUMN

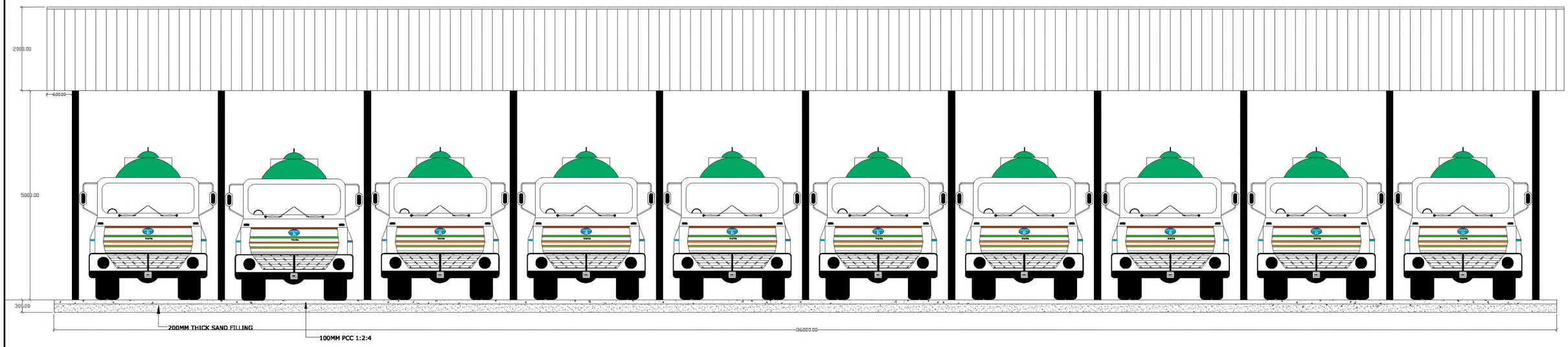


SECTION OF PLINTH BEAM

CLIENT: ADB Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	DRAWING SUB-TITLE: FOUNDATION DETAILS OF WEIGHBRIDGE OPERATOR ROOM ALL DIMENSIONS ARE IN MM	SCALE:NTS SHEET SIZE:A3	*Detailed Project Report (Draft Final)*

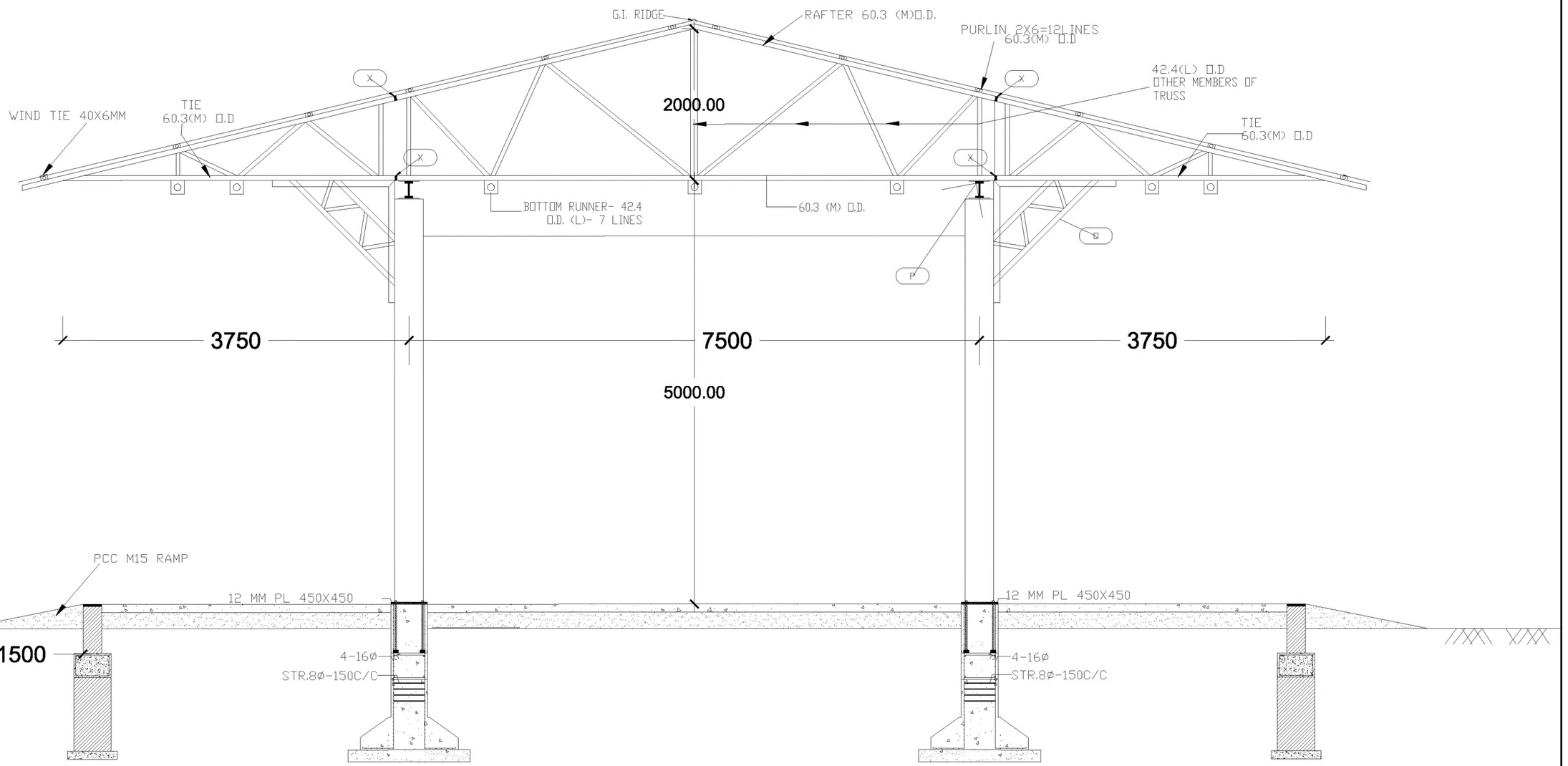
SMEC	1199	DPR	SIPMIU	DRW	SWM	24





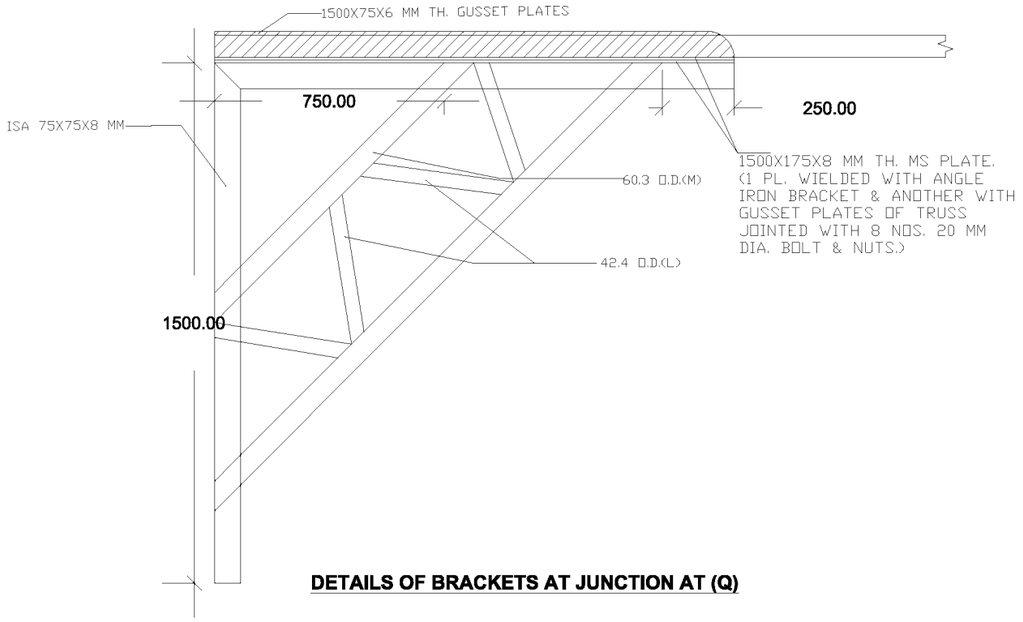
SECTION B-B

CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	**DRAWING SUB-TITLE:** PLAN & SECTION OF GARAGE FOR PRIMARY COLLECTION	**SCALE:NTS** / **SHEET SIZE:A3**	***Detailed Project Report (Draft Final)***	
			DATE: JUNE - 2009	**ALL DIMENSIONS ARE IN MM**	SMEC | 1199 | DPR | SIPMIU | DRW | SWM | 25		

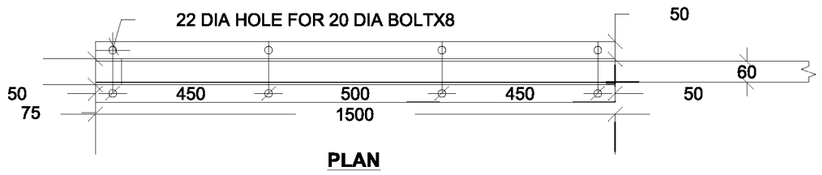


SECTION A-A

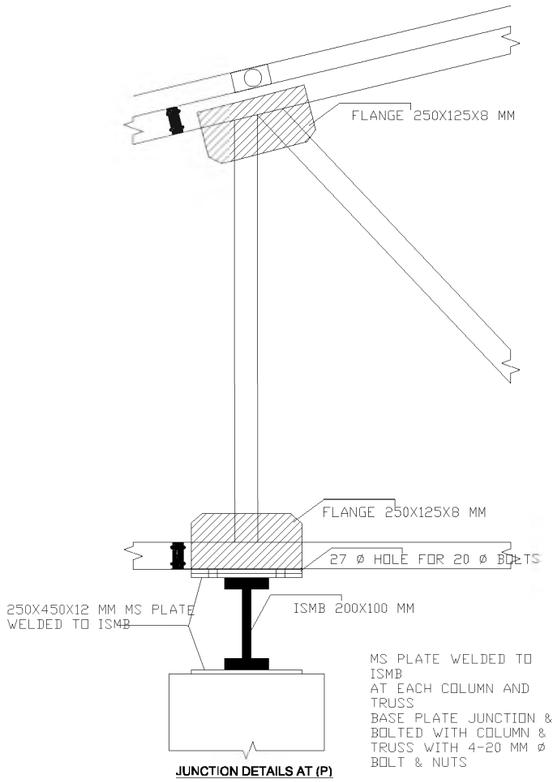
CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	**DRAWING SUB-TITLE:** SECTION OF GARAGE FOR PRIMARY COLLECTION	**SCALE:NTS**	***Detailed Project Report (Draft Final)***	
			DATE: JUNE - 2009	**ALL DIMENSIONS ARE IN MM**	**SHEET SIZE:A3**	SMEC 1199 DPR SIPMIU DRW SWM 26	



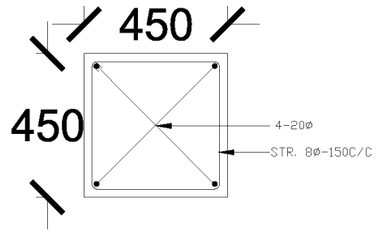
DETAILS OF BRACKETS AT JUNCTION AT (Q)



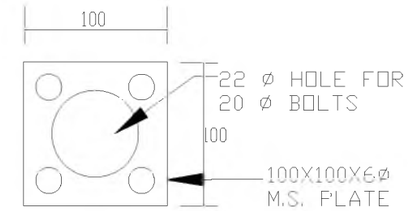
PLAN



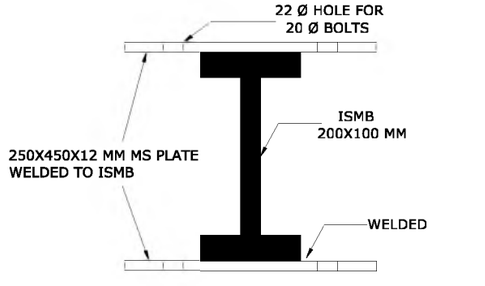
JUNCTION DETAILS AT (P)



COLUMN SECTION

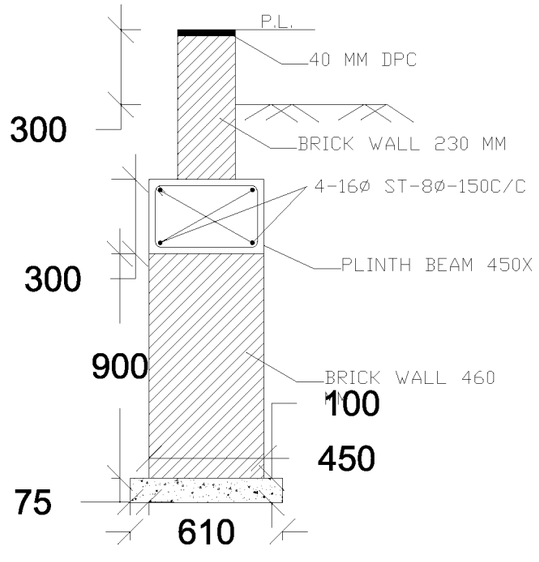


DETAILS OF TRUSS JOINT AT (X)

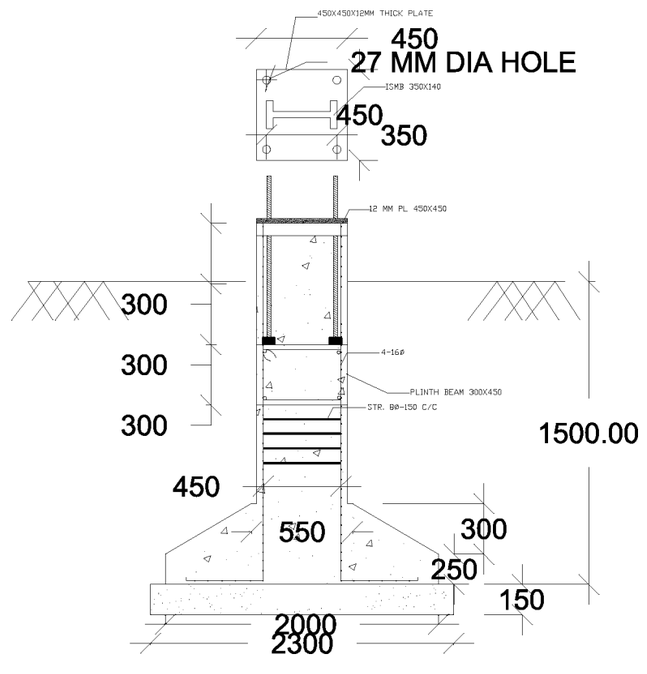


MS PLATE WELDED TO ISMB AT EACH COLUMN AND TRUSS BASE PLATE JUNCTION & BOLTED WITH COLUMN & TRUSS WITH 4-20 MM Ø BOLT & NUTS

JUNCTION DETAILS AT (P)



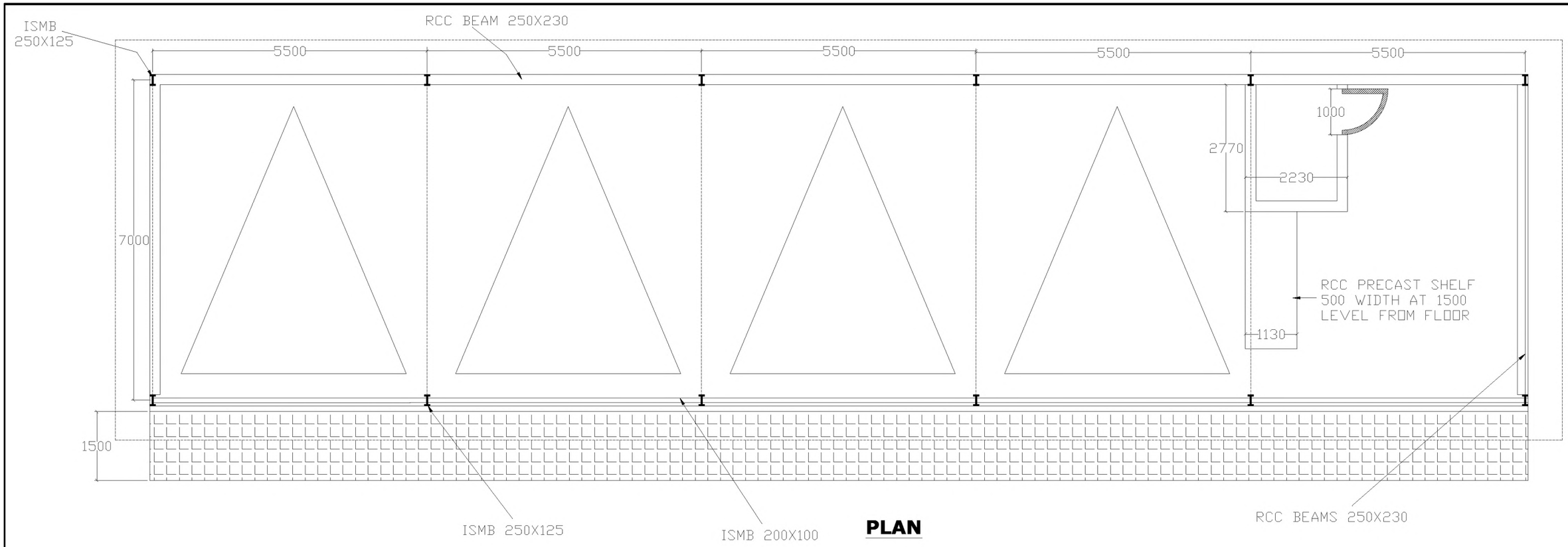
SECTION OF FOUNDATION OF BRICK WALLS



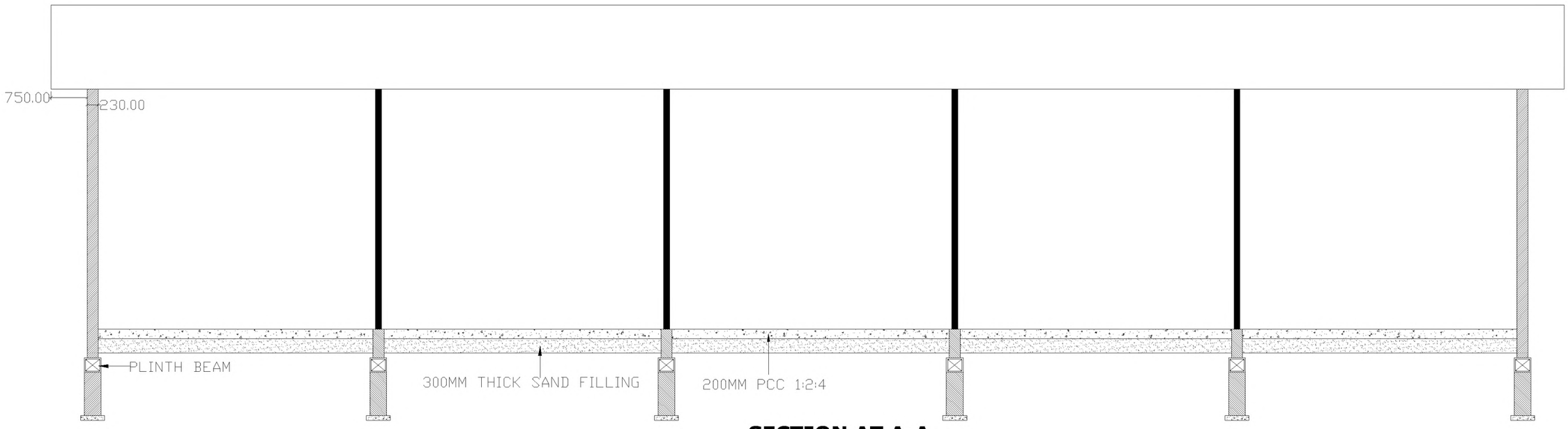
FOUNDATION DETAILS

CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001. TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** FOUNDATION DETAILS OF GARAGE FOR PRIMARY COLLECTION **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

SMEC	1199	DPR	SIPMIU	DRW	SWM	27

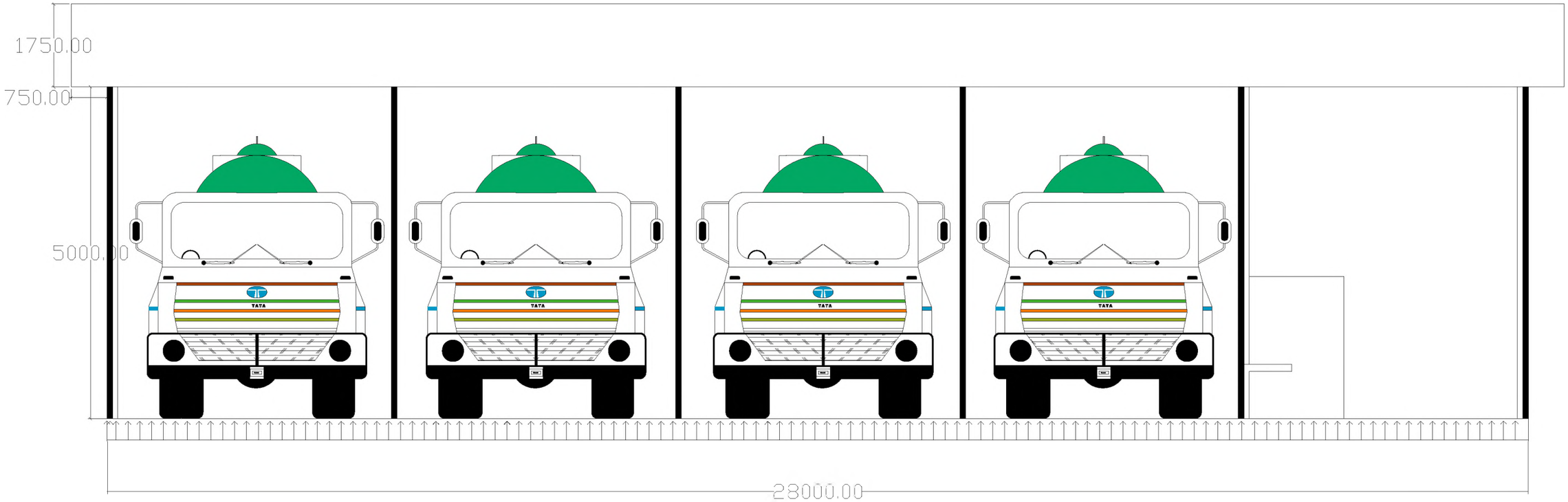


PLAN



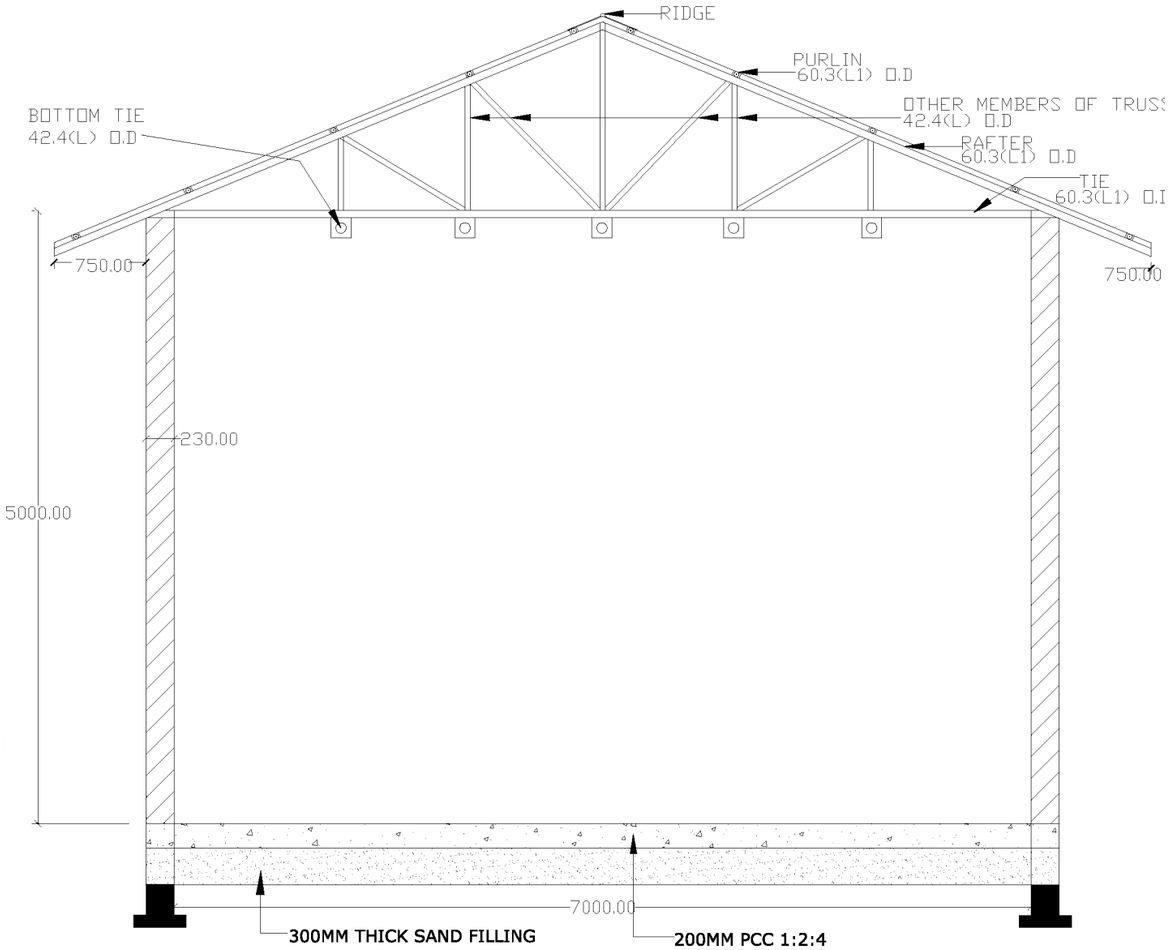
SECTION AT A-A

CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	**DRAWING SUB-TITLE:** PLAN AND SECTION OF GARAGE FOR SECONDARY TRANSPORTATION VEHICLES	**SCALE:NTS** / **SHEET SIZE:A3**	***Detailed Project Report (Draft Final)***
			DATE: JUNE - 2009	**ALL DIMENSIONS ARE IN MM**	SMEC 1199 DPR SIPMIU DRW SWM	28

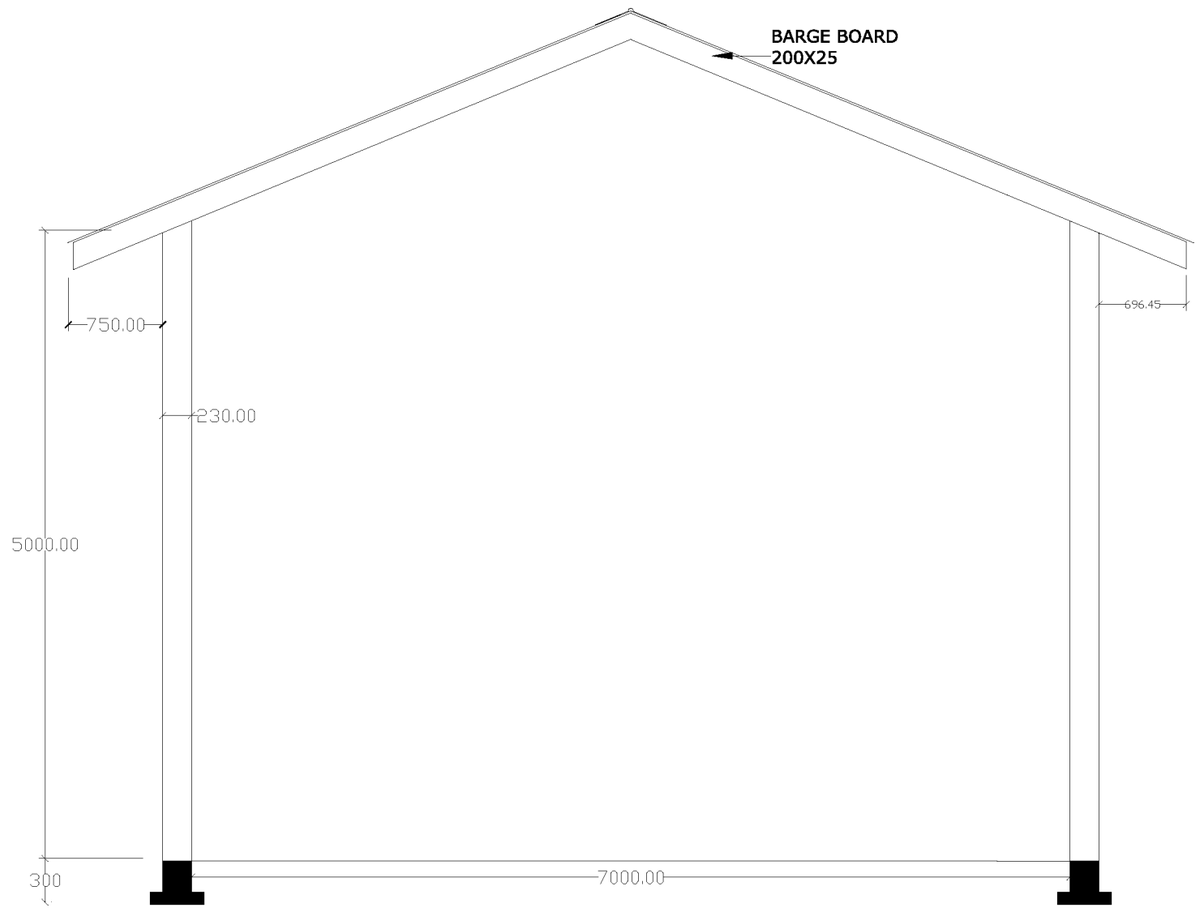


FRONT ELEVATION

CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** FRONT ELEVATION OF GARAGE FOR SECONDARY TRANSPORTATION VEHICLES **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***	
					SMEC 1199 DPR SIPMIU DRW SWM		29



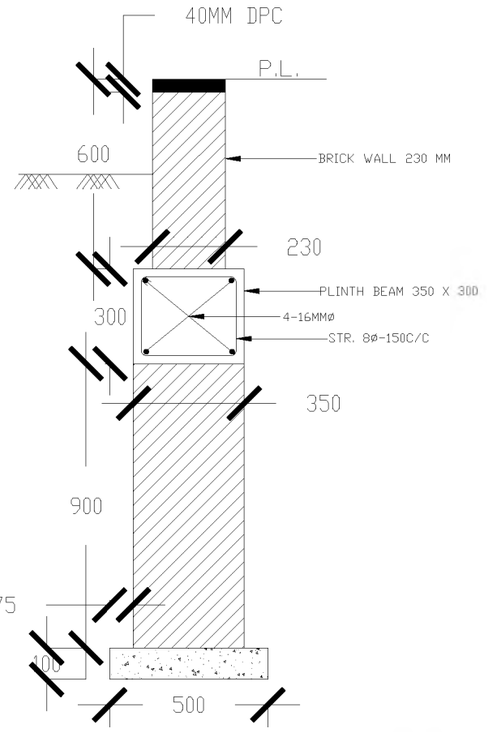
SECTION B-B



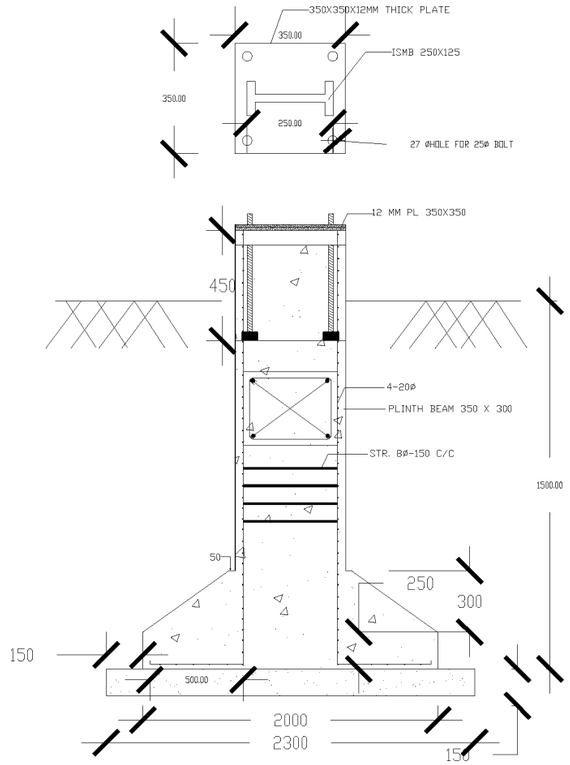
SIDE ELEVATION

CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** SECTION AND SIDE ELEVATION OF GARAGE FOR SECONDARY TRANSPORTATION VEHICLES **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

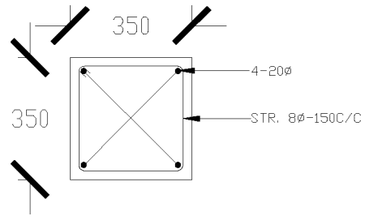
SMEC	1199	DPR	SIPMIU	DRW	SWM	30



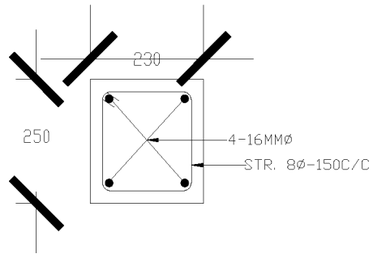
FOUNDATION OF BRICK WALLS



DETAILS OF FOOTINGS



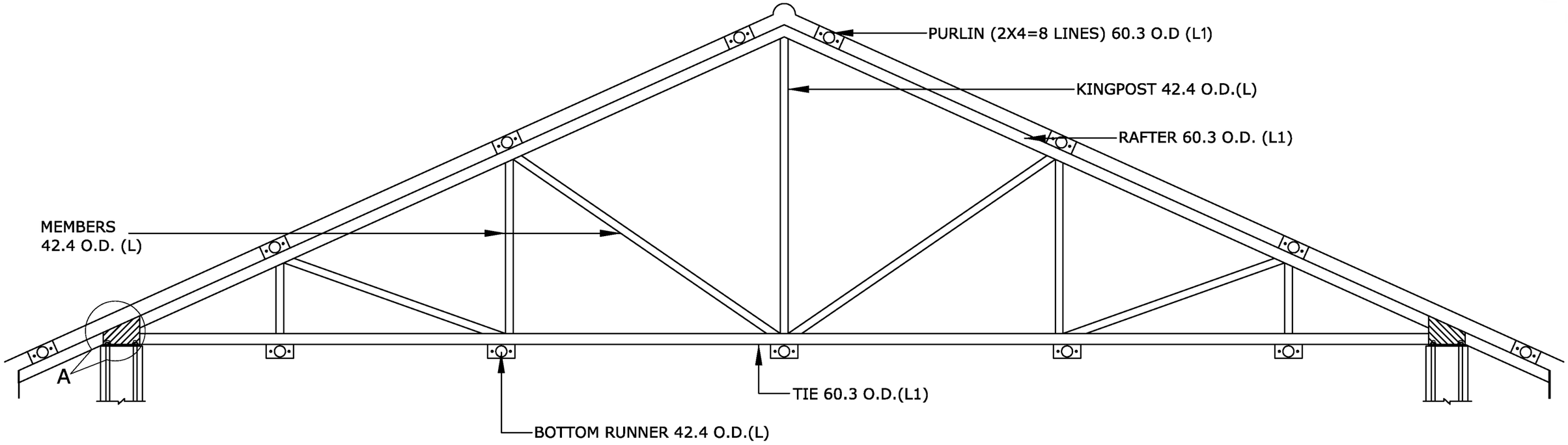
COLUMN SECTION

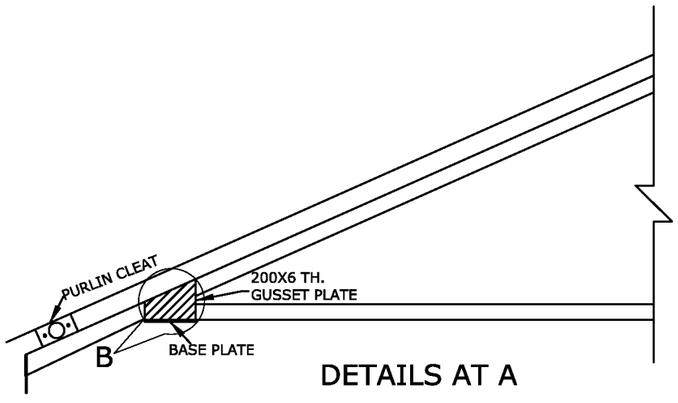


SECTION OF ROOF BEAM

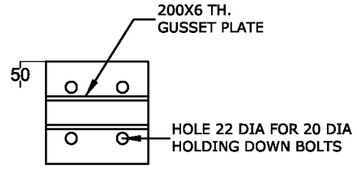
CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	**DRAWING SUB-TITLE:** FOUNDATION DETAILS OF GARAGE FOR SECONDARY TRANSPORTATION VEHICLES ALL DIMENSIONS ARE IN MM	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

SMEC	1199	DPR	SIPMIU	DRW	SWM	31

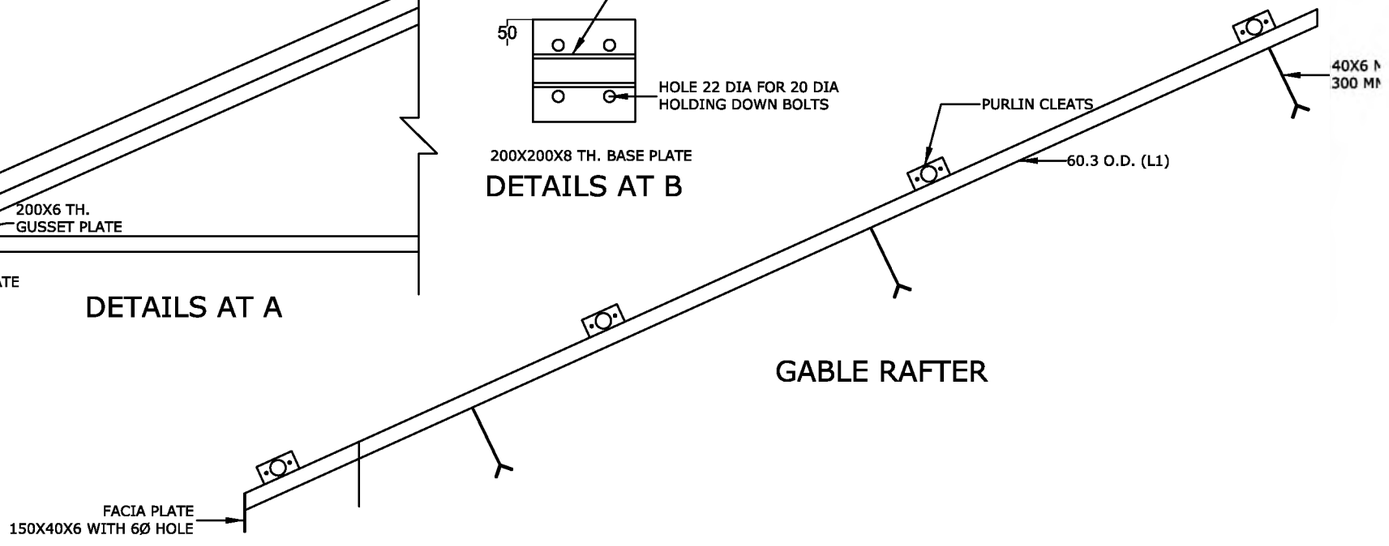




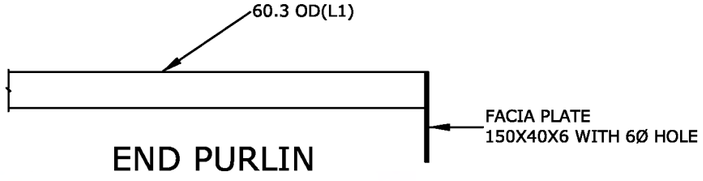
DETAILS AT A



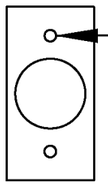
DETAILS AT B



GABLE RAFTER



END PURLIN

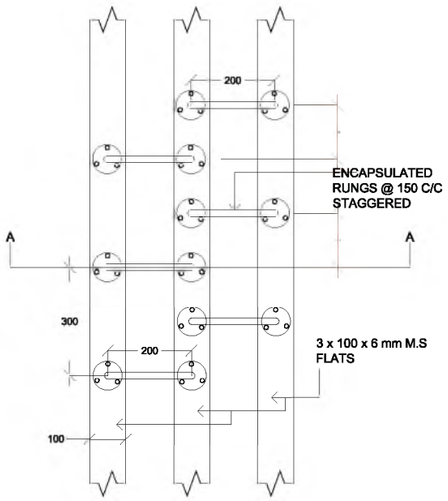


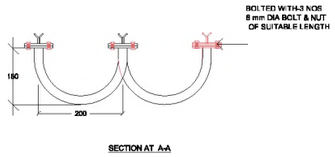
PURLIN CLEAT: 150X75X6 TH.
BOTTOM RUNNER CLEAT: 150X60X6 TH.

NOTES:

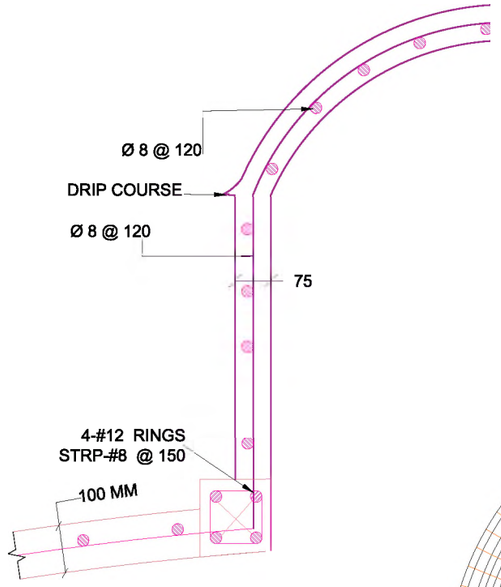
- ALL ELECTRIC ARC WELDING PROCESS SHOULD BE AS PER IS:816 & IS:823.
- MAXIMUM DIA OF ELECTRODES FOR WELDING SHOULD BE AS PER IS:814 & APPENDIX "B" OF IS:823
- PRECAUTIONS CONNECTED TO WELDING & CUTTING SHALL BE CONFORM TO THE SAFETY REQUIREMENTS GIVEN IN IS:818.
- INSPECTION AND TESTING OF WELDS SHALL BE AS PER IS:822.
- STEEL TUBE TRUSSES ARE NORMALLY SHOP WELDED WITH FLANGE PLATE & BASE PLATE AND BOLTED AT SITE.TUBE JUNCTIONS INVOLVES MACHINING OF TUBE ENDS TO A CURVED PROFILE TO SADDLE ON TO THE LARGER CHORD TUBES WITH FILLET WELDING.

CLIENT:	CONSULTANT:	PROJECT TITLE:	DRAWING TITLE:	DRAWING SUB-TITLE:	SCALE:NTS	Detailed Project Report (Draft Final)
ADB Asian Development Bank	SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS: GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	TRUSS DETAILS FOR SECONDARY TRANSPORTATION VEHICLES	SHEET SIZE: A3	
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SMEC | 1199 | DPR | SIPMIU | DRW | SWM | 32	

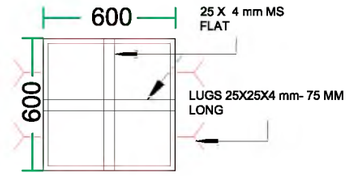




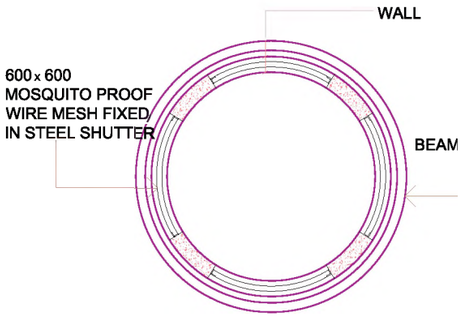
DETAILS OF ENCAPSULATED RUNGE INSIDE THE TANK



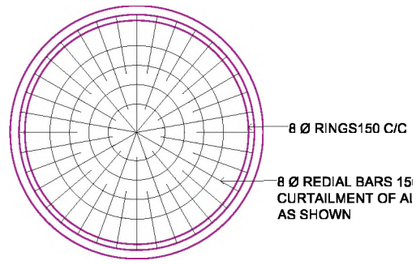
REINFORCEMENT DETAILS AT Y



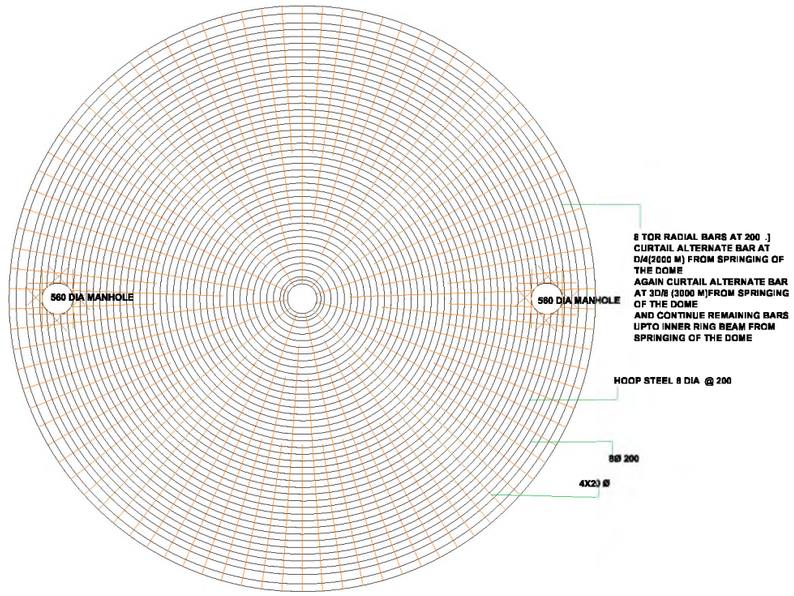
DETAILS OF MOSQUITO PROOF WIRE MESH
FIXED IN STEL SHUTTER



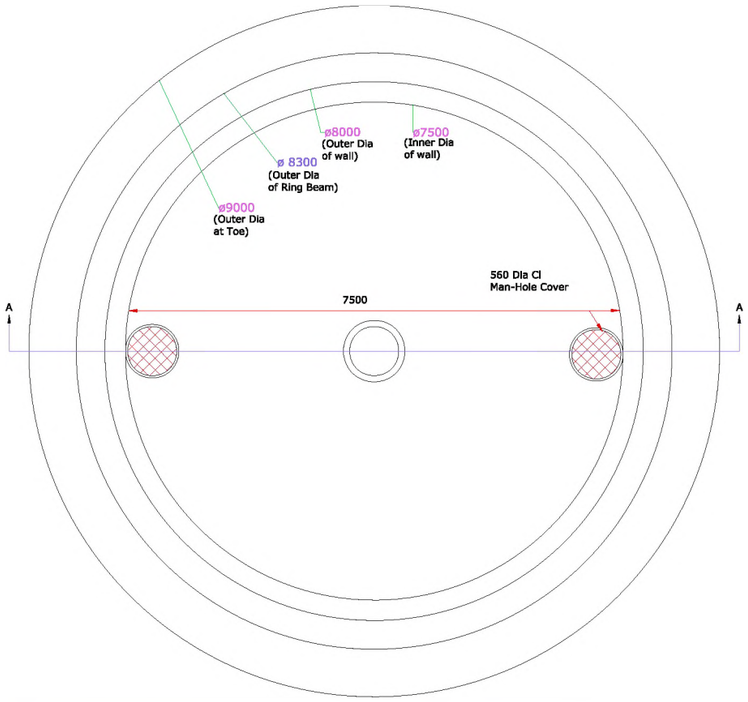
SECTION AT B-B



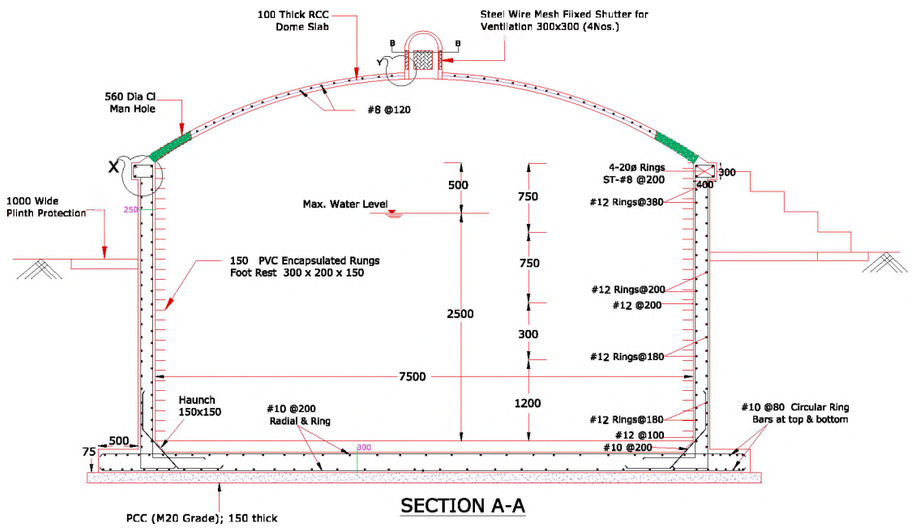
TOP DOME REINFORCEMENT
DETAILS



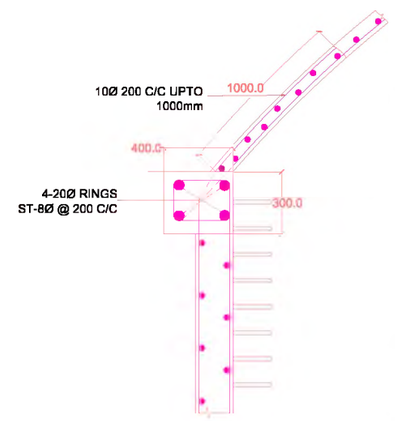
DOME REINFORCEMENT DETAILS



PLAN



SECTION A-A



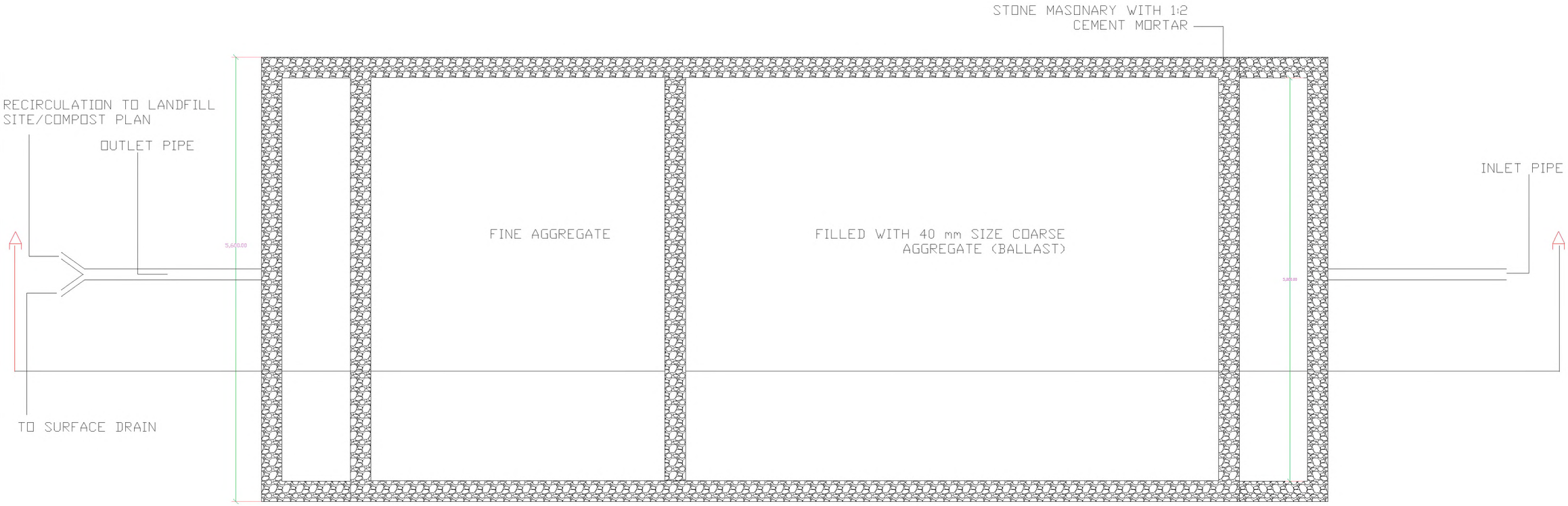
DETAILS AT "X"

GENERAL NOTES

1. ALL DIMENSION ARE TO BE READ AND NOT TO BE SCALED
2. CONTRACTORS ARE TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF THE WORK
3. FIGURED DIMENSIONS ARE TO BE FOLLOWED
4. UNLESS OTHERWISE STATED ALL DIMENSIONS ARE IN MILLIMETERS
5. EXECUTIVE AUTHORITY SHALL CHECK THE DRAWING BEFORE TAKING EXECUTION IN HAND
6. MIX OF CONCRETE FOR ALL R.C.C. WORK SHALL BE M-25 (MIX DESIGN) AS SPECIFIED IN IS 456 - 2000
7. MAXIMUM SIZE OF COARSE AGGREGATE SHALL BE 20 MM AND DOWNGRADED UNLESS SPECIFIED OTHERWISE.
8. AGGREGATES SHALL COMPLY WITH THE REQUIREMENTS I.S. 383-1970
9. CEMENT FOR ALL STRUCTURAL WORK SHALL BE ORDINARY OR LOW HEAT CEMENT CONFORMING TO I.S. 269-1976 OR AS DIRECTED BY ENGINEER IN CHARGE
10. ALL DETAILING OF REINFORCEMENT INCLUDING DUCTILITY REQUIREMENTS SHOULD CONFORM TO I.S. 456, I.S 13920 AND I.S. 4326
11. ALL REINFORCEMENT FOR R.C.C. WORK SHALL BE FE 415 HYSD CONFORMING TO IS 1786-1985
12. BENDS IN HOOKS FOR STIRRUPS SHALL BE 135 DEGREE.
13. MINIMUM CRUSHING STRENGTH OF BRICK SHALL BE 75 KG/CM2
14. ANY DISCREPANCY FOUND IN THE DRAWING SHALL BE BROUGHT TO THE NOTICE OF THE EXECUTING AGENCY FOR NECESSARY CLARIFICATION
15. THE MISSING DETAILS IF ANY IN THE DRAWING AND TECHNICALLY REQUIRED BASED ON SOUND ENGINEERING PRACTICE MUST BE FOLLOWED
16. WATER TO BE USED FOR CONCRETING SHALL MEET ALL REQUIREMENTS OF CLAUSE 5.4 OF I.S. 456-2000.
17. CLEAR COVER TO ALL REINFORCEMENT SHALL BE 25 MM
18. THIS STRUCTURE IS DESIGNED FOR EARTH QUAKE ZONE V AND WIND SPEED 50 M/SEC.
19. FOR ALL R.C.C. MEMBERS TO BE PLASTERED, SURFACE SHALL BE HACKED IMMEDIATELY AFTER REMOVAL OF FORM WORK.
20. DEVELOPMENT LENGTH OF BAR SHOULD BE TAKEN AS 50 #, WHERE # = DIA OF BAR

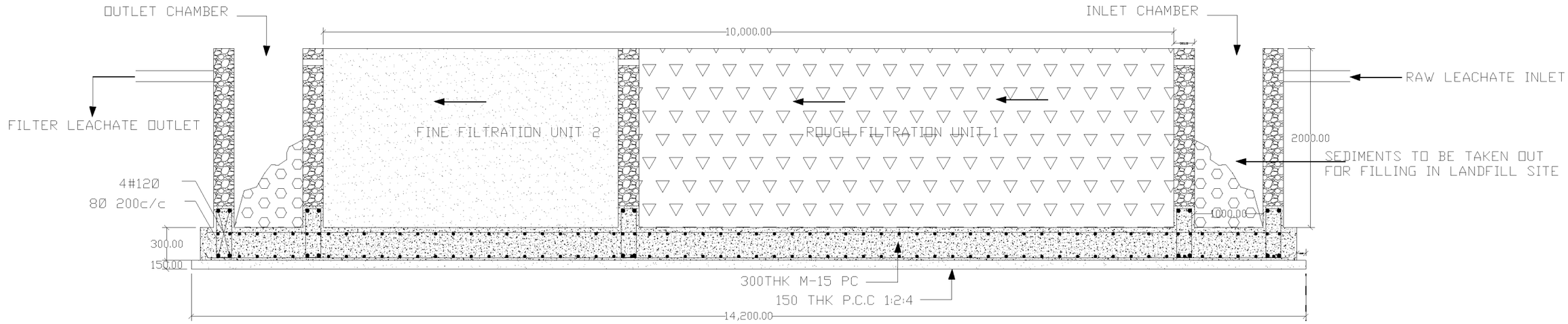
CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	**DRAWING SUB-TITLE:** LAYOUT PLAN OF GROUND LEVEL RESERVOIR ALL DIMENSIONS ARE IN MM	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

SMEC	1199	DPR	SIPMIU	DRW	SWM	33



PLAN

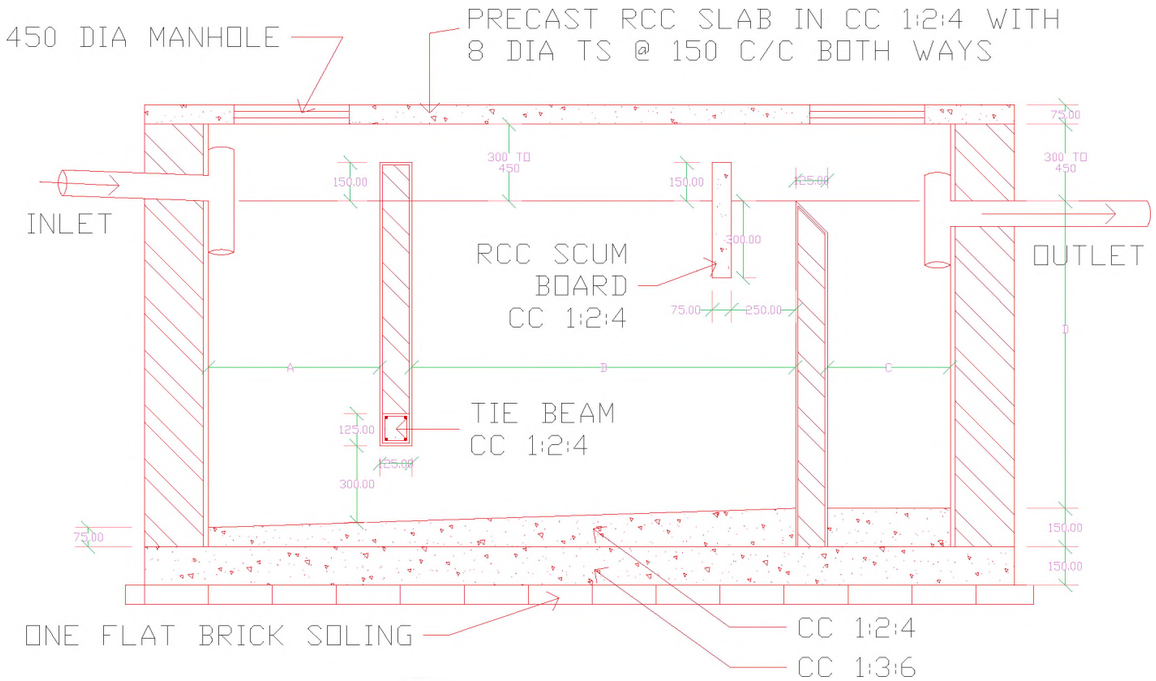
CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	**DRAWING SUB-TITLE:** PLAN OF LEACHATE TREATMENT PLANT	**SCALE:NTS**	***Detailed Project Report (Draft Final)***	
			DATE: JUNE - 2009	**ALL DIMENSIONS ARE IN MM**	**SHEET SIZE: A3**	SMEC 1199 DPR SIPMIU DRW SWM	34



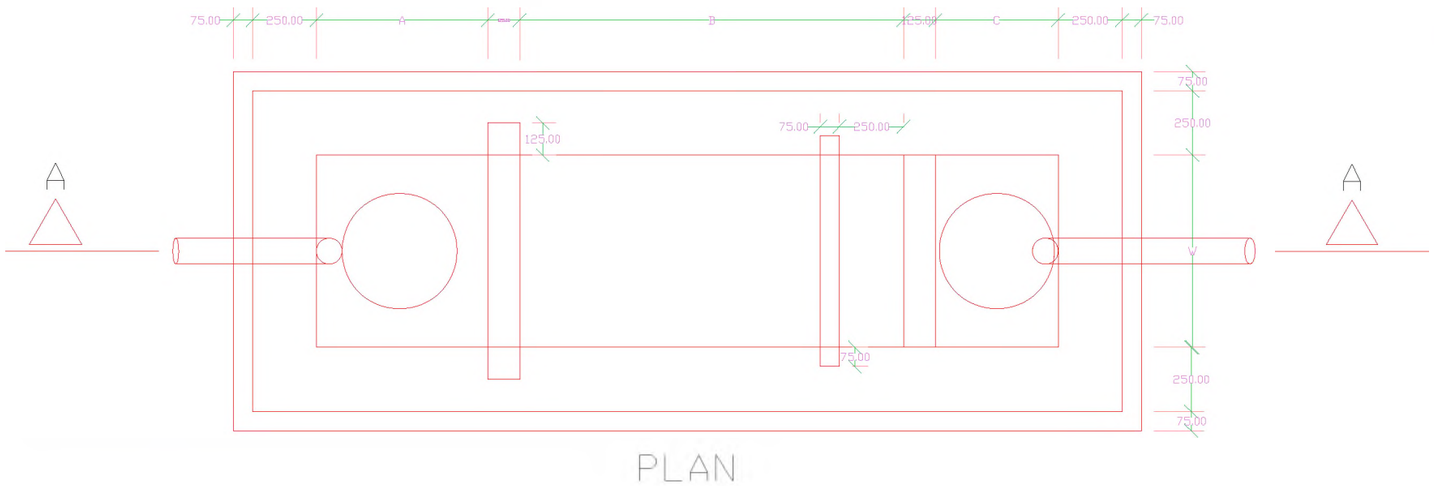
CLIENT: ADB Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001 TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** SECTION OF LEACHATE TREATMENT PLANT **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

SMEC	1199	DPR	SIPMIU	DRW	SWM	35

SEPTIC TANK



SECTION AT A-A

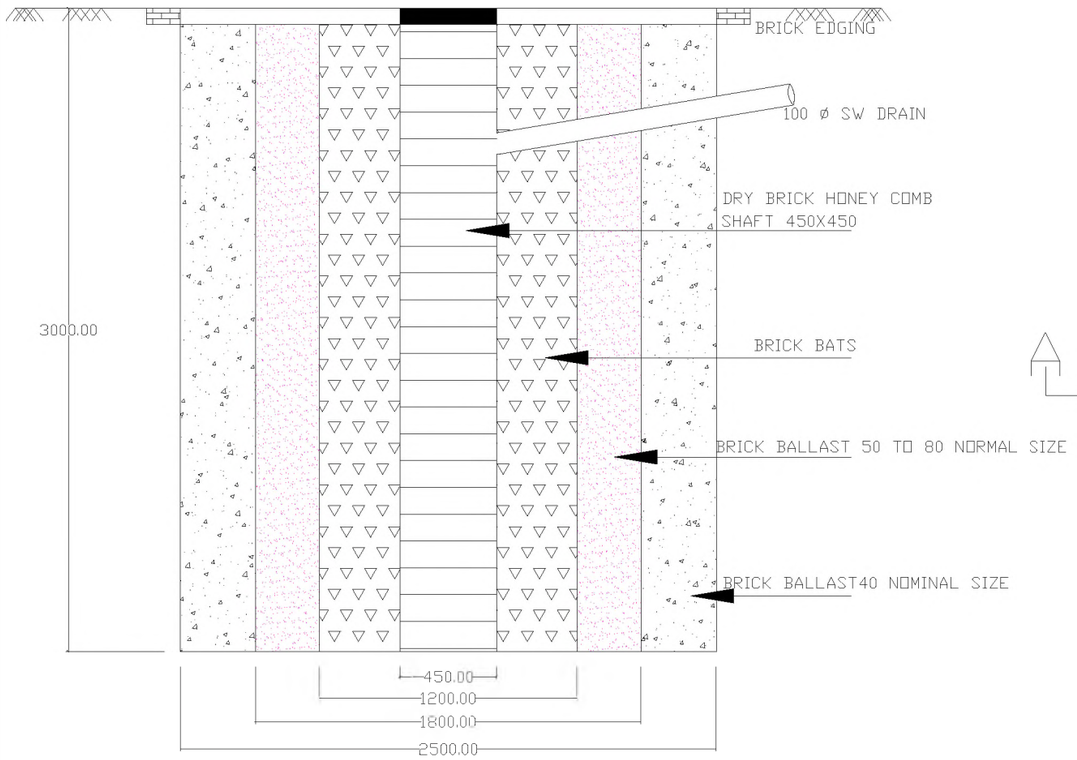


NOTE:
**ALL DIMENSIONS ARE IN mm
**NOT TO SCALE
**CLEANING INTERVAL: 2 YEARS

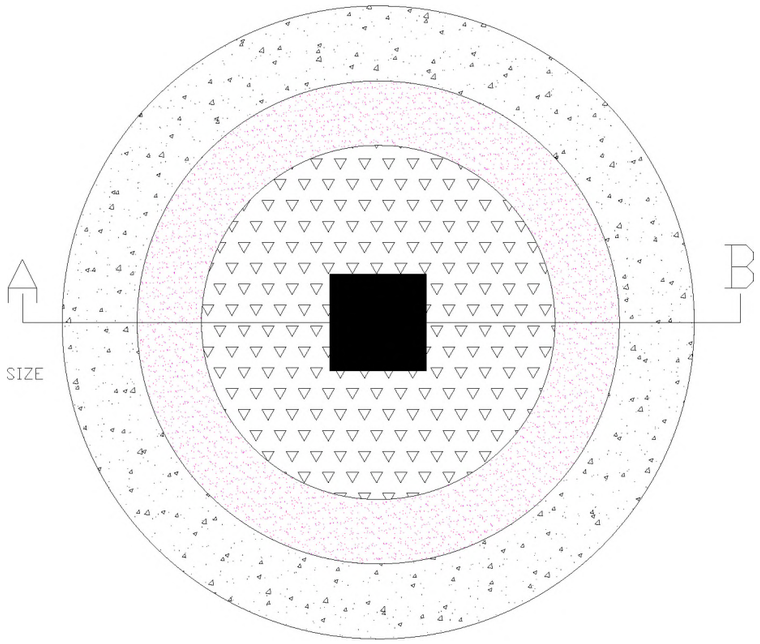
DIMENSIONS OF SEPTIK TANK FOR SPECIFIC USER No. 25

SEPTIK TANK						
USER	A	B	C	D	W	FREE BOARD
25	650	1500	500	1200	750	300 TO 450

CLIENT: Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	DRAWING SUB-TITLE: SEPTIC TANK FOR 25 USERS	SCALE:NTS / SHEET SIZE:A3	*Detailed Project Report (Draft Final)*
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SMEC | 1199 | DPR | SIPMIU | DRW | SWM | 36	



SECTION AT AB



PLAN

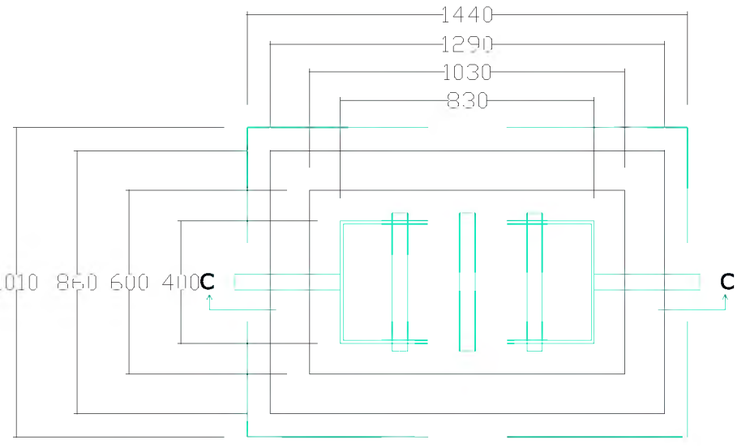
SOAK PIT 2.5 M DIA X 3 M DIA DEEP

CONSTRUCTION:-

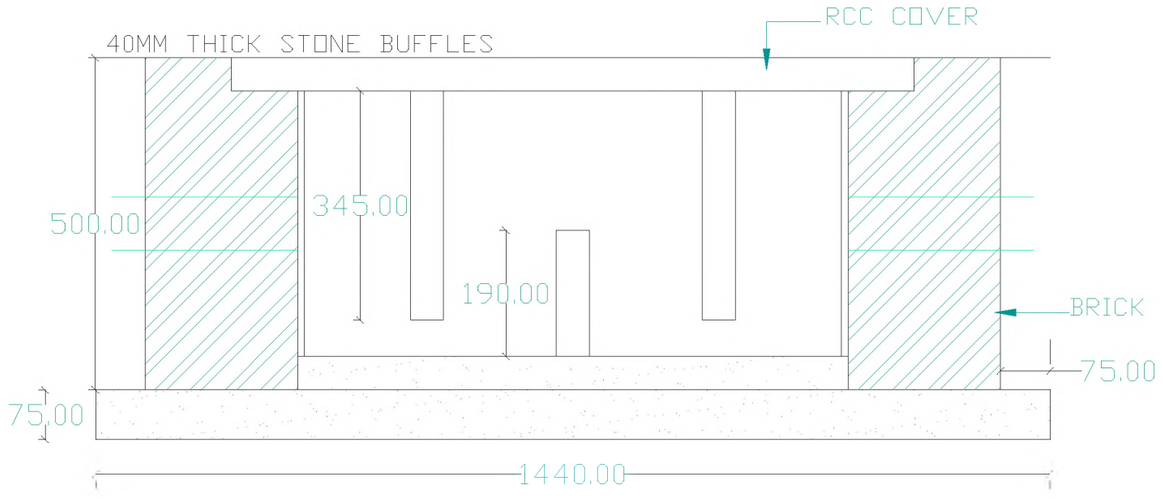
THE EARTH EXCAVATION SHALL BE CARRIED OUT TO THE EXACT DIMENSIONS AS SHOWN IN THE FIGURE. IN THE SOCK PIT SHALL BE CONSTRUCTED A HONEY-COMB DRY BRICK SHAFT 45 X 45 CM AND 292.5 CM HIGH. ROUND THE SHAFT AND WITHIN THE RADIUS OF 60 CM SHALL BE PLACED WELL BURNT BRICK BATS. BRICK BALLAST OF SIZE FROM 50 TO 80 MM NOMINAL SIZE SHALL BE PACKED ROUND THE BRICK BATS UPTO THE RADIUS OF 90 CM. THE REMAINING PORTION SHALL BE FILLED WITH BRICK BALLAST OF 40 MM NOMINAL SIZE. THE CONSTRUCTION OF SHAFT AND FILLING OF THE BATS AND THE BALLAST SHALL PROGRESS SIMULTANEOUSLY.

COVER AND DRAIN

OVER THE FILLING SHALL BE PLACED A SINGLE MATTING WHICH SHALL BE COVERED WITH MINIMUM LAYER OF 7.5 CM EARTH. THE SHAFT SHALL BE COVERED WITH 7.5 CM THICK STONE OR RCC SLAB 10 CM WIDE AND 10 CM DEEP BRICK EDGING WITH BRICKS OF CLASS DESIGNATION 75 SHALL BE PROVIDED ROUND THE PIT. THE CONNECTION OF THE OPEN SURFACE DRAIN TO THE SOAK PIT SHALL BE MADE BY MEANS OF 100 MM DIAMETER S.W. PIPE WITH OPEN JOINTS.

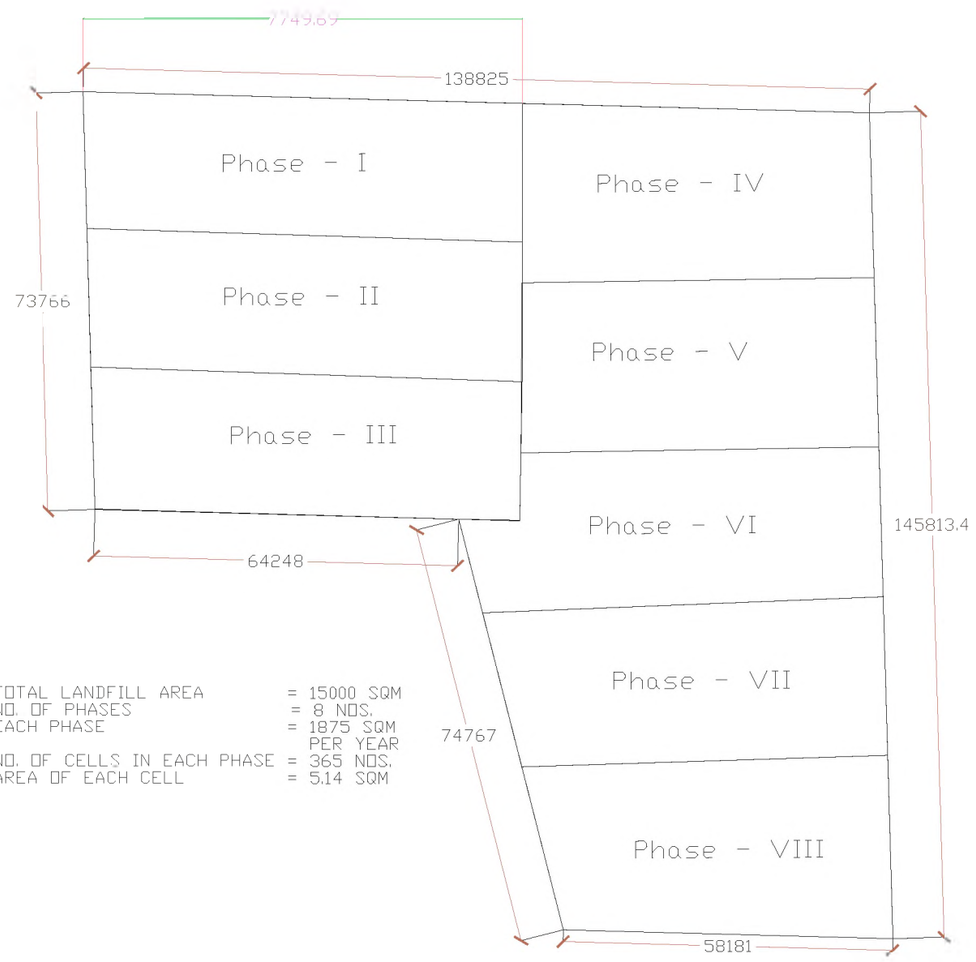


PLAN

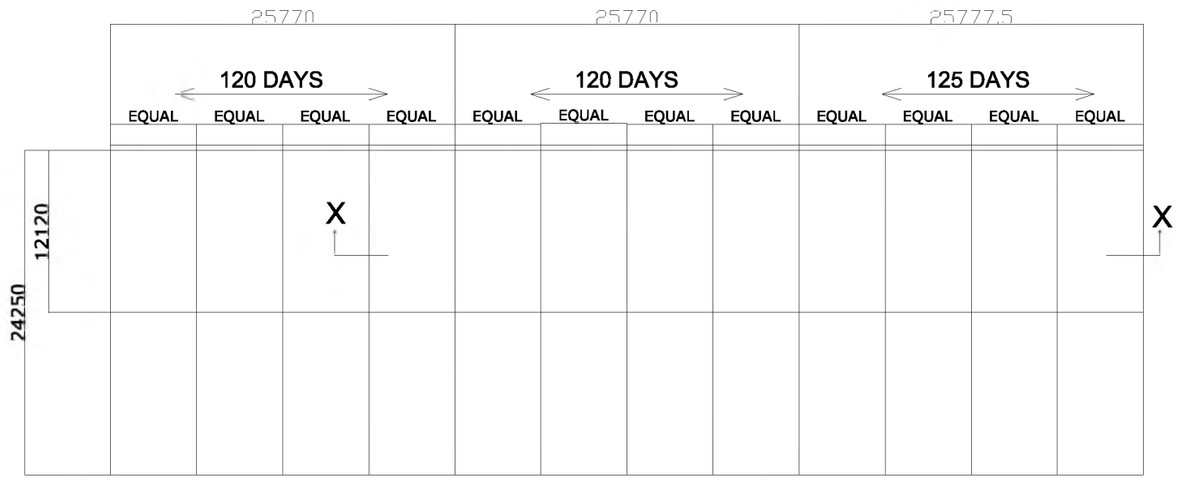


SECTION AT C-C

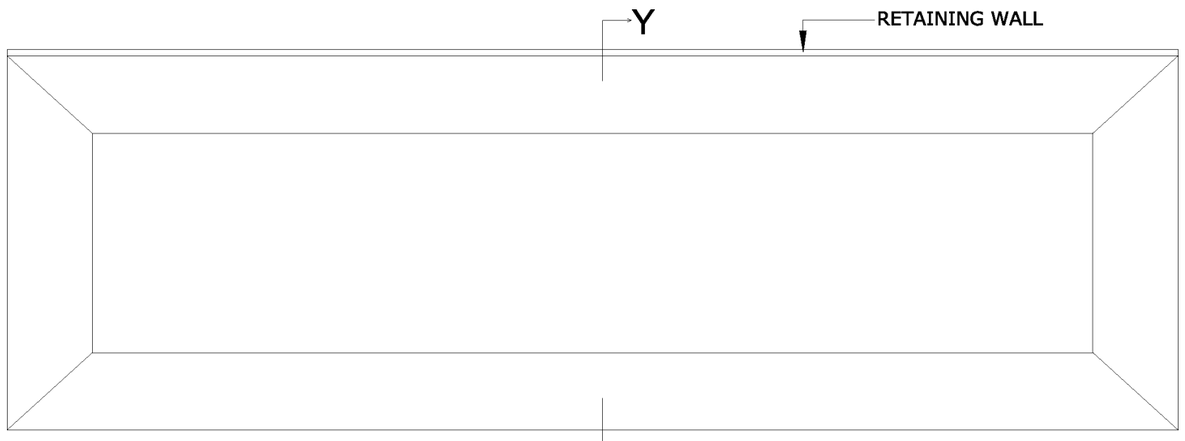
CLIENT: Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	DRAWING SUB-TITLE: SKETCH OF SOAK PIT 2.5M DIAX30M DEEP	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SMEC | 1199 | DPR | SIPMIU | DRW | SWM | 37	



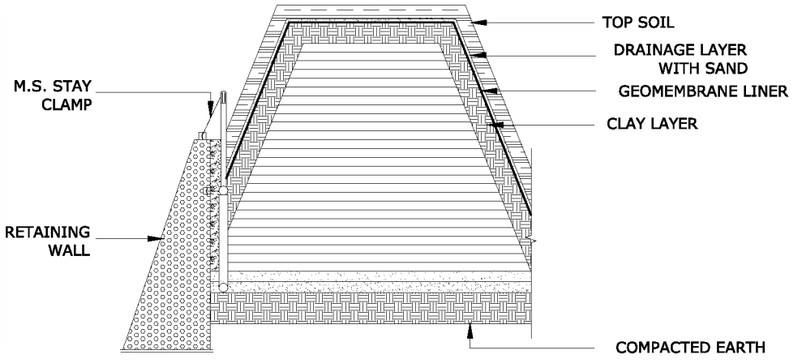
TOTAL LANDFILL AREA = 15000 SQM
NO. OF PHASES = 8 NOS.
EACH PHASE = 1875 SQM PER YEAR
NO. OF CELLS IN EACH PHASE = 365 NOS.
AREA OF EACH CELL = 5.14 SQM



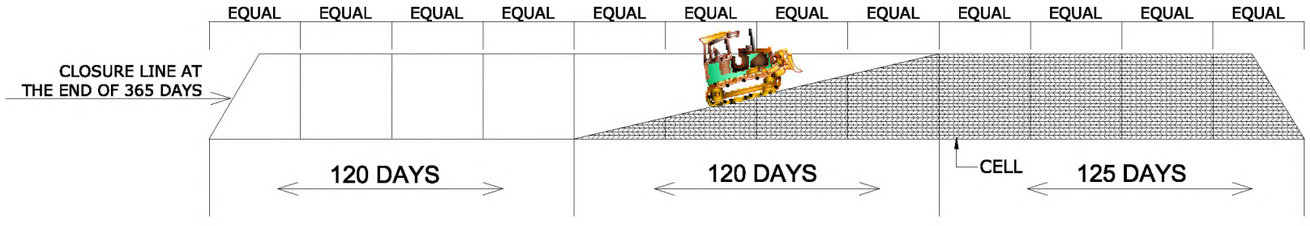
PLAN OF 1 PHASE (1875 SQ.M.)



PLAN OF 1 PHASE
(1875 SQ.M.)



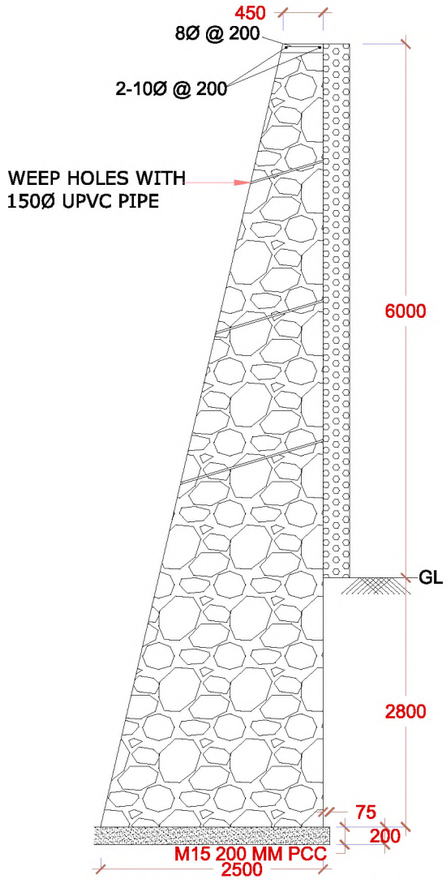
SECTION AT Y-Y OF PHASE 1 AFTER TOP SOIL COVER



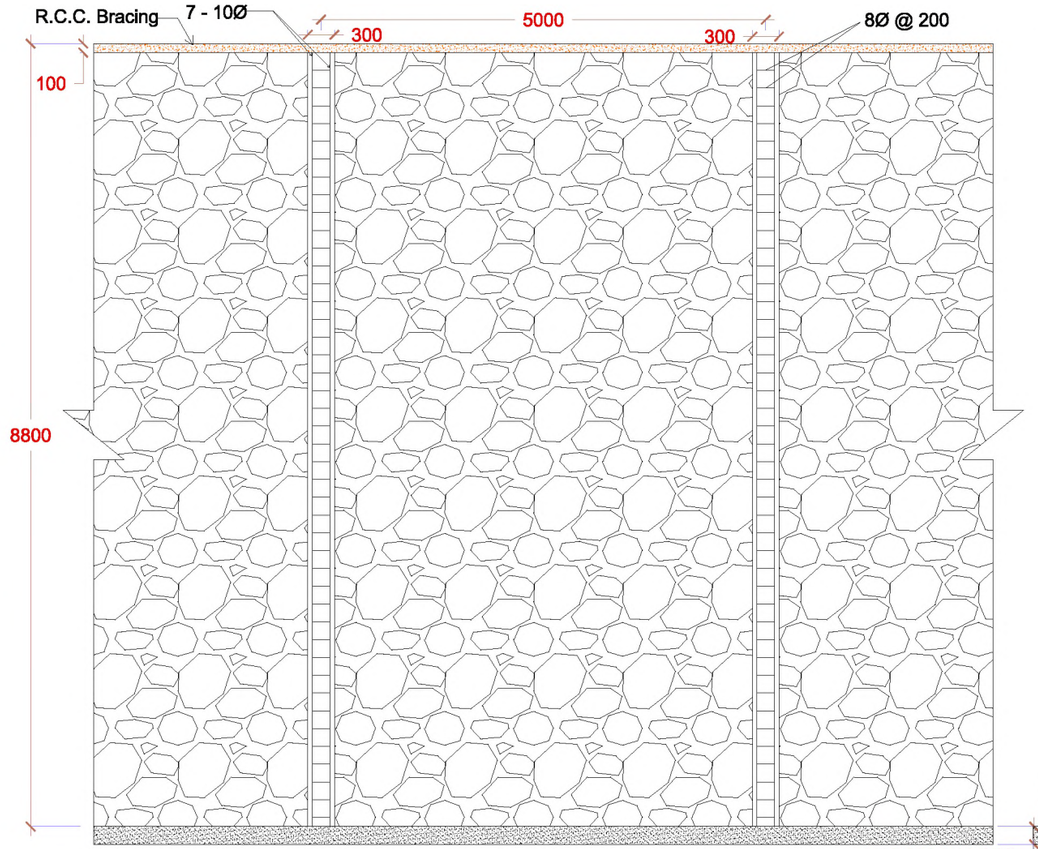
SECTION AT X-X (AFTER 185 DAYS)

TYPICAL SKETCH OF PLACEMENT OF CELLS

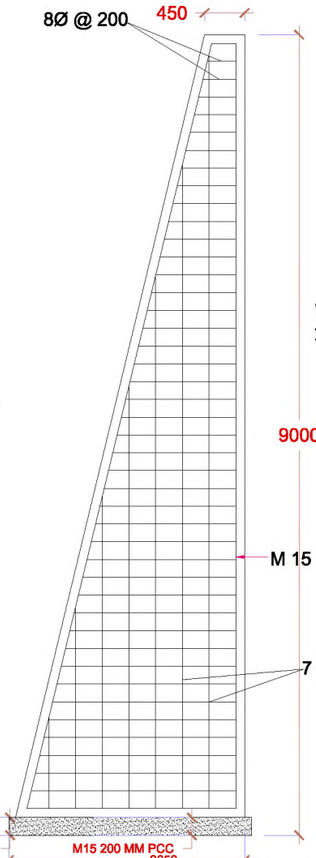
CLIENT: Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001. TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	DRAWING SUB-TITLE: PLAN & SECTION OF PHASE,CELL & CLOSURE OF PHASE	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SMEC | 1199 | DPR | SIPMIU | DRW | SWM	38



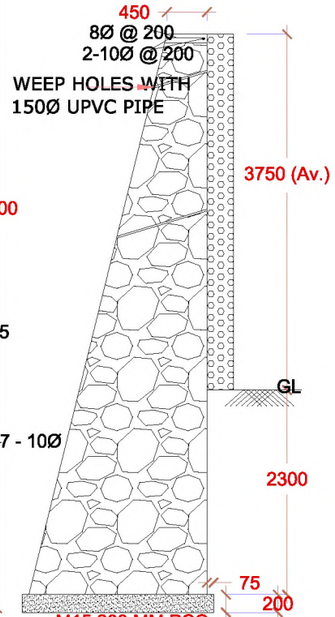
DETAILS OF STONE MASONARY WALL



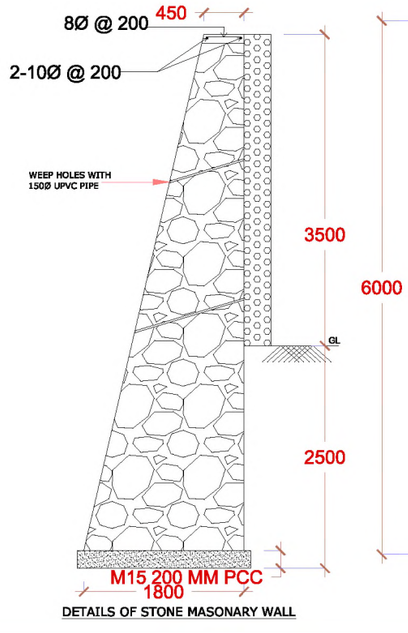
SECTIONAL ELEVATION OF STONE MASONARY WALL



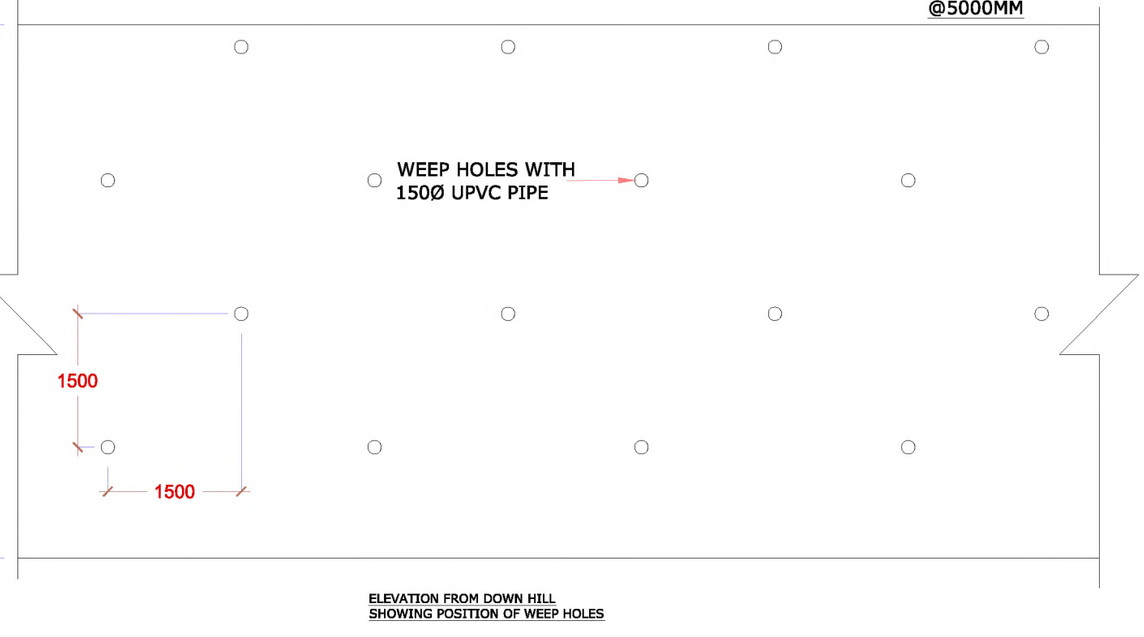
SECTION OF 200MM THICK
RCC STIFFNER COLUMNS
@5000MM



DETAILS OF STONE
MASONARY WALL



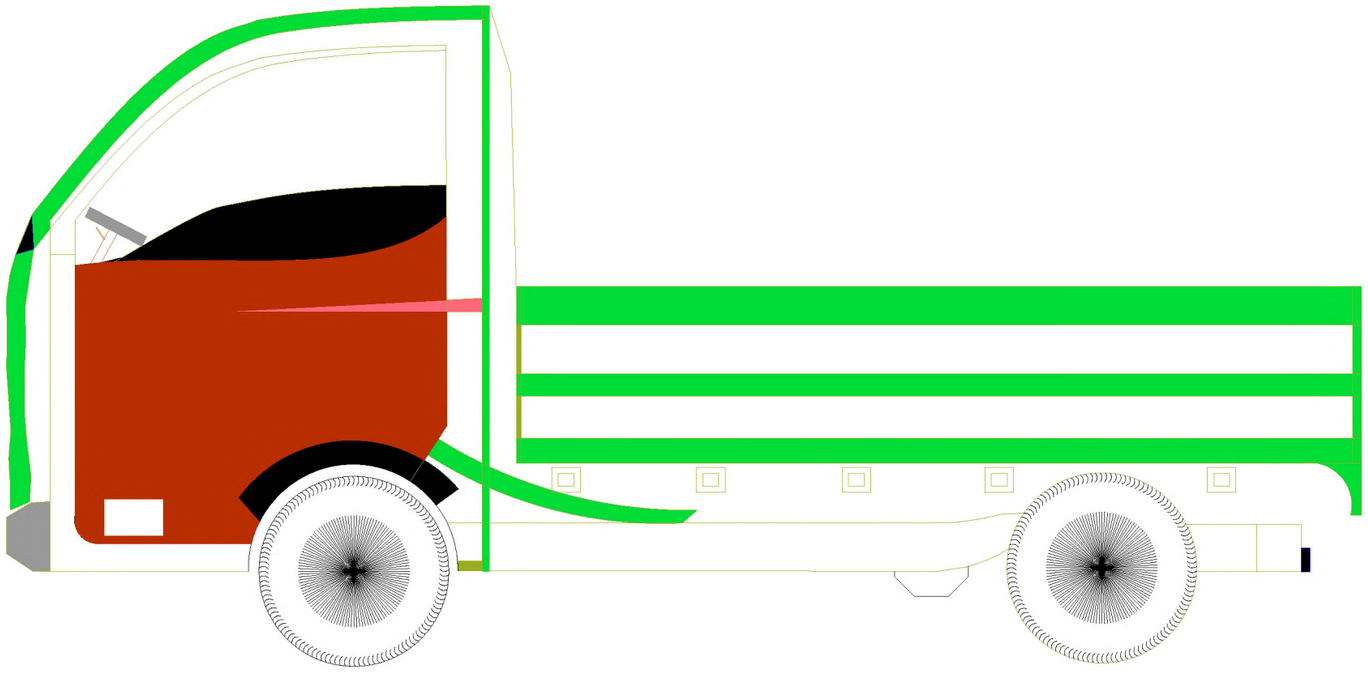
DETAILS OF STONE MASONARY WALL



ELEVATION FROM DOWN HILL
SHOWING POSITION OF WEEP HOLES

CLIENT: Asian Development Bank	CONSULTANT: SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001. TEL-0361-2633661FAX-0361-2631482	PROJECT TITLE: PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	DRAWING TITLE: GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA DATE: JUNE - 2009	DRAWING SUB-TITLE: PLAN, SECTION AND ELEVATION RETAINING WALL WITH RCC STIFFENERS AT MAIWONG, SHILLONG ALL DIMENSIONS ARE IN MM	SCALE:NTS SHEET SIZE: A3	*Detailed Project Report (Draft Final)*

SMEC	1199	DPR	SIPMIU	DRW	SWM	39



SPECIFICATIONS
TATA ACE bharat Stage II and III

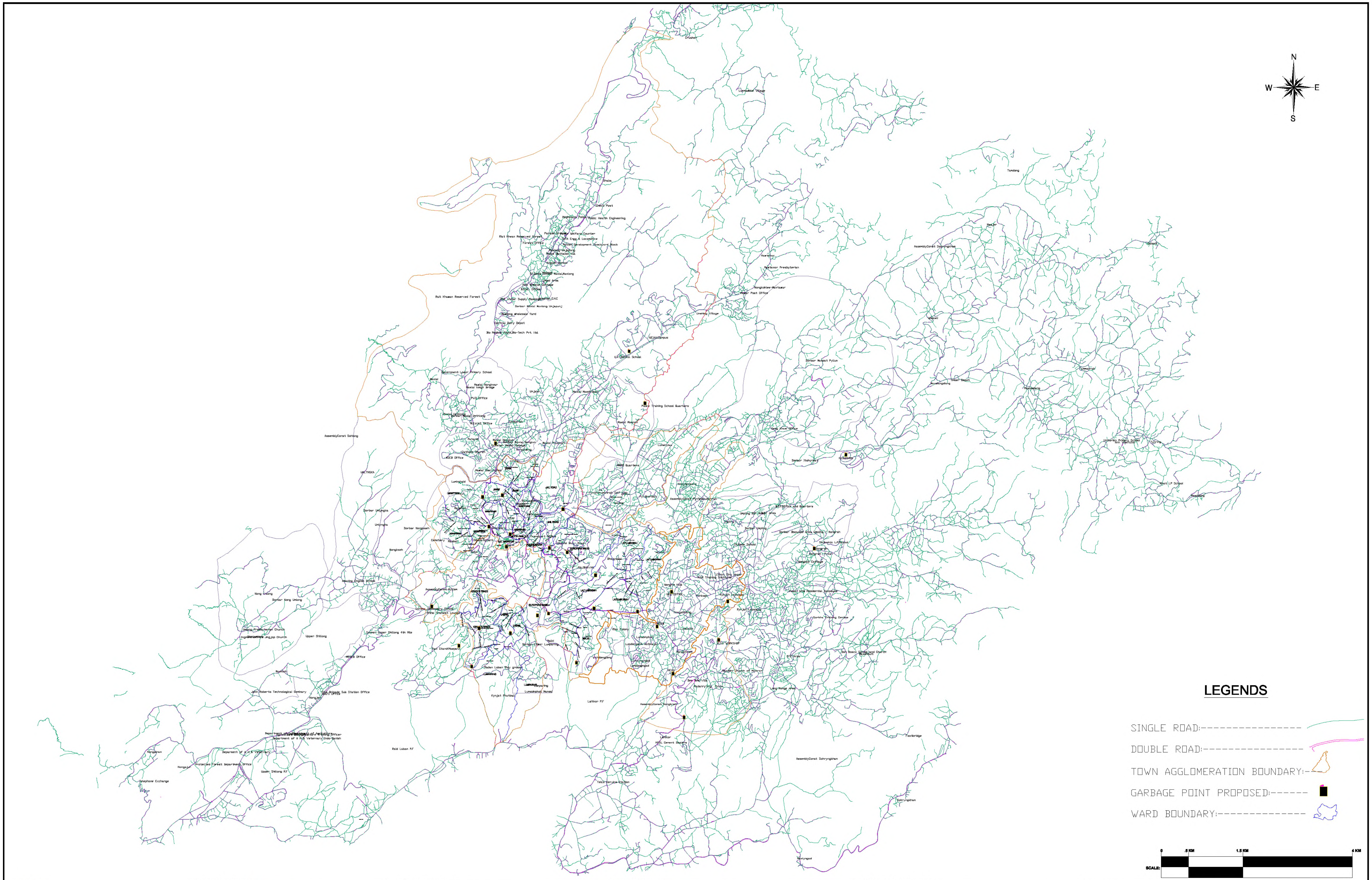
ENGINE
Model : TATA 275 IDI NA BS-II & III
Type : 4 stroke, naturally aspirated, indirect injection diesel engine
Max. Output : 16 hp @3200 rpm
Max. Torque : 3.8 mkg @2000 rpm
Displacement : 700 cc
Special itms : catalytic converter (only in BS III)
CLUTCH : Single plate dry friction diaphragm type
GEAR BOX : GBS 65.4/6.31
Type : Synchromesh (4 forward gears), Sliding mesh (reverse gear)
STEERING : Mechanical, variable ratio (20.5 to 24.5), 380 mm dia
BRAKES
Type : Dual circuit hydraulically activated
Front : Disc brakes
Rear : Drum brakes (200 mm dia x 30 mm)
Parking Brakes : Cable operated mechanical linkages acting on rear wheels
SUSPENSION
Type : Parabolic spring suspension at both front and rear
Shock absorber : Hydraulic double acting telescopic type

DIMENSION (MM)
Length : 3800
Width : 1500
Height : 1845
Wheelbase : 2100
Front Wheel Gauge : 1300
Rear Wheel Gauge : 1320
Loading Deck Length : 2140
Loading Deck Width : 1430
Height of side panel : 300
Loading height from ground : 676
Minimum turning diameter : 8.6 m
FUEL TANK CAPACITY : 30 litres
PERFORMANCE
Max. Speed : 64kmph
Max. gradbility : 22 %
Grade restartability : 21 %

WEIGHTS
Max. GVW : 150 kgs
Kerb Weight : 815 kgs
Seating Capacity : Driver + 1

CLIENT: Asian Development Bank	**CONSULTANT:** SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001. TEL-0361-2633661FAX-0361-2631482	**PROJECT TITLE:** PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	**DRAWING TITLE:** GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA **DATE: JUNE - 2009**	**DRAWING SUB-TITLE:** TRUCK **ALL DIMENSIONS ARE IN MM**	**SCALE:NTS** **SHEET SIZE: A3**	***Detailed Project Report (Draft Final)***

SMEC	1199	DPR	SIPMIU	DRW	SWM	40



CLIENT:	CONSULTANT:	PROJECT TITLE:	DRAWING TITLE:	DRAWING SUB-TITLE:		
ADB Asian Development Bank	SMEC INDIA PVT. LTD. BRANCH OFFICE ADDRESS- GOSWAMI BHAWAN, WARDSTREET,UZANBAZAR, GUWAHATI,PIN-781001, TEL-0361-2633661FAX-0361-2631482	PROJECT IMPLEMENTATION & URBAN MANAGEMENT IMPROVEMENT IN THE NORTH EASTERN REGION (PACKAGE-A)	GREATER SHILLONG SOLID WASTE PROCESSING PLANT, MEGHALAYA	PROPOSED TRANSFER POINTS	SCALE:NTS SHEET SIZE:A2	*Detailed Project Report (Draft Final)*
			DATE: JUNE - 2009	ALL DIMENSIONS ARE IN MM	SMEC | 1199 | DPR | SIPMIU | DRW | SWM	41

Project Implementation and Urban Management Improvement in the North Eastern Region – Package A

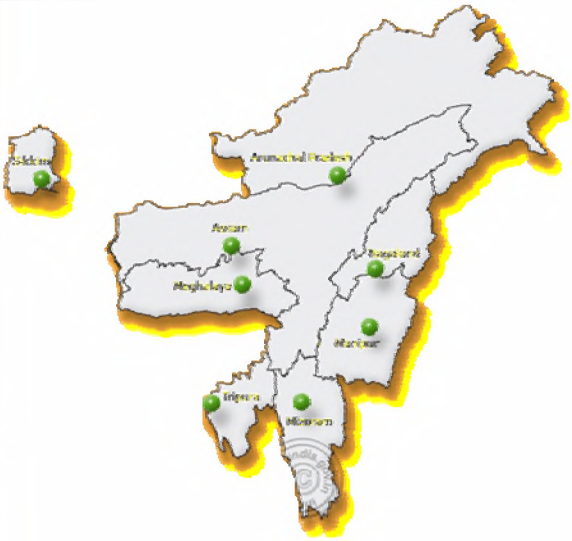
Draft Final DPR-Solid Waste Management Plan for Greater Shillong Planning Area

Asian Development Bank TA 4779 - IND

Volume III

Cost Estimate

June, 2009



SMEC INDIA

Abstract of Cost for Solid Waste Management Scheme for Shillong			
Sl. No.	Components	Total Estimated Cost	Total Estimated Cost (INR million)
I	**Primary Collection**		
a)	Providing 50 litres capacity LLDP bins of approved make for road side litter bins at strategic locations	300,000.00	0.30
b)	Providing 250 litres capacity bins of LLDP approved make for street sweeping.	750,000.00	0.75
I	**Sub Total**		**1.05**
II.	**Primary Collection and transportation Vehicles.**		
a)	4-Wheeler Hydraulic operated Vehicle.(30 Nos)	10,500,000.00	10.50
b)	Supply of equipment and PP Gears to personnel responsible for street sweeping	250,000.00	0.25
II	**Sub Total**		**10.75**
III.	**Secondary Collection and transportation Vehicles.**		
a)	4.5 cum. capacity Tipper Truck of approved make complying to all the requirements for the purpose. (17 Nos)	14,960,000.00	14.96
III.	**Sub Total**		**14.96**
IV	**Development of Sanitary Landfill Site**		
a)	**Weigh Bridge**		
i)	30 ton Weigh Bridge	325,000.00	0.33
ii)	Concrete Deck with pit	227,285.99	0.23
iii)	Weight Bridge Operator Room	228,493.38	0.23
iv)	Septic Tank	45,774.49	0.05
b)	Skid Steer Loader (JCB - 190)	2,700,000.00	2.70
c)	Bulldozer for dozing, leveling & back filling	5,600,000.00	5.60
d)	Approach road to land fill site	3,070,361.55	3.07
e)	Construction of retaining walls	8,516,468.45	8.52
f)	Construction of Sannitary Landfill Site	18,713,181.25	18.71
g)	Security Fencing	291,966.26	0.29
h)	Drainage	937,643.83	0.94
i)	R.C.C tank for Leachate Collection and Treatment	518,202.59	0.52
j)	Tubewell with pumping mains	191,500.00	0.19
k)	Ground level Resrvoir	785,976.89	0.79
l)	Fire Fighting Arrangements	99,600.00	0.10
IV	**Sub Total**		**42.25**
	Electrical Installation in Solid Waste Management Plant	1,724,178.00	1.72
V	**Sub Total**		**1.72**
VI	**Other Infrastructure Facilities**		
a)	Garage for Primary Transportation vehicles.	2,237,957.48	2.24
b)	Garage for Secondary Transportation vehicles.	1,315,191.61	1.32
c)	Operator's Rest Room	1,026,818.37	1.03
d)	Security Guard's Room	454,957.79	0.45
VI	**Sub Total**		**5.03**
VII	Environmental Budget (Mitigation & Monitoring Measure and Capacity Building)	828,000.00	0.83
VII	**Sub Total**		**0.83**
	TOTAL(I+II+III+IV+V+VI+VII)	76,598,557.92	76.59
	Say		**76.60**

ESTIMATE OF COST FOR CONSTRUCTION OF WEIGHT BRIDGE DECK WITH PIT

Sl No.	Description of Items	unit	nos	length	breadth	depth	Quantity (Rs)	Rate (Rs)	
Earthwork									
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete	cum							
	Hard soil or soil mixed with moorum, gravel, boulders upto one man size (above 0.3m each)								
	Main pit	cum	1	8.90	4.43	1.50	59.14		
	for footing	cum	4	1.50	1.50	0.50	4.50		
	for sump	cum	1	1.85	1.05	1.50	2.91		
	Sub Total	**cum**					**66.55**	**57.00**	**3793.59**
	Extra for every additional lift of 1.5m or part thereof:								
	(a) All types of soils								
	Excavation	cum	1	8.90	4.43	0.35	13.80		
	sump	cum	1	1.85	1.05	0.90	1.75		
	Sub Total	**cum**					**15.55**	**4.00**	**62.19**
Plain Cement Concrete									
2	Providing and laying cement concrete in proportion 1:2:4 corresponding to M15 (1 cement , 2 sand, 4 stone aggregates of 20 mm nominal size) including necessary curing complete, excluding shuttering , in foundation and below plinth and in septic tank inspection pits etc, complete	cum							
	under footing	cum	4	1.50	1.50	0.10	0.90		
	Bottom floor	cum	1	8.90	4.43	0.10	3.94		
		cum	1	1.85	1.05	0.10	0.19		
	side of Columns	cum	4	0.65	0.43	0.83	0.91		
	deduct(-)	cum	4	0.65	0.50	0.15	0.20		
	Sub Total	**cum**					**6.14**	**3521.00**	**21631.53**

Reinforced Cement Concrete									
3	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M200 (1 cement:1.5 sand : 3 graded stone aggregates of 20 mm nominal size) excluding shuttering and reinforcement)	cum							
	Concrete deck	cum	1	7.50	3.03	0.23	5.11		
	Bottom slab	cum	1	8.90	4.43	0.15	5.91		
	Sump cover	cum	1	0.75	0.75	0.10	0.06		
	footing	cum	4	1.35	1.35	0.20	1.46		
	dome	cum	4	0.96	0.96	0.20	0.74		
	pedestal	cum	4	0.65	0.50	0.83	1.07		
	deduct	cum	16	0.08	0.08	0.30	0.03		
		cum	4	0.65	0.50	0.15	0.20		
	Sub Total	**cum**					**14.58**	**4083.00**	**59518.10**
Reinforcement									
4	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level	qntl							
	Sub Total	**qntl**					**11.66**	**5910.00**	**68910.60**
BRICK WORK									
5	Brick work with F.P.S bricks of class designation 75 in foundation and plinth in	cum							
	Cement mortar 1:6 (I cement : 6 coarse sand)								
	Long Side	cum	2	7.50	0.41	1.93	11.90		
	Short Side	cum	2	3.93	0.41	1.93	6.23		
	sump	cum	2	1.05	0.30	2.15	1.35		
		cum	1	0.75	0.30	2.15	0.48		
	Sub Total	**cum**					**19.97**	**2440.00**	**48723.18**

Plastering									
6	Providing 12 mm thick cement plaster i/c cleaning the surface and curing complete as directed.								
	(b) Proportion 1:3								
	12 mm cement plaster	Sqm							
	inside(long walls)	Sqm	2	7.50	1.93		28.88		
	outside	Sqm	2	7.50	1.93		28.88		
	inside(short walls)	Sqm	2	3.93	1.93		15.13		
	sump(inside)	Sqm	2	0.75	2.15		3.23		
	outside	Sqm	2	1.05	2.15		4.52		
		Sqm	1	1.35	2.15		2.90		
	Sub Total	**Sqm**					**83.52**	**104.00**	**8686.39**
Formwork									
7	Centering and shuttering including strutting, proping etc and removal of form for.								
	Columns	Sqm	16	1.35	0.20		4.32		
		Sqm	8	0.50	0.83		3.30		
		Sqm	8	0.65	0.83		4.29		
	sub total	**sqm**					**11.91**	**274.00**	**3263.34**
	slabs	Sqm	1	7.50	3.03		22.73		
	sub total	**sqm**					**22.73**	**215.00**	**4885.88**
Steel Works									
8	Providing steel works in tees , flats, angles and channels including cutting, drilling holes , hoisting and fixing in postion complete.	qntl							
	Sub total	**qntl**					**1.60**	**4882.00**	**7811.20**
Total Cost for Weight Bridge Deck with Pit									**227285.99**

ESTIMATE OF COST FOR WEIGHT BRIDGE OPERATOR ROOM									
Sl No.	**Description of Items**	**Unit**	**Nos**	**Length/ dia**	**Breadth**	**Depth**	**Quantity**	**Rate (Rs)**	
	EARTHWORK								
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders. (above 0.3 m)								
	For footing	Cum	4	1.40	1.40	1.20	9.41		
	For plinth beam								
		Cum	2	4.00	0.30	0.23	0.55		
		Cum	2	3.00	0.30	0.23	0.41		
		Cum	1	1.20	0.30	0.23	0.08		
		Cum	1	1.50	0.30	0.23	0.10		
	For steps	Cum	1	1.50	0.80	0.15	0.18		
	Sub Total	**Cum**					**10.74**	**57.00**	**612.20**
2	Earthwork in filling with available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm thick including breaking clods consolidating each layer by ramming and watering, lead upto 50m and lift upto 1.5m	Cum	1				5.37		
	Sub Total	**Cum**					**5.37**	**46.00**	**247.02**
3	Sand filling in plinth in layers not exceeding 15 cm including breaking of clods, consolidating by ramming and watering complete as directed.	Cum	1	3.77	2.77	0.30	3.13		
	Sub Total	**Cum**					**3.13**	**479.00**	**1500.64**
4	a) Providing and injecting chemical emulsion for pre constructional Anti termite Termite treatment and creating a chemical barrier under and all around the column pits , walls , trenches, basement excavations, top surfaces of plinth fillings, junction of walls and floors along externel perimeter of the building, expansion joints, sorrunding of pipes,conduits etc, complete as directed.(Plinth area of the building at ground floor only shall be measured)	Sqm							
	Sub Total						**13.66**	**187.00**	**2554.96**

5	**CONCRETE WORK**								
	Providing and laying cement concrete in proportion 1:3:6 corresponding to M100 (1 cement, 3 sand,6 graded stone aggregates of 40 mm nominal size) including necessary curing excluding shuttering.								
	Under footing	Cum	4	1.65	1.65	0.10	1.09		
	Under steps	cum	1	1.50	0.80	0.10	0.12		
	Under floor	Cum	1	3.77	2.77	0.15	1.57		
	Sub Total	**Cum**					**2.78**	**2928.00**	**8126.47**
6	**DAMP PROOF COURSE**								
	Providing and laying damp-proof Course 40mm thick with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 12.5mm nominal size)								
		Sqm	1	16.70	0.23		3.84		
	Deduct for Doors	sqm	1	2.20	0.23		0.51		
	Sub Total	**Sqm**					**3.34**	**165.00**	**550.28**
7	Extra for providing and mixing water proofing material in cement concrete work @ 1 Kg per 50 Kg of cement			3.34cum					
	Sub Total	**per 50 Kg of cement**					**0.86**	**31.00**	**26.51**
	REINFORCED CEMENT CONCRETE								
8	Design Mix Concrete								
	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M200 (1 cement, 1.5 sand, 3 graded stone of 20 mm nominal Size) including curing complete etc(, excluding shuttering in foundation and below plinth and in septic tank inspection pits etc, complete								
	All work upto plinth level								
	In footing(base plate)	Cum	4	1.50	1.50	0.25	2.25		
	footing	cum	4	0.88	0.88	0.30	0.93		
	Plinth Beam	Cum	1	16.70	0.23	0.25	0.96		
	columns upto plinth	Cum	4	1.05	0.23	0.23	0.22		
	Sub Total	**Cum**					**4.36**	**4083.00**	**17808.86**

9	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M20 (1 cement, 1.5 sand, 3 graded stone of 20 mm nominal Size) including curing complete etc(, excluding shuttering in foundation and below plinth and in septic tank inspection pits etc, complete								
	Upto first floor level								
	Walls, Columns, Pillars, Post and Struts.								
	Column	Cum	4	3.20	0.23	0.23	0.68		
	Beam, plinth beams, girders, cantilevers, suspended floors and staircase								
	R.C.C in roof beam	Cum	2	4.00	0.23	0.23	0.42		
		Cum	2	3.00	0.23	0.23	0.32		
	R.C.C. in Lintels	Cum	1	16.70	0.23	0.15	0.58		
	RCC Slab	Cum	1	5.73	4.73	0.15	4.07		
	Sub Total	**Cum**					**6.06**	**4125.00**	**24994.63**
10	**Reinforcement Work**								
	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
	Sub Total	**qntl**					**9.94**	**5910.00**	**58725.37**
	Formwork								
11	Centering and shuttering including strutting, proping etc and removal of form for.								
	Foundation, footing, bases of columns etc. for mass concrete.	Sqm	16	1.50		0.25	6.00		
		Sqm	16	0.35		0.60	3.36		
	Sub Total	**Sqm**					**9.36**	**137.00**	**1282.32**
12	Lintel, beams, plinth beams, girders, bressumers and cantilevers.								
		Sqm	2	16.70		0.25	8.35		
		Sqm	2	7.00		0.23	3.22		
		Sqm	2	16.70		0.15	5.01		
	Sub Total	**Sqm**					**16.58**	**187.00**	**3100.46**
13	Suspended floors, roofs, landings,balconies and access platform								
		Sqm	1	5.73	4.73		27.10		
		Sqm					**27.10**	**215.00**	**5827.12**

14	Column, Pillars,piers, Abutments, posts and struts		16	3.20	0.23		11.78		
		Sqm					**11.78**	**274.00**	**3226.62**
15	Brick work with F.P.S bricks of class designation 75 in foundation and plinth in								
	Cement mortar 1:6 (I cement : 6 coarse sand)								
	Below plinth								
	Plinth Beam to plinth level	Cum	1	16.70	0.23	0.45	1.73		
	1st steps	Cum	1	1.50	0.75	0.15	0.17		
	2nd steps	Cum	1	1.50	0.50	0.15	0.11		
	3rd steps	Cum	1	1.50	0.25	0.15	0.06		
	Sub Total	**Cum**					**0.34**	**2440.00**	**823.50**
16	Brick work with F.P.s bricks of class designation 75 in superstructure above plinth level up to floor V level in all shapes and sizes								
	cement mortar 1:6								
		cum	1	16.70	0.23	3.20	12.29		
	Sub Total(A)	**cum**					**12.29**		
	Deduct								
	window 1	sqm	1	1.80	0.23	1.20	0.50		
	window 2	sqm	3	1.20	0.23	1.20	0.99		
	Door 1	sqm	1	1.20	0.23	2.20	0.61		
	Door 2	sqm	1	1.00	0.23	2.20	0.51		
	Ventilator	sqm	1	0.50	0.23	0.30	0.03		
	Sub Total (B)						**2.64**		
	Sub Total(A-B)	**sqm**					**9.65**	**2711.00**	**26169.55**
17	**WOOD WORK**								
	Providing dressed and rebated wood works in frames of doors and other similar works, framed and fitted in position with nails, spikes, nuts, bolts etc as required and directed complete.								
	Local wood(Pooma, holock, oak gamari and the like)								
	D1	Cum	1	6.80	0.10	0.05	0.03		
	D2	Cum	1	6.60	0.10	0.05	0.03		
	W1	Cum	1	8.40	0.10	0.05	0.13		
	W2	Cum	3	6.00	0.10	0.05	0.09		
	Sub Total	**Cum**					**0.28**	**19949.00**	**5645.57**

18	Providing and fixing 38 mm thick full paneled shutter for doors including iron hinges, tower bolts, screws etc as specified complete with								
	Red pine wood/local wood								
	D1	Sqm	1	2.10	1.10		2.31		
	D2	Sqm	1	2.10	0.90		1.89		
	Sub total	**Sqm**					**4.20**	**1256.00**	**5275.20**
19	**FITTINGS FOR DOORS AND WINDOWS**								
	Providing and fixing aluminium tower bolts socket with screws and directed								
	250 mm x12 mm	Each	4				4.00	**136.00**	544.00
	Providing and fixing aluminium sliding bolts as directed								
	(b) 300 mm x 16 mm, dia	Each	1				1.00	**290.00**	290.00
	Providing and fixing aluminium handles with srews stc								
	150 mm	Each	4				4.00	**29.00**	116.00
20	**STEEL WORK**								
	Providing and fixing ISI marked steel glazed doors, windows and ventilators of standard rolled steel sections, joints mitred and welded with 15x3 mm lugs, 10 cm long, embedded in cement concrete blocks 15x10x10cm of 1:3:6 (1 cement: 3 Coarse sand: 6 graded stone aggregate								
	Openable								
	W1	Sqm	1	1.80	1.20		2.16		
	W2	Sqm	3	1.20	1.20		4.32		
	Sub Total	**Sqm**					**6.48**	**1215.00**	**7873.20**
	Ventilators-centre hung	Sqm	1	0.50	0.30		0.15		
	Sub Total	**Sqm**					**0.15**	**1205.00**	**180.75**
21	**FLOORING**								
	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size.) finished with a floating coat of neat cement including cement slurry, but excluding the cost of nosing of steps etc. complete								
	40 mm thick								
	In Floors	Sqm	1	4.00	3.00		12.00		
	In steps	Sqm	3	1.50	0.25		1.13		
	deduct for toilet area	sqm	-1	1.20	1.50		-1.80		
	Sub Total	**Sqm**					**11.33**	**212.00**	**2400.90**

22	Providing 20mm thick cement plaster skirting with cement mortar 1:3 (1 cement and 3 sand) finished with floating coat of neat cetment including rounding of junction with floor as directed completely								
		Sqm	1	14.50	0.15		2.18		
	Sub Total	**Sqm**					**2.18**	**226.00**	**491.55**
23	Providing and fixing 10 mm thick acid and or alkali resistant tiles of approved make and colour using acid or alkali resistant tiles of approved make and colour using acid and alkali or resisting morter bedding and joints filled with acid and or alkali resis								
	In flooring on a bed of 10mm thick morter 1:4 (1 appropriate cement : 4 coarse sand)								
	Acid and alkali resistant tile								
	Toilet	Sqm	1	1.50	1.20		1.80		
	Sub Total	**Sqm**					**1.80**	**1003.00**	**1805.40**
24	In dado/skirting on 12 mm thick morter 1:4 (1 appropriate cement : 4 coarse sand)								
	Acid and alkali resistant tile								
	For Toilets	Sqm	1	5.40	1.50		8.10		
	Deduct for Door upto 1.5 m height	Sqm	1	-1.50	1.00		-1.50		
	Sub Total	**Sqm**					**6.60**	**1045.00**	**6897.00**
25	**FINISHING**								
	Providing 12 mm thick cement plaster i/c cleaning the surface and curing complete as directed								
	(c) Proportion 1:4								
	Internal Walls								
	ceiling	Sqm	1	4.00	3.00		12.00		
	Internal Walls	Sqm	1	22.10	2.90		53.26		
	Sub Total	**Sqm**					**65.26**	**96.00**	**6264.96**
26	20 mm cement plaster of mix								
	1:4 (1 cement : 4 coarse sand)								
	External Walls	Sqm	1	14.92	3.65		54.46		
	Deduct								
	W 1	Sqm	-1	1.80	1.20		-2.16		
	W 2	Sqm	-3	1.20	1.20		-4.32		
	Ventilators	Sqm	-1	0.50	0.30		-0.15		
	Door D1 & D2	Sqm	-1	2.10	1.10		-2.31		
		Sqm	-1	2.10	0.90		-1.89		
	Sub total	**Sqm**					**43.63**	**127.00**	**5540.76**

27	**Exterior / Interior Finishing**								
	Painting wall at the ground floor level with approved water proof cement paint (Snowcem and the like) to the new works including cleaning the surface etc complete.								
	Two coats	Sqm	1				46.63		
	Sub Total	**Sqm**					**46.63**	**48.00**	**2238.24**
28	Distempering with dry distemper of approved brand and manufacture (two or more coats) and of required shade on new work, over and including priming coat of whiting to give an even shade.	Sqm							
	Sub Total	**Sqm**					**53.26**	**30.00**	**1597.80**
29	Painting with synthetic enamel paint of approved brand and menufacture to give and even shade.								
	Two or more coats on new work.	Sqm					10.83	38.00	**411.54**
	SANITARY INSTALLATIONS								
30	Providing and fixing white vitreous china pedestral type closet (European type W.C pan) with seat and lid, 10 litre low level white P.V.C flushing cistern with manually controlled devices (handle lever) conforming to IS: 7231 with all; fittings and fixtures complete including cutting and making good the walls and floors wherever required								
	W.C pan with ISI marked white solid plastic seat and lid	Each	1				1.00	**2475.00**	2475.00
31	Providing and fixing P.V.C waste pipe for sink or wash basin including P.V.C waste fittings complete								
	Semi Rigid Pipe								
	32mm dia	Each	1				1.00	**48.00**	48.00
32	Providing and fixing 600X120x5mm glass shelf with edges round of supported on anodised aluminium angle with C.P Brass and guard rail complete with 40 mmlong screws, rawl plugs etc. complete	Each	1				1.00	**251.00**	251.00
33	Providing and fixing toilet paper holder								
	C.P Brass	Each	1				1.00	**147.00**	147.00
34	Providing and fixing soil,waste and vent pipes								
	100mm dia								
	Sand cast iron S&S pipe	Rmt	10				10.00	**518.00**	5180.00
35	Providing and fixing plain bend of required degree								
	75mm								
	Sand cast iron S&S	Rmt	8				8.00	**201.00**	1608.00
36	providing and fixing towel rail complete as directed								
	CP	Each	1				1.00	**398.00**	398.00

37	Providing and fixing PTMT liquid soap container 109 wide , 125 mm high and 112 mm distance from wall of standard shape with bracket of the same materials with snap fittings of approved quality and colour weighing not less than 105 gms.	Each	1				1.00	**189.00**	189.00
38	Providing and fixing complete as directed with all necessary fittings								
	Soap tray (Ordinary)	Each	1				1.00	**150.00**	150.00
	WATER SUPPLY								
39	Providing and fixing GI pipes complete with GI fittings and clamps including cutting and making good the walls etc								
	Exposed on wall								
	32mm dia nominal bore	Rmt	5				5.00	**248.00**	1240.00
	25mm dia nominal bore	Rmt	5				5.00	**206.00**	1030.00
	20mm dia nominal bore	Rmt	3				3.00	**153.00**	459.00
	15mm dia nominal bore	Rmt	2				2.00	**121.00**	242.00
40	Concealed by chiselling or breaking brickwall/CC/R.C.C and making good to damages								
	32mm dia nominal bore	Rmt	1				1.00	**381.00**	381.00
	25mm dia nominal bore	Rmt	2				2.00	**267.00**	534.00
	20mm dia nominal bore	Rmt	6				6.00	**196.00**	1176.00
	15mm dia nominal bore	Rmt	9				9.00	**167.00**	1503.00
41	Providing and fixing C.P brass bib cock of approved quality conforming to IS 8931								
	15mm nominal bore	each	4				4.00	**238.00**	952.00
42	Providing and fixing C.P brass stop cock(concealed) standared designed approved make conforming to IS:8931								
	15mm nominal bore	each	1				1.00	**301.00**	301.00
	Drainage								
43	Constructing brick masonary open surface drain with bricks of class designation 75 in cement morter 1:4 (1 cement : 4 fine sand) including earth excavation,10 cm thick bed concrete 1:5:10 (1 cement: 5 fine sand:10 graded stone aggregate 40 mm nominal size) and 25 mm thick cement concrete 1:2:4(1 cement:2 coarse sand:4 graded stone aggregate12.5 mm nominal size)for filling haunces including 12 mm cement plaster 1:4 (1 Cement :4 coarse sand) with a floating coat of neat cement inside the drain,its top and exposed side including disposal of surplus earth complete.								
	15 cm drain 20 cm average depth								
	With FPS bricks	Rmt					20.00	**354.00**	7080.00
	Total Cost for weight bridge Operator room								**228493.38**

ESTIMATE OF COST FOR SEPTIC TANK									
Sl no.	**Description of items**	**unit**	**Nos**	**Length /dia**	**Breadth**	**depth**	**Quantity**	**Rate(Rs)**	
	EARTHWORK IN EXCAVATION :								
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders (above 0.3m)	cum							
	Septic tank	cum	1	3.55	1.40	2.12	10.54		
	Soak pit upto 3 m depth	cum	1	7.00		0.90	6.30		
	soak pit lower portion	cum	1	1.54		0.20	0.31		
	Sub total	**cum**					**17.15**	**57.00**	**977.34**
2	Sand filling in plinth in layers not exceeding 15 cm including breaking of clods, consolidating by ramming and watering complete as directed.	cum	1	4.25	0.15	2.50	2.18	**479.00**	1044.22
	PLAIN CEMENT CONCRETE								
3	Providing and layingcement concrete in proportion 1:3:6 corresponding to M100 (1 cement :3 carse sand:6 graded stone aggr. 40mm nominal size) including necessary curing complete excluding shuttering								
	floor and foundation	Cum	1	3.40	1.40	0.15	0.71		
	sloping floor	Cum	1	2.90	1.25	0.11	0.41		
	sub total	**Cum**					**1.12**	**2928.00**	**3284.67**
	REINFORCED CEMENT CONCRETE								
4	Providing and laying cement concrete in proportion 1:1:5:3(1 cement:5coarse sand : 3 graded stone aggregate of 20mm nominal size) including curing etc complete excluding shuttering and reinforcement								
	Septic tank slab	Cum	1	3.40	1.25	0.08	0.63		
	soak pit slab	Cum	1	7.00	0.90	0.08	0.47		
	baffle wall	Cum	1	1.15	0.08	0.45	0.04		
	Sub total	**Cum**					**1.14**	**4083.00**	**4664.06**

	REINFORCEMENT								
5	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
		cum					1.26	**5910.00**	7446.60
	FORM WORK								
6	Centering and shuttering including strutting, proping etc and removal of form for.								
	Walls (any thickness) including attached pillasters, buttresses, plinth and string courses etc.								
	baffle wall	sqm	2	1.05	0.45		0.95	**207.00**	195.62
	Suspended floors roofs landings balconies and access platform								
	Septic tank slab	sqm	2	3.40	1.25		8.50		
	soak pit	sqm	1	7.00	0.90		6.30		
	Sub Total	**sqm**					**14.80**	**215.00**	**3182.00**
	BRICK WORK WITH F.P.S BRICKS								
7	Brick work with FPS bricks of class designation 75 in foundation and plinth in								
	cement mortar 1:4 (1 cement:4 coarse sand)								
		Cum	2	3.40	0.25	1.40	2.38		
		Cum	2	1.72	0.25	1.40	1.21		
		Cum	2	1.30	0.20	0.90	0.47		
	Sub total	**Cum**					**4.05**	**2630.00**	**10662.28**
8	Brick work with FPS bricks of class designation 75 in foundation and plinth in								
	cement morter 1:6(1cement :6 fine sand)	cum							
	Upper portion	cum	1	3.40	0.25	0.50	0.43		
	Lower portion	cum	1	3.40	0.25	0.20	0.17		
	Subtotal	cum					0.60	**2440.00**	1451.80
	FLOORING								
9	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) finished with a floating coat of neat cement including cement slurry, but excluding the cost of nosing of steps etc. complete	sqm	1	3.55	1.40		4.97		
	40 mm thick								
	Sub Total	**Sqm**					**4.97**	**212.00**	**1053.64**

	FINISHING								
10	Cement plaster(In fine sand)								
	12mm cement plaster of mix								
	1cement :4 fine sand	sqm	2	3.40		1.40	9.52		
			2	0.65		1.40	1.82		
	Sub total	sqm					11.34	**97.00**	1099.98
11	20mm cement plaster of mix								
	1 cement :4 fine sand								
		sqm	2	0.16	0.75		0.24	**127.00**	30.28
	MANHOLE COVER								
12	Providing and fixing in position pre-cast RCC manhole cover and framr of required shape and approved quality								
	Rectengular shape 650X 450mm internal dimensions	Each					2.00	**1015.00**	2030.00
	INSPECTION CHAMBER								
13	Constructing brick massonary chamber for under ground CI inspection chamber and bends with 75 class designation bricks in cement mortar 1:4(1 cement:4 coarsesand) CI cover with Frame (light duty) 455X610mm internal dimensions total weight of cover with frame to be not less than 38 kg								
	inside dimensions 455X610mm and 45cm deep for single line pipe	each					1.00	**3618.00**	3618.00
	PIPE FITTINGS								
14	Supplying and fitting and fixing ISI marked or similary approved HCI pipe including bolts and nuts and other fittings as required complete and all levels including bellow GL as directed and specified								
	In exposed surfaces or in trenches								
	100m Dia	Each					3.00	**410.00**	1230.00
15	Supplying fitting and fixing HCI plain single equal tee junction with dorr including bolts and nuts and other fittings as required complete at all levels including below GL as directed and specified								
	In exposed surfaces or in trenches								
	100m dia	Each					3.00	**428.00**	1284.00
16	supplying fitting and fixing HCI bend with door including bolts and nuts and other fittings as required complete at all levels including bellow GL as directed and specified								
	In exposed surfaces or in trenches								
	100mm dia	Each					3.00	**428.00**	1284.00

17	Making soak pit 2.5 m diameter 3.0 metre deep with 45X45 cm dry brick honey comb shaft with bricks of class designation 75 and S.W drain pipe 100 mm diameter and 1.20 m long complete as per standard design (Design and specifications enclosed)								
	With F.P.S bricks		1				1.00	**1236.00**	1236.00
	Toatal cost Septic tank								**45774.49**

ESTIMATE OF COST FOR APPROACH ROAD									
Sl. no	**Description of item**	**unit**	**Nos**	**Length/Dia**	**Breadth**	**depth**	**Quantity**	**Rate(Rs.)**	
	Length Road including the portion of Weight Bridge				3.50		1Km		
	Removal of Unserviceable Soil with Disposal upto 1000 metres.								
1	Removal of Unserviceable Soil including excavation, loading and disposal upto 1000 metres, lead but excluding replacement by suitable soil which shall be paid separately as per clause 305.								
			1	100.00	4.00	0.90	360.00		
			1	250.00	4.00	0.55	550.00		
			1	280.00	4.00	0.35	392.00		
			1	370.00	4.00	0.20	296.00		
	sub total	**cum**					**1598.00**	**50.00**	**79900.00**
2	Laying and spreading a surface, pulverising,mixing the spread soil in place with rotavator with 3 per cent slaked lime having minimum content of 70 percent of CaO, grading with motor grader and compacting with the road roller at OMC to the desired density to form a layer of improved sub grade.								
	By mechanical means								
		780		885.00	3.50	0.15	464.63		
				85.00	5.25	0.15	66.94		
				30.00	4.40	0.15	19.80		
	Sub Total	**cum**					**551.36**	**337.00**	**185809.16**
3	Providing and laying bituminous macadam with 100-120 TPH of mix plant producing an average output of 75 tonnes per hour using crushed aggregates of specified grading premixed with bituminious binder, transported to site, laid over a previously prepared surface with paver finisher to the required grade, level and alignment and rolled as per clause 501.6 and 501.7 to achieve the desired compaction								
	Grading I (40 mm nominal size) 80 - 100 mm thick			885.00	3.50	0.08	247.80		
				85.00	5.25	0.08	35.70		
				30.00	4.40	0.08	10.56		
	Sub total	**cum**					**294.06**	**5607.00**	**1648794.42**

	Providing and applying primer coat with bitumen emulsion on prepared surface of granular base including clearing of road srface and spraying primer at the rate shown in 500 - 1 using mechanical means								
4	(ii) Medium porosity								
		cum		885.00		3.50	3097.50		
				85.00		5.25	446.25		
				30.00		4.40	132.00		
	Sub total	**sqm**					**3675.75**	**49.00**	**180111.75**
5	Providing and laying semi dense bituminious concrete with 100-200 TPH batch type HMP producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminious binder @ 4.5 to 5 % of mix and filler, transporting the hot mix to work site, laying with a hydraustatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MoRTH specification clause No. 508 complete in all respect.								
	Grading I : 13 mm (Nominal Size) 35-40 mm thick								
				885.00	3.50	0.04	108.41		
				85.00	5.25	0.04	15.62		
				30.00	4.40	0.04	4.62		
	Sub Total	**cum**					**128.65**	**7213.00**	**927961.47**
6	Providing and applying tack coat with bitumen emulsion pressure distributor ar required rate on the prepared bituminious/ granular surface cleaned with mechanical broom.								
	(iii) Granular surface treated with primer								
				885.00		3.50	3097.50		
				85.00		5.25	446.25		
				30.00		4.40	132.00		
	Sub total	**sqm**					**3675.75**	**13.00**	**47784.75**
	Total Cost for Roadwork								**3070361.55**

COST ESTIMATE FOR RETAINING WALL									
Sl No.	**Description of Items**	**Unit**	**Nos**	**Length / Dia**	**Breadth**	**Depth**	**Quantity**	**Rate (Rs.)**	
	EARTHWORK								
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders (above 0.3m each)								
	for 9 m high retaining wall			75.00	2.65	3.00	596.25		
	for 7.75 m (Avg.) high retaining wall			175.00	2.15	2.50	940.63		
	for 6.25 m(Avg) high retaining wall			85.00	1.95	2.50	414.38		
	Sub total	**cum**					**1951.25**	**57.00**	**111221.25**
	PLAIN CEMENT CONCRETE								
2	Providing and laying cement concrete in proportion 1:2:4 corresponding to M150 (1 cement , 2 sand, 4 graded stone aggregates of 20 mm nominal size) including necessary curing complete, excluding shuttering , in foundation and below plinth and in septic tank inspection pits etc, complete								
	for 9 m high retaining wall			75.00	2.65	0.20	39.75		
	for 7.75 m (Avg.) high retaining wall			175.00	2.15	0.20	75.25		
	for 6.25 m(Avg) high retaining wall			85.00	1.95	0.20	33.15		
	Sub total	**cum**					**148.15**	**3521.00**	**521636.15**
	COURSED RUBBLE MASONRY								
3	Providing coursed random rubble masonry in foundation and plinth with unsized stone (mawthup) bonded with cement mortar of proportion 1:6 (1 cement , 6 sand including curing) complete (Average size is not less than 20 cm x 20 cm x 25 cm)								
	for 9 m high retaining wall			71.50	2.25	2.80	450.45		
	for 7.75 m (Avg.) high retaining wall			164.20	1.75	2.30	660.91		
	for 6.25 m(Avg) high retaining wall			79.60	1.40	2.30	256.31		
	Sub total	**cum**					**1367.67**	**2016.00**	**2757216.67**

4	Providing coursed random rubble masonry in super structure above plinth with unsized stone (mawthup) bonded with cement mortar of proportion 1:6 (1 cement , 6 sand including curing) complete (Average size is not less than 20 cm x 20 cm x 25 cm)								
	for 9 m high retaining wall			71.50	1.23	6.00	525.53		
	for 7.75 m (Avg.) high retaining wall	cum		164.20	0.98	4.00	640.38		
	for 6.25 m(Avg) high retaining wall			79.60	0.73	3.50	201.99		
	Sub total	**cum**					**1367.89**	**2126.00**	**2908134.14**
	FORMWORK								
5	Centering and shuttering including strutting, proping etc and removal of form for.								
	Foundation, footing, bases of columns etc. for mass concrete.								
	for 9 m high retaining wall	sqm	32		0.30	2.80	26.88		
	for 7.75 m (Avg.) high retaining wall	sqm	72		0.30	2.30	49.68		
	for 6.25 m(Avg) high retaining wall	sqm	36		0.30	2.30	24.84		
	Sub total	**sqm**					**101.40**	**137.00**	**13891.80**
	Walls (any thickness) including attached pillasters, buttresses, plinth and string courses etc.								
	for 9m high retaining wall	sqm	32	6.00	0.30		57.60		
	for 7.75 m (Avg.) high retaining wall	sqm	72	4.00	0.30		86.40		
	for 6.25 m(Avg) high retaining wall	sqm	36	3.50	0.30		37.80		
	Sub total	**sqm**					**181.80**	**207.00**	**37632.60**
	REINFORCED CEMENT CONCRETE								
6	Providing and laying cement concrete in proportion 1:2:4 corresponding to M150 (1 cement , 2 sand, 4 stone aggregates of 20 mm nominal size) including necessary curing complete, excluding shuttering , in foundation and below plinth								
	Foundation								
	for 9 m high retaining wall	cum	16	0.30	2.25	2.80	30.24		
	for 7.75 m (Avg.) high retaining wall	cum	36	0.30	1.75	2.30	43.47		
	for 6.25 m(Avg) high retaining wall	cum	18	0.30	1.40	2.30	17.39		
	Sub total	**cum**					**91.10**	**3521.00**	**320756.06**

7	Providing and laying cement concrete in retaining walls, return walls, walls (any thickness) including attached pillaster, columns, piers, abutments, pillars, posts, struts, buttresses, string or lacing courses, parapets, coping, bed blocks, anchor blocks,plain window sills, fillets etc. up to floor five level, excluding the cost of centering, shuttering and finishing.								
	1:2:4 (1 Cement : 2 coarse sand : 4 graded stone aggregate 40 mm nominal size)								
	for 9 m high retaining wall		16	0.30	1.23	6.00	35.28		
	for 7.75 m (Avg.) high retaining wall		36	0.30	0.98	4.00	42.12		
	for 6.25 m(Avg) high retaining wall		18	0.30	0.73	3.50	13.70		
	Sub total	**cum**					**91.10**	**3571.00**	**325327.03**
	REINFORCEMENT								
8	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
	Sub total	**qntl**		**85.65**			**85.65**	**5910.00**	**506191.50**
9	Providing and fixing of UPVC 150mm dia pipes for weep holes								
	for 9 m high retaining wall		150	1.23			183.75		
	for 7.75 m (Avg.) high retaining wall		234	0.98			228.15		
	for 6.25 m(Avg) high retaining wall		110	0.73			79.75		
	Sub total	**rmt**					**491.65**	**825.00**	**405611.25**
10	Providing boulder or stone filling with boulders or stones 15 cm size, 40 cm wide behind the retaining wall etc complete as directed.								
	for 9 m high retaining wall			75.00	0.40	6.00	180.00		
	for 7.75 m (Avg.) high retaining wall			175.00	0.40	5.25	367.50		
	for 6.25 m(Avg) high retaining wall			85.00	0.40	3.75	127.50		
	Sub Total	**cum**					**675.00**	**902.00**	**608850.00**
	Total Cost of Retaining wall								**8516468.45**

ESTIMATE OF COST FOR SANITARY LANDFILL SITE									
Sl. No	**Description of items**	**Unit**	**Nos**	**length/Dia /area**	**Breadth**	**Depth**	**Quantity**	**Rate (Rs)**	
	EARTHWORK,EROSION CONTROL & DRAINAGE								
1	Removal of unserviceable Soil including excavation, loading and disposal upto 1000 metres, lead but excluding replacement by suitable soil which shall be paid separately as per clause 305.	cum							
	Sub total	**cum**	**1**	**15000.00**		**0.75**	**11250.00**	**50.00**	**562500.00**
2	Consolidation of Base of landfill with power road roller of 8 to 12 tonne capacity including making good the undualatioMarket Rate etc. with earth etc. and rerolling the base of land fill area.	sqm							
	Sub total	**sqm**	**1**	**15000.00**			**15000.00**	**2.00**	**30000.00**
3	Supplying and filling of earth (clay)/ ammended soil with 10% bentonite mix in layers not exceeding 30cm in depth consolidating each deposited layer by ramming and watering ,including royalty of earth ,for all leads and lifts (the work is to be excuted as per drawings and direction of Engr. in charge)								
		cum	**1**	**15000.00**		**0.90**	**13500.00**	**460.00**	**6210000.00**
4	Providing & fixing 1.5 mm HDPE geomembrans at land fill site including insitu welding of HDPE membrans,laying,anchoring in trench,seaming,testing as per manufacture's directions as per standard design & drawings								
		sqm	1	15000.00			**15000.00**		
	Sub-total	**sqm**					**15000.00**	**33.00**	**495000.00**
5	Providing & fixing HDPE pipes (PN$,PE 80) IS 14333-1996/ UPVC PIPE (IS:12818/1992) of approved make for leachate, collection and connected to leachate holding tank as per standard design & drawings with all necessary accessories etc. all complete								
	150mm dia.OD	Rmt	1	1135.00			**1135.00**	**825.00**	**936375.00**
	250mm dia.OD	Rmt	1	265.00			**265.00**	**3400.00**	**901000.00**
6	Providing and fixing non-woven needle punched polypropylene geotextile (195GSM) including wrapping around 150dia.HDPE pipes for the leachate collection network conforming to technical specificatioMarket Rate etc.all complete as per approved design	sqm							
	150mm dia.OD	sqm	1	1135.00	0.50		**567.50**	**75.00**	**42562.50**
	250mm dia.OD	sqm	1	265.00	0.85		**225.25**	**75.00**	**16893.75**
7	Supplying and filling in open areas/sloping areas with locally available silty sand including dressing complete as per drawings and direction by the engineer-in-charge.(slope 1:1000)								
		cum	1	15000.00		0.30	**4500.00**		
	Subtotal	**cum**					**4500.00**	**575.00**	**2587500.00**

8	Supplying & filling in open areas / sloping areas with locally available COARSE SAND including dressing complete as per drawings and direction of engineer-in-charge	cum							
		cum	1	15000.00		0.30	**4500.00**		
	Sub total	**cum**					**4500.00**	**1275.00**	**5737500.00**
9	providing and fixing vent pipes to be erected on top of H.D.P.E geomembrane sheet. The bottom portion of the pipe should be perforated all round(the holes should be 12 mm dia at 80 mm triangular pitch upto 50 cm from bottom) in the landfill area at regular intervals as directed by the Engineer-in-charge.								
	100 mm dia U.P.V.C. pipe(I.S. 12818/1992) 3 meter long with U.P.V.C end cap -110mm dia.	each	40				**40.00**	**1460.00**	**58400.00**
10	Providing and fixing terminal guard								
	110 mm dia U.P.V.C	each	40				**40.00**	**75.00**	**3000.00**
11	Providing 5 H.P capacity diesel operated portable water pump of 80 mm dia suction of 65 mm dia outlet with flexible pipe suction 15 m length and delivary atleast-50 m length complete including trolly mounted base								
	Sub total	**Each**	**2**				**2.00**	**45000.00**	**90000.00**
12	Supplying and dibbling of selected lawn grass [Doob grass (Cynodon dactylon) carpet grass (Axonopus affinis)] after preparing the land by ploughing / working to a depth of 40-45 cm, removing of all unwanted debries (rubbies, pebbles, plant roots etc.) mixing of organic manure (10 Kg-15 Kg/sqm), levelling the surface and initial maintenance by proper and periodic rolling, mowing and irrigation etc. (as specified) for a period of six months from the date of dibbling including the application of recommended dose of fertilizers (N:P:K) mixture as specified and directed by the engineer in charge.								
	a) By Doob grass (Cynodon Dactylon)	Sqm	1	40.00	50.00		2000.00		
			1	9.00	50.00		450.00		
	Sub total	**Sqm**					**2450.00**	**225.00**	**551250.00**
13	Supplying and planting of ornamental trees (plant sapling height 1/-00//) including pit making (60 cm X 60 cm X 60 cmm), filling the pit with appropriate soil media, manure and fertilizers as per specification and necessary maintanance for a period of one year from the date of planting complete as specified and directed by the engineer in charge.								
	a) Pine Tree	Each					1600.00		
	Sub total						**1600.00**	**307.00**	**491200.00**
	Total Cost for Sanitary Landfill Site								**18713181.25**

Cost Estimate for Fencing									
Sl No.	**Description of Items**	**Unit**	**Nos**	**Length**	**Breadth**	**Depth**	**Quantity**	**Rate**	
				/Dia				(Rs.)	(Rs.)
1	1.8 m high fencing with 2.4m angle iron 50X50X6 posts place every 3 m apart embedded in cement concrete blocks every 15 post last but one end post and corner post shall be strutted on both side and end post on side only provided with 12 horizontal lines and 2 digonals intr woven with horizontal wires of barbed wire 9.38 Kg per 100m (min) between the two post and fixed with GI staples,turn buckles etc. complete.(Cost of post, struts,earth work and concrete to be paid for seperately)	Rmt		980			980		
	sub total	**Rmt**					**980**	**105.00**	**102900**
2	Providing steel works in Tees , flats, angles and channel including cutting, drilling holes, hoisting and fixing in position complete								
	Posts @ 3.0 m apart(angle 50 x 50 x 6)	qnt		588			26.46		
	Stiffeners on both sides of posts @ 10 m apart (angles 40 x 40 x 6)	qnt		294			10.29		
	sub total	**qnt**					**36.75**	**4482.00**	**164713.5**
3	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders (above 0.3m)	cum							
		cum	99	0.25	0.25	0.6	3.7125		
		cum	99	0.25	0.25	0.5	3.09375		
	sub total	**cum**					**6.80625**	**57.00**	**387.95625**
4	Providing and laying cement concrete in proportion 1:2:4 corresponding to M150 (1 cement , 2 sand, 4 graded stone aggregates of 20 mm nominal size) including necessary curing complete, excluding shuttering , in foundation and below plinth and in septic tank inspection pits etc, complete								
		cum	99	0.25	0.25	0.6	3.7125		
		cum	99	0.25	0.25	0.5	3.09375		
	sub total	**cum**					**6.8063**	**3521.00**	**23964.81**
	Total cost of Fencing								**291966.26**

ESTIMATE OF COST FOR DRAIN NEAR LANDFILL SITE									
Sl. No	**Description of items**	**Unit**	**Nos**	**length/Dia /area**	**Breadth**	**Depth**	**Quantity**	**Rate (Rs)**	
	DRAIN NEAR LANDFILL SITE								
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders (above 0.3m)	cum							
	Average depth =0.45 m, Width = 0.45 m	cum	1	530	0.8	0.45	**190.8**		
	Sub total						**190.8**	**57.00**	**10875.6**
2	Providing and laying cement concrete in proportion 1:3:6(I cement:3 sand:6 graded stone aggregate of 40 mm nominal size) including necessary curing complete excluding shuttering								
		cum		530	0.8	0.1	**42.4**		
	Sub total	**cum**					**42.4**	**2928.00**	**124147.2**
3	Providing shuttering including centering for flat surface such as slabs, chajja and for vertical faces such as columns, walls,ends of beams etc with dressed plank not less than 25cm thick firmly fixed etc complete as directed .								
	applicable upto 3.30 m height	sqm							
	outer side	sqm	2	530	0.9		**954**		
	inner side	sqm	2	530	0.8		**848**		
	Sub total	**sqm**					**1802**	**162.00**	**291924**
	Plain Cement Concrete								
4	Providing and laying cement concrete in proportion 1:2:4 corresponding to M150 (1 cement , 2 sand, 4 graded stone aggregates of 20 mm and down graded) including necessary curing complete, excluding shuttering , in foundation and below plinth and in septic tank inspection pits etc, complete								
	side wall	cum	2	465	0.1	0.9	**83.7**		
	bottom floor	cum	1	465	0.45	0.1	**20.925**		
	Sub total	**cum**					**104.625**	**3521.00**	**368384.625**

	Reinforced cement Concrete								
5	Providing and laying cement concrete in proportion 1:2:4 corresponding to M150 (1 cement , 2 sand, 4 graded stone aggregates of 20 mm nominal size) including necessary curing complete, excluding shuttering , in foundation and below plinth and in septic tank inspection pits etc, complete								
	Side wall	qnt	2	40	0.1	0.9	**7.2**		
	bottom floor	cum	1	40	0.45	0.1	**1.8**		
	slab	qnt	1	40	0.65	0.2	**5.2**		
	Sub total						**14.2**	**3521.00**	**49998.2**
6	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
	Sub total	**qntl**					**15.62**	**5910.00**	**92314.2**
	Total cost for drains								**937643.83**

Cost Estimate of Leachate holding tank									
Sl No.	**Description of Items**	**Unit**	**Nos**	**Length /Dia**	**Breadth**	**Depth**	**Quantity**	**Rate (Rs.)**	**(Rs.)**
	EARTHWORK								
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders(above 0.3m)	cum							
			1	14.00	6.20	0.45	39.06		
	Sub total	**cum**					**39.06**	**57.00**	**2226.42**
2	Providing and laying cement concrete in proportion 1:2:4 corresponding to M150 (1 cement , 2 sand, 4 stone aggregates of 20 mm nominal size) including necessary curing complete, excluding shuttering , in foundation and below plinth and in septic tank inspection pits etc, complete								
		cum	1	13.90	6.00	0.15	12.51		
	Sub total	**cum**					**12.51**	**3521.00**	**44047.71**
3	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M200 (1 cement:1.5 sand : 3 graded stone aggregates of 20 mm nominal size) including necessary curing complete, (excluding shuttering and reinforcement)								
		cum	1	13.70	5.80	0.30	23.84		
		cum	2	12.30	0.30	0.30	2.21		
		cum	4	5.60	0.30	0.30	2.02		
		cum	1	5.00	0.30	0.30	0.45		
		cum	4	1.00	0.30	0.30	0.36		
	Sub total	**cum**					**28.88**	**4083.00**	**117908.87**
4	Centering and shuttering including strutting, proping etc and removal of form for.	sqm							
	Foundation, footing, bases of columns etc. for mass concrete.		2	13.70	0.30		8.22		
			2	5.80	0.30		3.48		
			4	12.30	0.30		14.76		
			8	5.60	0.30		13.44		
		cum	2	5.00	0.30		3.00		
			8	1.00	0.30		2.40		
	Sub total						**45.30**	**137.00**	**6206.10**

	Reinforcement								
5	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
	Sub total	**qntl**	**28.878**				**31.77**	**5910.00**	**187735.88**
6	Providing coursed random rubble masonry in super structure above plinth with unsized stone bonded with cement mortar of proportion 1:6 (1 cement , 6 sand including curing) complete (Average size is not less than 20 cm x 20 cm x 25 cm)								
		cum	2	12.30	0.30	1.70	12.55		
		cum	2	5.60	0.30	1.70	5.71		
		cum	3	5.00	0.30	1.70	7.65		
	Sub total	**cum**					**25.91**	**2126.00**	**55080.41**
7	Providing 12 mm thick cement plaster i/c cleaning the surface and curing complete as directed								
	(a) Proportion 1:4 (1 Cement : 4 Fine Sand)								
		sqm	4		12.30	2.00	98.40		
		sqm	4		5.60	2.00	44.80		
		sqm	6		5.00	2.00	60.00		
	Sub total	**sqm**					**203.20**	**96.00**	**19507.20**
8	Providing cement concrete floor 65 mm thick in proportion 1:3:6 (1 cement: 3 sand :6 stone aggregate 20 mm nominal size) to the proper level and slopes including ramming and curing complete as directed.								
		sqm	1	10.00	5.00		50.00		
			2	5.00	1.00		10.00		
	Sub total	**sqm**					**60.00**	**205.00**	**12300.00**
9	Rough filtration bed								
	40 mm nominal size aggregate	cum	1	6.70	5.00	2.00	67.00	**750.00**	**50250.00**
10	Fine aggregate filtration bed	cum							
	River course sand 2 mm to 4.75 mm grain size	cum	1	3.30	5.00	2.00	33.00	**600.00**	**19800.00**
11	Supplying and fixing 100 mm dia soil pipes etc(1.80 m each) including cement mortar chaulk joints laid to the proper level, excavating the foundation and filling, dressing complete as directed.								
	(a) PVC	Rm	1	10.00			10.00		
	Sub total	**Rm**					**10.00**	**314.00**	**3140.00**
	Total Cost for Leachate Holding Tank								**518202.59**

ESTIMATE OF COST FOR TUBE WELL WITH PUMPING MAIN									
Sl no.	**Description of items**	**Unit**	**Nos**	**Length/dia**	**breadth**	**depth**	**quantity**	**Rate(Rs)**	
1	Construction of tube well from ground level and upto 100 m depth and above to accommodate housing and assembly pipe of following sizes in all types alluvium strata per percussion /rotary drilling method and with gravel as per IS :4097-1967 and packing as per Is:2800 (Part ii) 1979 as ameded uptodate (the work includes the cost of gravel and its primary packing during development loweing of housing and strainer assembly pipes with supply and wrapping of coir rope wherever necessary for arresting fine sand particles the work will not include cost of housing pipe and strainer pipe assembly and devlopment work but work would be completed after obtaining sand free water)								
	150mm dia nominal bore	Rmt	1	100.00			100.00	1200.00	
2	Devlopment of tube well as per IS speifications using suitable compressor to give sand free water for required yeild of the gravel packed tube well	Hr	1	24.00			24.00	2500.00	60000.00
3	Supply of ERW M.S black casing pipe ISI mark(Is:4270/1992)of grade fe-410 of following changes at site of work	Rmt	1	40.00			40.00	900.00	36000.00
	150mm nominal bore of pipe								
	168.3mm outside dia of pipe								
	5mm thickness of pipe								
4	Supply of strainer pipes made of ERW M.S black pipe ISI mark of following sizes at the site of work including required size of slopping as per IS:8100-1985 150mm nominal bore	Rmt	1	10.00			10.00	900.00	9000.00
5	Testing vertically of tube well by plumbing system and yeild test and draw down test by pumping system as per IS:2800 (Part II 1979)	Each	1				1.00	12000.00	12000.00
6	S & F tube well cover of MS sheet 6mm thick with nuts and bolts complete for casing size								
	150mm dia	Each	1				1.00	2000.00	2000.00
7	S & F MS clamp,set of 50X6mm flat iron with nuts and bolts etc for holding the riser pipe assembly of suumarisable pump set	Each	1				1.00	2000.00	2000.00
8	Constrution of 185cm dia platform as per approved design	Each	1				1.00	4500.00	4500.00

9	Supplying and Instatllation of submersible pumping motor pump sets ISI market (IS-8034-1989) of approved make like KSB, Kirloskar, Calama etc or equivalent ,making connection suitable for TW/DCB/Open Well .The job includes screwing and welding of flanges on FI riser pipes ,installation of complete fitting and acessories with riser pipes,jointing of elctrical cables and other connections making switch board electrical connections,earthing arrangemnts etc all lobour fo rtesting of dsubmersible pumps sets and supply of water to water mains ,complete in all respects.	Hr	1	24.00			24.00	2500.00	60000.00
	15 HP Power								
	93-133 M Head								
	24-12 cum/hr discharge								
10	Providing Fixing 80 mm nominal bore ,GI pipes complete with GI fittings including trenching and refilling etc	Rmt	1	10.00			10.00	600.00	6000.00
	Total Cost of Tube Well With Pumping Main								**191500.00**

ESTIMATE OF COST FOR GROUND LEVEL RESERVOIR									
Sl no.	**Description of items**	**unit**	**Nos**	**Length/dia**	**Breadth**	**depth**	**Quantity**	**Rate(Rs)**	
			Civil Work						
EARTHWORK									
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders(above 0.3m)	Cum	1	10.00		1.95	153.15		
	Sub total	**Cum**					**153.15**	**57.00**	**8729.44**
PLAIN CEMENT CONCRETE									
2	Providing and laying cement concrete in proportion 1:2:4 corresponding to M150 (1 cement, 2 sand, 4 graded stone aggregate of 20 mm nominal size) including necessary curing complete, excluding shuttering in foundation and below plinth and in septic tank inspection pits etc, complete								
	Sump	Cum	1	9.15		0.15	9.86		
	Sub total	**Cum**					**9.86**	**3521.00**	**34727.74**
WATER PROOFING									
3	Providing and laying five courses water proofing treatment with bitumen felt over PCC consisting of first and third and fifth course of blown bitumen 85/25 or 90/15 conforming to IS : 702 applied hot @ 1.45 Kg per square metre of area for each course,second and fourth course of PCC felt type 3 grade-1conforming to IS 1322 menufactured by Bengal Bitumen, STP Ltd. Arcus Ltd. Etc. including preparation of surface but excluding grading complete.	Sqm	1	9.15			65.75		
	Sub Total		**1**				**65.75**	**310.00**	**20383.60**
Steel Work									
4	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
	Steel	Qtl					51.81		
	Subtotal	**Qtl**					**51.81**	**5910.00**	**306206.56**
FORMWORK									
5	Centring,shuttering including struting, propping and removal of form for								
	Foundation footing base of column etc for mass concrete	Cum	1	9.00		0.30	8.48		
	Sub total	**Cum**					**8.48**	**137.00**	**1162.04**

6	Walls (any thickness) including attached pilasters ,butteresses plinth and string courses etc.	Sqm	1	8.00		2.20	55.29		
		cum	1	7.50		2.20	51.83		
	Sub total	**Sqm**					**107.13**	**207.00**	**22174.92**
7	Lintels beams plinth beams griders brssumers and cantilevers	Sqm	1	7.50		0.30	7.07		
			1	8.30		0.30	7.82		
	Sub total	**Sqm**					**14.89**	**187.00**	**2784.56**
8	Arches domes vaults exceeding 6 m span	Sqm	1	7.50			68.36		
	Sub total	**Sqm**					**68.36**	**590.00**	**40331.83**
REINFORCED CEMENT CONCRETE									
	Design Mix concrete								
9	Providing and laying in position machine batched machine mix,machine vibrated design mix cement concrete including pumping of concrete to site of laying but excluding of the cost of shuttering ,centring finshing and reinforcement including admixtures in recommended proportions as per IS 9103 to accelerate retard setting of concrete, improve workability without impairing strength and durability as per direction of engineer in charge. M25 grade reinforced cement concrete by using 410 kg of cement per cum of concrete. All work upto floor V level.								
	All work upto plinth level								
	Sump								
	Base slab	Cum	1	9.00		0.30	19.08		
	Walls columns pillars post and struts								
	Walls	Cum	1	8.00	0.25	2.20	13.39		
	Sub total	**Cum**					**32.48**	**4770.00**	**154906.97**
10	Reinforced cement concrete in arches archribs domes vaults shells folded plates and roofs having slope more than 15 degrees up to floor V level excluding the cost of centring,shuttering finishing and reinforcement.								
	Dome	Cum		12.80		0.10	6.89		
	Ring beam	Cum	1	8.30	0.40	0.30	2.98		
	Sub total	**Cum**					**9.87**	**6240.00**	**61572.90**
FLOORING									
11	Cement plaster dado with cement mortar 1:3 (1 cement :3 coarse sand) finished with a floating coat of a neat cement								
	18mm thick	Sqm	1	23.56	3.00		70.68		
	Sub total	**Sqm**					**70.68**	**193.00**	**13641.96**

ADMIXTURE AND CHEMICALS									
12	Providing and applying a superplasticising concrete admixture Sikament® or equivalent to produce very high early strength concrete floor slabs, foundations, slender components with dense reinforcement as in walls,columns,cantilever etc.	Kg per Cum					42.30		
	Sub Total						**42.30**	**378.00**	**15989.40**
13	Applying & spraying Antisol A or equivalent on newly laid concrete surfaces to form a thin film barrier against premature water loss without disturbing the normal setting action of concrete so as to achieve maximum properties for large areas of exposed concrete such as roof decks, water tanks ,balcony etc.	Kg/Cum					42.30		
	Sub Total						**42.30**	**76.00**	**3214.80**
14	Applying double coated bonding chemical to existing reinforcement and cement concrete for improving structural bonding of old and new concrete including cleaning, roughening etc. of existing surface @ 0.55 Kg per Sqm.	Sqm	2	8.20			16.40		
	Sub Total						**16.40**	**953.00**	**15626.02**
PLASTERING									
15	15 mm Cement plaster in wall finished with a floating coat of neat cement	Sqm							
	1:3 (1 Cement: 3 fine sand)		1	23.56		3.00	70.68		
	Sub Total						**70.68**	**140.00**	**9895.73**
16	6 mm cement plaster to ceiling / dome 1:3 (1 cement :3 fine sand)	Sqm	1	7.50			52.99		
	Sub Total						**52.99**	**101.00**	**5351.99**
17	Neat cement punning of the inside surface of wall	Sqm	1	23.56		3.00	70.68		
	Sub Total						**70.68**	**49.00**	**3463.50**
FILLING									
18	Earthwork in filling with available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm thick including breaking clods consolidating each layer by ramming and watering, lead upto 50m and lift upto 1.5m								
	Total excavated by						153.15		
	Deduct	Cum	1				-45.00		
	Subtotal						**108.15**	**46.00**	**4974.81**

PLINTH PROTECTION									
19	Making plinth protection 50 mm thick of cement concrete 1:3:6 (1 Cement:3:Coarse sand: 6 graded stone aggregate of 20 mm nominal size) over 75 mm bed of dry brick ballast 40 mm nominal size well rammed and consolidated and groutedwith fine sand including finishing the top smooth. (width 1.00 m)	Sqm	1	10.00			28.27		
	Sub Total						**28.27**	**290.00**	**8199.32**
PAINTING WORK									
20	Painting wall at the ground floor level with approved water proof cement paint (Snowcem and the like) to the new works including cleaning the surface etc complete.								
	Two coats								
	Cylindrical wall outside	Sqm	1	25.12		3.00	75.36		
	Dome top	Sqm	1	54.10		1.20	64.93		
	Sub Total	**Sqm**					**140.29**	**48.00**	**6733.70**
WATER SUPPLY									
	GI pipes and fittings								
21	providing and fixing GI pipes complete with GI fittings including trenching and refilling etc.(external work)	Rmt	1	14.00			14.00		
	80 mm nominal bore								
	Sub total	**Rmt**					**14.00**	**419.00**	**5866.00**
	BRASS FITTING								
22	Providing and fixing gunmetal gate valve with CI wheel of approved quality (screwed end)	Each	2				2.00		
	80 mm nominal bore	Each					2.00		
	Sub total	**Each**					**2.00**	**1574.00**	**3148.00**
23	Providing and fixing P.V.C encapsulated rungs with all fixing arrangements including the cost of MS flat iron 50x6 mm section -3 Nos. Vertical to be fitted with 25x25x4 mm, 75 mm length to the inside vertical surface of the water tank E. Rungs to be fitted with MS flats 150 mm c/c (staggered) by 10 mm dia bolts and nuts of suitable length	Rmt.		3.00			3.00		
	Sub total	**Rmt.**					**3.00**	**5850.00**	**17550.00**
24	Supply and fixing C.I cover without frame for manholes:								
	560 mm diameter C.I cover (Heavy Duty) the weight of cover to be not less than 108 Kg.	Nos	2				2.00		
	Sub total	**Nos**					**2.00**	**2,700.00**	**5400.00**

25	Providing and placing in position suitable PVC water stops conforming to IS 12200 of Deep Jyoti or equivalent for construction/ expansion joints between two RCC member and fixed to the reinforcement with binding wire before pouring concrete etc. complete.								
	Kickers (320 mm wide,5 mm thick)	**Rmt**					24.33	573.00	13941.09
	Total cost for ground level Reservoir (7.5 Dia internal dia)								**785976.89**

Cost estimate for fire fighting arrangement						
Sl no.	**Description of items**	**unit**	**Nos**	**Quantity**	**Rate(Rs)**	**Amount(Rs)**
1	Supplying, installing, fixing of dry chemical powder fire extinguisher conforming to IS: 10658 with ISI mark and CO2 cylinder will be conforming to IS:4308 with ISI mark (extinguisher will be trolley mounted) (50Kg.)					
	Fire extinguisher and CO2 cartidge will be MINIMAX/FIRE SHIELD	Each	3	3	33200.00	99,600.00
	Total Cost					**99,600.00**

Cost Estimate for Primary Transportation vehicle Garage

Sl No.	Description of Items	Unit	Nos	Length /Dia	Breadth	Depth	Quantity	Rate (Rs.)	(Rs.)
	EARTHWORK								
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders (above 0.3m)								
	For footing	Cum	22	2.30	2.30	1.65	192.03		
	For plinth	Cum	1	20.40	0.50	1.65	16.83		
		Cum	1	10.90	0.50	1.65	8.99		
	Sub Total	**Cum**					**217.85**	**57.00**	**12417.42**
	FILLING								
2	Earthwork in filling with available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm thick including breaking clods consolidating each layer by ramming and watering, lead upto 50m and lift upto 1.5m	Cum	1				175.71		
	For ramp	Cum	2	35.50	1.50	0.30	31.95		
	Sub Total	Cum					**207.66**	**46.00**	**9552.36**
3	Sand filling in plinth in layers not exceeding 15 cm including breaking of clods, consolidating by ramming and watering complete as directed.	Cum	1	35.5	15	0.30	159.75		
	Sub Total	**Cum**					**159.75**	**479.00**	**76520.25**
	CONCRETE WORK								
4	Providing and laying cement concrete in proportion 1:3:6 corresponding to M10 (1 cement, 3 sand,6 stone aggregates of 40 mm nominal size) upto plinth level including necessary curing excluding shuttering.								
	Under footing	Cum	22	2.30	2.30	0.15	17.46		
	Under brikwork	Cum	2	31.65	0.50	0.10	3.17		
		Cum	1	14.80	0.50	0.10	0.74		
	Sub Total	**Cum**					**21.36**	**2928.00**	**62547.94**

	REINFORCED CEMENT CONCRETE								
	Design Mix Concrete	cum							
	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M200 (1 cement:1.5 sand : 3 graded stone aggregates of 20 mm nominal size) excluding shuttering and reinforcement)								
	All work upto plinth level								
5	In footing	Cum	22	0.35	0.35	0.95	2.56		
		Cum	22	1.23	1.23	0.30	9.90		
		Cum	22	2.00	2.00	0.25	22.00		
	Sub Total	**Cum**					**34.46**	**4083.00**	**140718.0431**
	Plinth Beam	Cum	1	15.50	0.35	0.30	1.63		
		Cum	2	35.50	0.35	0.30	7.46		
	Sub Total	**Cum**					**9.08**	**4125.00**	**37465.3125**
	Reinforcement								
6	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
				43.55			47.905		
	Sub Total	**qntl**					**47.905**	**5910.00**	**283118.55**
7	Providing steel works in tees,flats,angles and channels including cutting, drilling holes,hoisting and fixing in position in complete.	qntl					75.67		
	Sub Total	**qntl**					**75.67**	**4882.00**	**369420.94**
	Formwork								
8	Centering and shuttering including strutting, proping etc and removal of form for.								
	Foundation, footing, bases of columns etc. for mass concrete.	Sqm	88	2.00		0.25	44.00		
		Sqm	88	0.35		0.95	29.26		
	Sub Total	**Sqm**					**73.26**	**137.00**	**10036.62**
	Lintel, beams, plinth beams, girders, bressumers and cantilevers.								
	Plinth Beam	Sqm	2	51.00		0.3	30.60		
	Sub Total	**Sqm**					**177.12**	**187.00**	**33121.44**
	BRICK WORK with F.P.S. BRICKS								
9	Brick work with F.P.s bricks of class designation 75 in foundation and plinth in								
	Cement mortar 1:6 (I cement : 6 coarse sand)	Cum	1	63.30	0.35	1.20	26.59		
		Cum	1	14.80	0.35	1.20	6.22		
	Sub Total	**Cum**					**32.80**	**2440.00**	**80036.88**

	FLOORING								
10	Providing and laying cement concrete in proportion 1:2:4 corresponding to M150 (1 cement, 2 sand,4 stone aggregates of 20 mm nominal size) upto plinth level including necessary curing excluding shuttering.								
	In Floors	cum	1	34.30	14.30	0.2	98.10		
	Sub Total	cum					**98.10**	**3521.00**	**345403.06**
11	Painting with synthetic enamel paint of approved brand and menufacture to give and even shade.								
	Two or more coats on new work.	Sqm					750.00	38.00	**28500.00**
	ROOF								
12	Providing steel work in built up tubular trusses including cutting , hoisting , fixing position, including welding etc and applying a coat of approved steel primer conplete as directed.	**Qntl**					74.00	**6776.00**	**501424**
13	Providing corrugated galvanised iron sheet roofing fixed with galvanised iron J or L hooks, bolts and nuts, 8 mm diameter with bitumen and GI limpet washers or GI limpet washers filled with white lead complete excluding the cost of purlins, rafters ad trusses.								
	0.63 mm thick	**Sqm**		35.5	15.00		543.045	**437.00**	**237310.665**
14	Providing ridges 450 mm overall width in plain GI sheet, 225 mm lappage, with galvanised iron J or L hooks, coach screws and washers complete.								
	0.63 mm thick	**Metre**					32.00	**228.00**	**7296**
15	Providing and fixing MS round holding downbolts with nuts and washer plates complete	**Kg**					52.00	**59.00**	**3068**
	Total Cost for Primary Transportation vehicle Garage								**2237957.476**

Cost Estimate for Secondary Transportation Vehicles Garage

Sl No.	Description of Items	Unit	Nos	Length	Breadth	Depth	Quantity	Rate	
	EARTHWORK								
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders(above 0.3m)								
	For footing	Cum	12	2.30	2.30	1.65	104.74		
	For plinth	Cum	2	11.90	0.60	1.20	17.14		
		Cum	2	4.60	0.60	1.20	6.62		
	Sub Total	**Cum**					**128.50**	**57.00**	7324.61
	FILLING								
2	Earthwork in filling with available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm thick including breaking clods consolidating each layer by ramming and watering, lead upto 50m and lift upto 1.5m	Cum	1				57.54		
	For ramp	Cum	1	27.50	1.50	0.30	12.38		
	Sub Total	Cum					**69.92**	**46.00**	3216.09
3	Sand filling in plinth in layers not exceeding 15 cm including breaking of clods, consolidating by ramming and watering complete as directed.	Cum	1	27.50	7.5	0.30	61.88		
	Sub Total	**Cum**					**61.88**	**479.00**	29638.13
	CONCRETE WORK								
4	providing and laying cement concrete in proportion 1:2:4 corresponding to M150 (1 cement, 2 coarse sand,4 graded stone aggregates of 40 mm nominal size) upto plinth level including necessary curing excluding shuttering.								
	Under footing	Cum	12	2.30	2.30	0.15	9.52		
	Under brik Wall	Cum	2	23.30	0.60	0.10	2.80		
		Cum	2	6.80	0.60	0.10	0.82		
	Sub Total	**Cum**					**13.13**	**3521.00**	46244.81

	RAINFORCED CEMENT CONCRETE								
5	Design Mix Concrete	cum							
	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M200 (1 cement:1.5 sand : 3 graded stone aggregates of 20 mm nominal size) excluding shuttering and reinforcement)								
	All work upto plinth level								
	In footing	Cum	12	1.28	1.28	0.30	5.85		
		Cum	12	2.00	2.00	0.25	12.00		
		Cum	12	0.45	0.45	0.95	2.31		
	Sub Total	**Cum**					**20.16**	**4083.00**	82316.34
6	Beam, plinth beams, girders, cantilevers, suspended floors and staircase								
	R.C.C in beam	Cum	1	35.00	0.45	0.30	4.73		
	Sub Total	**Cum**					**4.73**	**4125.00**	19490.63
	Reinforcement								
7	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
				24.89			27.379		
	Sub Total	**qntl**					**27.379**	**5910.00**	161809.89
8	Providing steel works in tees, flats, angles and channels including cutting, drilling holes, hoisting and fixing in position in complete.	qntl					37.17		
	Sub Total	**qntl**					**37.17**	**4882.00**	181463.94
	Formwork								
9	Centering and shuttering including strutting, proping etc and removal of form for.								
	Foundation, footing, bases of columns etc. for mass concrete.								
	Footing	Sqm	48	2.00		0.25	24.00		
		Sqm	48	0.45		0.95	20.52		
		Sqm	2	35.00		0.3	21.00		
	Sub Total	**Sqm**					**65.52**	**137.00**	8976.24
	Lintel, beams, plinth beams, girders, bressumers and cantilevers.								
	Plinth beam	Sqm	2	70.00		0.3	42.00		
	Roof beam	Sqm	2	42.50		0.25	21.25		
	Sub Total	**Sqm**					**63.25**	**187.00**	11827.75

	BRICK WORK with F.P.S. BRICKS								
10	Providing 1 st class bricks in required thickness in cement mortar 1:6 (1 cement : 6 fine sand) including curing complete as directed.								
	Below plinth								
		Cum	2	27.50	0.45	0.90	22.28		
		Cum	2	7.50	0.45	0.90	6.08		
		Cum	2	27.50	0.23	0.60	7.59		
		Cum	2	7.50	0.23	0.60	2.07		
	Sub Total	**Cum**					**38.01**	**2440.00**	92744.40
	Superstructure								
		Cum	1	26.12	0.23	5.00	30.04		
		Cum	1	2.769	0.23	2.40	1.53		
		Cum	1	14.54	0.23	5.00	16.72		
	Sub Total	**Cum**					**48.29**	**2711.00**	130907.38
	woodworks								
11	Providing dressed and rebated wood works in frames of doors and other similar works, framed and fitted in position with nails, spikes, nuts, bolts etc as required and directed complete.								
	Local wood(Pooma, holock, oak gamari and the like)								
	D1	Cum	1	2.10	0.1	0.075	0.0158		
	Sub Total	**Cum**					**0.0158**	**19949.00**	314.20
12	Providing and fixing 38 mm thick full paneled shutter for doors including iron hinges, tower bolts, screws etc as specified complete with								
	Red pine wood/local wood								
	D1	Sqm	1	2.10	1.00		2.1		
	Sub Total	**Sqm**					**2.1**	**1256.00**	2637.60
	FITTINGS FOR DOORS AND WINDOWS								
13	Providing and fixing aluminium tower bolts socket with screws and directed								
	250 mm x12 mm	Each	2				2	**136.00**	272.00
14	Providing and fixing aluminium sliding bolts as directed								
	(b) 300 mm x 16 mm, dia	Each	1				1	**290.00**	290.00
15	Providing and fixing aluminium handles with srews stc								
	150 mm	Each	2				2	**29.00**	58.00
16	Providing 12 mm thick cement plaster i/c cleaning the surface and curing complete as directed								
	(a) Proportion 1:4								
	Internal Walls	Sqm	1	27.5	5.00		137.50		
		Sqm	2	7.50	5.00		75.00		
		Sqm	2	2.77	2.40		13.29		
	Sub Total						**225.79**	**96.00**	**21675.96**

	20 mm cement plaster of mix								
	1:4 (1 cement : 4 coarse sand)								
17	External Walls	sqm	1	27.500	5.00		137.50		
		sqm	2	7.500	5.00		75.00		
	Sub Total						**212.50**	**127.00**	**26987.50**
18	White washing with lime to give an even shade								
	New Work (three or more coats)	Sqm					325.00	8.00	**2600.00**
19	Painting with synthetic enamel paint of approved brand and menufacture to give and even shade.								
	Two or more coats on new work.	Sqm					324.85	38.00	**12344.30**
	FLOORING								
20	Providing and laying cement concrete in proportion 1:2:4 corresponding to M15 (1 cement, 2 sand,4 stone aggregates of 20 mm nominal size) upto plinth level including necessary curing excluding shuttering.								
	In Floors	Cum	1	27.50	7.5	0.2	41.25		
	For Ramp	Cum	1	22.00	1.5	0.2	6.60		
	Sub Total	Cum					**47.85**	**3521.00**	**168479.85**
	ROOF								
21	Providing steel work in built up tubular trusses including cutting , hoisting , fixing position, including welding etc and applying a coat of approved steel primer conplete as directed.	**Qntl**					**27.75**	**6776.00**	188034.00
22	Providing corrugated galvanised iron sheet roofing fixed with galvanised iron J or L hooks, bolts and nuts, 8 mm diameter with bitumen and GI limpet washers or GI limpet washers filled with white lead complete excluding the cost of purlins, rafters ad trusses.								
	0.63 mm thick	**Sqm**		27.5	7		**246.00**	**437.00**	107502.00
23	Providing ridges 450 mm overall width in plain GI sheet, 225 mm lappage, with galvanised iron J or L hooks, coach screws and washers complete.								
	0.63 mm thick	**Metre**					**28.00**	**228.00**	6384.00
24	Providing and fixing MS round holding downbolts with nuts and washer plates complete as required as per structural drawing.	**Kg**					**28.00**	**59.00**	1652.00
	Total Cost for secondary transportation vehicle garage								**1315191.612**

Cost Estimate for Operators Rest Room

Sl No.	Description of Items	Unit	Nos	Length	Breadth	Depth	Quantity	Rate	
	EARTHWORK								
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders (above 0.3 m)								
	For footing	Cum	11	1.40	1.40	1.00	21.56		
	For plinth beam								
		Cum	2	8.00	0.30	0.23	1.10		
		Cum	2	9.12	0.30	0.23	1.26		
		Cum	2	4.00	0.30	0.23	0.55		
		Cum	2	3.00	0.30	0.23	0.41		
	Sub Total	Cum	8	24.12					
	For steps	Cum	1	1.50	0.60	0.15	0.14		
	Sub Total	**Cum**					**25.02**	**57.00**	**1426.34**
2	Earthwork in filling with available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm thick including breaking clods consolidating each layer by ramming and watering, lead upto 50m and lift upto 1.5m	Cum	1				15.93		
	Sub Total	**Cum**					**15.93**	**46.00**	**732.55**
3	Sand filling in plinth in layers not exceeding 15 cm including breaking of clods, consolidating by ramming and watering complete as directed.	Cum	1	9.12	8	0.30	21.89		
	Sub Total	**Cum**					**21.89**	**479.00**	**10484.35**
4	a) Providing and injecting chemical emulsion for pre constructional Anti termite Termite treatment and creating a chemical barrier under and all around the column pits , walls , trenches, basement excavations, top surfaces of plinth fillings, junction of walls and floors along externel perimeter of the building, expansion joints, sorrunding of pipes,conduits etc, complete as directed.(Plinth area of the building at ground floor only shall be measured)	Sqm							
	Sub Total						**89.82**	**187.00**	**16796.04**

	CONCRETE WORK								
5	Providing and laying cement concrete in proportion 1:3:6 corresponding to M100 (1 cement, 3 coarse sand,6 graded stone aggregates of 40 mm nominal size) including necessary curing complete excluding shuttering								
	Under footing	cum	11	1.40	1.40	0.10	2.16		
	under plinth beam	Cum	8	24.12	0.30	0.10	5.79		
	Under steps	Cum	1	1.50	0.60	0.15	0.14		
	Sub Total	**Cum**					**8.08**	**2928.00**	**23657.65**
	DAMP PROOF COURSE								
6	Providing and laying damp-proof Course 40mm thick with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 12.5mm nominal size)	Sqm	1	24.12	0.23		5.55		
	Sub Total	**Sqm**					**5.55**	**165.00**	**915.35**
7	Extra for providing and mixing water proofing material in cement concrete work @ 1 Kg per 50 Kg of cement			5.55 cum					
	Sub Total	**per 50 Kg of cement**					**1.42**	**31.00**	**44.02**
	REINFORCED CEMENT CONCRETE								
	Design Mix Concrete								
8	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M20 (1 cement:1.5 sand : 3 graded stone aggregates of 20 mm nominal size) excluding shuttering and reinforcement)								
	All work upto plinth level								
	In footing	Cum	11	1.20	1.20	0.15	2.38		
		Cum	11	1.20	0.72	0.30	2.83		
	In column	Cum	11	0.23	0.23	1.00	0.58		
	Sub Total	**Cum**					**5.79**	**4083.00**	**23637.71**
9	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M20 (1 cement:1.5 sand : 3 graded stone aggregates of 20 mm nominal size) excluding shuttering and reinforcement)								
	Walls, Columns, Pillars, Post and Struts.								
10	Column								
	Above plinth level	Cum	11	0.23	0.23	3.62	2.11		
	Sub Total	**Cum**					**2.11**	**4125.00**	**8689.22**

	Beam, plinth beams, girders, cantilevers, suspended floors and staircase								
	R.C.C in plinth beam	Cum	8	24.12	0.23	0.30	13.31		
	R.C.C in beam	Cum	4	8.00	0.23	0.30	2.21		
		Cum	3	9.12	0.23	0.30	1.89		
11	R.C.C. in Lintels	Cum	2	9.12	0.23	0.23	0.96		
		Cum	2	8.00	0.23	0.23	0.85		
	R.C.C. in Chajja	Cum	1	8.50	0.60	0.09	0.45		
	R.C.C in Racks	Cum	1	5.28	0.45	0.10	0.24		
	R.C.C. Loft	Cum	4	2.00	0.45	0.10	0.36		
		Cum	2	1.15	0.45	0.10	0.10		
	Sub Total	**Cum**					**20.37**	**4125.00**	**84020.99**
	Reinforcement								
12	Providing for steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
		Cum					26.525		
	Sub Total	**qntl**					**26.525**	**5910.00**	**156762.75**
	Formwork								
13	Centering and shuttering including strutting, proping etc and removal of form for.								
	Lintels, beams, plinth beams, girders, bressumers and cantilevers								
	Plinth Beam	Sqm	16	24.12	0.23		88.76		
	Floor Beam (A)	Sqm	2	24.00	0.83		39.84		
14	Floor Beam (B)	Sqm	2	27.36	0.23		12.59		
	R.C.C. Racks	Sqm	1	5.28	0.45		2.38		
	R.C.C. Loft	Sqm	4	2.00	0.60		4.80		
		Sqm	2	1.15	0.60		1.38		
	Sub Total	**Sqm**					**149.74**	**187.00**	**28001.98**
15	Columns, pillars, piers, Abutments, posts and struts	Sqm	44	4.10	0.23		41.49		
	Sub Total	Sqm					41.49	**274.00**	**11368.81**
	BRICK WORK with F.P.S. BRICKS								
	Brick work with F.P.s bricks of class designation 75 in foundation and plinth in								
	Cement mortar 1:6 (I cement : 6 coarse sand)								
16	**Below plinth**								
	Plinth Beam	Cum	8	24.12	0.23	0.60	26.63		
	In Steps	Cum	1	1.50	0.60	0.15	0.14		
		Cum	1	1.50	0.40	0.15	0.09		
		Cum	1	1.50	0.20	0.15	0.05		
	Sub Total	**Cum**					**26.90**	**2440.00**	**65632.29**

17	Brick work with F.P.S bricks of class designation 75 in superstructure above plinth level up to floor V level in all shapes and sizes								
	Cement mortar 1:6 (I cement : 6 coarse sand)								
	Brick Wall-Full	Cum	1	37.46	0.23	3.00	25.85		
		Cum	1	14.00	0.23	3.00	9.66		
	Deduct	Cum	-5	1.50	0.23	1.20	-2.07		
		Cum	-1	1.20	0.23	1.20	-0.33		
		Cum	-1	1.20	0.23	2.10	-0.58		
		Cum	-2	0.90	0.23	2.10	-0.87		
	Sub Total	**Cum**					**31.66**	**2711.00**	**85822.67**
18	Half Brick Masonary								
	Half brick masonary with bricks of class designation 75 in foundations and plinth:								
	Cement Morter 1:4 (1 cement : 4 coarse sand)	Sqm	1	7.00	3.00		21.00		
	Deduct						-3.47		
	Sub Total	**Sqm**					**17.54**	**549.00**	**9626.72**
19	**WOOD WORK**								
	Providing dressed and rebated wood works in frames of doors and other similar works, framed and fitted in position with nails, spikes, nuts, bolts etc as required and directed complete.								
	Local wood(Pooma, holock, oak gamari and the like)								
	D1	Cum	1	6.08	0.1	0.05	0.0304		
	D2	Cum	3	5.48	0.1	0.05	0.0822		
	D3	Cum	2	5.18	0.1	0.05	0.0518		
	Sub Total	**Cum**					**0.1644**	**19949.00**	**3279.62**
20	Providing and fixing 38 mm thick full paneled shutter for doors including iron hinges, tower bolts, screws etc as specified complete with								
	Red pine wood/local wood								
	D1	Sqm	1	2.10	1.20		2.52		
	D2	Sqm	3	2.10	0.90		5.67		
	D3	Sqm	2	2.10	0.75		3.15		
	Sub Total	**Sqm**					**11.34**	**1256.00**	**14243.04**
	FITTINGS FOR DOORS AND WINDOWS								
21	Providing and fixing aluminium tower bolts socket with screws and directed								
	250 mm x12 mm	Each	12				12	**136.00**	**1632.00**
22	Providing and fixing aluminium sliding bolts as directed								
	(b) 300 mm x 16 mm, dia	Each	6				6	**290.00**	**1740.00**
23	Providing and fixing aluminium handles with srews stc								
	150 mm	Each	12				10.00	**29.00**	**290.00**

	STEEL WORK								
	Providing and fixing ISI marked steel glazed doors, windows and ventilators of standard rolled steel sections, joints mitred and welded with 15x3 mm lugs, 10 cm long, embedded in cement concrete blocks 15x10x10cm of 1:3:6 (1 cement: 3 Coarse sand: 6 grade)								
24	Windows Openable (side hung)								
	W1	Sqm	5	1.50	1.20		9.00		
	W2	Sqm	1	1.20	1.20		1.44		
	Sub Total	**Sqm**					**10.44**	**1215.00**	**12684.60**
	Ventilators-centre hung	Sqm	2	0.75	0.60		0.90		
	Sub Total	**Sqm**					**0.90**	**1205.00**	**1084.50**
	FLOORING								
	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement including cement slurry, but excluding the cost of nosing of steps etc. complete								
25	(40 mm thick)								
	In Floors	Sqm	1	8.69	10.04		87.25		
	In Steps	Sqm	3	1.50	0.15		0.68		
		Sqm	3	1.50	0.2		0.90		
	Deduct toilet floor area	Sqm	-1	1.50	2.6		-3.90		
	Sub Total	**Sqm**					**84.92**	**212.00**	**18003.59**
	Providing 20mm thick cement plaster skirting with cement mortar 1:3 (1 cement and 3 sand) finished with floating coat of neat cement including								
26	rounding of junction with floor as directed completely								
		Sqm	1	34.24	0.18		6.16		
	Sub Total	**Sqm**					**6.16**	**226.60**	**1396.58**
	Providing and fixing 10 mm thick acid and or alkali resistant tiles of approved make and colour using acid or alkali resistant tiles of approved make and colour using acid and alkali or resisting morter bedding and joints filled with acid and or alkali resis								
27	In flooring on a bed of 10mm thick morter 1:4 (1 appropriate cement : 4 coarse sand)								
	Acid and alkali resistant tile								
	Toilet floor	Sqm	1	2.60	1.50		3.90		
	Sub Total	**Sqm**					**3.90**	**1003.00**	**3911.7**
	In dado/skirting on 12 mm thick morter 1:4 (1 appropriate cement : 4 coarse sand)								
28	Acid and alkali resistant tile								
	For Toilets	Sqm	1	8.20	3.00		24.60		
	Deduct for Doors	Sqm	1	2.10	0.75		1.58		
	Sub Total	**Sqm**					**26.18**	**1045.00**	**27352.88**

	FINISHING								
29	Providing 12 mm thick cement plaster i/c cleaning the surface and curing complete as directed								
	(c) Proportion 1:4								
	Internal Walls	Sqm	1	79.42	3.00		238.26		
	Deduct(Door, Window, Ventilator)						-21.54		
	Sub Total						216.72		
	External Walls	Sqm	2	18.73	3.00		112.38		
	Deduct(Door, Window, Ventilator)						-13.92		
	Sub Total	Sqm					98.46		
	Sub Total						**315.18**	**96.00**	**30257.28**
30	**Exterior / Interior Finishing**								
	Painting wall at the ground floor level with approved water proof cement paint (Snowcem and the like) to the new works including cleaning the surface etc complete.								
	Two coats	Sqm	1				98.46		
	Sub Total	**Sqm**					**98.46**	**48.00**	**4726.08**
31	Distempering with dry distemper of approved brand and manufacture (two or more coats) and of required shade on new work, over and including priming coat of whiting to give an even shade.	Sqm							
	Sub Total	**Sqm**					**216.72**	**30.00**	**6501.60**
32	Painting with synthetic enamel paint of approved brand and menufacture to give and even shade.								
	Two or more coats on new work.	Sqm					17.14	38.00	**651.32**
33	**SANITARY INSTALLATIONS**								
	Providing and fixing white vitreous china laboratory sink with CI bracket,CP brass chain with rubber plug 40 mm CP brass wasteand 40 mm CP brass trap with necessary CP brass unions complete including painting of fittings and brackets,cutting and making good the walls and floors wherever required								
	Size 600x 450 x 200 mm	Each	1				1	**2472.00**	**2472.00**
34	providing and fixing in position wash basin etc complete with all necessary fittings including cutting and making good the walls and floors wherever required and as directed by the Engineer in charge.								
	(a) 630X450mm white	Each	2				2	**1446.00**	**2892.00**
35	Providing and fixing P.V.C waste pipe for sink or wash basin including P.V.C waste fittings complete								
	Semi Rigid Pipe								
	32mm dia	Each	2				2	**48.00**	**96.00**

36	Providing and fixing 100mm sand cast iron grating for gully trap	Each	1				2	**18.00**	
37	Providing and fixing 600X450 bevelled edge mirror of superior glass (of approved quality) complete with 6mm thick hard board ground fixed to wooden cheats with C.P brass screws and washers complete	Each	1				1	**567.00**	**567.00**
38	Providing and fixing 600X120x5mm glass shelf with edges round of supported on anodised aluminium angle with C.P Brass and guard rail complete with 40 mmlong screws, rawl plugs etc. complete	Each	1				1	**251.00**	**251.00**
39	Providing and fixing toilet paper holder								
	C.P Brass	Each	1				1	**147.00**	**147.00**
40	Providing and fixing soil,waste and vent pipes								
	100mm dia								
	Sand cast iron S&S pipe	Rmt	10				10	**518.00**	**5180.00**
41	Providing and fixing plain bend of required degree								
	75mm								
	Sand cast iron S&S	Rmt	6				6	**201.00**	**1206.00**
42	Providing and fixing towel rail complete as directed								
	C.P Brass	Each	1				1	**398.00**	**398.00**
43	Providing and fixing PTMT liquid soap container 109 wide , 125 mm high and 112 mm distance from wall of standard shape with bracket of the same materials with snap fittings of approved quality and colour weighing not less than 105 gms.	Each	2				2	**189.00**	**378.00**
44	Supplying fitting and fixing overhead adjustable chrome plated (C.P)spray shower 15mm dia of sona make with wall flangs as directed and specified (pipes will be measured and paid separetly)								
	Supreme/Apex/lotus/Globe shower with arm	Each	1				2	**541.00**	**1082.00**
45	Providing and fixing complete as directed with all necessary fittings								
	Soap tray (Ordinary)	Each	1				1	**150.00**	**150.00**
46	Providing and fixing kitchen sink including brackets etc complete with all necessary fitting including cutting and making good the walls and floors wherever required and as directed by the engineer in charge								
	Stainless steel (510 x 1040 x 178)	Each	1				1	**3389.00**	**3389.00**
	WATER SUPPLY								
47	Providing and fixing GI pipes complete with GI fittings and clamps including cutting and making good the walls etc								
	Exposed on wall								
	32mm dia nominal bore	Rmt	5				5	**248.00**	**1240.00**
	25mm dia nominal bore	Rmt	4				4	**206.00**	**824.00**
	20mm dia nominal bore	Rmt	2				2	**153.00**	**306.00**
	15mm dia nominal bore	Rmt	1				1	**121.00**	**121.00**

48	Concealed by chiselling or breaking brickwall/CC/R.C.C and making good to damages								
	32mm dia nominal bore	Rmt	1				1	**381.00**	**381.00**
	25mm dia nominal bore	Rmt	2				2	**267.00**	**534.00**
	20mm dia nominal bore	Rmt	6				6	**196.00**	**1176.00**
	16mm dia nominal bore	Rmt	9				9	**167.00**	**1503.00**
49	Providing and fixing C.P brass bib cock of approved quality conforming to IS 8931								
	15mm nominal bore	each	4				4	**238.00**	**952.00**
50	Providing and fixing C.P brass stop cock(concealed) standared designand approved make confirming to IS:8931								
	15mm nominal bore	each	1				1	**301.00**	**301.00**
	ROOF								
51	Providing steel work in built up tubular trusses including cutting , hoisting , fixing position, including welding etc and applying a coat of approved steel primer complete as directed.	qntl					11.74	**6776.00**	**79550.24**
52	or L hooks, bolts and nuts, 8 mm diameter with bitumen and GI limpet washers or GI limpet washers filled with white lead complete excluding the cost of purlins, rafters ad trusses.								
	0.63 mm thick	Sqm					123.82	**437.00**	**54109.34**
53	Providing ridges 450 mm overall width in plain GI sheet, 225 mm lappage, with galvanised iron J or L hooks, coach screws and washers complete.								
	0.63 mm thick	Metre					10.9	**228.00**	**2485.20**
54	Providing dressed wood work in frames for partitions, false ceiling, etc sawn and put up in position and fixed with nails, nuts and bolts etc as required as complete.								
	local wood (champa and the like)	Cum					0.65	**24477.00**	**15910.05**
55	Providing and fixing 20 mm thick wooden panel ceiling (frame work for base to be paid seperately) with MS screws								
	Teak Wood	Sqm					82.33	**2058.00**	**169435.14**
56	Providing and fixing MS round holding downbolts with nuts and washer plates complete	Kg					32	**59.00**	**1888.00**
57	Structural steel work in single section fixed without connecting plate including cutting, hoisting, fixing in position and applying a priming coat of approved	Kg					41.42	**48.00**	**1988.16**

58	Constructing brick masonary open surface drain with bricks of class designation 75 in cement morter 1:4 (1 cement : 4 fine sand) including earth excavation,10 cm thick bed concrete 1:5:10 (1 cement: 5 fine sand:10 graded stone aggregate 40 mm nominal size) and 25 mm thick cement concrete 1:2:4(1 cement:2 coarse sand:4 graded stone aggregate12.5 mm nominal size)for filling haunces including 12 mm cement plaster 1:4 (1 Cement :4 coarse sand with a floating coat of neat cement inside the drain,its top and exposed side including disposal of surplus earth complete.								
	15 cm drain 20 cm average depth								
	With FPS bricks	Rmt					58	**354.00**	**20532**
	Total Cost for Operator rest room								**1026818.37**

ESTIMATE OF COST FOR SECURITY GUARD ROOM									
Sl.no	**Description of Items**	**unit**	**nos**	**length/Dia**	**breadth**	**depth**	**quantity**	**Rate (Rs)**	
	Earthwork								
1	Earthwork in excavation in foundation trenches, including dressing of sides and ramming of the bottom including stacking of serviceable stones, disposal and removal of excavated earth within a lead of 50m and lift of 1.50m complete								
	Hard soil or soil mixed with moorum, gravel, boulders (above 0.3 m)								
	For footing	cum	4	1.40	1.40	1.00	7.84		
	For plinth beam	cum	1	21.20	0.25	0.40	2.12		
		cum	1	6.00	4.40	0.20	5.28		
		cum	1	3.00	1.05	0.15	0.47		
	Sub total	**cum**					**15.71**	**57.00**	**895.61**
2	Earthwork in filling with available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm thick including breaking clods consolidating each layer by ramming and watering, lead upto 50m and lift upto 1.5m	cum							
	Sub total	**cum**					**12.65**	**46.00**	**581.90**
3	Sand filling in plinth in layers not exceeding 15 cm including breaking of clods, consolidating by ramming and watering complete as directed. (maximum depth 45 cm)	cum	1	6.00	4.40	0.30	7.92		
	Sub total						**7.92**	**479.00**	**3793.68**
4	a) Providing and injecting chemical emulsion for pre constructional Anti Termite treatment and creating a chemical barrier under and all around the column pits , walls , trenches, basement excavations, top surfaces of plinth fillings, junction of walls and floors along externel perimeter of the building, expansion joints, sorrunding of pipes,conduits etc, complete as directed.(Plinth area of the building at ground floor only shall be measured)	Sqm							
	Sub Total						**72.96**	**187.00**	**13643.52**
	CONCRETE WORK								
5	Providing and laying cement concrete in proportion 1:3:6 corresponding to M100 (1 cement, 3 sand,6 graded stone aggregates of 40 mm nominal size) including necessary curing excluding shuttering.								
	under footing	cum	4	1.45	1.45	0.10	0.84		
	under plinth beam	cum	2	27.20	0.23	0.10	1.25		
	under steps	cum	1	3.00	1.05	0.15	0.47		
	Under floor	cum	1	4.00	4.00	0.15	2.40		
		cum	1	3.00	1.80	0.15	0.81		
		cum	1	1.50	1.80	0.15	0.41		
		cum	1	1.50	2.20	0.15	0.50		
	Sub total	**cum**					**6.67**	**2928.00**	**19543.52**

	DAMPPROOF COURSE								
5	Providing and laying damp-proof Course 40mm thick with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 12.5mm nominal size)	sqm	1	27.20	0.23		6.26		
	Sub total	**sqm**					**6.26**	**165.00**	**1032.24**
6	Extra for providing and mixing water proofing material in cement concrete work @ 1 Kg per 50 Kg of cement			6.256 cum					
	Sub Total	**per 50 Kg of cement**					**1.60**	**31.00**	**49.60**
	REINFORCED CEMENT CONCRETE								
7	Design Mix concrete								
	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M200 (1 cement:1.5 sand : 3 graded stone aggregates of 20 mm nominal size) excluding shuttering and reinforcement)								
	Column below plinth level	cum	4	0.23	0.35	0.90	0.29		
	In footing	cum	4	1.30	1.30	0.15	1.01		
		cum	4	1.30	0.77	0.30	1.19		
	Subtotal	**cum**					**2.50**	**4083.00**	**10196.07**
8	Providing and laying cement concrete in proportion 1:1.5:3 corresponding to M200 (1 cement:1.5 sand : 3 graded stone aggregates of 20 mm nominal size) excluding shuttering and reinforcement)								
	Upto first floor level								
	wall columns, pillars , post and struts.								
	Column Above plinth level	cum	4	0.23	1.35	3.50	4.35		
	Beam plinth Beams griders cantilevers suspended floors and staircase								
	RCC in roof beam	cum	1	21.20	0.23	0.40	1.95		
	RCC in plith beam	cum	1	36.99	0.23	0.40	3.40		
		cum	1	6.40	0.23	0.30	0.44		
	RCC in lintels	cum	1	12.90	0.23	0.23	0.68		
	RCC in Chajja	cum	4	1.80	0.60	0.08	0.35		
		cum	1	2.30	0.60	0.08	0.11		
	Rcc in racks	cum	1	2.00	0.50	0.10	0.10		
	Sub total	**cum**					**7.03**	**4125.00**	**29013.15**
	Reinforcement								
9	Providing tor steel reinforcement in RCC work including cutting, bending, cranking and tying in position with binding wire, 20 gauge, as shown in drawings complete upto floor two level								
		cum		17.21			18.95		
	Sub total	**qnt**					**18.95**	**5910.00**	**111994.50**

	BRICK WORK								
10	Brick work with F.P.S bricks of class designation 75 in foundation and plinth in Cement mortar 1:6 (I cement : 6 coarse sand)								
	Plinth beams	cum	1	21.07	0.23	0.60	2.91		
	In steps	cum	1	1.50	0.75	0.15	0.17		
		cum	1	1.50	0.50	0.15	0.11		
		cum	1	1.50	0.25	0.15	0.06		
	Sub total						**3.25**	**2440.00**	**7918.19**
11	Brick work with F.P.S bricks of class designation 75 in superstructure above plinth level up to floor V level in all shapes and sizes cement mortar 1:6								
	Brick wall-full	cum	1	21.07	0.23	3.00	14.54		
	Deduct								
	Windows	cum	-1	1.20	0.23	1.20	-0.33		
		cum	-1	1.50	0.23	1.20	-0.41		
		cum	-1	2.00	0.23	1.20	-0.55		
	Doors	cum	-1	1.00	0.23	2.10	-0.48		
	Ventilators	cum	-2	0.60	0.23	0.75	-0.21		
	Sub total	**cum**					**12.55**	**2711.00**	**34026.03**
12	Half Brick Masonary								
	Half brick masonary with bricks of class designation 75 in foundations and plinth:								
	Cement Morter 1:4 (1 cement : 4 coarse sand)	Sqm	1	5.50	3.0		16.50		
	Deduct	Sqm	-2	0.75	2.1		-3.15		
	Sub Total	**Sqm**					**13.35**	**549.00**	**7329.15**
	WOOD WORK								
13	Providing dressed and rebated wood works in frames of doors and other similar works, framed and fitted in position with nails, spikes, nuts, bolts etc as required and directed complete.								
	Local wood(Pooma, holock, oak gamari and the like)	cum	1	15.10	0.10	0.05	0.09		
	Sub total						**0.10**	**19949.00**	**1994.90**
14	Providing and fixing 38 mm thick full paneled shutter for doors including iron hinges, tower bolts, screws etc as specified complete with Red pine wood/local wood								
	Doors D1	sqm	1	2.10	1.00		2.10		
	Door D2	sqm	2	2.10	0.75		3.15		
	Sub total	**sqm**					**5.25**	**1256.00**	**6594.00**

	FITTINGS FOR DOOR AND WINDOWS								
15	Providing and fixing aluminium tower bolts socket with screws and directed								
	250 mm x12 mm	Each	2				2.00	**136.00**	272.00
16	Providing and fixing aluminium sliding bolts as directed								
	(b) 300 mm x 16 mm, dia	Each	3				3.00	**290.00**	870.00
17	Providing and fixing aluminium handles with srews stc								
	150 mm	Each	6				6.00	**29.00**	174.00
18	Providing and fixing aluminium hanging floor door ISI marked anodised anodic coating not less than grade AC 10 as per IS: 1868) transparent or dyed to required colour or shade with necessary screws etc. complete								
	Twin rubber stopper	Each	2				2.00	**128.00**	256.00
	STEEL WORK								
19	Providing and fixing ISI marked steel glazed doors, windows and ventilators of standard rolled steel sections, joints mitred and welded with 15x3 mm lugs, 10 cm long, embedded in cement concrete blocks 15x10x10cm of 1:3:6 (1 cement: 3 Coarse sand: 6 graded stone aggregate 20mm nominal size) or with wooden plugs								
	Windows Openable (Side Hung)	sqm	1	2.00	1.20		2.40		
		sqm	1	1.50	1.20		1.80		
		sqm	1	1.20	1.20		1.44		
	Sub total	**sqm**					**5.64**	**1215.00**	**6852.60**
	Ventilator Centre Hung	sqm	2	0.75	0.60		0.90	**1205.00**	1084.50
	FLOORING								
20	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggr. 20 mm nominal size) finished with a floating coat of neat cement including cement slurry, but excluding the cost of nosing of steps etc. complete								
	40 mm thick								
	In floors	sqm	1	4.00	4.00		16.00		
		sqm	1	1.50	1.80		2.70		
	in steps	sqm	3	3.20	0.15		1.44		
	Sub total	**sqm**					**20.14**	**212.00**	**4269.68**
21	Providing 20mm thick cement plaster skirting with cement mortar 1:3 (1 cement and 3 sand) finished with floating coat of neat cetment including rounding of junction with floor as directed completely								
		sqm	1	19.12	0.20		3.82		
	Sub total	**sqm**					**3.82**	**226.00**	**863.32**

22	Providing and laying Ceramic Glazed floor tiles 300 x 300 mm (thickness to be specified by the manufacturer) of 1st quality conforming to IS:15622, of approved make in all colours, shades except White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick Cement Morter 1:4 (1 cement : 4 coarse sand) including pointing the joints with white cement and matching pigments etc., complete								
	Toilet	sqm	1	1.50	2.20		3.30		
	Sub total	**sqm**					**3.30**	**725.00**	**2392.50**
23	Providing and fixing 10 mm thick acid and or alkali resistant tiles of approved make and colour using acid or alkali resistant tiles of approved make and colour using acid and alkali or resisting morter bedding and joints filled with acid and or alkali resis								
	In dado/skirting on 12 mm thick morter 1:4 (1 appropriate cement : 4 coarse sand)								
	For Toilet	sqm	1	7.40	1.50		11.10		
	Less for doors	sqm	-1	0.75	1.50		-1.125		
	Sub total	**sqm**					**9.98**	**1045.00**	**10423.88**
	Finishing								
24	Providing12 mm thick cement plaster i/c cleaning the surface and curing complete as directed								
	12 mm cement plaster of mix								
	1:4 (I cement : 4 fine sand)								
	Internal Walls	sqm	1	30.00	3.00		90.00		
	Deduct								
	Doors	sqm	-1	2.10	1.00		-2.10		
		sqm	-2	2.10	0.75		-3.15		
	Windows	sqm	-1	1.20	1.20		-1.44		
		sqm	-1	1.50	1.20		-1.80		
		sqm	-1	2.00	1.20		-2.40		
	Vendilators	sqm	-2	0.60	0.75		-0.90		
		sqm					-9.39		
	Sub-Total	**sqm**					**68.82**	**97.00**	**6675.54**

	20 mm cement plaster of mix								
	1:4 (1 cement : 4 coarse sand)								
	External Walls	sqm	2	6.075	3.00		36.45		
		sqm	2	4.460	3.50		31.22		
							67.67		
25	Deduct								
	Vendilators	sqm	-2	0.60	0.75		-0.90		
	Doors	sqm	-1	2.10	1.00		-2.10		
	Windows	sqm	-1	1.20	1.20		-1.44		
		sqm	-1	1.50	1.20		-1.80		
			-1	2.00	1.20		-2.40		
	Subtotal	**sqm**					**126.70**	**127.00**	**16090.90**
	Exterior / Interior Finishing								
26	Painting wall at the ground floor level with approved water proof cement paint (Snowcem and the like) to the new works including cleaning the surface etc complete.								
	Two coats	Sqm	1				126.70		
	Sub Total	**Sqm**					**126.70**	**48.00**	**6081.60**
27	Distempering with dry distemper of approved brand and manufacture (two or more coats) and of required shade on new work, over and including priming coat of whiting to give an even shade.	Sqm							
	Sub Total	**Sqm**					**68.82**	**30.00**	**2064.60**
28	Painting with synthetic enamel paint of approved brand and menufacture to give and even shade.								
	Two or more coats on new work.	Sqm					33.66	38.00	**1278.89**
	SANITARY FITTINGS								
29	Providing and fixing white vitreous china laboratory sink with CI bracket,CP brass chain with rubber plug 40 mm CP brass wasteand 40 mm CP brass trap with necessary CP brass unions complete including painting of fittings and brackets,cutting and making good the walls and floors wherever required								
	Size 600x 450 x 200 mm								
	Sub Total	**each**	**1**					**2472.00**	**2472.00**
30	Providing and fixing in position wash basin etc complete with all necessary fittings including cutting and making good the walls and floors wherever required and as directed by the Engineer in charge.								
	a) 630X450mm white	Each	1				1.00	**1446.00**	1446.00
31	Providing and fixing P.V.C waste pipe for sink or wash basin including P.V.C waste fittings complete								
	Semi Rigid Pipe (32mm dia)	Each	1				1.00	**48.00**	48.00

32	Providing and fixing 100mm sand cast iron grating for gully trap	Each	1				1.00	**18.00**	18.00
33	Providing and fixing 600X450 bevelled edge mirror of superior glass (of approved quality) complete with 6mm thick hard board ground fixed to wooden cheats with C.P brass screws and washers complete	Each	1				1.00	**567.00**	567.00
33	Providing and fixing 600X120x5mm glass shelf with edges round of supported on anodised aluminium angle with C.P Brass and guard rail complete with 40 mmlong screws, rawl plugs etc. complete	Each	1				1.00	**251.00**	251.00
34	Providing and fixing toilet paper holder								
	C.P Brass	each	1				1.00	**147.00**	147.00
35	Providing and fixing soil,waste and vent pipes								
	100mm dia								
	Sand cast iron S&S pipe	Rmt	1	2.00			2.00	**518.00**	1036.00
36	Providing and fixing plain bend of required degree								
	75mm								
	Sand cast iron S&S	Rmt	1	7.00			7.00	**201.00**	1407.00
37	providing and fixing towel rail complete as directed								
	CP	each	1				1.00	**398.00**	398.00
38	Providing and fixing PTMT liquid soap container 109 wide , 125 mm high and 112 mm distance from wall of standard shape with bracket of the same materials with snap fittings of approved quality and colour weighing not less than 105 gms.	Each	1				1.00	**189.00**	189.00
	WATER SUPPLY								
39	Providing and fixing GI pipes complete with GI fittings and clamps including cutting and making good the walls etc								
	exposed on wall								
	20mm dia nominal bore	Rmt	1	30.00			30.00	**153.00**	4590.00
40	Providing and fixing C.P brass stop cock(concealed) standared designand approved make confirming to IS:8931								
	15mm nominal bore	Each	2				2.00	**220.00**	440.00
	ROOFING								
41	Providing steel work in built up tubular trusses including cutting , hoisting , fixing position, including welding etc and applying a coat of approved steel primer conplete as directed.	Kg					5.21	**6776.00**	35314.12

42	providing corrugated galvanised iron sheet roofing fixed with galvanised iron J or L hooks, bolts and nuts, 8 mm diameter with bitumen and GI limpet washers or GI limpet washers filled with white lead complete excluding the cost of purlins, rafters ad trusses.								
	0.63 mm thick	Sqm					46.66	**437.00**	20390.42
43	Providing ridges 450 mm overall width in plain GI sheet, 225 mm lappage, with galvanised iron J or L hooks, coach screws and washers complete.								
	0.63 mm thick	Metre					7.20	**228.00**	1641.60
44	providing dressed wood work in frames for partitions, false ceiling, etc sawn and put up in position and fixed with nails, nuts and bolts etc as required as complete.								
	local wood (champa and the like)	Cum					0.20	**24477.00**	4895.40
45	Providing and fixing 20 mm thick wooden panel ceiling (frame work for base to be paid seperately) with MS screws								
	Teak Wood	Sqm					24.88	**2058.00**	51203.04
46	Providing and fixing MS round holding downbolts with nuts and washer plates complete	Kg					16.00	**59.00**	944.00
47	Structural steel work in single section fixed without connecting plate including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete	Kg					28.80	**48.00**	1382.40
	Drainage								
48	Constructing brick masonary open surface drain with bricks of class designation 75 in cement morter 1:4 (1 cement : 4 fine sand) including earth excavation,10 cm thick bed concrete 1:5:10 (1 cement: 5 fine sand:10 graded stone aggregate 40 mm nominal size) and 25 mm thick cement concrete 1:2:4(1 cement:2 coarse sand:4 graded stone aggregate12.5 mm nominal size)for filling haunces including 12 mm cement plaster 1:4 (1 Cement :4 coarse sand with a floating coat of neat cement inside the drain,its top and exposed side including disposal of surplus earth complete.								
	15 cm drain 20 cm average depth								
	With FPS bricks	Rmt					33.00	**354.00**	11682.00
49	500 Litre capacity Overhead PVC Tank	Lts	2				500.00	**6.00**	3000.00
50	Providing fitting and fixing recessed soap tray of hindware make complete as specified and directed								
	White								
	Size 150mm X150mm	Each	1				1.00	**276.00**	276.00

51	Providing fitting and fixing 110mm dia PVC cowel with ISI make complete as Dierected	Each	1				1.00	**87.00**	87.00
52	Supplying fitting and fixing PVC plain tee of supreme /prince or other ISI approved including joining and fixing and fitting exetra as necessary complete at all levels including bellow GL as directed and specified								
	Concealed by chiselling or breaking brick wall/CC/ RCC and making good to damages								
	110mm dia	Each	1				1.00	**214.00**	214.00
	75mm dia	Each	1				1.00	**130.00**	130.00
53	Providing fitting and fixing 24mm /29mm thick polymer reinforced moulded PVC door shutters fixed to the Chowkaths with necessary,hings screws,bolts as specified as directed at all (door fixtures and fittings to be measured and paid separately								
	Sub total	**Sq m**	**1**	**2.10**	**0.75**		**1.58**	**1603.00**	**2532.74**
	Total Cost of Security Guard Room								**454957.79**

BOQ OF ADDITIONAL REQUIREMENT OF ELECTRICAL DISTRIBUTION IN SOLID WASTE MANAGEMENT PLANT AT MAWIONG,SHILLONG INCLUDING BOQ and SITC COSTS

(i) MCB DB at Machinery Plant Unit , SWM, Shillong					
Supply, Installation, Testing, Commisioning (SITC) of One No, 6 Way MCB DB with Outgoing Terminal Block and a set of indicating Lamps comprising of:					
Sl No	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
1	40 A, 4 Pole, MCB as Incomer from MDP	No	1	LS	18000
2	6 A, TPN MCB as Outgoing for **Water Pump**	No	1		
3	10 A, DP MCB for Outgoing to Weigh Bridgee and Control Room	No	3		
4	10 A, DP MCB for Outgoing to **Operator's Rest Room**	No	1		
5	10 A, DP, MCB for outgoing to (4 Nos) **Secondary Vehicle Parking Garage**	No	1		
6	16 A, DP, MCB for Outgoing to (20 Nos) of **Primary Transportation Vehicle Parking**	No	1		
	Total (i)				**18000**

(ii)Security Guard Room at SWM, Shillong						
(Near the main gate to be supplied from the Bio Medical Plant Transformer)						
Sl No	**Description**		**Unit**	**Qty**	**Rate**	**Amount**
1	6 A,SPN,MCB in 4 Way MCB DB		No	1	864	864
2	40 W, Havells MAGNUM 1 FTL		No	2	2040	4080
3	8 W, CFL on Batten Holders		No	5	200	1000
4	48 "(1200 mm) Ceiling Fans inc. all Accessories		No	1	1600	1600
6	6 A, 5 Pin sockets		No	1	60	60
7	Circuit Wiring with 3 X 1C,2.5 Sq mm Stranded Copper Wires in PVC conduit		Rm	16	150	2400
8	Point Wiring with 3 X 1 C, 1.5 Sq mm Stranded Copper Wires including all accessories;					
	i	Short Points (3 Mts)	No	4	636	2544
	ii	Long Points (3 to 6 Mts)	No	3	696	2088
9	Incomer with 1 X 3 C, 6 Sq mm PVC insulated and sheathed copper conductor including all mounting and laying in 50 cm trenches with bricks & sand protection, from the biomedical plant to the S/G Room		Rm	50	540	27000
	Total (ii)					**37556**

(iii) Weigh Bridge cum Control Room at SWM, Shillong						
Sl No	**Description**		**Unit**	**Qty**	**Rate**	**Amount**
1	6 A,SPN,MCB in 4 Way MCB DB		No	1	864	864
2	40 W,Havells MAGNUM 1 FTL		No	2	2040	4080
3	8 W, CFL on Batten Holders		No	5	200	1000
4	48 "(1200 mm) Ceiling Fans inc. all Accessories		No	1	600	1600
5	6 A, 5 Pin sockets		No	1	60	60
6	Circuit Wiring with 3 X 1 C, 2.5 Sq mm Stranded Copper Wires in PVC conduit		Rm	16	150	2400
7	Point Wiring with 3 X 1 C, 1.5 Sq mm Stranded Copper Wires (1X3) including all accessories;					
	i	Short Points (3 Mts)	No	4	636	2544
	ii	Long Points(3 to 6 Mts)	No	3	696	2088
8	Incomer with 1X3 C, 6 Sq mm PVC insulated and sheathed copper conductor including all mountingin 50 cm trenches with bricks & sand protection.		Rm	50	540	27000
	Total(iii)					**41636**

(iv) Operator's Rest Room at SWM, Shillong					
Sl No	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
1	2+8 Way, DP MCB as Incomer and SP MCB as outgoing with common neutral Terminal Block	No	1	LS	7068
2	Circuit Wiring with 3 X 1 C, 2.5 Sq mm stranded Copper conductor with PVC insulation in PVC Conduit	Rm	30	150	4500
3	Point Wiring with 3 X 1 C , 1.5 sq mm stranded copper conductor with PVC insulation with PVC Conduit				
	i) Short Point (<3 Mts)	No	3	636	1908
	ii)Medium Point(3 to 6 Mts)	No	6	696	4176
	iii) Long Point (6 to 9 Mts)	No	2	756	1512
4	1 X 40 W, FTL	No	4	200	800
5	8 W CFL on Batten Holders	No	5	200	1000
6	48 "(1200 mm) Ceiling Fans inc. all Accessories	No	2	1600	3200
7	8" (200 mm) Exhaust Fan	No	1	1000	1000
8	16 A, 6 Pin sockets	No	1	120	120
9	Incomer with 1 X 2 C, 10 sq mm PVC insulated and sheated copper cable laid in 50 mm deep trenches covered in sand and protected	Mts	100	564	56400
	Total (iv)				**81684**

(v) Garage for 4 nos of Secondary Transportation vehicles at SWM, Shillong					
Sl No	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
1	2+6 Way, DP MCB as Incomer and SP MCB as outgoing with common neutral Terminal Block	No	1	LS	7068
2	Circuit Wiring with 3 X 1 C, 2.5 Sq mm stranded Copper conductor with PVC insulation in PVC Conduit	Rm	50	150	7500
3	Point Wiring with 3x1C , 1.5 sq mm stranded copper conductor with PVC insulation with PVC Conduit				
	i) Short Point (<3 Mts)	Nos	2	636	1272
	ii)Medium Point(3 to 6 Mts)	Nos	2	696	1392
	iii) Long Point (6 to 9 Mts)	Nos	3	756	2268
4	Havells ' SOLAR1' with 1 x70 W, MH Lamp	Nos	5	3600	18000
5	1X 40 W, FTL	Nos	2	200	400
6	16 A, 6 Pin Sockets	Nos	2	120	240
7	Incomer with 1 X 2 C, 10 sq mm PVC insulated and sheated copper cable laid in 50 mm deep trenches covered in sand and protected	Mts	150	564	84600
	Total (v)				**122740**

(vi) Garage for Primary Transportation vehicles (20 Nos) Parking at SWM, Shillong					
Sl No	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
1	2+12 Way, DP MCB as Incomer and SP MCB as outgoing with common neutral Terminal Block	No	1	LS	7086
2	Circuit Wiring with 3 X 1 C, 2.5 Sq mm stranded Copper conductor with PVC insulation in PVC Conduit	Rm	90	150	13500
3	Point Wiring with 3x1C , 1.5 sq mm stranded copper conductor with PVC insulation with PVC Conduit				
	i) Short Point (<3 Mts)	Nos	6	636	3816
	ii)Medium Point(3 to 6 Mts)	Nos	10	696	6960
	iii) Long Point (6 to 9 Mts)	Nos	11	756	8316
4	'MAGNUM 1' with 1X 36 W FTL	Nos	22	2040	44880
5	1X 40 W, FTL	Nos	2	200	400
6	16 A, 6 Pin Sockets	Nos	3	120	360
7	Incomer with 1 X 2 C, 10 sq mm PVC insulated and sheated copper cable laid in 50 mm deep trenches covered in sand and protected	Mts	150	564	84600
	Total (vi)				**169918**

(viii) Earthing Connection					
Earthing will be done using 3.0 Mts long 50 mm dia GI pipes with 2 mm holed spaced crosswise, with flange/clamp for connection at the top end to be buried in a pit of 50 mm or more dia. Specified electrodes shall be surrounded with salt and charcoal layers of 300 mm thick with provision for water arrangement. Connections to panel and equipments shall be made by GI Strip or wires.					
Sl No	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
1	Earth Electrode with salt and Charcoal in pit	Nos	1	7200	7200
2	Earth Electrode without salt and Charcoal	Nos	5	3600	18000
3	25 x3 mm GI Strip	Mts	30	60	1800
4	8 SWG GI Wire	Mts	15	21.6	324
	Total (vii)				**27324**

(ix) Tube Well at SWM, Shillong					
Sl No	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
1	1 x 4 C , 10 Sq mm stranded copper wires PVC insulated and sheathed cables laid in ground	Rm	120	576	69120
2	Terminal Block with DOL Starter	No	1	4500	4500
	Total (ix)				**73620**

(x) Road Lighting at SWM , Shillong					
Sl No	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
1	Havells 'ORION' fixture with 70 W, SON lamps are to be fitted with swaged steel poles along the road of the plant from the main gate to the end of the road at convenient distances to be connected by 2.5 Sq mm ,3 core under ground cables. The lamps should be mounted on outer side of the curves and on one side of the straight road to be determined at site.	Nos	75	12000	900000
	Total (x)				**900000**

(xi) Lighting at Landfill Yard at SWM, Shillong					
Sl No	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
1	1 X 3 C, 6 Sq mm PVC insulated and sheathed copper conductor including all mounting in 50 cm trenches with bricks & sand	Mts	50	540	27000
2	4 way, MCB DB with 10 A MCB as outgoing including installation thereof as in the office building	Each	1	2500	2500
3	One independent free standing sheet steel (16 Gauge) outdoor cubicle comprising 4 way MCB DB including DN Rails and neutral				
a	10 A ,DP, MCB as Incomer	Nos	1		
b	6 A, SP,MCB with outgoing terminal blocks	Nos	2	7000	7000
4	Havell's ORION FTL,1 X36/40 W to be mounted on equal no of Ms swaged tubular poles connected by 3 core underground cables. The mounting of the lamp should be on the outside of the landfill site.	No	8	12000	96000
5	3 X 1 C , 4 sq mm PVC stranded copper wires	Mts	280	250	70000
6	3 X 1 C , 2.5 sq mm PVC stranded copper wires	Mts	280	150	42000
7	Earthing Electrode without salt and charcoal in pit	No	2	3600	7200
	Total (xi)				**251700**
	Grand Total(i+ii+iii+iv+v+vi+vii+viii+ix+x+xi)				**1724178**
	Rupees Seventeen Lakh Twenty Four Thousand One Hundred and Seventy Eight Only				

Project Implementation and Urban Management Improvement in the North Eastern Region – Package A

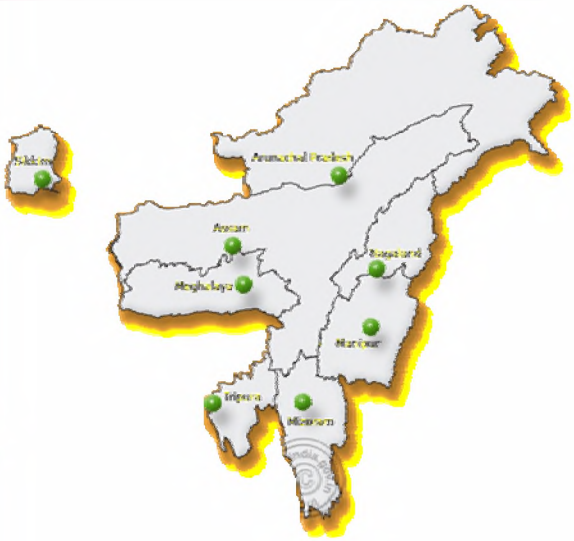
Draft Final DPR-Solid Waste Management Plan for Greater Shillong Planning Area

Asian Development Bank TA 4779 - IND

Volume V

Due Diligence Report

June, 2009



SMEC INDIA

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A. INTRODUCTION

1. The North Eastern Region Capital Cities Development Investment Program envisages achieving sustainable urban development in the project cities of Agartala, Aizawl, Kohima, Gangtok, Shillong, Itanagar, Imphal, Guwahati and Dibrugarh through investments in urban infrastructure sectors. The urban infrastructure and services improvement is proposed in the following sectors (i) water supply, (ii) sewerage and sanitation, (iii) solid waste management, (iv) urban transportation and roads (v) drainage and landslip protection, and (vi) slum upgrading.

2. The sub project component of solid waste management in Shillong includes development of a new landfill site in addition to the existing landfill site and the aerobic compost plant that are already in operation. In line with the requirements of the solid waste management (SWM) for the Shillong City, the Department of Urban Affairs, Government of Meghalaya has initiated the development of a sanitary landfill site at Mawiong in Shillong. Mawiong is located close to the existing SWM site along the Shillong –Guwahati Road. The proposed site has been acquired by Shillong Municipal Board on lease from Forests and Environment Department, Government of Meghalaya. The area comprises of land with pine tree growth. The land acquisition for the site has been initiated in the year 1938[1] by the then Government of Assam[2].

3. The objective of this due diligence report is to determine the level of risk of resettlement in the project site for SWM in Shillong to ownership of the land for the proposed landfill site and to Asian Development Bank (ADB) by association. The study is to determine any outstanding resettlement issues that will undermine investment in the landfill site.

B. METHODOLOGY

4. The methodology adopted for the due diligence report, included survey of land and consultations with the Government agencies involved with the proposed site at Mawiong. Field survey has been done by the TA Consultant jointly with the representative of the Department of Urban Affairs (DUA). Consultations on the right over the land for the proposed landfill site have been carried out with the DUA and the Forests and Environment Department, Government of Meghalaya, supported with Government documents. **Appendix 1** presents photographic documentation of the area proposed for landfill site in Shillong.

C. CHRONOLOGY OF ACITIVITIES RELATING TO THE SWM SITE

5. Shillong Municipality, Government of Assam proposed to develop a Solid Waste Management site along the Shillong – Guwahati Road in the mid thirties of twentieth century. For this, it approached the Forests and Environment Department, Government of Assam and received on lease a land plot of size 18 acres (7.2 ha approx.) in Riat Khwan Forests Compartment No. 4. The lease has been regularized later for a period of seventy years from 1956 to 2026. The land plot is now under leasehold by the Shillong Municipal Board, provided by the Forests and Environment Department, Government of Meghalaya. Chronology of events states that the land plot for the SWM site in Shillong had been with the Forests and Environment Department at least since 1938 and does not involve any claim of any private owner (refer **Appendix 2** for documentary evidence).

6. **Table 1** outlines the Chronology of Events. **Figure 1** shows the location of proposed SWM landfill site.

[1] Lease granted to Shillong Municipality by Order No. 2391-G-S-8 dated 19.05.1938 for 18 acres of land in Riat Khwan Forest Compartment No. 4.

[2] Shillong had been a part of Assam during 1938. In early seventies the State of Meghalaya was formed when Shillong became the Capital City of the newly formed State of Meghalaya.

TABLE 1: CHRONOLOGY OF EVENTS

Month/Year	Events
1938	Shillong Municipality, Government of Assam proposed to develop a Solid Waste Management site along the Shillong – Guwahati Road in the mid thirties of nineteenth century. For this, it approached the Forests and Environment Department, Government of Assam.
May 1938	Lease granted to Shillong Municipality by Order No. 2391-G-S-8 dated 19.05.1938 for 18 acres of land in Riat Khwan Forest Compartment No. 4.
1956	The lease has been regularized later for a period of seventy years from 1956 to 2026.
2008	The land plot is now under leasehold by the Shillong Municipal Board, provided by the Forests and Environment Department, Government of Meghalaya.

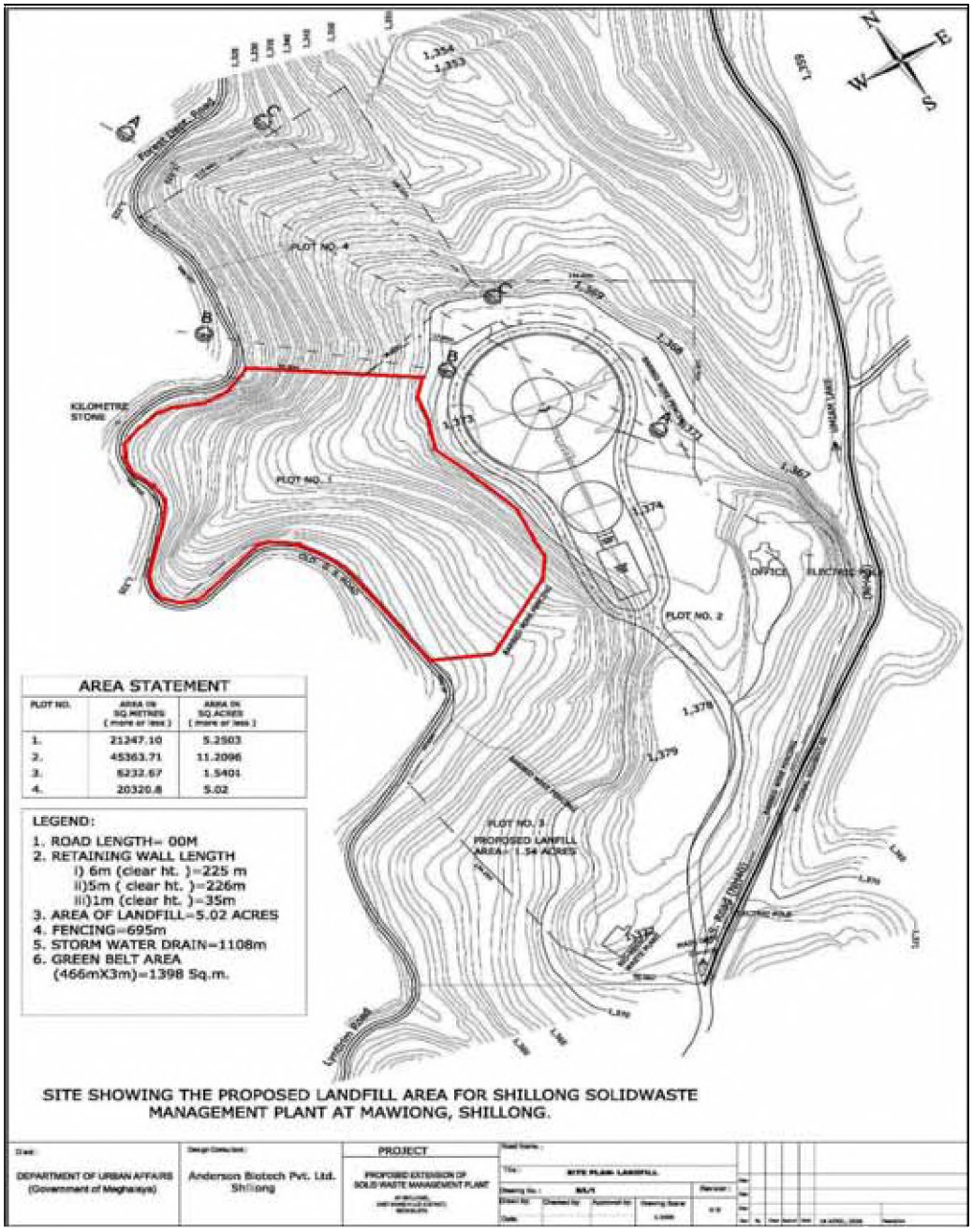


Figure 1: Location of Proposed SWM Landfill Site in Shillong

D. LAND ACQUISITION AND ASSISTANCE PROGRAMME

7. It is clear from the preceding discussion that the land plot for the SWM site in Shillong is on leasehold granted to Shillong Municipal Board by Forests and Environment Department, Government of Meghalaya. There is no trace of private ownership way back to 1938. However, the existing lease has been regularized in 1956 for a period of seventy years, till the end of 2026. There is no claimant as private owner for the said land plot. Thus, the question of paying compensation for land acquisition does not arise.

8. However, for leasehold occupancy of the said land plot, the Shillong Municipal Board is paying an amount of Rs. 90/- per annum till it is revised by the Government of Meghalaya at any point of time[3].

E. TIMELINE FOR COMPLETION

9. The said land plot for the proposed landfill site is already available with Shillong Municipal Board on leasehold. The lease will remain valid till the end of 2026 as per the regularization of 1956. The lease may be extended beyond 2026 within the framework of mutual consent between the Shillong Municipal Board, the present leaseholder and the Forests and Environment Department, Government of Meghalaya, the lessee.

F. OUTSTANDING ISSUES

10. There is no outstanding issue regarding the leasehold usufruct right in part of Shillong Municipal Board with the Forests and Environment Department, Government of Meghalaya.

G. ASSESSMENT ON THE RISK TO LAND OWNERS AND ASIAN DEVELOPMENT BANK

11. Documentation (**Appendix 2**) indicates that the said land plot for the proposed landfill site is already available with Shillong Municipal Board on leasehold. The lease will remain valid till the end of 2026 as per the regularization of 1956. The lease may be extended beyond 2026 within the framework of mutual consent between the Shillong Municipal Board, the present leaseholder and the Forests and Environment Department, Government of Meghalaya, the lessee.

12. Since the proposed subproject does not require any fresh land uptake that involves adverse impact on any private owner, there is no risk for ADB in approving the loan application for the subproject.

[3] As per Clause No. 2 of the Notification No. FOR. 76/99/16 dated 25.02.2000 of the Forests and Environment Department, Government of Meghalaya

APPENDIX 1: PHOTOGRAPHIC PRESENTATION OF SOLID WASTE MANAGEMENT SITE IN SHILLONG, MEGHALAYA

Entrance of the SWM Site along Shillong–Guwahati Road

On the way to the proposed landfill site

Proposed site for landfill in Shillong

Proposed landfill site from Forest Department Road

Proposed landfill site from Old Shillong–Guwahati Road

Pine forest existing in the proposed landfill site

APPENDIX 2: GOVERNMENT DOCUMENT ON LEASE OF THE PROPOSED LANDFILL SITE IN SHILLONG, MEGHALAYA

GOVERNMENT OF MEGHALAYA
FORESTS & ENVIRIONMENT DEPARTMENT

NOTIFICATION

FOR. 76/99/16 Dated Shillong the 25th February 2000.

The Governor of Meghalaya is pleased to extend the lease granted to the Shillong Municipality by the Government of Assam, vide their order No. 2391-G-S-8 dated 19-05-1938, for 18 acres of land in Riat Khwan Forest Compartment No. 4 for the purpose of trenching ground of Municipal waste, and which has been in perpetual use till date for the said purpose, on the following conditions :

1) That the lease is regularised and extended for the period from 1956 to 2026 (Seventy years).
2) That the Shillong Municipality will pay Land Rent of Rs. 90/- per annum, which may be revised by the Government of Meghalaya, at any point of time.
3) That the area shall be used exclusively for dumping of garbage and management of waste.
4) That out of this allocated area, 11 acres can be used for setting of aerobic compost plant which will help in disposal of accumulated waste.
5) That the Municipality will construct an internal fire line to isolate the adjoining forests.
6) That the Municipality will demarcate the area by constructing proper fencing.
7) That the Municipality will not sublet the project plant or sub-lease the area allocated to any other organisation or individual.
8) That the Municipality will not fell or damage any tree standing in area.
9) That the Municipality shall not pose any further encumberance on the forest due to establishment and or running of the project.
10) That the Municipality and its staff shall observe the rules and acts applicable to the forests in Meghalaya.

Principal Secretary
Forests & Environment Department

FOR. 76/99/16-A Dated Shillong the 25th February 2000.

Copy Forwarded To

1. The Principal Chief Conservator of Forests, Meghalaya Shillong for his information and necessary action
2. The Chief Executive Officer, Shillong Municipal Board for his information and necessary action
3. The Chief Conservator of Forests (Territorial) / Conservator of Forests (Territorial) Khasi & Jaintia Hills / Divisional Forest Officer (Territorial) Khasi Hills Division for their information and necessary action.

By Orders etc.

Under Secretary to the Government of Meghalaya
Forests & Environment Department

LAND POSSESSION CERTIFICATE

This is to certify that an area of 18 acres in the Riat Khwan Reserve Forest, Compartment No. 4 has been allotted to the Shillong Municipality on lease for the period 1938 - 2026. The Municipality is allowed to implement the solid waste management scheme on 11 acres out of this holding without sub-letting or sub leasing it to any other private agency.

Principal Secretary
Forests & Environment Department

Project Implementation and Urban Management Improvement in the North Eastern Region – Package A

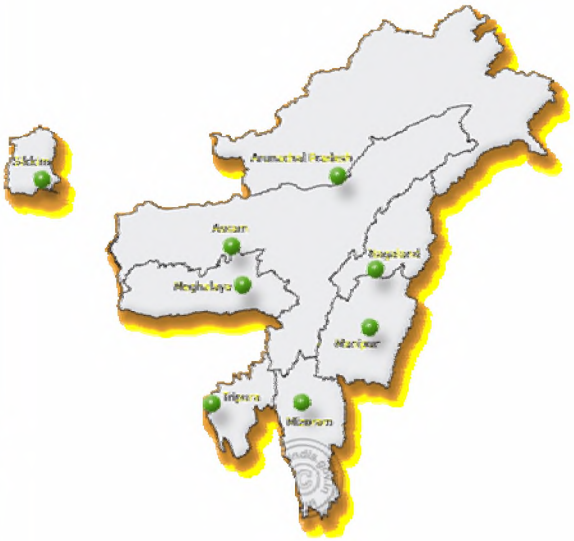
Draft Final DPR-Solid Waste Management Plan in Greater Shillong Planning Area

Asian Development Bank TA 4779 - IND

Volume VI

Initial Environmental Examination Report

June, 2009



SMEC INDIA

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ACRONYMS

ADB	Asian Development Bank
ADTA	Advisory Technical Assistance
BPL	Below Poverty Line
BWQC	Biological Water Quality Criteria
CFE	Certificates for Establishment
CFO	Consent for Operation
DSCs	Design and Supervision Consultants
DO	Dissolve Oxygen
EARP	Environmental Assessment and Review Procedures
EMP	Environmental Management Plan
EC	Environmental clearance
GIS	Geographic Information System
GSPA	Greater Shillong Planning Area
IPMU	Investment Program Management Unit
IPDF	Indigenous People's Development Framework
IPEC	Investment Program Empowered Committee
IPMIU	Investment Program Management and Implementation Unit
IPPMS	Investment Program Performance Monitoring System
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
LAD	Local Administration Department
UDHD	Urban Development and Housing Department
LIBOR	London Interbank offered Rate
LCB	Local Competitive Bidding
MoDNER	Ministry for Development of North-eastern Region
MOUD	Ministry of Urban Development
MFF	Multitranche Finance Facility
NER	North Eastern Region
NERCCDIP[1]	North Eastern Region Capital Cities Development Investment Program
NERUDP[2]	North Eastern Region Urban Development Project
NBCC	National Building Construction Company
NOC	No Objection Certificate

[1] **Phase I**-Formerly North Eastern Region Urban Development Project
[2] **Phase II**- Cities includes Dibrugarh, Guwahati, Imphal and Itanagar

PPTA	Project Preparatory Technical Assistance
PC	Planning Commission
PHEDs	Public Health Engineering Departments
PSC	Program Steering Committee
PMC	Project Management Consultants
RP	Resettlement plans
SMB	Shillong Municipal Board
SEA	State level Executing Agency
SES	Socio Economic Survey
SWM	Solid Waste Management
SSC	State Steering Committee
SPCB	State Pollution Control Board
STPs	Sewerage Treatment Plants
SIPMIU	State Level Investment Program Management and Implementation Unit
SEIAA	State Environment Impact Assessment Authority
SWMHR	Solid Waste Management and Handling Rules
SES	Socio-economic survey
UDD	Urban Development Department

I. INTRODUCTION

A. OVERVIEW

1. The North Eastern Region Capital Cities Development Investment Program (NERCCDIP) envisages achieving sustainable urban development in the Project Cities of Agartala, Aizawl, Kohima, Gangtok and Shillong through investments in urban infrastructure sectors. The urban infrastructure and services improvement is proposed in the following sectors (i) water supply, (ii) sewerage and sanitation, and (iii) solid waste management. The expected impact of the Investment Program, is increased economic growth potential, reduced poverty, and reduced imbalances between the NER and the rest of the country. The expected outcomes of the Investment Program will be an improved urban environment and better living conditions for the 1.65 million people expected to be living in the Investment Program cities by 2018. To this end, the Investment Program will (i) improve and expand urban infrastructure and services in the cities including in slums and (iii) strengthen urban institutional, management, and the financing capacity of the institutions, including the urban local bodies. Based on considerations of economic justification, absorptive capacity and sustainability of the implementing agencies, sub-projects have been identified in each city in the priority infrastructure sectors.

2. Though the Project aims to improve the environmental condition of urban areas, the proposed improvements of infrastructure facilities may exert certain adverse impacts on the natural environment. While developing urban infrastructure facilities, impacts during the construction stage are expected to be more severe than impacts during the operation phase, though for a short duration. Exceptions being some facilities such as solid waste landfills and sewage treatment plants, which may also exert adverse impacts during the operation phase, if due care is not taken.

3. The mandatory requirements applicable to the NERCCDIP may also necessitate the proposed components to go through the environmental assessment process at an appropriate level. Hence, considering these issues and particularly to facilitate the State-level Investment Program Management and Implementation Units (SIPMIU) and the Executing Agencies (EA) with definite environmental criteria to be met for implementation of NERCCDIP sub-projects and sub-components, an environmental assessment and review framework (EARF) has been prepared (see EARF for NERCCDIP). The EARF provides criteria for sub-project selection and guidelines for environmental assessment.

4. Above all, this exercise ensures that the NERCCDIP, in its project cycle, will not deteriorate or interfere with the environmental sensitivity of a project area but rather improve environmental quality through development of infrastructure facilities. Moreover, any component included in NERCCDIP shall comply with the environmental requirements of the Government of India (GoI), the respective state governments, and ADB. Details of components and sub-components financed under the NERCCDIP are given below.

B. NERCCDIP COMPLIANCE

5. The NERCCDIP will consist of two parts. Part A covers urban infrastructure and services improvement including the rehabilitation, improvement and expansion of (i) water supplies, (ii) sewerage and sanitation, and (iii) solid waste management. Part B covers provision of project management support, institutional development, capacity building and project administration. **Table 1** outlines the broad components by sector proposed in the program cities.

TABLE 1: PROPOSED NERCCDIP COMPONENTS

Sub- Projects	Components
Water supply	(a) source and treatment works; (b) distribution system including Non-Revenue Water (NRW) reduction; and (c) institutional development and
Sewerage and Sanitation	(a) collection and treatment system; (b) low cost sanitation facilities; and (c) institutional
Solid Waste Management	(a) improvement of collection system; (b) treatment and disposal system; and (c) institutional

6. In accordance with ADB's environmental safeguard requirements for a Multi-Tranche Financing Facility (MFF), the environmental assessment of individual tranches is required. Accordingly, the following four sub-projects are proposed for Tranche I: (i) water supply in Gangtok, (ii) NRW and small-scale water supply improvements in Agartala, Aizawl, and Kohima. (iii) solid waste management in Kohima, and (iv) solid waste management in Shillong. The focus of this IEE is solid waste management in Shillong.

C. ENVIRONMENTAL REGULATORY COMPLIANCE

7. The implementation of any sub-project proposed under NERCCDIP will be governed by the Environmental Acts, Rules, Policies, and Regulations of the GoI and the respective state governments of the Northeast Region. These regulations impose restrictions on the activities to minimize/mitigate likely impacts on the environment. The following are the environmental regulations applicable to NERCCDIP:

(i) The Water (Prevention and Control of Pollution) Act, 1974, amended 1988;

(ii) The Water (Prevention and Control of Pollution) Rules, 1975;

(iii) The Air (Prevention and Control of Pollution) Act 1981, amended 1987;

(iv) The Air (Prevention and Control of Pollution) Rules, 1982;

(v) The Environment (Protection) Act, 1986, amended 1991 and including the following Rules/Notification issued under this Act;

(vi) The Environment (Protection) Rules, 1986, including amendments;

(vii) The Municipal Solid Wastes (Management and Handling) Rules, 2000;

(viii) The Hazardous Wastes (Management and Handling) Rules, 1989;

(ix) The Bio-Medical Waste (Management and Handling) Rules, 1998;

(x) Noise Pollution (Regulation and Control) Rules, 2000;

(xi) Wild Life (Protection) Amendment Act, 2002;

(xii) Environmental Impact Assessment Notification, 2006;

(xiii) Environmental Standards of Central Pollution Control Board (CPCB);

(xiv) The Indian Wildlife (Protection) Act, 1972, amended 1993;

(xv) The Wildlife (Protection) Rules, 1995;

(xvi) The Indian Forest Act, 1927;

(xvii) Forest (Conservation) Act, 1980, amended 1988;

(xviii) Forest (Conservation) Rules, 1981 amended 1992 and 2003; and

(xix) Guidelines for Diversion of Forest Lands for Non-Forest Purpose under the Forest (Conservation) Act, 1980.

8. Any component included in NERCCDIP shall comply with the above environmental laws, standards, rules and requirements. Key standards include those related to drinking water quality, air quality, effluent discharge, leachate quality, and protected areas. Compliance is required in all stages of the project including design, construction, and operation and maintenance. Components relevant to this sub-project, which fall under the ambit of environmental regulations and mandatory requirement, are indicated in **Table 2**.

TABLE 2: ENVIRONMENTAL REGULATORY COMPLIANCE FOR SUB PROJECT

Sl. No	Component	Applicable Legislation	Compliance	Action Required
1	All components that require forest land acquisition	Forest (Conservation) Act, 1980 &and Wildlife Act, 1972	Approval of the Ministry of Environment and Forests, GoI	Identification of non-forest land and afforestation program need to be formulated
2.	Municipal Solid Waste Facility	Municipal Solid Waste Management and Handling Rules (SWMHR), 2000; Water (Prevention and Control of Pollution) Act, 1974 and/or the Air (Prevention and Control of Pollution) Act, 1981	Authorization from SPCB. No Objection Certificates (NOC), Certificates for Establishment (CFE) and Certificates for Operation (CFO).	Municipal Authority to receive proper authorization (CFE and CFO) from State Pollution Control Board (SPCB) for setting up waste processing and disposal facility including landfills.
			Renewal of CFO during operation	Based on the performance of the solid waste facility and its compliance with the discharge standards CFO will be renewed every year.

9. Under the Water (Prevention and Control of Pollution) Act, 1974 and/or the Air (Prevention and Control of Pollution) Act, 1981, the following sub-projects require Consent for Establishment (CFE) and Consent for Operation (CFO) from the respective State Pollution Control Board (SPCB). The applicable forms, "FORM-1", to get the Consent for Emission/ Constitution of Emission under Section 21 of the Air (Prevention and Control of Pollution) Act 1981 and "FORM-A", Consent for Discharge under Section 25/26 of the Water Act, 1974 is given in **Annexure 3**. The CFE/CFO is issued upon project review and site visits. The Board issues the CFE before start of construction and the CFO after completion of construction and satisfying CFE conditions, if any. During the operation period, the effluent and air emissions must conform to the stipulated standards (CPCB Environmental Standards). The CFO is renewed every year based on the operation performance of the facility. The following sub-projects require SPCB consent for establishment and operation.

(i) New or augmentation of water treatment plants (under the Water Act);

(ii) New or augmentation of sewage treatment plants (under the Water Act);

(iii) Solid waste composting and landfills (under the Water Act and the Air Act);

(iv) Diesel generators (under the Air Act); and

(v) Hot Mix Plants, Wet Mix Plants, Stone Crushers etc, if installed for construction (under the Air Act).

10. The new EIA Notification of 2006 of GoI, which replaces the EIA Notification of 1994, requires environmental clearance for certain defined activities/projects. This Notification classifies the projects/activities that require environmental clearance (EC) into 'A' and 'B' categories depending on the impact potential and/or scale of project. For both category projects, prior environmental clearance is mandatory before any construction work, or preparation of land except for securing the land, is started on such project or activity. Clearance provisions are as follows:

(i) Category 'A' projects require prior environmental clearance from the MoEF, Government of India[3];

(ii) Category 'B' projects require prior environmental clearance from the State Environment Impact Assessment Authority (SEIAA)[4]; and

(iii) This Notification provides that, any project or activity specified in Category 'B' will be treated as Category A, if located in whole or in part within 10 km from the boundary of (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, (iv) inter-State boundaries and international boundaries. Also, in the case where a SEIAA does not exist, Category B project will be reclassified as Category A and reviewed by the MoEF.

11. Consequently, the only NERCCDIP subproject listed in the EIA Notification of 2006 Schedule of Projects Requiring Prior Environmental Clearance is solid waste facilities, otherwise referred to as Common Municipal Solid Waste Facilities (CMSWF). Common municipal solid waste management facilities qualify as Category B projects and are thus reviewed by the respective SEIAA. For solid waste facilities, the Government of India further ensures environmental safeguards through its Municipal Solid Waste Management and Handling Rules (SWMHR), 2000 as published under MoEF.

12. This subproject focuses only on solid waste components. Therefore the construction of a sanitary landfill site (solid waste facility) qualifies the project as a Category B under GoI law. The project is to be reviewed by the Meghalaya SEIAA, as well as ensure environmental safeguards through its Municipal Solid Waste Management and Handling Rules (SWMHR), 2000 as published under MoEF.

[3] For Category A projects, based on the preliminary details provided by the project proponent as per Notification, the Expert Appraisal Committee (EAC) of MoEF, determine comprehensive TOR for EIA studies. This TOR will be finalized within 60 days. On the recommendation of the EAC based on EIA studies, MoEF provides the EC.

[4] The B category projects will be further divided by State Level EAC into B1 – that require EIA studies and B2 – no EIA studies. The Sate Level EAC will determine TOR for EIA studies for B1 projects with in 60 days. On the recommendation of the State level EAC based on EIA studies, SEIAA provides the EC.

13. These Rules issued under the Environment (Protection) Act, 1986 with the objective of regulating the management and handling of the municipal solid wastes is applicable to all municipal solid waste subprojects. The important provisions are:

    (i) Solid waste generated in a municipal area shall be managed, including segregation, collection, transportation, and disposal in accordance with the Rules.

    (ii) The State Pollution Control Board will authorize waste processing and landfills.

    (iii) Solid waste processing and landfills shall meet design and operation specifications/standards specified under the Rules. These include site and facility design specifications, output compost characteristics, pollution control and monitoring programs, including closure of landfill site and post-care.

14. At the state government level, solid waste subprojects require review by the respective State Pollution Control Board (SPCB). These subprojects are required to obtain the following clearances from SPCB: No Objection Certificates (NOC), Certificates for Establishment (CFE) and Certificates for Operation (CFO).

FOREST LEGISLATION

15. Forest legislation in India dates back to enactment of the Indian Forest Act, 1927. This Act empowers the State Government to declare "any forest land or waste-land, which is the property of Government or over which the Government has proprietary rights or to the whole or any part of the forest-produce of which the Government is entitled", a reserved forest or protected forest. The State Government may assign to any village-community the rights of Government over a reserved forest - those are called village-forests. Act also allows Government control over forest and lands not being the property of Government.

16. Acts like clearing or break up of any land for cultivation or for any other purpose, damage to vegetation/trees and quarrying or removing any forest produce from reserved forest is prohibited. All these are also applicable to village-forests. For protected forests, with the provision of the Act, the State Government makes rules to regulate activities like: cutting of trees and removal of forest produce; clearing or breaking up of land for cultivation or any other purpose; and for protection and management of any portion of protected forest.

17. Forest (Conservation) Act, 1980 (amended in 1988) enacted by Government of India, restricts the deforestation of forests for use of non-forest purposes. According to the Act, State Government requires prior approval of GoI for the use of forest land for non-forest purposes (means the breaking up or clearing of any forest land) or for assigning least to any private person or agency not controlled by government. The Forest (Conservation) Rules, 2003 issued under this Act, provide specific procedures to be followed for conversion of forest land for non-forest purposes.

18. Limited sub-projects notably solid waste composting and landfills may require acquisition of forest land[5]. The Government of Meghalaya Forest & Environment Department has officially granted permission (**Annexure 4**) to use the land for solid waste disposal purposes for the existing and proposed solid waste disposal site; this is because the site is part of Riatkhwan

[5] The term 'Forest land' refers to land owned by the Forest Department; it may or may not include reserved forest, protected forest or any area recorded as forest in the government records.

Reserve Forest. The Government of Meghalaya Forest & Environment Department has extended the lease under letter no. FOR 76/99/16 dated 25th February 2000 to the Shillong Municipality for 18 Acres of land in Riat Khwan Forest Compartment No-4 (Plot No-1, Plot No-2 and Plot-3).The Possession Certificate of proposed solid waste site has been also issued by the Forest Department.

19. Linear subprojects like water supply rising mains/trunks mains may traverse forest lands. The forest land conversion will follow the "Guidelines for Diversion of Forest Lands for Non-Forest Purpose" under Forest (Conservation) Act, 1980. Compensatory afforestation is one of the most important conditions stipulated for diversion of forest land. The proposals for conversion will be forwarded by the State Government to the MoEF, GoI:

    (i) Forest land involving up to 5 ha will cleared by the Regional Office of the MoEF.

    (ii) Forest land involving more than 5 ha and up to 20 ha sent will be cleared by the Regional Office after referring the case to MoEF.

    (iii) Conversion of forest land (i) having density above 0.4 irrespective of the area involved, and, (ii) of more than 20 ha in the plains and 10 ha in the hilly region, irrespective of density, will be cleared by MoEF.

    (iv) Compensatory afforestation is compulsory for conversion:

    (v) Afforestation will be done over an equivalent area of non-forest land.

    (vi) As far as possible, the non-forest land for compensatory afforestation should be identified contiguous to or in the proximity of Reserved Forest or Protected Forest. If non-forest lands are not available in the same district other non-forest land may be identified elsewhere in the state.

    (vii) Where non-forest lands are not available, compensatory afforestation may be carried out over degraded forest twice in extent to the area being diverted.

    The flow chart of Forest clearance is given in **Annexure 2**.

20. Conversion of forest lands that are part of National Parks/Sanctuaries and Tiger Reserve areas (notified under Indian Wildlife (Protection) Act, 1972) is not permitted. In exceptional case, the State Government requires consent of the Indian Board of Wildlife for obtaining approval of the State Legislature for denotification of the area as a sanctuary.

21. Cutting of trees in non-forest land, irrespective of land ownership, also requires permission from the State Forest Department. Afforestation to the extent of two trees per each tree felled is mandatory.

D. PURPOSE OF IEE

22. This IEE deals with the environment assessment of the solid waste sub components in Shillong.

    The NERCCDIP covers five cities, in each of which sub-projects in the various priority infrastructure sectors are identified. In accordance with the ADB's environmental assessment requirement for Multi-Tranche Financing Facility (MFF) modality, the environmental assessment of sample sub-projects has been carried out.

23. Solid Waste Management is managed by three different authorities viz. (i) The Shillong Municipal Board (SMB) within the municipal area (ii) The Dorbars, outside the municipal area, and (iii) The Defense Authorities, within the cantonment area. The Municipal Solid Waste in

Shillong in general is a mixture of bio-medical, residential, commercial and hotel wastes apart from construction debris.

24. The proposed transfer station, garage and disposal site will be located within the existing landfill site at Municipal Trenching Ground at Marten, Mawiong which has been operational and used for disposal purposes since 1938. The site already includes an operating compost facility.

25. The collected wastes throughout the city are disposed at Mawiong disposal site at a distance of about 8 km from the city. The proposed land fill area is 5.2503 Acres. The existing and proposed location map of the solid waste and compost facility in Shillong is presented in **Figure 1.0**. Plot No-1 is proposed solid waste disposal site, which is the part of Compartment no-4 (It includes Plot No-1, Plot No-2 and Plot-3 of 18 Acres land) in Forest Department's record and the Possession Certificate for the same has been issued by the Forest Department under Notification letter no FOR 76/99/16 dated 25 February, 2000 (Refer **Annexure 4**). There are no sensitive receptors occurring within 500 m of the site. Umiam Lake is approximately 3.0 km from proposed disposal site. The proposed Solid Waste Disposal site and Umian reservoir is shown in **Figure 1.0 (a)**. The existing and proposed solid waste disposal site is the part of Riatkhwan Reserve Forest, which is shown in **Figure 1.0 (b)**. The Meghalaya Forests and Environment Department has officially granted permission to use the land for solid waste disposal purposes (Annexure 4).

E. ENVIRONMENTAL CATEGORY

26. The project has been categorized as Category B project per ADB as none of the components are proposed at locations in or near sensitive and valuable ecosystems. The existing and proposed Solid Waste Disposal site is the part of Riat Khwan Reserve Forest. The Government of Meghalaya Forest & Environment Department has extended the lease under letter no. FOR 76/99/16 dated 25th February 2000 to the Shillong Municipality for 18 Acres of land in Riat Khwan Forest Compartment No-4 (Plot No-1, Plot No-2 and Plot-3 of **Figure 1.0**) for the purpose of trenching ground of Municipal waste with certain conditions **(Refer Annexure 4)**. The land possession certificate has been also issued by the Forest & Environment Department to Shillong Municipality **(Refer Annexure 4)**. The lease period is from 1938 to 2026.

27. At present the proposed Disposal site is Plot No-1 and the Umiam Lake (a man-made reservoir used for hydroelectric power) is 3.0 km from proposed Disposal site. Umiam Lake is a "potential Ramsar site". It has not been officially designated a Ramsar Wetland. The Meghalaya State Biodiversity Action Plan has identified pockets of rich biodiversity as conservation hotspots. None of the identified hotspots are located within the Greater Shillong boundaries. Also all the project interventions are within the GSPA boundaries and (ii) no project components are located within the sensitive areas of GSPA. The proposed landfill at the existing disposal site is a continuation of the disposal land use that has occurred on the property since 1938.

28. As such, an Initial Environmental Examination (IEE) has been conducted, and no significant adverse impact has been envisaged, as mentioned above. The details are given in REA checklist enclosed as **Annexure 5**. To further mitigate any environmental impacts, an Environmental Management Plan (EMP) is included as part of this IEE.

F. SCOPE OF IEE

29. The IEE is based on secondary sources information such as information collected from previous PPTA/ DPR report prepared by Lea Associates, information collected from SPCB & forest department and field reconnaissance surveys. Stakeholder consultation was an integral part of the IEE.

30. This Report contains eight (8) sections including this introductory section:

(i) Introduction;
(ii) Description of project components;
(iii) Description of the environment;
(iv) Screening of potential environmental impacts and mitigation measures;
(v) Environmental management plan;
(vi) Public consultation and information disclosure;
(vii) Finding and recommendation; and
(viii) Conclusions.

G. IMPLEMENTATION SCHEDULE

31. The investment program is to be implemented over a ten-year period, commencing in FY 2009. Completion is scheduled by 2015. Implementation of sub-projects is proposed in three tranches over the program implementation period of (2009-2015). The implementation of the solid waste sub-projects in Shillong is proposed to be undertaken in the first tranche (with expected approval in 2009).

H. PROJECT BENEFITS

32. The solid waste management sub project in Shillong has proposed improvements in collection of solid waste through house-to-house waste collection, source segregation, transportation and scientific disposal of the wastes. The benefits accrued due to the present project components are:

(i) Reduction in unhygienic conditions;
(ii) Cleaner surroundings;
(iii) Reduction in choking of drains and streams;
(iv) Improvement in the conditions within the city;
(v) Reduction in vulnerability to diseases; and,
(vi) Reduction in the hazards of pollution of surface water and ground water.

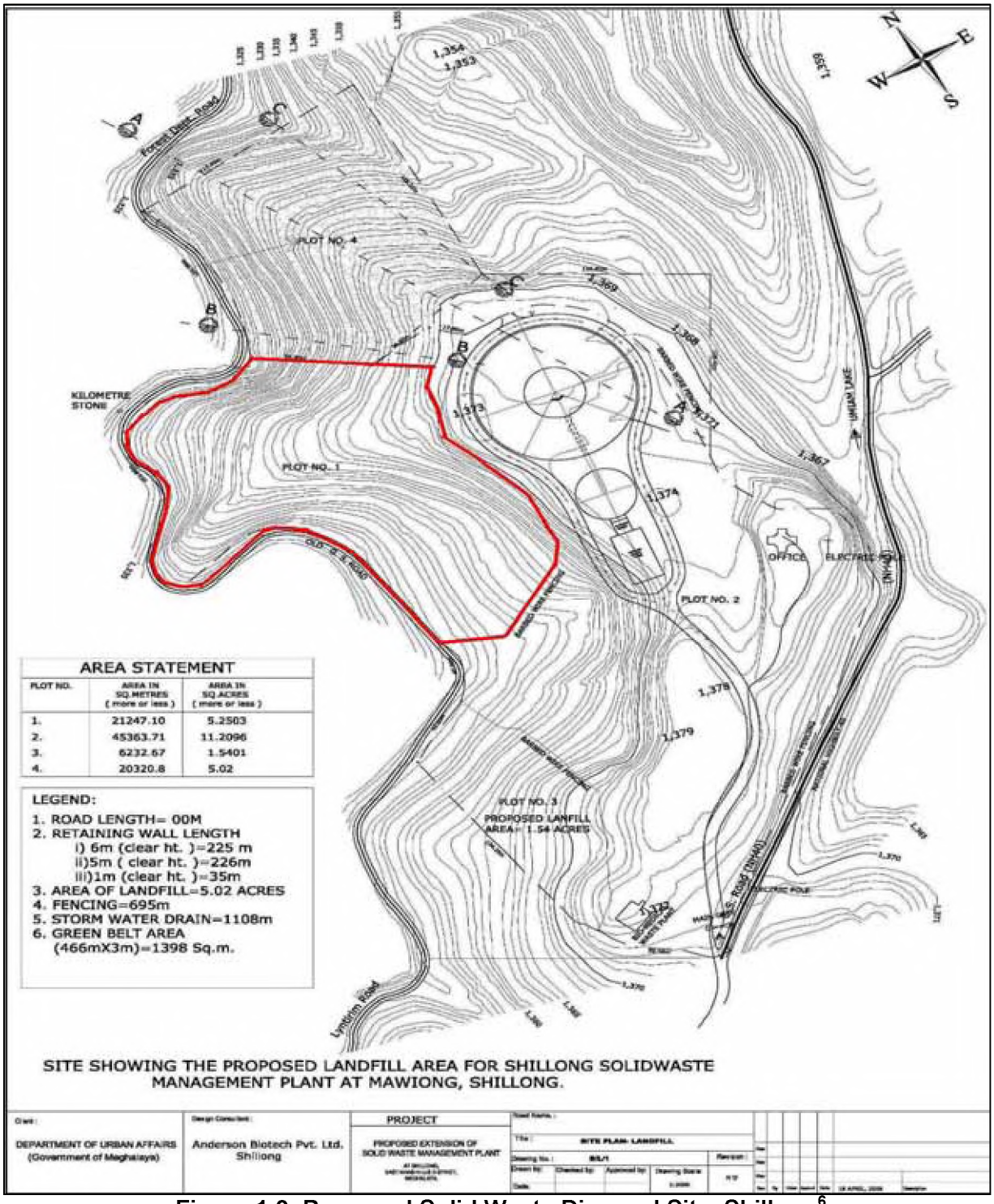


Figure 1.0: Proposed Solid Waste Disposal Site, Shillong[6]

[6] **Source:** Director, Urban Affairs, Meghalaya, Shillong

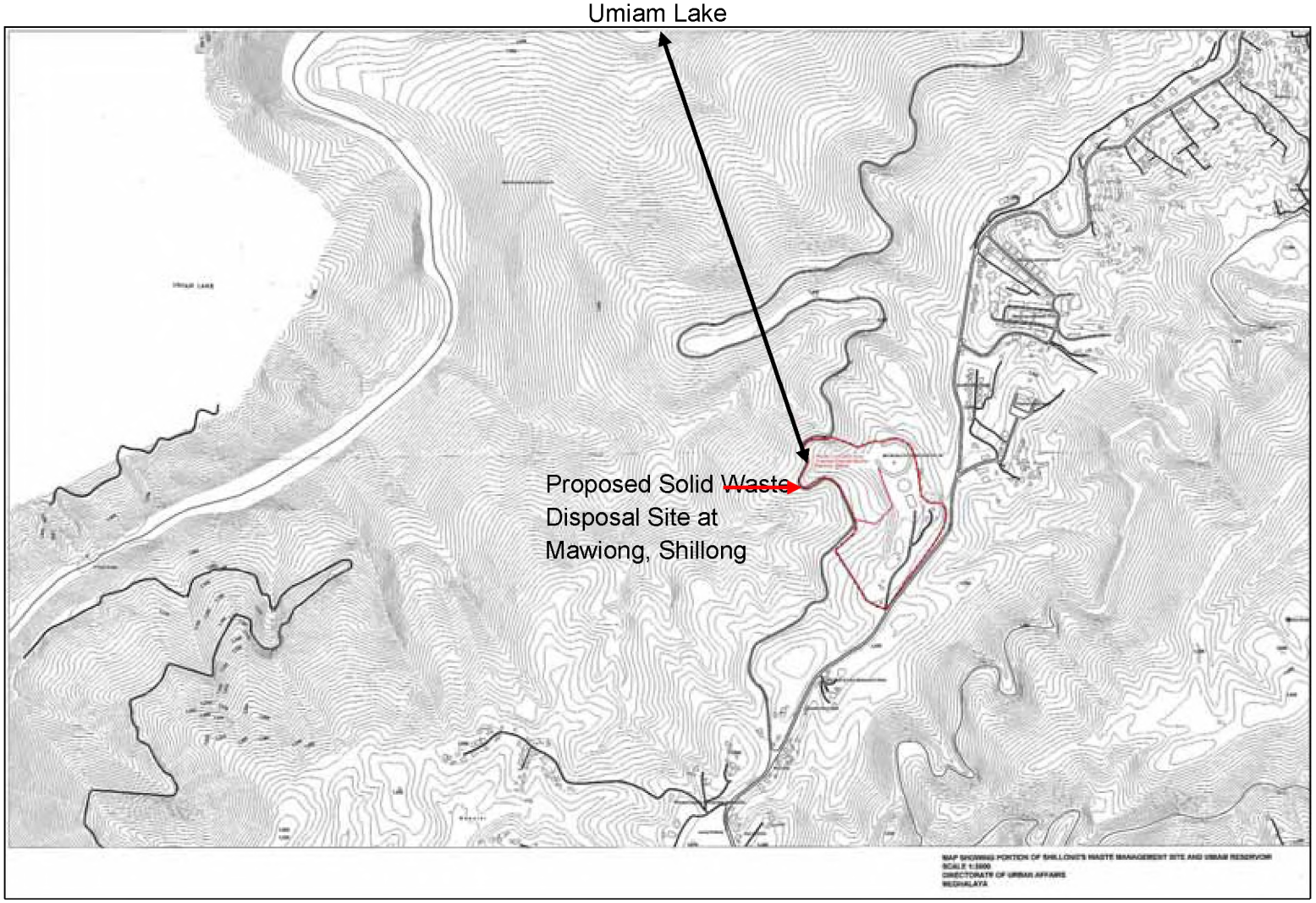


FIGURE 1.0 (A): THE PROPOSED SOLID WASTE DISPOSAL SITE AND UMIAM RESERVOIR

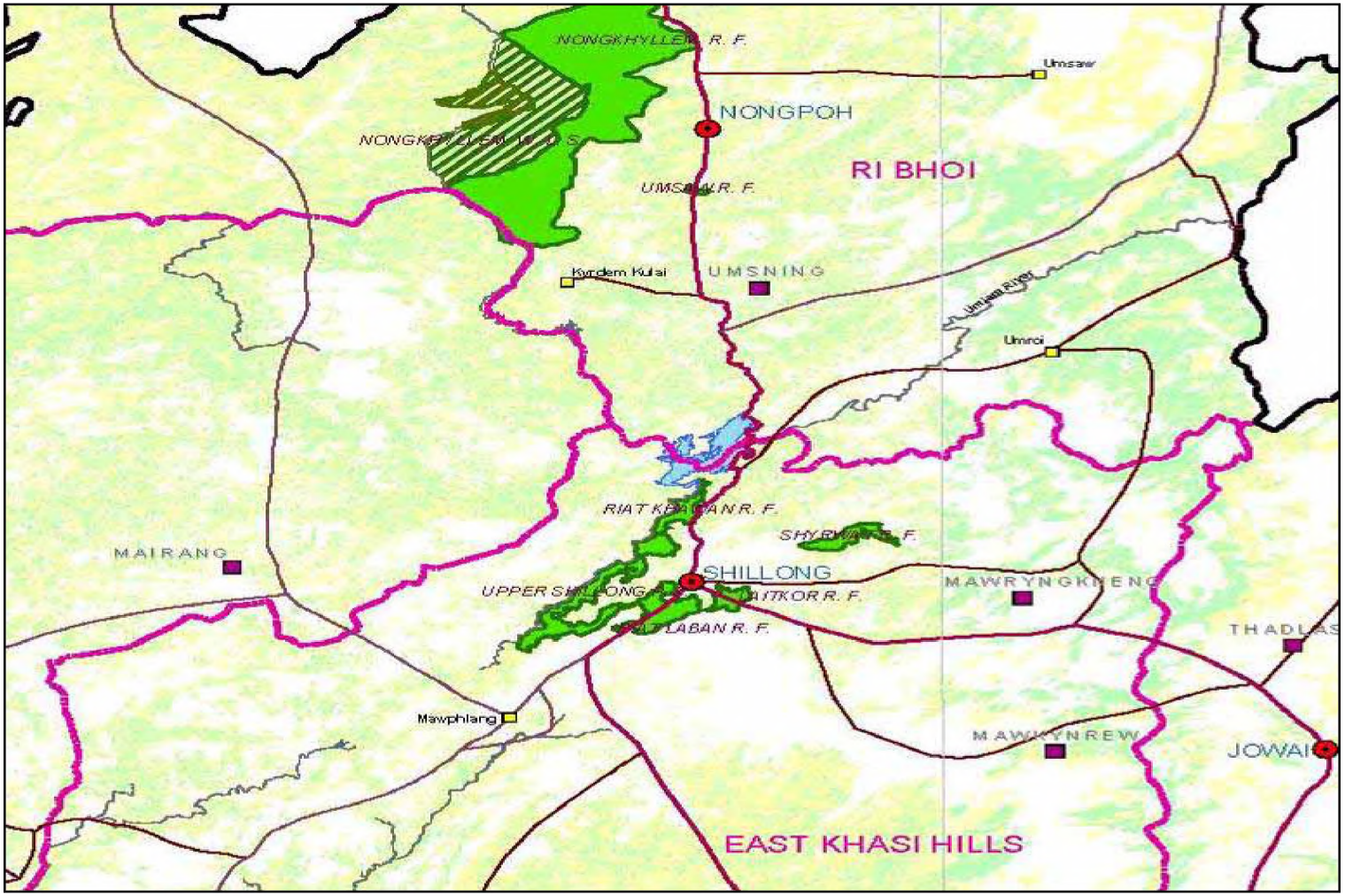


FIGURE 1.0 (B): THE EXISTING AND PROPOSED SOLID WASTE DISPOSAL SITE IN RIATKHWAN RESERVE FOREST

II. DESCRIPTION OF THE PROJECT COMPONENTS

A. PROJECT COMPONENTS

33. Shillong Municipal Board (SMB) was created in 1910. At present, SMB is governed as per the provisions of the Meghalaya Municipal Act, 1973 and the Meghalaya Municipal (amendment) Act, 2000. Unlike the other municipalities in the Project area, the SMB lacks public representation. The last election was held in 1967. In 1973, the elected Board was superseded by the government and the SMB since then has functioned as an administrative body under the direction of a Chief Executive Officer appointed by the State Government. The CEO operates through two executive officers and staff.

34. The functions of SMB as per the Meghalaya Municipal Act are managing water supply, lighting, drainage, sanitation and other amenities. The Act also mentions (Section 60, u/s 1) setting apart of funds for specific purposes including water and lighting, removal of sewerage and rubbish, public health administration including measures to control epidemic, construction, maintenance and improvement of roads, bridges, squares, gardens, tanks, ghats, well, drains, latrines and urinals and variety of other purposes in the interest of residents of the municipal area, which promote comfort or convenience of the inhabitants.

35. The Greater Shillong Planning Area (GSPA) is spread over an area of 173.87 sq.km. It comprises three distinct areas, comprising the Shillong Municipal Board (SMB) area, 6 other urban centers namely Shillong Cantonment, Mawlai, Nongthymmai, Pynthorumkhrah, Madantring, and Nongmynsong[7] towns and rural areas with 32 settlements. GSPA, with its total population of 312,539 (2001 Census) accounts for 78% of the total urban population of Meghalaya. Shillong is mainly a service centre for the entire state, apart from being a major tourist destination. The city population is 77% tribal, with most of the population belonging to Khasi tribe. There are 19 notified slums within GSPA, which account for about 22% of the population. The per capita income in 2005 was INR 1,881 per month, slightly above the Indian urban average of INR 1,695. About 25% of the city population is classified by the state government as below poverty line (BPL).

36. Solid Waste Management is managed by three different authorities viz. (i) The Shillong Municipal Board (SMB) within the municipal area (ii) The Dorbars, outside the municipal area, and (iii) The Defense Authorities, within the cantonment area. The Municipal Solid Waste in Shillong in general is a mixture of bio-medical, residential, commercial and hotel wastes apart from construction debris. The proposed transfer station, garage and disposal site will be located within the existing landfill site at Municipal Trenching Ground at Marten, Mawiong. The collected wastes throughout the city are disposed at Mawiong disposal site at a distance of about 8 km from the city. The site has been operational since 1938. The proposed land fill area is 5.2503 Acres. The existing and proposed location map of the solid waste and compost facility in Shillong is presented in **Figure 1.0**. Plot No-1 is proposed solid waste disposal site, which is the part of Compartment no-4 (It includes Plot No-1, Plot No-2 and Plot-3 of 18 Acres land) in Forest Department's record and the Possession Certificate for the same has been issued by the Forest Department under Notification letter no FOR 76/99/16 dated 25 February, 2000 **(Refer Annexure 4)**. Umiam Lake is approximately 3.0 km from proposed disposal site. The proposed Solid Waste Disposal site and Umian reservoir is shown in **Figure 1.0(a)**. The existing and proposed solid waste disposal site is the part of Riatkhwan Reserve Forest, which is shown in

[7] The town was included as part of the Shillong Urban Agglomeration in 2001.

Figure 1.0(b). The photographs of existing disposal site at Marten, Mawiong are given in **Annexure 6**.

IMPROVEMENT OF COLLECTION SYSTEM

37. The proposal includes improvement of the following: (i) primary and secondary collection efficiencies, (ii) existing system for transportation of wastes, and (iii) treatment and disposal of wastes in accordance with SWHR. The proposed components include:

IMPROVEMENT OF COLLECTION SYSTEM

38. Improvement of the existing SW collection system from 45% to 60% by 2011, through improvements in primary and secondary collection facilities and through an intensive community awareness and consultation program, in consultation with communities, dorbars and NGOs. The proposed components include:

- Introduction of house-to-house waste collection through source segregation on a pilot basis, initially to about 2000 households within the SMB area.
- Provision of 1000, 30 litre dustbins to be placed in public places;
- Provision of 2000, 25-litre household dustbins and 2000 Nos. heavy duty PVC bags to be used for segregation of wastes at source (non biodegradable);
- Provision of 250 wheelbarrows to be used by sweepers in the central areas of the city; and,
- Provision of 35 nos, 4.5 cum community dustbins to be used in areas where bell ringing or house-to-house service is not provided.

TRANSPORTATION FACILITIES

39. Operational improvements of the existing refuse vehicles through incorporation of more vehicles with proper tipping and hydraulic loading/unloading arrangements.

- Provision of 5, medium duty tipper trucks for collecting the wastes from house to house with introduction of bell ringing system in the periphery areas to households along the main road;
- Provision of 7 new dumper placers for secondary collection. The medium tippers and dumper placers shall be used for carrying waste from the waste generating sources to transfer station; and,
- Provision of 6 large tipper trucks with 8-10 cum waste carrying capacities per trip. The larger tipper shall be used for carrying waste from transfer station to sanitary landfill sites.

GARAGE AND TRANSFER STATION

40. The proposed components include

- Development of a transfer station at the existing disposal site at Mawlai towards increase in vehicle trips and area of coverage. The transfer station shall also function as recovery centre for segregation of biodegradable portions from the recoverable/ recyclables.

- Construction of new parking/garage/workshop facility at Mawlai (the existing disposal site) for accommodation and maintenance of 24 refuse vehicles. The garage shall also be used for maintenance of wheelbarrows and mechanised containers.

TREATMENT AND DISPOSAL

41. The proposed components include

- Development of a sanitary landfill site at Mawiong, with adequate leachate collection facilities and environmental protection measures.
- Provision of 2 bulldozers, 2 tipper trucks and 1 JCBs for disposal site and composting plant operations;
- Provision of environmental protection measures at the present disposal site at Mawlai, as intermediate protection measures till the new sanitary landfill site starts operation; and,
- Introduction of weighbridges at landfill sites to track waste supply to compost plant and fuel consumption.

CAPACITY DEVELOPMENT

42. This will consist of the following

- Safeguards compliance studies;
- Community awareness programs,
- Compost marketing studies;
- Private sector participation opportunities studies

B. PROJECT ALTERNATIVES

43. There is currently no alternative site for Solid Waste Disposal, however, the proposed site is intended to serve as an immediate sanitary disposal location at the existing disposal site for the near future, while the Shillong government is actively searching for more land to be used for future landfill activity. The proposed solid waste system will be designed in compliance with the MSW Rules, 2000 of GoI. The hygiene, efficiency and environmental suitability are the main criteria in selecting the waste collection, transportation and disposal system.

44. Door-to-door waste collection system is proposed. This system is preferred to the community bin collection system, which is generally unhygienic. The door-to-door collection system will ensure proper collection of waste and will avoid littering of the streets and unhygienic neighborhoods. Litter bins are proposed on main roads and commercial areas to avoid littering. The secondary collection and transportation system proposed ensures no manual handling of waste. Solid waste will be transported in closed vehicles to avoid the nuisance. The containers are lifted and unloaded mechanically minimizing the health risk to the sanitary workers. A sanitary landfill site and a compost plant are proposed to be developed at the disposal site.

45. These above mentioned measures will ensure establishment of an efficient solid waste management system in Shillong that will conform to the SWHR of the GoI and also minimize impacts on the environment and better the quality of life in the urban area.

III. DESCRIPTION OF THE ENVIRONMENT

A. ENVIRONMENTAL PROFILE OF SHILLONG

46. Shillong, which had been the Capital of Assam, since 1874, was founded by Col. Henry Hopkins, the then Commissioner of Assam, in 1864. In 1972 it became the capital city of the State of Meghalaya. It falls under the East Khasi Hills District being one of the seven districts of the State. Popularly referred to as "The Scotland of the East", Shillong functioned, during the British regime, as the administrative capital of the erstwhile Assam province apart from being the only major tourist destination in the region. Situated at 250 31' 26'' - 250 39' 56''N Latitude and 910 47'20'' - 9200'39'' E Longitude, the altitude of the city varies between 1400 to 1900 meters (m) above mean sea level (MSL). The National Highway NH-40 links Shillong with Guwahati and rest of the country. There is a minor airport at Umroi, 35 kilometers (km) from Shillong. Guwahati, the largest urban centre of the region, is located 120 km from Shillong, is the nearest railhead and airport.

47. The Greater Shillong Planning Area (GSPA) is spread over an area of 173.87 sq.km. It comprises three distinct areas, comprising the Shillong Municipal Board (SMB) area, 6 other urban centers namely Shillong Cantonment, Mawlai, Nongthymmai, Pynthorumkhrah, Madantring, and Nongmynsong8 towns and rural areas with 32 settlements. GSPA, with its total population of 312,539 (2001 Census) accounts for 78% of the total urban population of Meghalaya. Shillong is mainly a service centre for the entire state, apart from being a major tourist destination. The city population is 77% tribal, with most of the population belonging to Khasi tribe. There are 19 notified slums within GSPA, which account for about 22% of the population. The per capita income in 2005 was INR 1,881 per month, slightly above the Indian urban average of INR 1,695. About 25% of the city population is classified by the state government as below povertyline (BPL).

48. The city is located in Seismic Zone V. The slopes within the city are generally only moderately steep and range generally from 5% to 10% with some more steep areas. Shillong experiences a humid sub tropical climate, and is characterized by moderate warm wet summers and cool dry winters. The average annual rainfall is about 2100 millimeters (mm), mostly from the southwest monsoon. The physical growth of the city is in the northeastern direction, where the new Shillong Township is proposed. The growth of the city can be traced to the establishment of the cantonment by the British in 1867. In 1878, two sub urban villages of Mawkhar and Laban were formed into a station with the consent of the Syiem of the Mylliem. Subsequently, Lachumiere and Haneng Umkhrah were included in the station. The station was converted into a municipality in 1910.

49. Shillong is the only city, amongst the five project cities, which contains tribal areas falling under the VI Schedule[9] of the Constitution. There are two distinct areas; one comprising the SMB, which does not fall within the power and ambit of the Autonomous District Councils (ADC), and the rest of the GSPA governed by the Sixth Schedule. Outside the SMB and within GSPA, the

[8] The town was included as part of the Shillong Urban Agglomeration in 2001.

[9] Clause (2) of Article 244 of the Constitution of India, stipulates that the provisions of the Sixth Schedule shall apply to the administration of the tribal areas in the State of Assam, Meghalaya, Tripura and Mizoram. In accordance to the Sixth Schedule each of these areas shall be an 'autonomous district', the word 'autonomous' indicates a right of self-government. This essentially means that the tribal area of Meghalaya will be governed not by other provisions of the Constitution relating to the States or Union Territories of the Union of India but by the provisions of the Sixth Schedule alone, which contain a self contained code for the governance of the tribal areas. Although the VI Schedule also applies to Tripura and Mizoram, neither Agartala nor Aizawl has tribal areas within the boundaries of the city.

Autonomous District Council and the village heads, or dorbar schnongs,[10] play an important role in provision of civic services and in small development works particularly water supply.

B. PHYSICAL RESOURCES

a. TERRAIN

50. Shillong falls on deeply dissected central upland of the Meghalaya Plateau. The relief of the city varies from 1400 to 1900m above mean sea level (MSL). The Khasi Hills range at the south descends at a slope of 200+ towards the city and acts as a water divide. The slope within the city ranges from 5% to 10%, except at the locations such as Happy Valley, Pynthomukhrah and Polo Ground area, where slope are gentle within the range of upto 5%. Wah Umkhrah, Wah Umshyrpi and Wah Umkhen are the three main streams draining the city through a number of second and third order tributaries.

b. CLIMATE

51. The climate of Shillong is characterized by moderate warm wet summers and cool dry winters. Shillong experiences a humid sub tropical climate. There are four distinct seasons: mild summer (March to mid May), rainy season (mid May to mid October), autumn (mid October to November) and winter (December to February). The average maximum and minimum temperature is around 17°C and 7.5° C respectively. The average annual rainfall in Shillong is about 2100 mm. Shillong experiences a prolonged rainy seasons with intermittent rain for almost throughout the year, since it is located close to "Cherrapunjee". The wettest place in the World (aerial disdatnce approximately 30 km). Two thirds of the rainfall occurs in months from June to September from southwest monsoons. The relative humidity is highest during rainy season (above 80%). The humidity is generally more than 50% for all throughout the year (except March).

c. GEOLOGY AND SEISMICITY

52. Shillong lies on low-grade metamorphic rocks of Shillong Group. The rock types are predominantly of quartzite with subordinate of phyllites and slates followed by schist and gneisses. The Quartzite band dips at 200 to 400 in North-North East to South-South West direction. The rock band is found at a depth of one to three metres from the topsoil level, except at places where the crusted Quartzite bands are exposed. Four sets of joints have been noted in these quartzite, which have rendered them splintery at places where all the sets are intensely developed. The quartzite exhibits broad open folds.

53. The generalized lithological succession in the area is presented in the **Table 3.1**.

[10] These are grass root traditional institutions involved in the civic affairs of the city. The Dorbar Schnong, though without constitutional or state recognition, is the most powerful and active body at the local level. The headman of the Dorbar Schnong looks after (i) certain administrative, municipal and financial functions (ii) law and order and common properties of the village and (iii) conventional municipal services like water supply, sanitation, management of roads, footpaths and water sources.

TABLE 3.1: LITHOLOGICAL SUCCESSION IN SHILLONG

Type of material	Nature of material	Depth of occurrence
Top soil	Sandy and micaceous	0m-1.5m
Weathered rock/debris	Unconsolidated, saturated with water	1.5m-4/6m
Weathered quartzite interbanded with metabasic	Hard and fresh bed rock	6m-20/30m
Hard and fresh quartzite interbanded with metabasic rocks	Hard and fresh rock	30m-35m

54. No major fault or thrust occurs within the Shillong Urban Zone but prominent lineament and a major shear zone (Tyrsad-Barapani Shear) occur in the vicinity. Shillong falls in the seismic Zone V.

55. The base of Shillong group is marked by conglomerate bed containing cobbles and boulders of Archaen rocks. In case of Shillong the other environmental factors like lithology, regolithic characteristics have very limited or no influence on the foundation, which is already found to be suitable, and the area is free from landslide problems.

d. SOILS

56. The soil in Shillong is mainly laterite soil, deficient in phosphorus and potash content but rich in nitrogen and organic matter. The soils are mildly acidic in nature. pH ranges from 4.8 to 6.2. Some areas have alluvial fills, which are heavy loams and contain larger amount of organic matter. The thickness of the soil varies from 1 to 10 meters.

e. Land Use

57. Shillong Master Plan Area covers an area of around 17400 hectares and includes 6 urban areas and 32 rural settlements. Of the total area, 5494.10 hectares or 31.58% is developed area, 1573.88 hectares or 9.04 % is undevelopable area, 5077.02 hectares or 29.18% is developable area, 803.07 hectares or 4.62 % is under urban agriculture and rest are covered by forest and water bodies. The Master Plan has classified the existing land use of Greater Shillong as given in **Table 3.2** and proposed land use (Shillong Master Plan) is given in **Table 3.3**. The land use pattern of Greater Shillong Planning Area is shown in **Figure 3.1**. The existing and proposed land use of Shillong Master Plan is shown in **Figure 3.2** and **Figure 3.3** respectively.

TABLE 3.2: EXISTING LAND USE IN SHILLONG, 1991

Land use	Area in hectares	Percentage to total area	Percentage to developed area
Residential	2662.78	15.30	48.47
Commercial	56.62	0.33	1.03
Public and Semi Public Uses	1202.01		
Administrative	*117.93*	.68	2.16
Institutional	*903.20*	5.19	16.44
Organized open spaces	*118.13*	.68	2.16

Land use	Area in hectares	Percentage to total area	Percentage to developed area
Graveyards	*61.75*	.35	1.12
Security	779.33	4.48	14.18
Industrial	10.00	0.06	0.18
Circulation	783.36	4.50	14.26
Vacant	6650.90	38.23	-
Urban Agriculture	803.07	4.62	-
Forests and Water Bodies	4451.93	25.58	-
Total	17400	100.0	100

Source: *Master Plan of Shillong, 1991-2011, Directorate of Urban Affairs, Meghalaya, Shillong*

TABLE 3.3: PROPOSED LAND USE (SHILLONG MASTER PLAN)

Land use	Area in hectares	Percentage to total area	Percentage to developed area
Residential	5095.27	29.28	60.85
Commercial	97.72	0.56	1.17
Public and Semi Public Uses	1326.03	0.85	1.76
a) Administrative	147.93	5.54	1.76
b) Institutional	963.2	0.88	11.51
c) Organized open spaces	161.75	0.35	0.74
d) Graveyards	53.15	4.48	9.31
Security	779.33	0.34	0.72
Industrial	60.00	5.82	
Circulation	1013.41	4.53	
Urban Agriculture	788.07	25.24	
Forests and Water Bodies	4391.93	22.13	
Conservation	3848.24		

Source: *Master Plan of Shillong, 1991-2011, Directorate of Urban Affairs, Meghalaya, Shillong*

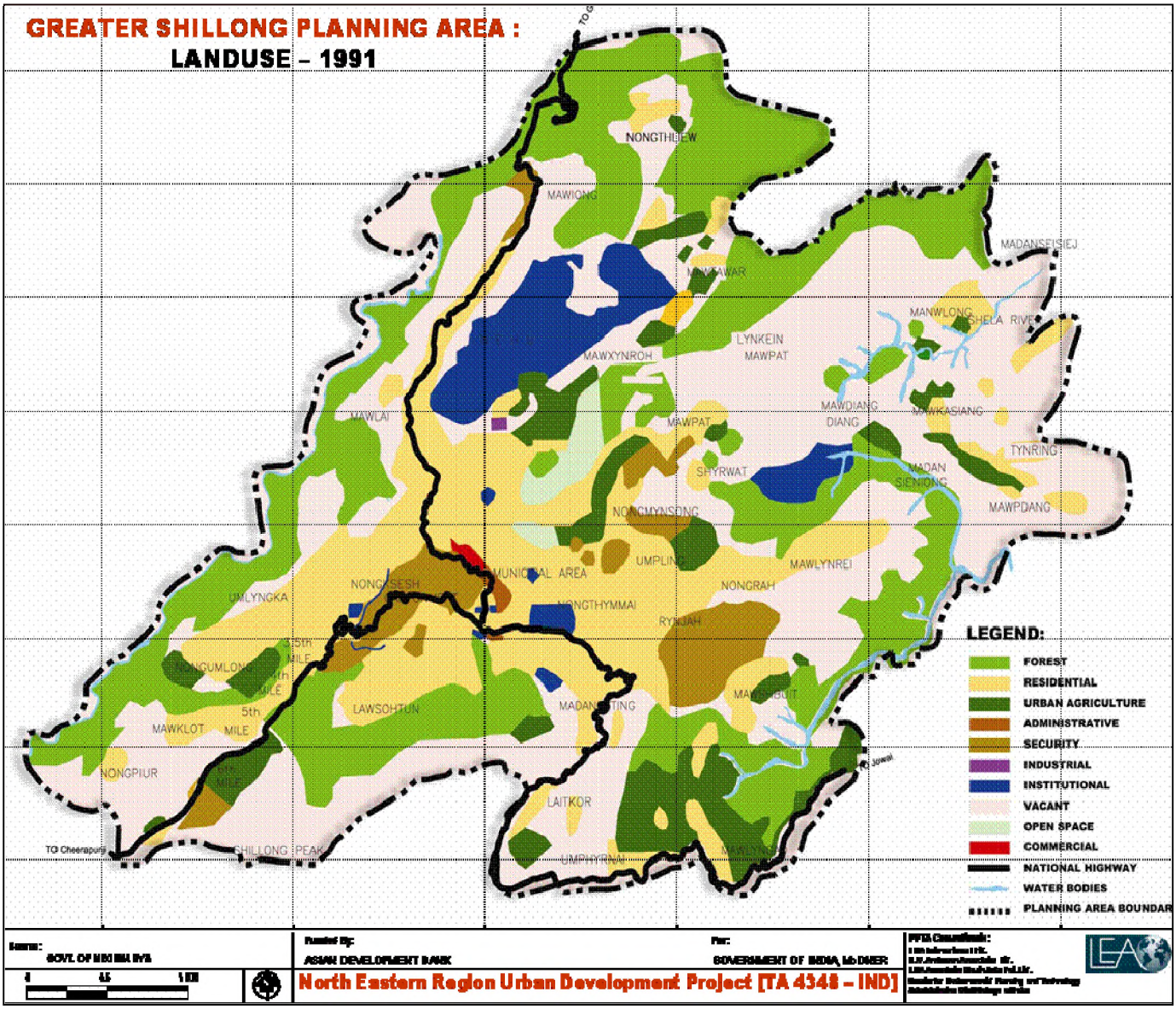


Figure 3.1: Existing Land Use in GSPA, 1991

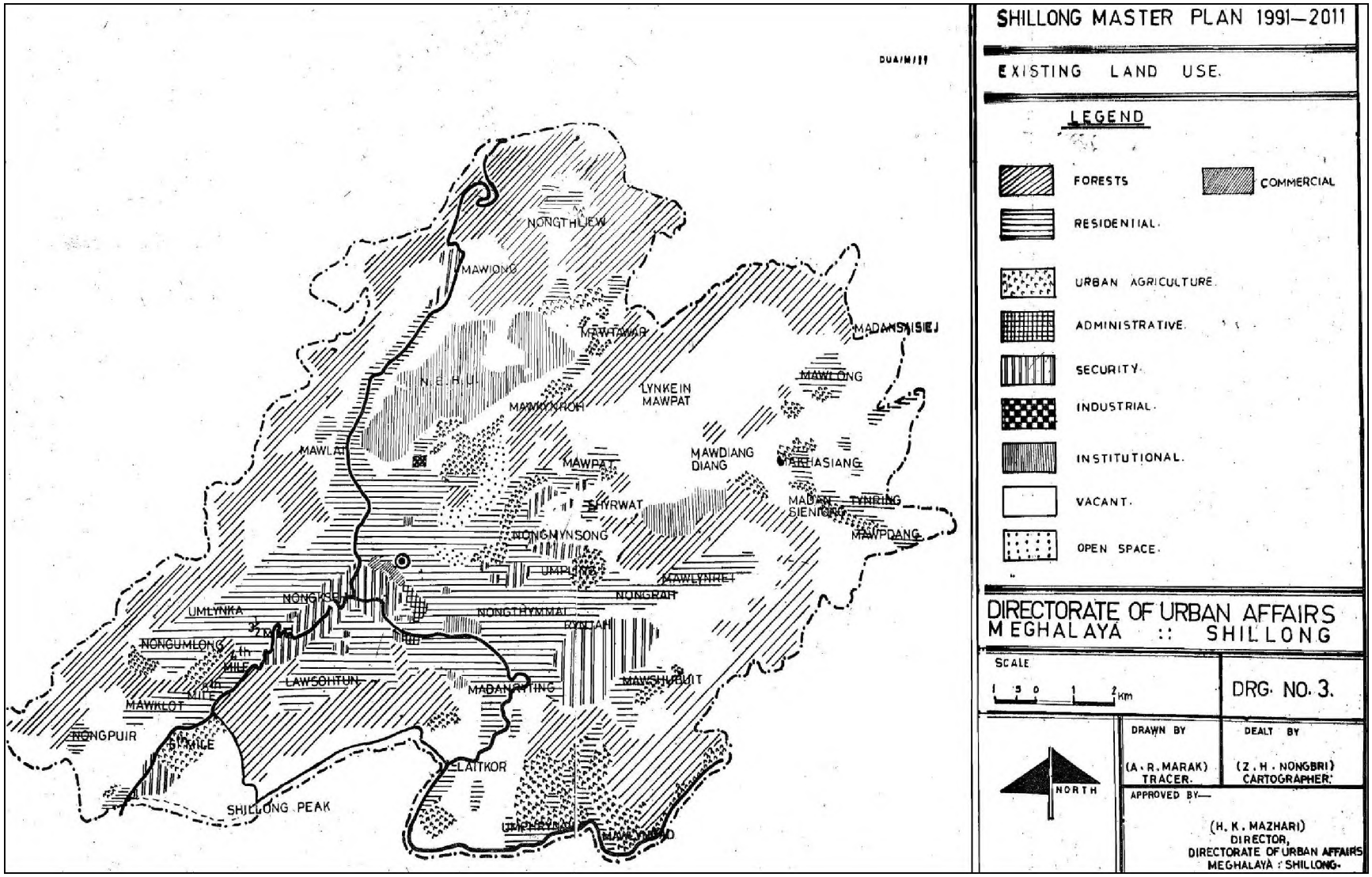


Figure 3.2: Existing Land Use Map Of Shillong Master Plan

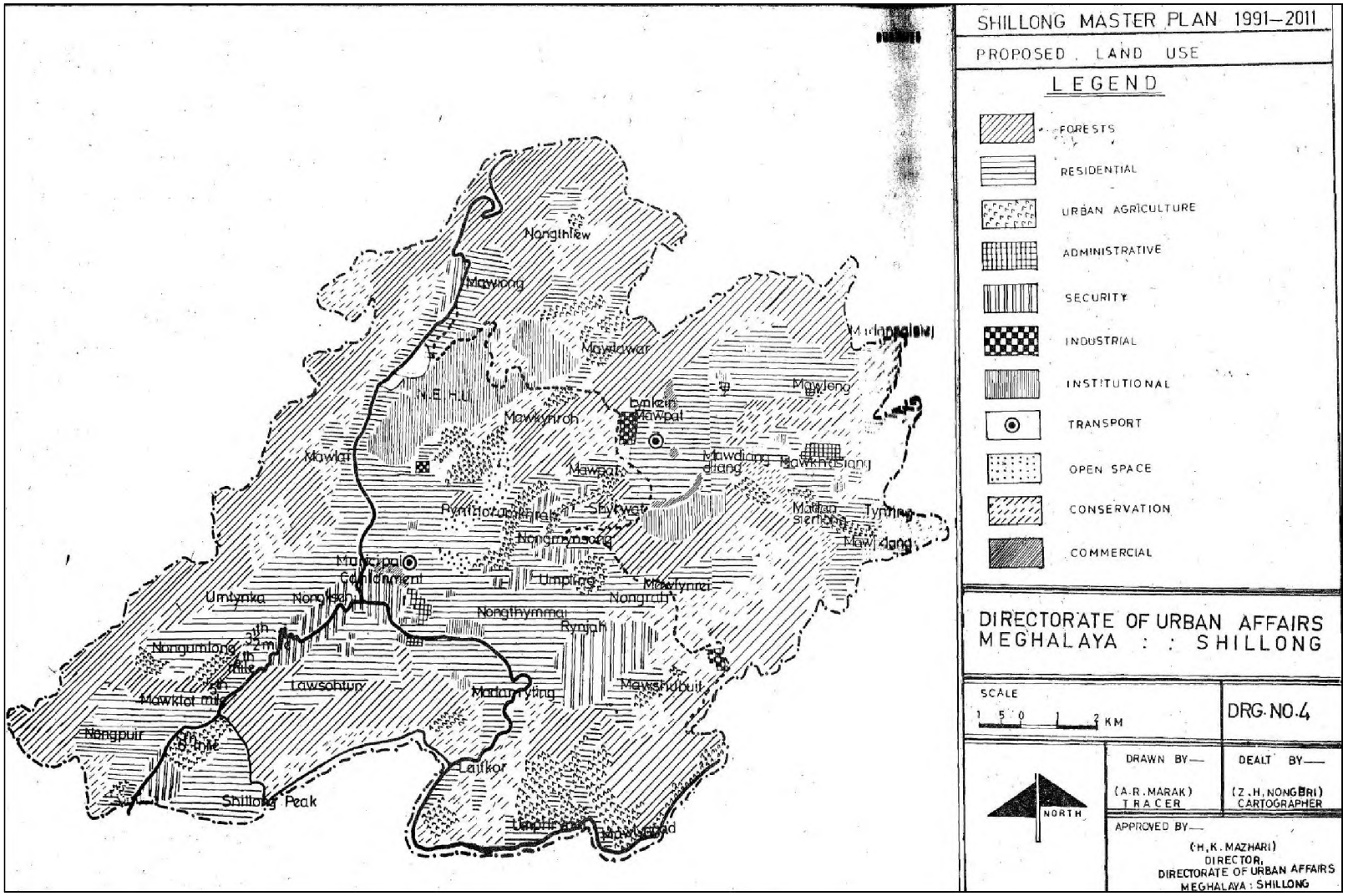


Figure 3.3: Existing Land Use Map Of Shillong Master Plan

f. SURFACE WATER RESOURCES

58. There is no stream or surface water that drain in or near the proposed disposal site, where as natural stream/ tributaries are available below approximately 1 km from proposed disposal site.

59. The Umkhrah and Umshyrpi Rivers are the two major rivers of Shillong city. These two rivers are running in the centre of the city and it is approximately 8 km away from proposed disposal site. These two rivers finally joins the Umain Reservior. These are basically the second order rivers that flow across the city from south-east towards north-west directions and then join together to form River Wah Ro Ro near Sunapani after a sudden fall known as "Bidon and Bishop Falls" prior to its confluence with the River Uniam further downstream. The water of these rivers is mostly used for irrigation, bathing and washing purposes. This river flows north into Lake Barapani (Umiam reservoir) and ultimately into Brahmaputra River. Other Rivulets such as Wah Demthring, Wah Nongrimbah flows towards the southeastern side and rivers Wah Dieng Lieng, Wah Um Jasai flows towards the western side of the city. The Drainage map of Shillong Urban Agglomeration with major watersheds is given in **Figure 3.4**. Siltation in Umiam lake has also been an issue raised by the government in recent years.

g. GROUND WATER RESOURCES

60. As per Central Ground Water Board (CGWB) the occurrence and movement of ground water in Shillong area is controlled by secondary structures and joints. Ground Water occurs under semi-confined conditions in the zone of permanent saturation. Drilling of good number of bore wells in Shillong area with the Down- the- Hole -Hammer Rig has proved that hard rock area holds and transmits sufficient quantity of water under favorable conditions. The yield of medium deep tube well varies from 5 to 25 m^3/hr.

h. Surface Water Quality

61. The water quality of Umshyrpi and Umkhrah rivers monitored during 1997-2000 is presented in **Table 3.4**.

TABLE 3.4: WATER QUALITY OF UMSHYRPI AND UMKHRAH RIVERS

Sampling Time	pH	DO mg/l	CON □mho/ cm	TDS mg/l	NO_2 mg/l	NO_3 mg/l	BOD mg/l	COD mg/l	TC MPN/ 100ml	FC MPN/ 100ml
River Umshyrpi										
Nov 1997	7.0	5.0	258.0	180.5	0.20	9.60	79.5	130.0	94,000	49,000
Mar 1998	7.6	4.3	262.4	185.8	0.30	10.00	84.7	140.5	1,00,000	54,000
Apr 1999	7.4	2.9	290.0	200.4	0.45	12.50	90.8	150.0	1,10,000	60,000
May 2000	7.2	7.9	134.0	-	0.10	-	40.0	68.4	35,000	22,000
River Umkhrah										
Nov 1997	7.0	3.0	290.0	220.5	0.50	12.50	94.50	178.50	1,60,000	1,10,000
Mar 1998	7.1	2.5	285.0	210.8	0.40	13.20	96.00	189.00	1,79,000	1,15,000
Apr 1999	7.6	Nil	360.0	279.2	0.62	14.50	112.50	210.00	2,00,000	1,30,000
May 2000	7.2	7.9	221.0	-	0.14	-	43.20	70.50	90,000	50,000

Source: *Meghalaya State Pollution Control Board*

62. Water Quality Analysis show, low dissolved oxygen (DO), higher Bio-chemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) values and higher values of Total Coliform (TC), Faecal coliform (FC) and Nitrite (N) during 1997 and 1998 (lean season) as compared to those recorded during the year 2000 (peak monsoon season). The reason being that high dilution takes place during the monsoon months. During the monsoon, even with maximum dilution, the BOD values are normally more than 30 mg/lit (exceeding the maximum permissible limits of BOD concentration in industrial effluents for discharge into inland surface water bodies). **Figure 3.5** and **Figure 3.6** presents the DO – BOD profiles of the Umkhrah and Umshyrpi River. Sewage disposal from households is predominantly through septic tanks and soak pits with many households releasing their soak pit effluents into streams or springs. As a consequence, the river Umkhrah and Umshyrpi have become highly polluted, hence the high BOD and low DO levels. Direct discharge into drains is also a common practice.

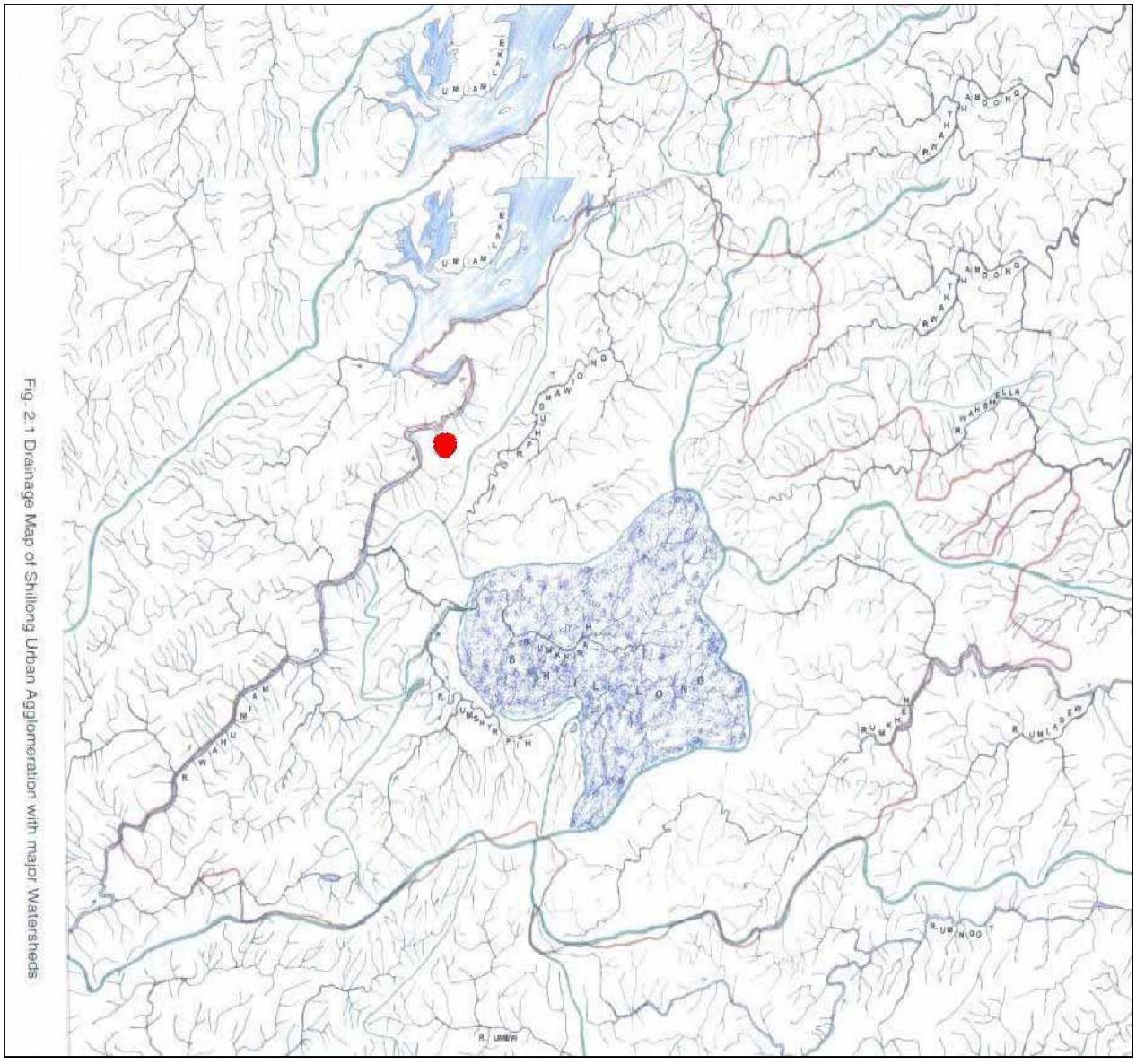


Figure 3.4: Drainage Map Of Shillong Urban Agglomeration with Major Watersheds

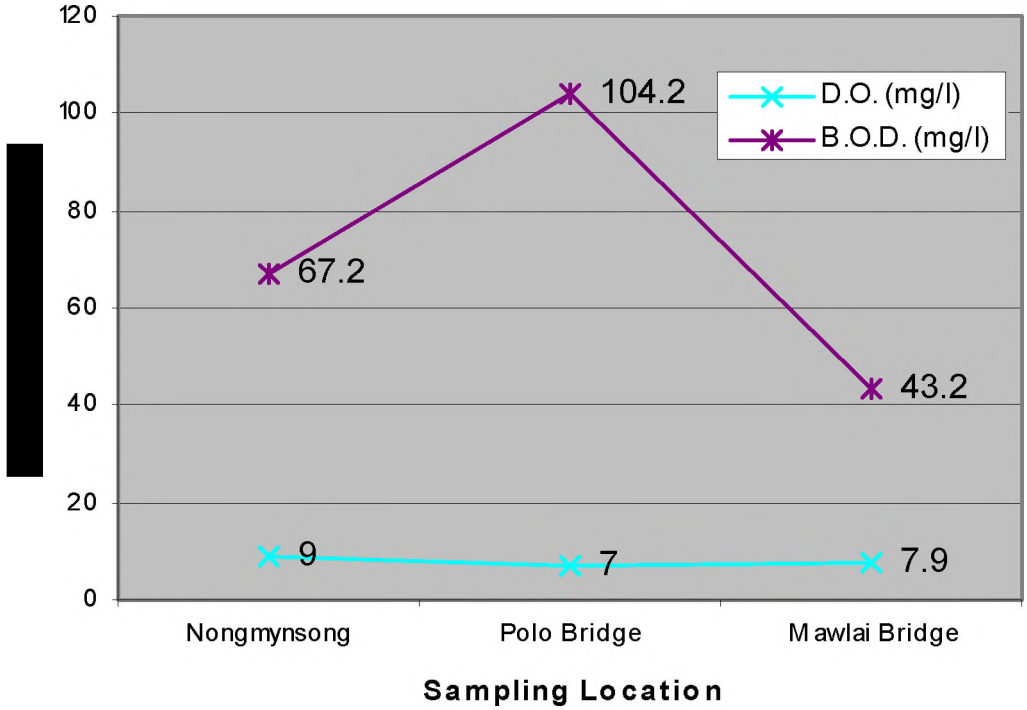


Figure 3.5: DO-BOD Profile of River Umkhrah

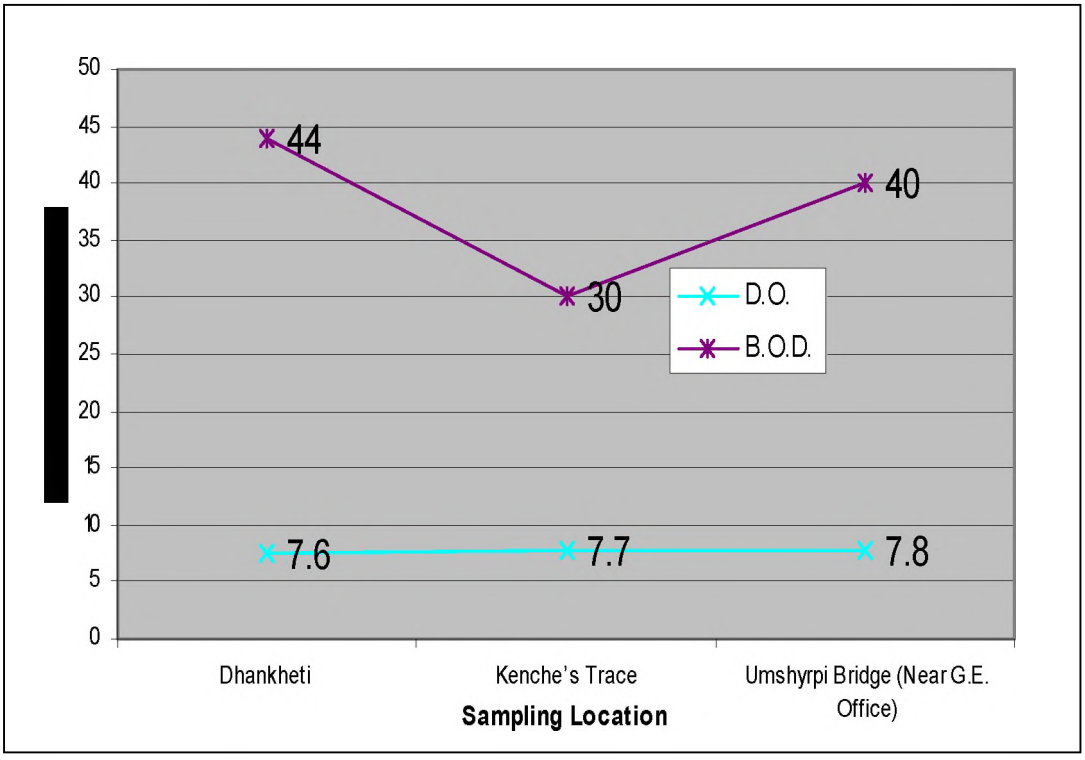


Figure 3.6: DO-BOD Profile of River Umshyrpi

63. **Water Quality of Umiam Lake:** The water quality of Umiam Lake is given in **Table 3.5**. As the table indicates, the water quality of Umiam lake is considered moderately polluted according to the BOD levels. Siltation has also been an issue raised in recent years.

TABLE 3.5: WATER QUALITY OF UMIAM LAKE

Table – 2
WATER QUALITY OF UMIAM LAKE

PARAMETER	APRIL 2003	JULY 2003	OCT. 2003	JAN. 2004
pH	7.0	7.5	7.2	6.8
Conductivity (µmho/cm)	275.5	215.0	220.5	286.0
Turbidity (NTU)		32.0		
Chloride (mg/l)		12.0		
Hardness (mg/l)		32.0		
Alkalinity (mg/l)		32.0		
Nitrite (mg/l)	0.3	Nil	Nil	0.06
Nitrate (mg/l)	11.6	2.0	2.5	8.0
Sulphate (mg/l)		4.0		
Phosphate (mg/l)		BDL		
Calcium (mg/l)		3.0		
Dissolved Oxygen (mg/l)	6.4	6.8	6.2	6.5
Biochemical Oxygen Demand (mg/l)	12.5	8.0	10.0	9.6
Chemical Oxygen Demand (mg/l)		24.0		
Ammonia Nitrogen (mg/l)		1.1		
Kjeldahl Nitrogen (mg/l)		1.8		
Total Dissolved Solids (mg/l)		150.8		
Total Coliform (MPN/100 ml)	3300	2200	3400	3500
Faecal Coliform (MPN/100 ml)	2600	1700	2200	1700
Sodium (mg/l)		4.0		
Potassium (mg/l)		3.4		
Magnesium (mg/l)		4.0		
TSS (mg/l)		90.2		
Flouride (mg/l)		0.04		
Arsenic (µg/l)		Nil		
Cadmium (µg/l)		Nil		
Copper (µg/l)		Nil		
Lead (µg/l)		Nil		
Chromium (µg/l)		Nil		
Nickel (µg/l)		Nil		
Zinc (µg/l)		0.006		
Iron (mg/l)		0.1		
Temperature ° C	17.0	24.0	24.0	12.0

Meghalaya State Pollution Control Board, Shillong

Source: *Meghalaya Sate Pollution Control Board*

i GROUND Water Quality

64. Ground water extraction for public use is insignificant in Shillong. The ground water quality from 11 deep tube well located in different part of the city are presented in **Table 3.6**. These samples were collected and analyzed by various government and private agencies during 1998-2000.

TABLE 3.6: GROUND WATER QUALITY PROFILE IN SHILLONG

Sl. No.	Location (Year)	TC MPN/ 100 ml	pH	COND µmho/cm	TH mg/l	No_2 mg/l	Cl mg/l	Fe mg/l	Alk. Mg/l
1.	Mawroh, Mawlai (2000)	-	6.6	-	18	0.1	-	1.3	-
2.	Dinam Hall, Jaiaw (2000)	-	5.9	47	-	-	22	1.44	19.2
3.	Pynthrbah (1998)	-	5.5	31	8	-	50	0.06	28.8
4.	Government Press (1998)	-	-	-	36	0.2	30	0.07	76.8
5.	Seven Set School (1998)	-	5.2	184	-	BDL	-	0.08	9.6
6.	Hotel Polo Tower (1999)	-	-	-	-	-	-	0.57	-
7.	Cleve Colony (1999)	-	7.75	113	5	BDL	11	0.07	18
8.	Oakland (1999)	-	-	-	-	-	22	0.08	4
9.	Centre Point Hotel, Police Bazaar (1999)	6	5.8	410	90	0.067	68.9	0.174	20
10.	Dhankheti, LIC Building	-	6.05	52	-	-	1.0	1.096	-
11.	Fire Brigade	170	6.3	38	30	Trace	15	1.3	40

Source: *The State of Environment of Shillong city, MSPCB*

j. AMBIENT AIR QUALITY

65. The Meghalaya State Pollution Control Board is maintaining six ambient air quality-monitoring locations viz. (i) Nongthymmai, (ii) Dhankheti, (iii) Barik, (iv) Police Bazaar, (v) Bara Bazaar and (vi) Mawlai. The Ambient Air Quality for February-March, 2000, monitored at these locations is presented in **Table 3.7**.

TABLE 3.7: AMBIENT AIR QUALITY IN SHILLONG CITY (FEBRUARY – MARCH 2000)

Sl. No.	Land use	Station	Conc. in µg/Nm^3 (24 Hrs Average)		
			SO_2	NO_x	SPM
1.	Road Crossing (Residential)	Nonthymmai	30.6	44.9	347.2
2.	Road Crossing (Residential)	Dhankheti	11.8	42.1	400.8
3.	Road Crossing	Barik	10.6	28.1	227.3
4.	Commercial	Police Bazar	9.2	30.8	259.9
5.	Commercial	Barabazar	4.2	37.9	234.9
6.	Road Crossing (Residential)	Mawlai	19.2	43.2	349.8

Source: *Meghalaya Sate Pollution Control Board*

66. Result shows that the concentration of both Sulphur Dioxide (SO_2) and Oxides of Nitrogen (NO_X) are well within the prescribed norms for residential and other areas i.e. 80 µg/m^3 (24 hours weighted average) whereas the concentration of Suspended Particulate Matter (SPM) exceeds the prescribed norms for residential and other areas i.e. 200 µg/m^3 (24 hours weighted average) at all monitored locations.

67. In absence of air polluting industrial activities in the city, the high concentration of SPM may be attributed to vehicle emissions, since the monitored locations are either along the National Highway or busy traffic crossings.

k. AMBIENT NOISE LEVELS

68. Ambient noise monitoring (day time only) had been carried out by Shillong Pollution Control Board at 26 locations. The results are presented in **Table 3.8**.

TABLE 3.8: AMBIENT NOISE LEVEL IN SHILLONG CITY DURING DECEMBER 2000

Sl. No.	Location	Category of Area/Zone	Daytime Noise Level in dB (A) Leq.	Daytime Noise Limit in dB (A) Leq.
1.	Lumpyngngad (A.G. Qtrs.)	Residential	50.5	55.0
2.	Laitumkhrah (Fire Brigade)	Residential	65.0	55.0
3.	Golf Links	Residential	46.8	55.0
4.	Polo Ground	Residential	53.0	55.0
5.	Mawkhar	Residential	53.6	55.0
6.	Mawlai (Jingkieng)	Residential	65.9	55.0
7.	Umpling (BSF)	Residential	46.8	55.0
8.	Mawiong (G.S. Road)	Residential	62.7	55.0
9.	Nongthymmai (Dum Dum)	Residential	67.7	55.0
10.	Barabazar (Motphran)	Commercial	65.4	65.0
11.	Police Bazar (Police Point)	Commercial	71.4	65.0
12.	Garikhana	Commercial	68.8	65.0
13.	Mawlai (Petrol Pump)	Commercial	65.6	65.0
14.	Rynjah Bazar	Commercial	62.1	65.0
15.	Nazareth Hospital	Silence Zone	50.9	50.0
16.	Don Bosco Square	Silence Zone	61.2	50.0
17.	Shillong College	Silence Zone	49.5	50.0
18.	K.J.P. Synod Hospital (Jaiaw)	Silence Zone	50.1	50.0

Sl. No.	Location	Category of Area/Zone	Daytime Noise Level in dB (A) Leq.	Daytime Noise Limit in dB (A) Leq.
19.	Dhankheti	Silence Zone	69.6	50.0
20.	Military Hospital	Silence Zone	64.1	50.0
21.	Red Cross (Laban)	Silence Zone	59.6	50.0
22.	Civil Hospital	Silence Zone	64.1	50.0
23.	Legislative Assembly	Silence Zone	58.8	50.0
24.	Main Secretariat Compound	Silence Zone	56.1	50.0
25.	St. Anthony's College (Gate)	Silence Zone	53.2	50.0
26.	Mayurbhanj Campus (NEHU)	Silence Zone	48.1	50.0

Source: *Meghalaya Sate Pollution Control Board*

Note: 1. **Day time** (6:00 am to 10:00 pm)
2. **Night time** (10:00 pm to 6:00 am)
3. **Silence Zone**- Area comprising not less than 100 meters around Hospital, Educational Institutions and Court.
4. **dB(A)Leq**: Denotes the time-weighted average of the level of sound in decibels on scale, "A" which is related to human hearing.

69. The summary of the monitoring results is as follows:

- Out of 9 monitoring locations in residential areas, at 4 locations the noise levels (Leq) are exceeding national standards [55 dB (A)]
- The ambient noise levels (Leq) in all monitored commercial areas (4 locations) exceed the national standards of 65 dB (A).
- In all deemed silence zone areas, except for Mayurbhanj Campus (NEHU), high noise levels exceeding the permissible limit of 50 dB (A) are recorded.

C. ECOLOGICAL RESOURCES

a. Forest and Vegetation

70. Within the Shillong Master Plan area of 174 sq. km, there exists about 6.0 sq. km of Reserved Forests in three pockets and another 12 sq. km of Protected Forests. The Reserve Forests in Greater Shillong Area are:

- Riat Laban
- Laitkor Protected Forest
- Raid Laban (Forest committee under long term lease to FD)
- Riat Khwan RF (Catchment of Umiam)
- Shyrwat RF

- Short round RF (Golf Link area)

71. The Upper Shillong Protected Forest and adjacent areas (Riat Laban Reserve Forest and Laitkor Protected forest) are located close to Shillong City. The forest around Shillong peak is a traditional Sacred Grove.

72. While a major area of these forests is sub-tropical pine forest, there exist small pockets of wet temperate broad leaf forests. In the upper Shillong, Riat Laban and Laitkor, sub-tropical pine and broad leaf vegetation are seen. The pine forests have only Khasi Pine (Pinus kesiya). Among broad leafed trees, a few flowering trees such as Rhododendron formosum, R. arborea and Pyrus pashia are observed. A prominent timber species of the forests is the Oak (Quercus griffithii).

73. However in some of the areas of Greater Shillong, the luxuriant sub tropical pine forest has become degraded to almost barren land as a consequence of forest clearing and jhum cultivation. The secondary formations are of negligible density and number. Some of the common trees and ferns are:

- Schima khasiana
- S. wallichi
- Engelhardtia spicata
- Acacia mollisima
- Myrica nagi
- Alnus nepalensis
- Rhododendron arboretum
- Rhus simi alata
- Quercus spp.
- Lantana camera
- Rubus ellipticus
- Eupatorium bushes
- Asteraceae rubiaceae

b. Phyto diversity of Shillong

74. A phyto diversity survey was carried out at the following identified locations in GSPA :

- Barapani (Kalikhola)
- Raitkhwan
- Umkhra River Bank

- Umshillong
- Mawphlong
- New Shillong

75. Diversity was measured using the Shannon-Wiener Diversity Index, and evenness with the Evenness index, calculated using the following formulae:

Shannon-Wiener Index of Diversity, $H = -\Sigma\, p_i \log p_i$
Where, $p_i = n_i/N$, n_i = number of individuals of the ith species,
N = total number of individuals of all the species

Evenness Index, $J = H/H_{max}$
Where H= Shannon-Wiener Index of Diversity
H_{max} = Log S, where S = number of species

76. The indices were employed to get a comprehensive, easily comparable, and quantitative estimate of the diversity and degree of evenness (i.e., uniformity) of the plant community. The key characteristics of these locations are presented in **Table 3.9**.

77. The key findings of the biodiversity assessment are as follows:

TABLE 3.9: PHYTO DIVERSITY AT VARIOUS LOCATIONS WITHIN GSPA

Characteristics	Barapani (Kalikhola)	Riat khan	Umkhra River bank	Umshilling	Maphlong	New Shillong
Tree species (no)	10	7	4	6	16	17
Shrubs & herbs (no)	13	15	19	14	21	19
Relative dominance						
Highest (species)	36.766, Pinus kesiya	29.39 Pinus kesiya	***71.17 Eucalyptus cytrodora***	***30.8 Ilex khasiana***	11.71 Ilex khasina	46.3 ***Pinus keshiya***
Lowest (species)	4.668 Sapium baccatum.	5.47 ***Myrica esculenta***		9.32 ***Garcinia cowa***	1.51 Exbucklandia populnea	0.994 ***Lindera latifolia***
Relative density						
Highest (species)	33.628 Pinus kesiya	33.33 Pinus kesiya	***52.63 Eucalyptus cytrodora***	25.0 ***Pinus kesiya***, ***Ilex khasiana***	13.79 Ilex khasiana	50.39 ***Pinus ke***shiya
Lowest (species)	3.65 Albizia procera , Artocarpus chama	***4.44 Myrica esculenta***		36.25 ***Litcea citrata***	1.72 Exbucklandia populnea	0.79 ***Melia azedarach***
Relative frequency						
Highest	4.126	140	***60***	40.0	40.0	***100***

Characteristics	Barapani (Kalikhola)	Riat khan	Umkhra River bank	Umshilling	Maphlong	New Shillong
(species)	Pinus kesiya	Pinus kesiya	***Eucalyptus cytrodora***	***Pinus kesiya***	Zanthoxylum khasianum , Glochidion assamicum and Ilex khasiana	***Pinus keshiya***
Lowest (species)		***10 Myrica esculenta***		10.0 ***Litcea citrata***		***10 Schima wallichii***
IVI value						
Highest (species)	170.394 Pinus kesiya	202.73 Pinus kesiya	***183.8 Eucalyptus cytrodora***	89.95 ***Pinus Kesiya***	65.5 Ilex khasiana	***Pinus Kashiya***
Lowest (species)	109.22 Rhus hookeri	***19.92 Myrica esculenta***			13.24 *Exbucklandia* populnea	12.11 ***Melia azedarach***
Stocking value						
Highest (species)	248.589 Pinus kesiya	12.348 ***Pinus kesiya***	***7.962 Eucalyptus cytrodora***	4.65 ***Litcea citrata***	4.88 *Ilex khasiana*	
Lowest (species)	27.90 ***Sapium baccatum***	**2.301** ***Myrica esculenta***		1.40 ***Garcinia cowa***.	0.631 *Exbucklandia populnea*	
Trees						
Shannon diversity index (H)	1.93 Kalikhola	1.79	1.09 ***Eucalyptus cytrodora***	1.72	2.66	2
Evenness index (E)	0.84 Kalikhola	0.92	0.79 ***Eucalyptus cytrodora***	0.96	0.96	0.7
Simpson's Index	0.195	0.192	0.387	0.186	0.076	0.274
1/Simposon's Index	5.211	5.201	2.582	5.378	0.195	3.654
Species richness or α-diversity	5.438	4.234.	3.12	4.612	10.774	8.081
β- diversity (Whittaker's measure)		-0.984	-0.979	-0.970	-0.972	-0.987
Shrubs and herbs						
Shannon diversity index (H)	1.78	1.94	2.34	2.44	2.92	2.54

Characteristics	Barapani (Kalikhola)	Riat khan	Umkhra River bank	Umshilling	Maphlong	New Shillong
Evenness index (E)	0.74	0.78	0.91	0.93	0.96	0.92
Species richness or α-diversity			3.128	4.234	10.774	8.081
β- diversity (Whittaker's measure)						
Dominence index	0.255					
Medicinal value plants		***Cannbis sativa Plantago major*** , ***Cynodon actylon***		***Gaultheria fragrantissima, Centella asiatica, Achyranthes aspera***	Lyonia ovalifolia, Digitaria corymbosa , Centella asiatica and Gaultheria fragrantissima.	Lantana camara, Cynodon dactylon and Amomum subulatum

c. Terrestrial & Aquatic Fauna

78. As per the survey carried out by Zoological Survey of India in 1986, there are diverse terrestrial and aquatic fauna found within Greater Shillong Area. However, none of these are endangered. The prominent species are mentioned in **Table 3.10**.

TABLE 3.10: SHILLONG – TERRESTRIAL & AQUATIC FAUNA

Group	Species
Lepidoptera	Eurema blaada, Mucalesis mineus, Pelopidas mathais, Euploe core, Eurema hecabe
Odonota	Crocothemis sp., Orthetrum sp.
Crustacean	Prawns
Reptilla	Calotes versicolor
Ambhibia	Rana limnocharis, R. cyanpphlyctis

d. Avifauna

79. As per Bio diversity Conservation Prioritization Project (BCPP), there are four sites in Greater Shillong Area, highly ranked in terms of biodiversity. These areas are: Umshing, Shillong, Laitkor Peak, Mawphlang. These areas are also designated as Important Bird Area by IBA and Endemic Bird Area by EBA. The prominent species include Brown Shrike (Lanius C. cristatus), Grey Backed Shrike (Lanius T. tephronotus), Grey Headed Myna (Stumus M. malebaricus) and Jungle Crow (Corvus macrohynchos).

e. Biodiversity Rich Areas

80. As per the Meghalaya State Biodiversity Action Plan[11], there are no biodiversity conservation hotspots within the Shillong Master Plan area. Site visits and interactions with the stakeholders in Shillong especially with the officials of the Forest Department and NGOs, has helped in identifying pockets in the city rich in biodiversity and ideal for conservation. (**Refer Table 3.11**).

TABLE 3.11: SHILLONG – BIO DIVERSITY RICH AREAS

Name of Location	Key Feature
Wards Lake	Few primitive plants in fringe areas of lake.
Barapani Lake	Birds and Fishes
Elephant Falls	Amphibia, Birds
Bidon-Bishop Falls	Amphibia, Birds
Sweet Falls	Amphibia, Birds and Reptiles
Botanical Garden	Biodiversity and biotechnologically important species.
Source: *Meghalaya State Biodiversity Action Plan*	

D. SOCIAL AND CULTURAL RESOURCES

81. GSPA with its total population of 312539 accounts for 78% of the total urban population of Meghalaya. Distribution of population within GSPA is not consistent with Shillong Urban Agglomeration area densely populated. Only 14% of the total geographical area of Greater Shillong i.e the core area is supporting 82% of the total population. While the population growth rate in Shillong Municipal Area and the cantonment has continuously declined, the urban centers within the SUA i.e., Pynthorumkhrah and Madantring (classified as urban in 1981) have shown high growth rates.

- **Migration Pattern** - Unlike other project cities more than 82.8% of the people are born within Shillong. Migration is not common within GSPA.

- **Sex Ratio** - Sex ratio in the city was quite low in 1991 at 892 females per 1000 males. However, between 1991-2001, the figure has increased to 1009 females per 1000 males more than the national average of 933.

- **Literacy and Education (For Population Above 6 years)** - The literacy rate in GSPA is 88%, which is more than the national average of 65.4% (Census 2001). In terms of education around 15% of the population is having education up to class V.

- **Work Participation Rate** - The work participation rate within the city is 27.6% much less than the national average of 39.3%. Though there has been a significant increase in the total main workers from 14% in 1991 to 31% in 2001 the percentage of non-workers has also increased tremendously from 27% in 1991 to 67.1% in 2001indicating towards growing unemployment.

[11] Prepared as part of the National Biodiversity Strategy and Action Plan (NBSAP), Government of India

- **Occupational Profile** - Occupational profile of the city reflects a predominance of tertiary sector with 39% of the population engaged in government services followed by 25% in other non-defined services.

PHYSICAL & CULTURAL HERITAGE

82. Shillong has numerous waterfalls viz. Elephant Falls in Upper Shillong, Sweet falls in Happy Valley and the Bishop Bidon falls in Mawlai. There are several beautiful Cathedrals in and around the city. Shillong has one of the oldest natural golf courses in the world.

INDIGENOUS PEOPLE

83. In Shillong and the entire state of Meghalaya, the tribes constitute the mainstream society. Shillong has predominantly tribal population (77% of the total population) with Khasis being the dominant tribe followed by Jaintia, Bhoi, War and Garo. All the tribal communities are into modern means of livelihood. They have the same traditions, customs and usage with a little variation owing to geographical divisions. The most predominant indigenous group is Khasi accounting for 85% of the total IPs. The Khasi speak the language of Khasi and follow Christianity.

E. ECONOMIC DEVELOPMENT

INDUSTRIAL DEVELOPMENT

84. There is only one industrial estate in Shillong located at Short Round Road with an area of 4.1 Ha. The estate has 9 industries, all small-scale units. List of industries and type of units established in the estate are presented in **Table 3.12**.

TABLE 3.12: INDUSTRIES & TYPE OF UNITS ESTABLISHED IN THE SHILLONG INDUSTRIAL ESTATE

Name of Industrial unit	Nature of Industrial Activity
M/S R.K.B Industries	Processing of Paraffin wax from stack wax for manufacture of candles and polishes.
M/S Meghalaya iron and steel fabrication unit	Iron and steel fabrication works.
M/S Above Pharmaceuticals	Repacking and bottling plants.
M/S EMO Chemicals and Additives (p) Ltd.	Bitumen emulsion processing.
M/S Warjri Industries	Manufacturing of fencing materials.
M/S Meghalaya Watches	HMT watch Assembly
M/S Meghalaya Roller Flour Mills	Heat products.
M/S Meghalaya Metals and Minerals (p) Ltd	ACSR and ACC conductors
M/S Meghalaya Wood Crafts	Wood Mosaics

85. Most of mentioned industries in the industrial estate are non-polluting except one flourmill, which generates liquid effluents. The other small scale units of Shillong relate to automobile repairing and servicing workshops, steel and wooden furniture, tyre retreading, printing press, bakeries and confectionaries, flour mills, rice mills and other handicraft units. Automobile repairing and servicing workshops is the prominent activity. **Table 3.13** shows the distribution of automobile workshops along with daily quality of waste generated.

TABLE 3.13: TOWN WISE DISTRIBUTIONS OF AUTOMOBILE WORKSHOPS IN SHILLONG

Name of the town	No. of Workshops	Daily quantity of waste generated	
		Solid (kg)	Liquid (kl)
Shillong municipal Area	68	735.0	4.25
Shillong Cantonment Area	7	148.0	.265
Madantring Area	24	505.0	.795
Nongthymmai Area	52	600.0	4.42
Mawlai Area	31	363.0	9.75
Pynthorumkhrah Area	-	-	-

Source: *Draft Final Report, TR-17, TA-4348*

F. PHYSICAL INFRASTRUCTURE SERVICES

a. Water Supply

86. The main source of water supply for Greater Shillong is River Umiam situated at a distance of 24 km to the southwest of the city. Across the river Umiam, a 50 meter high dam has been constructed by the PHED at Mawphlang, having a live storage of 7.21 million cubic meters and dead storage of 1.94 million cubic meters. Water is lifted from the river and pumped to the inlet of treatment plant at an elevation of 1847 m through a three stage pumping with a total static lift of 302 meter (m).

87. Water production and distribution in the Greater Shillong Area is managed by three agencies – The Public Health Engineering Department (PHED), the Shillong Municipal Board (SMB) and the Cantonment. Production and distribution for areas outside the municipal boundaries is under PHED, while distribution within the municipality is under SMB. Salient features of the water supply in Shillong are mentioned in **Table 3.14**.

TABLE 3.14: SHILLONG – SALIENT FEATURES OF WATER SUPPLY

Sl. No.	Particulars	Item
1.	Households with tap in dwelling (%)	47
2.	Residential water consumption (lpcpd)	85
3.	Water availability (lpcpd) (consumer end)	102
4.	Unaccounted for water (%)	50
6.	Priority for improvement	1
7.	Water Supply Sources	Umiew River, Wah Risa, Wahjalynnoh, Umjasai, Crinoline, Madan Laban, Wah Ding ling, Patta Khana.
8.	Distance from the city (km)	24
9.	Water Supply from PHED (MLD)	33.75
10.	Remaining Supply from seven sources (MLD)	2.7-3.7
11.	Total Production (%)	36.45-37.45
12.	Quantity reaching Consumers (MLD)	18.5
13.	Actual Demand in 2005 (MLD)	59.06

Sl. No.	Particulars	Item
14.	Total Number of Zonal Reservoirs	21

b. Sewerage and Sanitation

88. At present, Shillong does not possess any sewerage system. All the house sullage (kitchen and bath room waste water) drains either into the Um Shyrpi in the south or in the Um Khrah in the north.

89. Sewage disposal from households is predominantly through septic tanks and soak pits with many households releasing their soak pit effluents into streams or springs. As a consequence, the river Umkhrah and Umshyrpi have become highly polluted. Direct discharge into drains is also a common practice.

90. A survey was carried out by Meghalaya State Pollution Control Board along the banks of river Umkhrah in 2002, to assess the extent of pollution caused by the direct discharge of sewage into the river. The survey covered the area along the bank of the river Umkhrah from Laplang up to Mawlai Bridge. A total of 1255 houses were surveyed. The results of the surveys are presented in **Table 3.15**.

TABLE 3.15: SHILLONG – SANITATION STATUS

Sl. No.	Particulars	Item	Comments
1.	Toilet in dwelling (%)	73	SES
2.	Pipe to stream or drain (%)	8	SES
3.	Priority for improvement	2/6, 4/6(Community toilets)	SES

Source: *Draft Final Report, TR-17, TA-4348*

91. From **Table 3.15** it can be seen that around 40% of raw sewage is being directly discharged into the river increasing its pollution load.

c. Drainage

92. The drains are kutcha in Greater Shillong Area except for Shillong Municipality, where the drains are pucca. The natural flow of the drains has been blocked due to dumping of garbage in the drains. The wastewater from households and commercial areas also flows down these drains and ultimately draining into the rivers Umkhrah and Umshyrpi. The municipal drain of Shillong either terminates directly in these two rivers or into their secondary or tertiary tributaries. It is therefore observed that the natural streams in most parts of Shillong are gradually being converted from storm water drains to sewage canal carrying the sewage of the city. As such there are no instances of flooding within Greater Shillong Area but flooding during the rainy season does occur in the Polo Ground area.

93. The salient features of the major tributaries of Umkhrah and Umshyrpi rivers, showing the location of their confluence and their command areas are furnished in **Table 3.16** and **Table 3.17**.

TABLE 3.16: MAJOR TRIBUTARIES OF UMKHRAH RIVER

Name of Tributaries/Drain	Location of Confluence	Command Area	Major Character
Wah Disoi	Below Mawpdang Bridge, Mawprem	Mawprem, Garikhana, Lama Villa, Jaiaw Langsning, Slaughter House Area, Naspatigarhi	Domestic Sewage, Trade Effluent
Jaiaw Lumsyntiew Drain	Behind Old CRPF Camp, Mawlai	KJP Synod Hospital, Jaiaw	Domestic Sewage, Hospital Effluent
Mawlai Phudmuri Drain	Slaughter House	Mawlai Phudmuri Slaughter House	Domestic Sewage, Slaughter House Waste
Mawlai Stream	Near Cremation Ground, Jaiaw	Raitsamthiah, Jaiaw	Domestic Sewage, Trade Effluent
Jaiaw Drain	Near Lawmali Graveyard	Raitsamthiah, Wahingdoh	Domestic Sewage,
Raitsamthiah-Wahingdoh Drain	Lawmali Bridge	Ganesh Das Hospital	Domestic Sewage, Hospital Effluent
Lawmali Drain	Lawmali Bridge	Keating Road, Mawlonghat, Barabazar, Mawkhar, Police Bazaar, Umsohsun, Jail Road, Wahingdoh	Domestic Sewage, Trade Effluent, Hospital Effluent
Wahindoh-Raimohan Drain	Wahindoh Bridge	Botanical Garden, Wards Lake, Oak Land	Domestic Sewage, Trade Effluent
Oakland Drain	Polo Bazaar	Lower Lachumiere, Laitumkhrah	Domestic Sewage, Trade Effluent
Laitumkhrah Drain	4th Furlong	Lawjynriew, Lumpyngngad, Jinkieng Nongthymmai, Nongrim Hills, Nongrimbah, Nongrimmaw, Demseiniong	Domestic Sewage
Wah Thangsniang Stream	Demseiniong	Mawpat, Lalchand Basti	Domestic Sewage, Domestic/Trade Effluent
Wah Kdait	Below Spread Eagles Falls	Happy Valley	Domestic Sewage
Phud Raimut	Laplang Bridge	Nongthymmai, Madantring	Domestic Sewage
Wah Demthring			Domestic Sewage, Domestic/Trade Effluent

Source: *Meghalaya State Pollution Control Board*

TABLE 3.17: MAJOR TRIBUTARIES OF UMSHYRPI RIVER

Name of Tributaries/Drain	Location Of Confluence	Command Area	Major Character
Motinagar Stream	Fish Dale	Motinagar, Fire Brigade, Area, Park View Nursing Home Area	Domestic Sewage, Garage Effluent, Hospital Effluent
Dhankheti Stream	Near Wood Land	Parts Of Laitumkhrah,	Trade Effluent,

Name of Tributaries/Drain	Location Of Confluence	Command Area	Major Character
	Hospital	Laitumkhrah Bazaar, Woodland Hospital	Domestic Sewage, Hospital Effluent, Sullage
Malki Stream	Near Seven Set School	Malki Area	Domestic Sewage And Sullage
Wah Risa Stream	Near Cinolin Swimming School	Malki Reserved Forest	Fresh Water
Um Kynrud Stream	Idgah, Laban	Laban Area	Domestic Sewage And Garage Effluent And Sullage
Wah Sohkhlur Stream	Near Kenches Trace Bridge	Madan Laban, Kenches Trace Area	Domestic Sewage And Sullage
Um Jasai Stream	Near Ribong Bridge	Ribong, Lawshotun Area, Defence Area	Domestic Sewage And Sullage
Wah Dienglieng		Lum Shillong Reserved Forests, Risa Colony	Fresh Water

Source: *Meghalaya State Pollution Control Board*

d. Solid Waste Management

94. Municipal Solid Waste Management in Shillong may be classified into two categories i.e

Organised areas: -areas falling under the jurisdiction of Shillong Municipality or Cantonment Board;

Unorganised areas: - areas outside the Shillong Municipality or Cantonment Board;

95. There are no actual records with respect to the solid waste generation in Shillong city. Available information reveals that the Shillong Municipal Board is lifting about 75-80 MT/ day and the Cantonment Board is lifting about 15 to18 MT/day. The solid waste generated in other towns of the Shillong agglomeration, viz Madanrting, Mawlai, Nongthymmai and Pynthor Umkhrah remains unaccounted for.

96. Average Physical Characteristics (Wet Weight Basis) and Chemical Characteristics (Dry Weight Basis) of Shillong 's solid waste is given in **Table 3.18** and **Table 3.19** respectively.

TABLE 3.18: AVERAGE PHYSICAL CHARACTERISTIC OF SHILLONG'S SOLID WASTE IN PERCENTAGE (WET WEIGHT BASIS)

Sl. No.	Particulars of Waste	Contents (%)
1	Compostable matter	48.41
2	Paper	10.91
3	Rubber & Leather	1.81
4	Plastics	0.96
5	Rags/ Textiles	2.85

Sl. No.	Particulars of Waste	Contents (%)
6	Wooden	1.85
7	Metals	0.85
8	Glass & Crockery	2.51
9	Stone, Bricks, ashes, fine organics etc.	29.85
10	Moisture	44.80

Source: *The State of Environment of Shillong city, MSPCB*

TABLE 3.19: AVERAGE CHEMICAL CHARACTERISTIC OF SHILLONG'S SOLID WASTE IN PERCENTAGE (DRY WEIGHT BASIS)

Sl. No.	Particulars of Waste	Contents (%)
1	pH	7.60
2	Organic matter (in %)	61.00
3	Carbon (in %)	35.40
4	Nitrogen (in %)	0.61
5	Phosphorous (in %)	0.20
6	Potash (ask_{20} in %)	0.23
7	C/N ratio	58.31
8	Colorific Value (Keal/Kg)	2704.80

Source: *The State of Environment of Shillong city, MSPCB*

97. Monitoring of the Quality of compost from solid waste dumping site (land fill site) at Mawiong is given in **Table 3.20**.

TABLE 3.20: MONITORING OF THE QUALITY OF COMPOST FROM SOLID WASTE SITE AT MAWIONG

MONITORING OF THE QUALITY OF COMPOST FROM SOLID WASTE DUMPING SITE (LANDFILL SITE) AT MAWIONG

During 2004, the Board has carried out the monitoring on the quality of compost from the solid waste dumping ground at Mawiong with respect to heavy metals concentration. The result presented in Table 1.0 shows that the concentration of Chromium is found to be above the prescribed standards. Other parameters tested were within the prescribed standards.

Table 1.0: QUALITY OF COMPOST OF SHILLONG MUNICIPAL DUMPING GROUND, MAWIONG

Sl. No	Parameters	Standards for compost quality to ensure safe application of compost	Results
1.	Cadmium (mg/kg)	5.0	1.0
2.	Chromium (mg/kg)	50.0	71.0
3.	Copper (mg/kg)	300.0	133.0
4.	Lead (mg/kg)	100.0	41.0
5.	Nickel (mg/kg)	50.0	31.0
6.	Zinc (mg/kg)	1000.0	373.0

Source: MSPCB

98. Monitoring of the Quality of Leachates from solid waste dumping site (land fill site) at Mawiong is given in **Table 3.21**. As the table indicates, pollution levels for several indicators (TDS, TSS, BOD, and Chloride) at the existing site are higher than the standards.

TABLE 3.21: MONITORING OF THE QUALITY OF LEACHATES FROM SOLID WASTE SITE AT MAWIONG

MONITORING OF THE QUALITY OF LEACHATES FROM SOLID WASTE DUMPING SITE (LANDFILL SITE) AT MAWIONG

During 2002, 2004 and 2007, the Board has carried out the monitoring on the quality of Leachates from the solid waste dumping ground at Mawiong .The results presented in Table below indicates that the concentrations of Total Dissolved Solids ,Total Suspended Solid, , Biochemical Oxygen Demand, Chloride were found to be above the prescribed standards .

Table 1.0: LEACHATE QUALITY OF SHILLONG MUNICIPAL DUMPING GROUND, MAWIONG

Sl. No.	Parameters	Standards for Land Disposal as per Municipal Solid Waste (Management and handling) Rules 2000	Monitoring Results of the Year		
			2002	2004	2007
1.	pH	5.5 – 9.0	10.8	11.0	7.2
2.	Total Dissolved Solids (mg/l)	2100.0	9415	9614	5500.0
3.	Total Suspended Solids (mg/l)	200.0	960	1075	800.0
4.	Chemical Oxygen Demand (mg/l)	-	1800	--	1400.0
5.	Bio-chemical Oxygen Demand (mg/l)	100.0	1145.6	1240.5	910.0
6.	Ammonia Nitrogen (mg/l)	-	45.3	55.3	50.4
7.	Total Kjeldahl Nitrogen (mg/l)	-	--	90.0	80.0
8.	Chloride (mg/l)	600.0	1090	1142.2	900.2
9.	Chromium (mg/l)	-	--	0.36	0.1
10.	Copper (mg/l)	-	--	1.6	0.3
11.	Lead (mg/l)	-	--	5.2	0.1
12.	Zinc (mg/l)	-	--	261.7	0.5

Source: MSPCB

e. Road and Transportation

99. Shillong is connected to Guwahati towards the north through NH-40 and to Silchar towards the south-east through NH-44. The total road length of Shillong is 142.5 km with a road density of 0.8 km/sq km. Salient Features of Roads and Transportation, GSPA, 2005 is given in **Table 3.22**.

TABLE 3.22: SALIENT FEATURES OF ROADS AND TRANSPORTATION, GSPA 2005

S. No.	Particulars	Item
1.	Households with paved roads or footpaths (%)	92
2.	Households with cars (%)	16
3.	Average journey speed (kmph) on road network	8-20
4.	Priority for improvement	3/6

100. The main constraints and problem areas with regards to roads in Shillong are narrow and winding hilly roads with poor geometrics lack of parking spaces and lack of pedestrian facilities.

f. Slum Upgradation

101. There are 19 notified slum pockets within the Shillong Master Plan Area. Nearly 22% of the city's population lives in these slums. The slums in Shillong have a unique characteristic as compared to other slums. While in the rest of the country, slums and squatter settlements are formed by squatting on government lands, the slums in Shillong are located on private lands, in most cases with the permission of the landlord. However, the cause of formation of slums remains the same i.e., poor access to services and infrastructure. The localities with the largest concentration of slum population include Lumparing, Laban, Pynthomukhrah, Laitumkhrah, and Lummawrie.

g. Heath Facilities

102. According to 1991 census there are 8 hospitals, one family planning center, one maternity and child welfare center, one T.B center and ten dispensaries. There are altogether 1124 beds in the different medical centers within Shillong Municipality.

h. Education Facilities

103. As per 1991 census, in Shillong Urban Agglomeration there are 109 Primary Schools, 52 Junior Secondary and Middle Schools, 64 Secondary Schools, 12 Colleges, 20 Vocational institutions and 1 university. The city has sufficient number of educational institutions, but lacks in specialized educational facilities such as technical and medical colleges.

IV. SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

104. The assessment for each of the sub-projects has been carried out for potential impacts during the following stages of the project planning and implementation:

(i) **Location impacts.** Impacts associated with site selection, including impacts on environment and resettlement or livelihood related impacts on communities

(ii) **Design impacts.** Impacts arising from project design, including the technology used, scale of operations, discharge standards etc

(iii) **Construction impacts.** Impacts resulting from construction activities including site clearance, earthworks, civil works, etc.

(iv) **O&M impacts.** Impacts associated with the operation and maintenance of the infrastructure built in the project.

105. Screening of environmental impacts has been based on the impact magnitude (negligible/moderate/severe – in the order of increasing degree) and impact duration (temporary/permanent). The following **Table 4.1** shows the screening of impacts; N/T represents the lowest impact while S/P represents the highest impact. Numerator represents the Degree of Impact and denominator represents the Duration of impact.

TABLE 4.1: SCREENING OF IMPACTS

Duration of Impact	Magnitude (Degree of Impact)		
	Negligible (N)	***Moderate (M)***	***Severe (S)***
Temporary (T)	N/T	M/T	S/T
Permanent (P)	N/P	M/P	S/P

106. The following tables show the potential environmental impacts and mitigation measures of all the sub-project components proposed for Shillong under NERCCDIP.

A. ENVIRONMENTAL IMPACTS AND MITIGATION: LOCATION AND DESIGN

107. In many environmental assessments there are certain effects that, although they will occur during either the construction or operation stage, should be considered as impacts primarily of the location or design of the project, as they would not occur if an alternative location or design was chosen. For example, if leachate from an unsealed landfill drains into an exploited aquifer and pollutes water sources this would be an impact of both location and design as it would not have occurred with a sealed landfill located in an area with no groundwater resources.

108. In the case of this subproject there are few impacts that can clearly be said to result from the design or location. This is because:

(i) The proposed transfer station, garage, and sanitary landfill (5.25 acres) will be sited the Municipal Trenching Ground at Marten, Mawiong (18 acres). The government owns the land so there is no land acquisition involved.

(ii) The existing and proposed solid waste disposal site is the part of Riatkhwan Reserve Forest, however, the Government of Meghalaya Forest & Environment Department has officially granted permission (Annexure 4) to use the land for solid waste disposal purposes. The Government of Meghalaya Forest & Environment Department has extended the lease under letter no. FOR 76/99/16 dated 25th February 2000 to the Shillong Municipality for 18 Acres of land in Riat Khwan Forest Compartment No-4 (Plot No-1, Plot No-2 and Plot-3).The Possession Certificate of proposed solid waste site has been also issued by the Forest Department.

(iii) The proposed sanitary landfill will present significant improvements over the existing waste disposal operations of Shillong.

(iv) The infrastructure involves relatively straightforward construction and operation, so it is unlikely that there will be major environmental impacts;

(v) Any sensitive environmental receptors (surface waters) will be protected by detailed design and proper engineering. Proper operation and maintenance of the landfill site will be critical to protecting the environment, therefore, training for Shillong Municipality staff is built into the project.

(vi) Impacts associated with the construction process, and are produced because that process involves excavation or other ground disturbance. However the routine nature of the impacts means that most can be easily mitigated.

(vii) The project site is sufficiently elevated above water bodies to avoid flooding and impacts to groundwater.

(viii) The collected wastes throughout the city are disposed at Mawiong disposal site at a distance of about 8 km from the city, so the project will not have impacts on surrounding inhabitants.

(ix) There are no sensitive receptors occurring within 500 m of the site. Umiam Lake is located approximately 3.0 km away from the site, and any leachate will be collected and treated as part of the project design.

(x) The project will generate significant benefits for the whole Shilllong Municipality as a whole

(xi) A buffer zone of no-development shall be maintained around landfill site and shall be incorporated in the Town Planning Department's land-use plans, as per the MSW Handling Rules, 2000.

109. **Scope of Land Acquisition and Resettlement.** There are no resettlement issues anticipated for the solid waste facility in Shillong. All the projects of solid waste are proposed on available government lands. Hence, permanent land acquisition is not envisaged as part of this sub project. The proposed transfer station, garage and disposal site will be located within the existing landfill site at Municipal Trenching Ground at Marten, Mawiong. The collected wastes throughout the city are disposed at Mawiong disposal site at a distance of about 8 km from the city, the same route and location used historically for waste collection in Shillong. The proposed land fill area is 5.2503 Acres. The Possession Certificate of proposed solid waste site has been issued by the Forest Department under Notification letter no FOR 76/99/16 dated 25 February, 2000 (Refer **Annexure 4**) and hence, the land acquisition and resettlement impacts are not envisaged. The garage and transfer station will be located at same location, as

existing disposal site is operational. No temporary impacts such as temporary land occupation and temporary loss of access to resources and services during construction are anticipated.

110. An overview of the land acquisition and resettlement requirements is given in **Table 4.2**.

TABLE 4.2: SUMMARY OF LAND ACQUISTION / RESETTLEMENT

S. No	Project	Land Acquisition / Resettlement requirements	Area of land required (Ha)	Number of AHs significantly impacted	Number of AHs consulted and surveyed
a.	Rehabilitation of existing disposal site	×	0		
b.	New Disposal Site	×	0		
c.	Transfer Station and Garage at the existing disposal site	×	0		

111. For the unidentified components in the solid waste component[12], the extent of land acquisition and resettlement are unknown at this stage. These will be addressed at the detailed design stage consistent with this Resettlement Framework. This classifies the solid waste sub-project component into 'Sc' category (Insignificant Resettlement), based on ADB's Involuntary Resettlement (IR) Policy.

112. **Landfill Design**. The sanitary landfill site will be designed to meet the standards of the GOI MSW Handling Rules, 2000, including leachate treatment and collection. The Municipality is also required to improve the existing dumping site as per provisions of the MSWHR, 2000 (Schedule I). The project will make provisions of environmental protection measures and short-term sanitary landfill facilities (approx. 6 acres) at the present disposal site at Mawlai, as intermediate protection measures till the new sanitary landfill site starts operation. Although the sanitary landfillll site is 5.0 acres, not large enough to meet the Rule's requirements of lasting 20-25 years, the landfill will act as near term solution while the Shillong Municipality is actively searching to identify land to suffice future landfill operations.

113. Design Impacts:

(i) The cell dumping process may cause side slippage during heavy rainfall. Appropriate slope protection measure need to be incorporated into the designs.

(ii) There is the risk of runoff from the uphill areas contaminating the water bodies in the downhill areas. Provision of drainage interceptors (impermeable lining and collection pipes) to capture the runoff and redirect into the leachate tanks shall be done.

[12] In addition to the identified components to be taken up in the NERCCDIP, at a later stage of the project, the SIPMIU may, based on the priorities of the Government of Meghalaya, identify eligible sub-projects conforming to the sub-project selection criteria to be taken up under the program. Cost provisions for inclusion of such components is provided for in the program costs, under a different category called "the unidentified projects".

(iii) The proposed landfill site at Mawiong is located in a densely vegetated area. The layout of the landfill site shall be designed to minimize impact on floral resources.

B. ENVIRONMENTAL IMPACTS AND MITIGATION: CONSTRUCTION

114. There will therefore be quite large physical changes at the site as a result of the excavation and other earthworks, and this relatively large quantity of waste could not be dumped without causing further adverse physical impacts (on air quality (dust), topography, soil quality, etc) at the disposal site. It will be important therefore to take steps to reduce the amount of dumping by finding beneficial uses for as much of the waste material as possible. The civil works contractor (appointed to carry out the construction work) should be required to:

(i) Re-use as much excavated material in this project as possible (for example in creating the bunds or for landfill cover as outlined above);

(ii) Retain suitable soil in stockpiles for use when the landfill is operating, to cover waste periodically and for the final covering when each cell is full.

115. Most excavation is likely to be conducted in the dry season to avoid the difficult conditions that can occur when earthworks are carried out during rain. There will therefore be a risk of producing dust. Although this is a rural location where there is no inhabitation nearby, precautions will nevertheless be needed to reduce dust to provide a suitable and safe environment for workers. Contractors should therefore be required to:

(i) Cover or damp down working areas and stockpiled soil in dry, windy weather;

(ii) Use tarpaulins to cover loose material during transportation to and from the site.

116. Another physical impact associated with large-scale excavation is the effect on drainage and the local water table if groundwater and/or surface water collect in the cavities as they are dug. Conducting the work in the dry season will reduce these impacts, but as the area surrounding the site contains downhill surface waters careful design and engineering will be required to protect these waters from leachate.

117. The other construction work at the landfill site (e.g., applying impermeable sheeting, installing pipes, etc.) will all have physical impacts but these will be small compared to those of the landfill excavation, and will thus be of little significance in themselves.

118. There are no protected areas in the vicinity of this site (the closest sensitive area is Umiam Lake which is sufficiently far—approximately 3.0 km away) and no special ecological interest, because natural habitat of the site was destroyed many years ago (1938) when the area was cleared for waste disposal purposes. Any surface waters located downhill of the proposed site will be carefully considered for their protection detailed design and engineering stage. Construction should therefore have no major ecological impacts. To ensure further environmental protections of surrounding area the contractor should be required to ensure that:

(i) No toxic materials (fuel, oil, cement, etc) are stored at or near the site;

(ii) The contractor's Method Statement (submitted with the tender) includes adequate safety measures to prevent fuel and other spills as a result of accidents.

119. The other aspect of the work that may have economic implications is the transportation of

waste material to a disposal site and to locations where it can be put to beneficial use as recommended above. This will require a large number of truck movements, which could disrupt traffic, particularly if such vehicles were to enter the town. This activity will be implemented by the contractor in liaison with Shillong Municipality, and the following precautions should be adopted to reduce effects on traffic:

(i) Plan transportation routes carefully to prevent heavy vehicles entering Khulna town; and ensure that if this cannot be avoided, vehicles use main roads only, and do not use narrow local roads, except in the immediate vicinity of delivery sites;

(ii) Schedule transportation activities to avoid peak traffic periods.

120. Construction activities inevitably produce noise and dust, and these plus the visual appearance of the site and restrictions in access caused by excavation and the presence of vehicles and machinery, are generally the factors that disturb people who live or work in the vicinity. These should however not be major problems in this case as the facilities are all located in rural areas outside the town, and there are no people living nearby.

121. The health and safety of workers will be protected by measures included in a Health and Safety Plan, which the contractor will be required to produce and apply. Even though rural areas are sparsely populated, this should include measures to assure the safety of the public. The plan should thus require:

(i) Exclusion of the public from all sites;

(ii) Provision and use of appropriate Personal Protective Equipment (PPE) by all workers;

(iii) Health and Safety Training for all site personnel;

(iv) Documented procedures to be followed for all site activities;

(v) Accident reports and records;

(vi) Etc.

122. Construction work can provide short-term socio-economic gains for local communities if contractors employ local people in the workforce. To ensure that these benefits are directed to communities that are most affected by the work, contractors should be encouraged to employ at least 50% of their workforce from communities in the vicinity of construction sites. This will help to mitigate the impacts of any disturbance as well as creating a positive impression of the project. Building a workforce from mainly local people will also avoid problems that can occur if workers are imported, including social difficulties in the host community and issues of health and sanitation in poorly serviced temporary accommodation camps.

123. Construction Impacts:

(i) Construction activities associated with sanitary landfill site (at Mawiong) will result in increase in daytime noise levels. Impacts to be mitigated through procurement of equipments / vehicles with inbuilt mechanism to arrest high noise levels. Construction during the night time to be strictly avoided.

(ii) Leveling, compaction and construction of the landfill site will result in generation of fugitive dust, which needs to be suppressed with regular water sprinkling.

(iii) Health impact on construction workers associated with dust and noise generation. Workers to be provided with appropriate PPEs

C. ENVIRONMENTAL IMPACTS AND MITIGATION: O & M

124. Shillong Municipality will be responsible for operating the waste management facilities and will be given further support by the project in the form of staff training and financial assistance. All solid waste management activity is required to comply with the GoI Municipal Solid Waste Handling Rules, 2000.

125. Waste for landfilling will be moved into position by bulldozer and backhoe, and will be compacted when the vehicles move over the surface. When a cell is full, vertical gas venting pipes will be installed and the waste will be covered with compacted clay, sand and layer of topsoil, to seal the cell and control odour and pests.

126. At the composting plant, waste will be sorted manually and any unsuitable material will be removed and transferred to the landfill. Biodegradable waste will be left to decompose in a series of piles ("windrows") in the open air, and material will be turned periodically by a machine provided by the project. Once the compost has been formed it will be loaded into bags and taken away on a truck for sale to retailers or direct to farmers.

127. If the composting plant is to be successful, Shillong Municipality will need to ensure that residents separate out their biodegradable waste into a "green" waste bin at source, and that the segregation is maintained during secondary transfer and transportation. The project will fund community awareness education programs to inform the community about the facility and their role in waste separation.

128. Clearly it is imperative that Shillong Municipality maintains both the transfer station and the landfill in proper working order, because if the system begins to fall into disrepair then waste will rapidly accumulate in the streets and the sanitary landfill will become an insanitary dumpsite, with consequent adverse impacts on environmental health. Capacity building, public education campaigns and other support provided by this subproject are aimed at promoting the long-term successful operation of the system.

129. If waste is collected regularly from the transfer station and full or partially full bins are not left in or around the facility for extended periods then there should be no direct physical impacts during operation. Even air quality should not deteriorate greatly if bins are taken to the landfill daily or more frequently, any spilled waste is cleared away rapidly and the transfer station and waste bins are hosed down regularly. Procedures will be set out in Operation and Maintenance (O&M) manuals prepared during the detailed design stage, so the design consultant should ensure that:

(i) O&M procedures require staff at the transfer station deposit any spilled waste into bins immediately and to wash down internal floors and empty waste bins at least daily;

(ii) O&M procedures require staff to be fully trained before they begin work at the transfer station and given refresher training annually;

(iii) The transfer station includes adequate drainage that is connected to the municipal system.

130. The greatest physical impacts will occur at the landfill, where decomposing waste will rise to higher heights ground level, which will alter the topography and appearance of the site.

Although these impacts would be significant at certain locations that should not be the case here as there are no people living in the vicinity whose views of that landscape would be impeded. However, the landfill design includes effective screening by the planting of densely-leaved trees at the perimeter of the site.

131. The landfill design includes measures to collect leachate and prevent pollution of surface- and ground- water. Leachate will be treated by simple sedimentation and evaporation, and sludge that collects in the bottom of ponds will be allowed to dry out before being returned to the landfill. Given the amount of rain that falls in this region, and the pollution of land and water that can occur if a landfill is subjected to flooding, the consultant responsible for the detailed design should ensue that:

(i) Surface water drains at the site are adequate to retain and dispose of the heaviest rains;

(ii) O&M procedures require drains to be kept in working order at all times and checked regularly and cleared of any sediment or other debris.

132. Landfill management must involve the covering of waste until a cell is full and is being closed. The site therefore will need to operate as a sanitary landfill as noxious odours and pests that are associated with open dumping are also present. Two actions are required in order to prevent this:

(i) Operating procedures should involve periodic covering of deposited waste, sot simply when a cell is full; and

(ii) O&M procedures for the transfer station and landfill should be prepared by an experienced solid waste management expert.

133. As described above, proper design and engineering, and O&M should ensure that no significant impacts on surface waters in or around the proposed landfill site, and therefore the solid waste management system should operate without adverse ecological impacts. Routine environmental monitoring, as described below, will track environmental quality around the site during operation.

134. Poorly-managed landfills can cause negative ecological impacts by allowing the development of large colonies of scavenging birds, rodents and other vermin, which can then be a nuisance and a health hazard in nearby communities, and can damage crops on surrounding farmland. Such animals are discouraged by the regular covering of waste, so this reinforces the need to adopt this mitigation measure. Shillong Municipality should also routinely monitor the incidence of pests at the site so that controlling action (for example by regular culling) can be taken if necessary.

135. There can be small ecological gains as well as improvements in the appearance of such sites if trees are planted at the periphery and on completed waste cells, so this should be done.

136. Business and small industry in the town should operate more efficiently if their waste is removed speedily and efficiently, so there should be small economic gains once the system is operating. The main direct economic benefit will be obtained by companies that are involved in operating the secondary transfer system, supplying the trucks to transport the waste, and/or operating the landfill if this is contracted out to local business.

137. There should also be a significant economic benefit in the long term from the commercial

sale of organic fertilizer produced at the composting plant. There should also be economic gains from increased yields in farms where the compost is used to fertilize the land, and these could be significant in areas where nutrients have been leached out by paddy cultivation and denuded by regular planting of the same or similar crops.

138. The only negative economic impact from the operating waste management system will be on traffic and transport in and around the transfer station in the town and on roads leading to the landfill, as there will be more heavy traffic on roads at these locations. This should be mitigated by carrying waste to the landfill outside peak traffic periods, even in the early morning if necessary. Any remaining economic impacts should be counterbalanced by the economic and other benefits of the scheme.

139. The main beneficiaries of the improved waste management infrastructure and system will be the citizens of the town, whose general environment, and in some cases living conditions, will be improved considerably. There should be fewer unsightly mounds of garbage in the town, including in slum areas, and the attendant appearance, smell and public health risks should be reduced.

140. There will also be socio-economic benefits for people who are able to gain employment to operate the scheme and/or with Shillong Municipality if they operate elements of the system themselves. Farmers who benefit from fertilizer produced at the composting plant should also experience an increase in their income.

141. O&M Impacts shall pertain to:

(i) Noise pollution due to movement of the heavy refuse vehicles to the site to be reduced through development of vegetative buffer.

(ii) Everyday earth cover of 2-3 cm above the garbage layer will require significant quantities of borrow materials. Earth obtained from excavation of the cells and of leachate pits is to be used as earth cover.

(iii) Overflowing of leachate pipes due to heavy loads (especially in the rainy season) and choking due to accumulation of debris and wastes leading to pollution of nearby streams. A trench in front of leachate pipes be constructed with covering of plastic /tarpaulin layer to take the overflow. The perforations in the leachate pipe shall be cleaned by hosing with water jet.

(iv) Early filling of leachate pit during rainy season cause spillage and pollution in the nearby stream thereby requiring frequent emptying of leachate pits.

(v) Washing waters from the transfer station loaded with grit may lead to choking of nearby storm water drains. A grit chamber to be provided to arrest such particles at the outfall line of the washing platform.

(vi) Floor washing in the garage and workshop may have oil and grease which can contaminate the storm water drain and ultimately the nearby streams. An oil and grease trap to be provided at the outfall line from the garage.

(vii) Routing and scheduling of refuse vehicles may not match with users waste dumping behavior. The mismatch to be minimized with adequate awareness programs through NGOs, CBOs, and the media.

142. Overview of Potential Impacts and Mitigation Measures of Solid Waste Disposal site is given in **Table 4.3**.

TABLE 4.3: OVERVIEW OF POTENTIAL IMPACTS AND MITIGATION MEASURES, SOLID WASTE

Sl No	Impacts	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
1	**REHABILITATION OF EXISTING DISPOSAL SITE**			Provision of environmental protection measures and short-term sanitary landfill facilities (approx. 6 acres) at the present disposal site at Mawlai, as intermediate protection measures till the new sanitary landfill site starts operation. Existing site shall come into compliance with Schedule I of MSWHR, 2000 which states that improvement of existing landfill sites will done per provisions of these rules	Shillong Municipality (SWM Div.)
2	**NEW DISPOSAL SITE AT MAWIONG 8 KM FROM SHILLONG CITY**			Sanitary land filling process will be followed in tandem with the existing compost plant at this site. Only the rejects from the plant will be dumped in a cell dumping sanitary landfill process. The cells will be protected by one isolated footing barrier wall at the bottom. In addition, it will also have half perforated leachate pipes to collect the leachate and drain the same at the leachate pit. The site will require obtaining a COE from SPCB to establish site.	Shillong Municipality (SWM Div.)
2.1	**Location Impacts**				
(i)	Odour related and other Impacts on surrounding habitations and proposed developments	Permanent	Moderate	Sanitary land filling shall reduce the chances of foul odour to a large extent. The edge of the proposed land is approximately 8 km away from the city. Further a green buffer zone will be developed along the landfill site.	Shillong Municipality (SWM Div.) / DSMC/SIPMIU
(ii)	Flooding during monsoon season	Temporary	Significant	Storm drains surrounding the landfill will be designed to	DSMC

Sl No	Impacts	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
	will pollute surrounding area with leachate.			withstand heaviest monsoon rain	
(iii)	Resettlement Impacts	NA	NA	All improvements are proposed on government owned land	Shillong Municipality (SWM Div.) / DSMC/SIPMIU
2.2	**Design Impact**			Design will allow facility to comply with MSWHR, 2000.	DSMC/ SIPMIU
(i)	The daily earth cover of 2-3cm above the garbage layer will require a significant amount of earth. Risk of side slippage during rainy season.	Permanent	Moderate	The excavated earth at the time leachate pit construction shall be stored and used for earth cover of cells. If this is found inadequate and any additional borrowing is required from other surrounding areas, restoration of borrow areas shall be done. Appropriate slope protection measures shall be integrated as part of the design.	DSMC/ SIPMIU
(ii)	The site selected for location of the disposal site is a valley. Potential impacts to surface waters.	Permanent	Moderate	Appropriate leachate capturing measures and drainage interceptors to capture the direct runoff from the landfill site and redirecting into the leachate pipes shall effectively minimize the impacts of runoff polluting surface, ground water, and soil. The landfill facility shall be developed as per the provisions of MSW Rules, 2000.	DSMC/ SIPMIU
(iii)	Production of leachate during operation stage can potentially contaminate soil, surface and ground water resources.	Permanent	Moderate	The landfill design includes measures to collect leachate and prevent pollution of surface- and ground- water. Leachate will be treated by simple sedimentation and evaporation, and sludge that collects in the bottom of ponds will be allowed to dry out before being returned to the landfill. Given the amount of rain that falls in this region, and	DSMC/ SIPMIU

Sl No	Impacts	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
				the pollution of land and water that can occur if a landfill is subjected to flooding, the consultant responsible for the detailed design should ensue that: Surface water drains at the site are adequate to retain and dispose of the heaviest rains.	
(iv)	Production of Methane gas	Permanent	Moderate	Use of a compost system to reduce methane gas output.	
(iv)	Site drainage could cause ponding or flooding	Permanent	Moderate	Site drainage measures are needed to prevent ponding and flooding, promote slope stability, and reduce surface erosion and run-off.	
2.3	**Construction Impacts**				
(i)	The movement of heavy vehicle for construction of compost plant and preparing the landfill site will cause noise pollution problem in the vicinity.	Temporary	Moderate	All the vehicles used for the construction shall comply with relevant environmental standard. Worker to be provided with PPE's like earplugs to minimize the health impacts. Construction in the night time to be restricted to the extent possible.	Contractor/ DSMC / SIPMIU
(ii)	Trees on site could be removed when landfill is built	Temporary	Moderate	Plant and maintain two trees for every one removed	Contractor/ DSMC
(iv)	Excavation of landfill will produce large amounts of waste soil and stone	Temporary	Moderate	Re-use excavated material in this project wherever possible (eg bunds), Retain soil for covering waste when landfill is operating	Contractor/ DSMC
(v)	Excavation could generate dust in dry, windy weather	Temporary	Moderate	Remove waste soil for disposal as soon as it is excavated; Spray stockpiled soil and working areas in windy weather	Contractor/ DSMC
(vi)	Rainwater could collect in excavated areas	Temporary	Moderate	Conduct all excavation in the dry season	Contractor
(vii)	Water discharged from site may damage ecology	Temporary	Moderate	Do not store toxic materials at or near the landfill site; Include accident & spill	Contractor; Shillong Municipality

Sl No	Impacts	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
	of rivers if polluted			prevention in Method Statement	
(viii)	Economic benefits if local people are employed in Contractor's workforce	Temporary	Moderate	Contractor should employ at least 50% of workforce from communities in vicinity of work sites if possible	Contractor
(ix)	Workers and the public are at risk from accidents on site	Temporary	Moderate	Prepare and implement a site Health and Safety Plan that includes measures to: Exclude the public from all construction sites; Ensure that workers use Personal Protective Equipment; Provide Health & Safety Training for all personnel; Follow documented procedures for all site activities; Keep accident reports and records.	Contractor;
(xi)	Leveling and compaction of the site & Construction of haul roads will involve significant dust generation problems.	Temporary	Moderate	Regular water sprinkling to be ensured to minimize the impact. Worker to be provided with PPE's like dust masks.	Contractor/ DSMC/ SIPMIU
(xii)	Siltation caused during construction	Temporary	Moderate	The Design consideration will take care of temporary silt runoff due to construction. Silt fences will be used to mitigate siltation impacts.	Contractor/ DSMC/ SIPMIU
2.4	**O&M Impacts**			Facility requires CFO from SPCB to operate.	Shillong Municipality
(i)	Composting may fail if public do not separate green waste	Permanent	Significant	Public education on benefits of composting & role of public	Shillong Municipality (SWM Div)
(ii)	Town environment will deteriorate if system malfunctions			Public education; build capacity of Shillong Municipality staff; Maintain facilities and system in full working order	Shillong Municipality (SWM Div
(iii)	Refuse vehicles movement towards the site may lead to increase in day	Permanent	Moderate	Green buffer to be developed around the site.	Shillong Municipality (SWM Div)

Sl No	Impacts	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
	time noise levels.				
(iv)	Landfill may flood in monsoon, polluting land and water	Permanent	Significant	Ensure surface water drains will handle heaviest rains; &M procedure: regularly clear drains of debris and ensure they are in working order at all times	Shillong Municipality (SWM Div
(v)	Traffic may be impeded by heavy waste vehicles	Permanent	Significant	Carry waste to landfill outside peak traffic periods	Shillong Municipality (SWM Div
(vi)	The leachate collected in the pits has high contamination levels. Improper disposal of the leachate will lead to pollution of soil, surface and ground water resources.	Permanent	Moderate	O&M procedures require drains to be kept in working order at all times and checked regularly and cleared of any sediment or other debris. Monitoring leachate collection system in accordance with the MSWHR, 2000 requirements.	Shillong Municipality (SWM Div)
(vii)	Half perforated leachate pipes to be laid at the bottom of the disposal site. The pipes at times may overflow due to heavy load (especially in the rainy season). The pipes wrapped with iron mesh may also get choked due to accumulation of debris and wastes. This may lead to overflowing of leachate instead of flowing through the leachate pipe. The leachate may overflows and may pollute the nearby streams.	Permanent	Moderate	It is suggested that a small trench (of 1ft depth) with a covering of plastic/tarpaulin layer be constructed in front of the leachate pipes to take care the overflow. The perforations shall be cleaned by hosing with water jet. Regular monitoring of the same is necessary.	Shillong Municipality (SWM Div)

Sl No	Impacts	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
(viii)	Early filling of leachate pit during rainy season may cause spillage and pollute the nearby stream.	Temporary	Moderate	Regular monitoring and cleaning of leachate pits shall be necessary.	Shillong Municipality (SWM Div)
3	**TRANSFER STATION AT THE EXISTING DISPOSAL SITE**			Development of a transfer station and garage at the existing disposal site at Mawlai towards increase in vehicle trips and area of coverage. The transfer station shall also function as recovery centre for segregation of biodegradable portions from the recoverables/ recyclables	
3.1	**Location Impacts**				
(i)	May lead to nuisance in term of foul odors, breeding of vermin and other associated impacts if wastes are not cleared at regular intervals.	Permanent	Moderate	The transfer station shall be sited at the existing dumpsite in Mawlai away from inhabited areas and away from sensitive receptors.	Shillong Municipality (SWM Div)/ SIPMIU
3.2	**Design Impacts**				
(i)	The wash waters from the transfer station in absence of any drainage arrangements will stagnate around the site leading to prevalence of unsanitary conditions.	Permanent	Moderate	Proper drainage arrangements shall be made around the site to prevent any stagnation of wash waters.	Shillong Municipality (SWM Div)/ DSMC
(ii)	Wash waters from the transfer station may cause choking of nearby drains.	Permanent	Moderate	A grit chamber to be provided to arrest the materials contained in the wash waters.	Shillong Municipality (SWM Div)/ DSMC
3.3	**Construction Impacts**				
(i)	Construction activity can generate dust in dry, windy weather	Temporary	Moderate	Spray stockpiled soil and working areas in windy weather	Contractor/ DSMC
3.4	**O&M Impacts**				
(i)	Transfer Station could produce	Permanent	Moderate	O&M procedure: remove any spilled waste immediately;	

Sl No	Impacts	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
	odour if not cleaned regularly			&M procedure: wash floors & empty waste bins daily; O&M procedure: initial and annual training for all staff; Ensure transfer station design includes adequate drainage	
(ii)	The impacts associated with operation stage include frequent movements of waste collection vehicles, production of foul odours, waste spillage and breeding of vermins and other associated impacts.	Permanent	Moderate	Regular washing and disinfections of transfer station shall be carried out. Vegetative buffer around the site shall be provided. Ensuring that wastes are collected stored and transferred as per the SWHR 2000.	Shillong Municipality (SWM Div)
4	**GARAGE**			Construction of new parking/garage/workshop facility at Mawlai (the existing disposal site) for accommodation and maintenance of 24 refuse vehicles. The garage shall also be used for maintenance of wheelbarrows and mechanised containers.	
4.1	**Location Impacts**				
(i)	The garage and maintenance workshop is to be located on Govt. land so no impacts are envisaged.	NA	NA	NA	NA
4.2	**Design & Construction Impacts**				
(i)	NA			NA	NA
4.4	**O&M Impacts**				
(ii)	Garage washing waste water will contain oil and grease, which may increase the pollution load at the storm water drains.	Permanent	Negligible	An Oil trap to be provided to arrest the oil and grease.	Shillong Municipality (SWM Div)

Sl No	Impacts	Duration/ Extent	Magnitude	Mitigation Measures	Responsibility
5	**IMPROVEMENT OF COLLECTION SYSTEM**			The proposal includes improvement of the following: (i) primary and secondary collection efficiencies, (ii) existing system for transportation of wastes, and (iii) treatment and disposal of wastes in accordance with SWHR. The proposed components include: Improvement of the existing SW collection system from 45% to 60% by 2011, through improvements in primary and secondary collection facilities and through an intensive community awareness and consultation program, in consultation with communities, dorbars and NGOs. The proposed components include: Introduction of house-to-house waste collection through source segregation on a pilot basis, initially to about 2000 households within the SMB area; Provision of 1000, 30 litre dustbins to be placed in public places; Provision of 2000, 25-litre household dustbins and 2000 Nos. heavy duty PVC bags to be used for segregation of wastes at source (non biodegradable); Provision of 250 wheelbarrows to be used by sweepers in the central areas of the city; and, Provision of 35 nos, 4.5 cum community dustbins to be used in areas where bell ringing or house-to-house service is not provided.	
5.1	**Location, design and construction impacts**				
(i)	NA			NA	NA
5.4	**O&M Impacts**				
(ii)	It may happen that the scheduling of vehicles do not match with peoples waste dumping behavior. This may lead to improper collection even with such improvements.	Temporary	Moderate	Adequate public awareness programme to be arranged through Village Councils and NGOs to educate people about the routing and scheduling to ensure their participation.	Shillong Municipality (SWM Div) / NGO

V. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

A. INSTITUTIONAL REQUIREMENTS

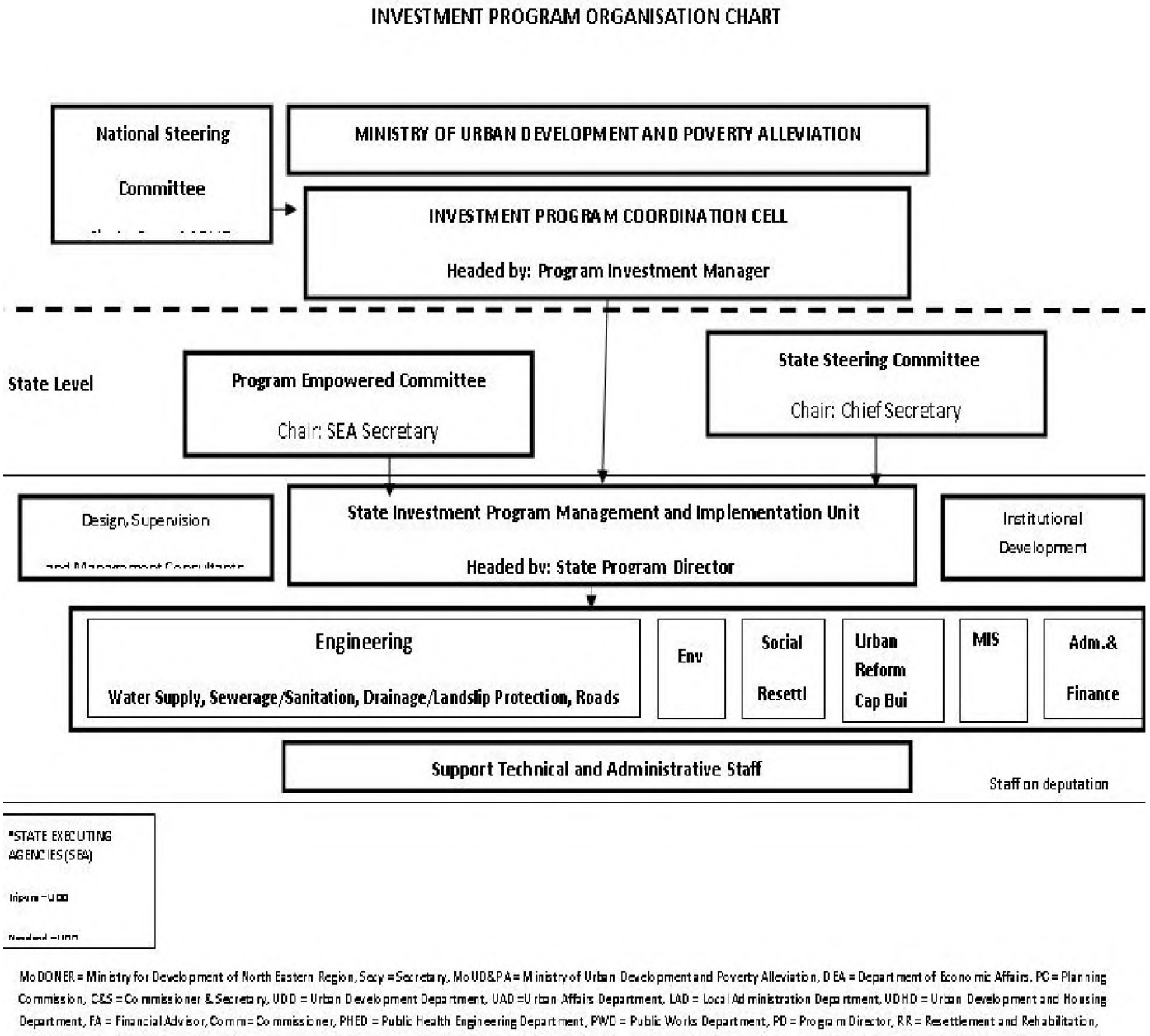
143. The national-level Executing Agency (NEA) for the Investment Program will be MOUD. An Investment Program Coordination Cell (IPCC) will be established in MOUD. IPCC will be responsible for overall management of the Investment Program in the five cities. It will be headed by an Investment Program Manager and consist of at least a three person-team of administrative/financial, technical, and social/environmental officials whose major tasks will include (i) monitoring overall Program implementation, (ii) reviewing the subprojects submitted by States in accordance with subproject selection criteria, and submission of the periodic financing requests to Department of Economic Affairs (DEA), (iii) reporting to ADB on Investment Program implementation progress and other matters, (iv) monitoring the overall reform program and compliance with loan covenants, and (v) providing assistance to the States. A national level Steering Committee (NSC) will be set up by GOI within three months of loan effectiveness to monitor the use of funds under MFF and overall implementation performance of the Investment Program. NSC will be chaired by the Secretary MOUD and comprise representatives of DEA, MDONER, and the Planning Commission. The IPCC will be assisted by a Project Management Consultant (PMC) to provide support and coordination for environmental assessment and review procedures. A State-level Executing Agency (SEA) in each State will be responsible for executing the part of the loan falling under the respective State Governments. There would be in each State a State Steering Committee (SSC), an Investment Program Empowered Committee (IPEC).

144. A consolidated State Investment Program Management and Implementation Unit (SIPMIU) will be established in each of the five SEAs. The SIPMIU to be headed by a State Investment Program Director will be responsible for overall management and implementation, including program progress monitoring at state level, preparing and forwarding subprojects for approval to SSC and MOUD, ensuring compliance with the design and monitoring framework and subproject selection criteria and loan covenants and urban reform targets, and coordinating with MOUD and other State agencies selection of consultants and contractors, approval of the detailed designs of the subprojects, disbursement requests for ADB and forwarding the same to the MOUD for onward transmission to ADB, administering the contracts of consultants and contractors, certifying payments and preparing change orders, and implementing awareness programs, environment and resettlement plans.

145. For implementation of the infrastructure components of the subprojects, the SIPMIU would have a number of small engineering cells each headed by an additional chief engineer/superintending engineer or additional director and with staff deputed from line departments and ULBs where applicable. The tasks of the engineering units would include designing, contracting, supervising and administering work in various sectors of the Program. There would be also units for implementation of awareness campaigns, consultations with affected persons, rehabilitation and resettlement, environmental management, and capacity building and training. For environmental issues, an Environmental Safeguards staff member is to be designated within SIPMIU to oversee all issues pertaining to environmental assessment and review procedures.

146. The SIPMIU will be assisted by the Design, Supervision, and Management Consultants (DSMC), who will design the infrastructure, manage tendering of contracts, and supervise the construction process. DSMC will also assist in providing capacity development support and training. The SIPMIU will appoint Construction Contractors (CC) to build elements of the infrastructure. The CCs will be managed by the SIPMIU, and construction will be supervised

by the DSMC. **Figure 5** illustrates the organizational chart of the proposed institutional arrangement.



MoDONER = Ministry for Development of North Eastern Region, Secy = Secretary, MoUD&PA = Ministry of Urban Development and Poverty Alleviation, DEA = Department of Economic Affairs, PC = Planning Commission, C&S = Commissioner & Secretary, UDD = Urban Development Department, UAD = Urban Affairs Department, LAD = Local Administration Department, UDHD = Urban Development and Housing Department, FA = Financial Advisor, Comm = Commissioner, PHED = Public Health Engineering Department, PWD = Public Works Department, PD = Program Director, R.R = Resettlement and Rehabilitation,

Figure 5: Organizational Chart of Investment Program

B. ENVIRONMENTAL MONITORING PLAN

147. An integral part of environmental protection is the continuous monitoring of the conditions of the receiving environment to determine if any undesirable changes are occurring as a result of the investment program. Since the effects on living receptors are received mainly through the surface water, air, and surrounding soil, environmental monitoring principally requires quantitative measurements of the amount of pollutants present in these environmental media.

148. Environmental monitoring will be done during construction in three levels; namely as monitoring of development of performance indicators done by the Environmental Specialist of the Design, Supervision, and Management Consultants, monitoring of implementation of mitigation measures done by the Contractor; and overall regulatory monitoring of the environmental issues done by Environmental Officer of the SIPMIU. Management of the landfill site will require compliance with all rules set out by the GoI Municipal Solid Waste Handling Rules, 2000.

149. The environmental monitoring plan of all relevant environmental parameters, with a description of the sampling stations, frequency of monitoring, applicable standards and responsible agencies is presented in **Table 5.1**.

TABLE 5.1: ENVIRONMENTAL MONITORING PLAN FOR SHILLONG

Sl No	Attributes	Stage	Parameters to be Monitored	Location	Frequency	Standard	Responsibility
1	Top soil conservation & Adequate Drainage arrangements within / around the disposal site	Construction Stage	Visual inspection to check separate stockpiling of topsoil. Monitoring includes checking siltation caused during construction and the use of silt fences Stockpiles of earth not to be higher than 2 and side slopes shall not be more than 1:2. Proper Drainage arrangements to prevent any water logging within / around the site especially in the area around the leach pits.	Proposed Landfill site at Mawiong colony.	Monthly Inspection by the SIPMIU during the site preparation period		Contractor / SIPMIU
2	Leachate Monitoring	Operation Stage	Overflowing of leachate pits, Chocking of leachate pipes. Quality of leachate in terms of pH, TDS, BOD, COD, Coliforms	Landfill site at Mawlai - Leachate pits and lechate pipes..	Daily inspection by operation and monthly inspection by the SIPMIU (for first 3 years of operation). Leachate Quality monitoring to be done twice a year for first three years of	MSW Handling Rules, 2000	Operator / SIPMIU

Sl No	Attributes	Stage	Parameters to be Monitored	Location	Frequency	Standard	Responsibility
					operation		
3	Odour Monitoring in peripheral residential areas of the landfill site in the downwind direction	Operation Stage	Hydrogen Sulphide (H_2S) and Ammonia (NH_3)	At roadway	Once in 6 month for the first three years of operation		Operator
4	Vegetative Buffer Survival Rate	Operation Stage	Survival Rate of Proposed Trees around the disposal site	Within landfill site at Mawlai	Twice a year till the trees reach a minimum height of 2 m	-	Operator
5.	Surface water quality of Umiam Lake	Operation Stage	pH, TDS, BOD, COD, Coli forms	Umiam Lake	Twice a year		SPCB
6.	Ground water within 50 meters of site	Operation Stage	Basic parameters set by SPCB for groundwater quality (including iron, ph, etc.)	At designated groundwater sampling locations at/near site.	Twice a year (Pre-monsoon, post monsoon)	MSW Handling Rules, 2000; Ground Water Board.	SPCB
7	Water Quality of Transfer Station wash waters	Operation Stage	pH, TDS, BOD, COD, Coli forms	At Transfer Station	Twice a year for the first three years of operation	IS: 2296	SPCB
8	Standard for compost	Operation Stage	Visual inspection to check for physical composition (e.g., glass, plastic and other physical inerts and fragments); and no offensive smell. Also testing of compost to meet standards.	Compost facility	Twice a year	MSW Handling Rules, 2000	Operator /SPCB
9	Collection Efficiency	Operation Stage	Visual inspection to check for uncleared garbage piles and spillage along haul routes	5 different localities/ month covered by the Collection	Once every month at 5 different localities for the first 3 years of operation	-	Shillong Municipality

Sl No	Attributes	Stage	Parameters to be Monitored	Location	Frequency	Standard	Responsibility
				Network			
10	Community Perception	Operation Stage	Community Perception Survey to identify the problems associated with the process and develop suitable modifications	5 different localities/ month covered by the Collection Network	Once every month at 5 different localities for the first 3 years of operation	-	Shillong Municipality
11	Bio Medical Waste	Operation Stage	Visual inspection for bio medical waste	Nearest Community collection point near hospitals like (I) Welsh Mission Hospital (ii) Ganesh Das Hospital (iii) Nazareth Hospital	Once every three month for the first three years of operation	Rules for Handling and Management of Bio Medical Waste, 1998	Shillong Municipality

Note: In many cases repetition of monitoring locations will be observed for different sub projects. This has been intentionally kept as it may so happen that different sub projects are prioritised and phased differently

150. The following environmental parameters shall be monitored on a regular basis as per the standards stipulated in the Municipal Solid Waste Handling Rules, 2000:

- Standard for compost
- Quality of leachate after treatment
- Surface water quality
- Ground water quality
- Quantity and quality of gas generated
- Ambient air quality

C. CAPACITY BUILDING

151. Members of the Environmental Cell of the State Investment Program Management Implementation Unit (SIPMIU) and Engineers of Nodal / Line Departments associated with the proposed improvements in NERCCDIP will be trained in environmental protection both in theoretical and practical aspects for urban infrastructure, specifically solid waste management projects. While theoretical aspects will form the bedrock of the training programme, it will be the practical site visits and /or hands-on training at site itself, which will be of direct use to the Program. Training in complying with the Municipal Solid Waste

Handling Rules, 2000 will be an important focus.

152. The training programme will kick off with a Sensitization Workshop for Secretaries, Chief Engineers and Superintendent Engineers of the line departments and also involving the Project Director and Environmental Officer of the Investment Program Management Unit (SIPMIU).

153. The Environmental Specialist of the Design and Supervision Consultants (DSC) will provide the basic training required for environmental awareness followed by specific aspects of Urban Sector Projects along with Environmental implications in NERCCDIP. Specific modules customized for the available skill set shall be devised after assessing the capabilities of the members of the Training Programme and the requirements of the Program. The entire training would cover basic principles of environmental assessment and management; mitigation plans and programmes, implementation techniques, monitoring methods and tools. Specific issues of Urban Environmental Management shall be taken up in separate sessions.

154. Typical modules that would be present for the training session would be as follows:

(i) Sensitization

(ii) Introduction to Environment

(iii) Environmental Considerations in Urban Development Projects

(iv) Review of IEE and Integration into Design

(v) Improved Co-ordination within Nodal Departments

(vi) Special issues in NERCCDIP

(vii) Role during construction

(viii) Monitoring & Reporting System

155. The proposed training program along with the frequency of sessions is presented in **Table 5.2**.

TABLE 5.2: TRAINING PROGRAM FOR ENVIRONMENTAL MANAGEMENT

Programme	Description	Participants	Form of Training	Duration/ Location	Training Conducting Agency
A. Pre-Construction Stage					
Sensitization Workshop	**Introduction to Environment:** ▪ Basic Concept of environment ▪ Environmental Regulations and Statutory requirements as per Government of	Secretaries, Chief Engineer Superintendent Engineers of PWD, PHED and UDD, the Development Commissioner, Mayor, senior management of	Workshop	½ Working Day	Environmental Specialist of the Design and Supervision Consultants

Programme	Description	Participants	Form of Training	Duration/ Location	Training Conducting Agency
	India and ADB	Shillong Municipality and Project Director (PD) and Environmental Officer (EO) of the SIPMIU			
Session I					
Module I	**Introduction to Environment:** ▪ Basic Concept of environment ▪ Environmental Regulations and Statutory requirements as per Government of India and ADB	Engineers of PWD, PHED and SWM Division and senior management of Shillong Municipality, SIPMIU (Technical Unit) and SIPMIU (Environmental Unit)	Lecture	¼ Working Day	Environmental Specialist of the Design and Supervision Consultants
Module II	**Environmental Considerations in Urban Development and Solid Waste Management (SWM) Projects:** ▪ Environmental components affected by urban development and SWM in construction and operation stages ▪ Activities causing pollution during construction and operation stages ▪ Environmental Management Good Practices in Urban Infrastructure and SWM Projects ▪ MSW Handling Rules, 2000 monitoring requirements.	Engineers of PWD, PHED and SWM Division and senior management of Shillong Municipality, SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the EO)	Workshop	¼ Working Day	Environmental Specialist of the Design and Supervision Consultants
Module III	**Review of IEE and its Integration into Designs:** ▪ IEE Methodology	Engineers of PWD, PHED and SWM Division and senior management of	Lecture and Field Visit	½ Working Day	Environmental Specialist of the Design and Supervision

Programme	Description	Participants	Form of Training	Duration/ Location	Training Conducting Agency
	▪ ADB and GoI requirements ▪ Environmental Provisions in NERCCDIP ▪ Implementation Arrangements ▪ Methodology of Assessment of Pollution Monitoring ▪ Methodology for site selection of borrow areas, waste disposal areas etc.	Shillong Municipality, SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the EO)			Consultants
Module IV	**Improved Co-ordination with other Departments:** ▪ Overview of NERCCDIP ▪ Environmental & Social Impacts ▪ Statutory Permissions – Procedural Requirements ▪ Co-operation & Co-ordination with other Departments.	Engineers of PWD, PHED and UDD of Shillong Division, SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the EO)	Lecture / Interactive Sessions	½ Working Day	Environmental Specialist of the Design and Supervision Consultants
Module V	**Special Issues in NERCCDIP** ▪ Bio-Diversity Assessment & Conservation ▪ Geomorphological Assessment and Slope Protection ▪ Statutory Permissions – Procedural Requirements ▪ Consultation and Counseling	SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the EO)	Lecture	½ Working Day	Environmental Specialist of the Design and Supervision Consultants

Programme	Description	Participants	Form of Training	Duration/ Location	Training Conducting Agency
B. Construction Stage					
Session II					
Module VI	**Role during Construction** ▪ Roles and Responsibilities of officials/ contractors/ consultants towards protection of environment ▪ Implementation Arrangements ▪ Monitoring mechanisms	Engineers of PWD, PHED and SWM Division of Shillong Municipality, SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the EO)	Lecture / Interactive Sessions	½ Working Day	Environmental Specialist of the Design and Supervision Consultants
Module VII	**Monitoring and Reporting System** Monitoring mechanisms MSW Handling Rules, 2000 monitoring requirements.	SIPMIU (Technical Unit) and SIPMIU (Environmental Unit including the EO); SWM Division and senior management of Shillong Municipality	Lecture / Interactive Sessions	½ Working Day	Environmental Specialist of the Design and Supervision Consultants

D. ENVIRONMENTAL BUDGET

156. As part of good engineering practices, there have been several measures as erosion prevention, rehabilitation of borrow areas, safety, signage, provision of temporary drains, etc the costs for which are included in the design costs of specific subprojects. Therefore, these items of costs have not been included in the IEE budget. Only those items not covered under budgets for construction and RAP are costed in the IEE budget. The IEE costs include mitigation, monitoring and capacity building costs. The summary budget for the environmental management costs for different subprojects is presented in **Table 5.3**.

TABLE 5.3: ENVIRONMENTAL BUDGET, SOLID WASTE

Sl. No.	Particulars	Stages	Unit	Rate (INR)	Cost (INR Million)
A.	**Mitigation Measures**				
3.1	Silt Fencing	Construction	Per running meter	500	0.025
3.2	Vegetative Buffer	Operation	Per tree	350	0.182
3.3	Oil and Grease Trap	Operation	Per Unit	5000	0.005
3.4	Grit Chamber	Operation	Per Unit	3500	0.004
	Sub -Total (A)				**0.216**
B.	**Monitoring Measures**				
3.1	Leachate Monitoring	Operation	Per sample	3000	0.018

Sl. No.	Particulars	Stages	Unit	Rate (INR)	Cost (INR Million)
3.2	Odour Monitoring	Operation	Per sample	3000	0.018
3.3	Wash Water Quality	Operation	Per sample	2000	0.012
	Sub -Total (B)				**0.048**
C	**Capacity Building**				
1	Sensitization Workshop	Pre-Construction	L.S		0.075
2	Training Session I	Pre-Construction	L.S		0.300
3	Training Session II	Construction	L.S		0.150
	Sub-Total C				**0.525**
	Total (A+B+C)				**0.789**
	Add Contingencies (@5 %)				**0.828**

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. PROCESS FOR CONSULTATION

157. Consultations with stakeholders on environmental issues have been taken up as an integral part of the PPTA process. These consultations provided inputs to the various sector specialists in identification of the felt needs of the communities, and the relevant stakeholders. The outputs of the consultation sessions are documented in Volume TR11 (Draft Final Report, TR-11, TA-4348) on Stakeholder Consultations. Consultations were held with the following stakeholders:

- Officials of State Government Departments;
- Elected representatives;
- NGOs and environmental groups; and,
- Communities.

Primary Consultation

158. The tools for consultation included formal meetings, structured discussions, focus group discussions apart from questionnaire administered for a sample population. A total of 13 primary consultation meetings have been held in Shillong during April- September 2005. **Table 6.1** lists the details of the meetings such as location, date, time, venue etc of the meeting.

TABLE 6.1: DETAILS OF PRIMARY CONSULTATION PROGRAM IN SHILLONG

S. No.	Type of Consultation	Stakeholder	Area	Venue	No of Participants	Date	Time	Duration
1	FGD	Community	Upper Lumparing	Residence of one of the participants	9	17-9-05	10.30-11.30	60 min
2	FGD	Community	Madan Laban	Community Hall	14	19-9-05	16.30-17.30	60 min
3	FGD	Community	Happy Valley, Madantring Durbar	Residence of one of The participant	6	20-9-05	14.30-15.15	45 min
4	FGD	Community	Khliehschnong, Pynthorumkhrah Durbar	Residence of one of The participant	5	21-9-05	8.00-8.30 am	30 min
5	FGD	Community	Bara Patthar	Sarva Shiksha Abhiyan School	14	23-9-05	11.00-12.00	60 min
	Gender and Women's groups							

S. No.	Type of Consultation	Stakeholder	Area	Venue	No of Participants	Date	Time	Duration
6	FGD	Women from several areas, SHG and members of residential women association	Lumshopo, Lumbordorbar, Mynsi	Lumshopo Community Hall	17	27-6-05	11.30-13.30	120 min
7	FGD	Local residents/Women	Upper Laban, Lachumiere	Residence of one of the participants in Upper Laban	15	28-6-05	15.30-17.00	90 min
	Non Governmental Organizations (NGO)							
12	Interview with President of NGO	New Age NGO	Shillong	Office of NGO	1	22-04-05		
9	Project Information Dissemination and FGD with community development societies	Thrift and Credit Societies Self Help Groups	Shillong	Urban Affairs Department	21	27-4-05	14.00-15.00	60 min
8	FGD (Gender) with NGO groups and community based women groups	Impulse Network WISE) Civil and democratic rights groups Voluntary Health Association of Shillong Northeast network Freedom Project	Shillong	St. Mary's Convent	10	28-6-05	12.00-14.30	150 min
	Interview with President of Impulse Netwofk, Ms	Impulse Network	Shillong	Office of NGO	1	19-9-05	14.00-14.30	30 min

S. No.	Type of Consultation	Stakeholder	Area	Venue	No of Participants	Date	Time	Duration
	Hasina Kharbih							
11	Interview with Program manager and Coordinator	World Vision	Shillong	Office of NGO	2	20-9-05	10.30-11.00 am	30 min
	Community Based Organizations							
13	FGD	Traditional Women's organization -Synkenthai	Nonglum	Residence of Headman of Mawlai Durbar	9	23-9-05	13.30 – 14.30 pm	60 min

Secondary and Tertiary Consultations

159. The summary of consultations held during the PPTA assignment in Shillong is presented in **Table 6.2**. The details of the various issues raised and suggestions received during the various consultation sessions are summarized in the **Table 6.2**.

TABLE 6.2: SUMMARY OF CONSULTATIONS HELD IN SHILLONG

Stage of PPTA	Stakeholders Consulted	Tool	Scope of consultation	Consultations carried out by
Study Inception	State Government officials from Urban Development Department Shillong Municipal Board Public Health Engineering Department Public Works Department Department of Forests	Formal meetings/ Discussions	Introduction of project, project components, time frame and expectations from the departments Overview of Environment and Social assessments	Team leader, deputy team leader, environment specialist
Inception workshop	Officials from Ministry of Development of North-eastern region (MoDNER), GoI Government of Meghalaya	Workshop	Discussions on approach and methodology for the study, including EA/SA	PPTA team
Situation analysis	State Government Departments NGOs including Impulse Network, World Vision, Women for Integrated Sustainable Development (WISE), Voluntary Health Association of Shillong, North East Network, Freedom Project.	Formal meetings/ Discussions	Status of infrastructure services	Sector specialists
Interim workshop	Officials from Ministry of Development of North-eastern region	Workshop	Dissemination of findings of interim report	PPTA team

Stage of PPTA	Stakeholders Consulted	Tool	Scope of consultation	Consultations carried out by
	(MoDNER), GoI Government of Meghalaya			
Feasibility analysis	State Government Departments NGOs including Impulse Network, World Vision, Women for Integrated Sustainable Development (WISE), Voluntary Health Association of Shillong, North East Network, Freedom Project. Local leaders and elected representatives, panchayat members Communities and self help groups	Formal meetings/ Structured Discussions FGDs, SES	Felt needs/ perceptions of the communities Willingness to Pay (WTP) for the infrastructure improvements Environmental issues due to project interventions Possibilities of involvement of communities	Team Leader, Sector Specialists Environment specialist Public Consultation specialist Biodiversity specialist
Finalization of project components	State Government Departments NGOs including Impulse Network, World Vision, Women for Integrated Sustainable Development (WISE), Voluntary Health Association of Shillong, North East Network, Freedom Project. Local leaders and elected representatives, panchayat members Communities and self help groups	Meetings	Response to the communities on incorporation of felt needs and perceptions Dissemination of project components	Team Leader, Sector Specialists Environment specialist Public Consultation specialist

B. CONSULTATION OUTCOMES

Inception Stage

160. The consultations at the Inception stage provided the team an opportunity to provide an orientation to the departments of the Government of Meghalaya on the project, its likely scope, time frame and the nature and extent of studies including environmental and social assessments to be carried out as part of the project.

Situation Analysis and Assessment

161. The process of consultation with stakeholders was carried out as part of the situation analysis for the various infrastructure sectors. These consultations provided inputs in identifying the needs and priorities of these agencies to be taken up for implementation in the proposed project. A sector wise summary of the issues particularly relevant to the environment in the project is presented in the **Table 6.3**.

TABLE 6.3: ISSUES RAISED AND SUGGESTIONS RECEIVED – SITUATION ANALYSIS STAGE

Sector	Stakeholders consulted	Issues raised / suggestions received	Response
Solid Wastes Management	SMB, Durbar, NGOs	• Existing solid waste dumping site is located in Riat Khwan RF. The dumping method followed is open and crude posing serious danger to the forest and the bio diversity. • Leachate from the waste is flowing into streams draining into Umiam Lake and polluting it. • Present disposal not in conformance with the SWHR – 2000. • Inefficiency of collection system leading into disposal of wastes in the streams, drains and valleys.	• Conformance of the SWHR – 2000 shall be done in the project. • Identification of alternative disposal site with provision for treatment and collection of leachate will be done. Development of the site as sanitary land filling site. • Enhancement of the collection system through fleet augmentation, provision of community bins, transfers stations shall be done. • Possibilities of involvement of NGOs, CBOs, for collection and disposal of solid wastes from steep and inaccessible areas will be looked into.

162. The situation analysis for each of the sectors were presented in the Interim Workshop wherein sector wise potential list of proposals in each of the priority infrastructure sectors were presented to the representatives of the various line departments. The discussions and feedback obtained on the proposals provided feedback towards the feasibility analysis for the formulation of projects.

Feasibility Analysis

163. The inputs received from the stakeholders during the interim workshop, provided critical inputs towards scoping of the proposed improvements in each of the infrastructure sectors. Further consultations were carried out wherein specific improvements and sub-projects were discussed. These consultations also provided an opportunity to identify the sub-projects as desired by the communities, NGOs, to be implemented in the project. These projects, have been included as part of the proposed components to the extent possible. During these consultations, the stakeholders have been apprised of the participatory approach that shall be further adopted during the detailed design and implementation of the components.

C. FRAMEWORK FOR CONTINUED PARTICIPATION IN SUBSEQUENT PROGRAM STAGES

164. Regular and continued participation of the communities shall be ensured during the project. The participation framework for the NERUDP proposes regular and continued stakeholder participation, at all stages during the project design and implementation. A grievance redressal cell shall be set up within the PIU to register grievances of the people regarding technical, social and environmental aspects. This participatory process shall ensure that all views of the people are adequately reviewed and suitably incorporated in the design and implementation process. Further, to ensure an effective disclosure of the project proposals to

the stakeholders and the communities in Shillong, an extensive project awareness campaigns shall be carried out regarding different sectoral projects with the following objectives:

- To educate the communities on the project provisions and the potential benefits due to the proposed improvements
- To impart awareness on hygienic practices to be adopted for proper utilization of the proposed infrastructure improvements.

165. For the benefit of the community the IEE will be translated made available13 at: (i) SMB office; (ii) District Magistrate Office; and, (iii) PMU. Hard copies of the IEE will be kept in the city library, accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. Electronic version of the IEE will be placed in the official website of the PMU / State Government and the official website of ADB after approval of the IEE by Government and ADB. The PMU will issue Notification on the locality-wise start date of implementation of the project. The notice will be issued by the PMU in local newspapers one month ahead of the implementation works. This will create awareness of the project implementation among the public. Posters designed to mass campaign the basic tenets of the IEE will be distributed to libraries in different localities that will be generating mass awareness. Copies of the summary of the IEE will be kept in the PMU office and will be distributed to any person willing to consult the IEE.

[13] In accordance with Operations Manual Section F2/BP on involuntary resettlement

VII. FINDINGS AND RECOMMENDATIONS

166. The proposed transfer station, garage and disposal site will be located within the existing landfill site at Municipal Trenching Ground at Marten, Mawiong. The collected wastes throughout the city are disposed at Mawiong disposal site at a distance of about 8 km from the city. The site has been operational since 1938. The proposed land fill area is 5.2503 Acres (Plot No-1). Plot No-1 is the part of Compartment no-4 of Riat Khwan Reserve Forest (It includes Plot No-1, Plot No-2 and Plot-3). The Government of Meghalaya Forest & Environment Department has extended the lease from 1938 to 2026 under letter no. FOR 76/99/16 dated 25th February 2000 to the Shillong Municipality for 18 Acres of land in Riat Khwan Forest Compartment No-4 for the purpose of trenching ground of Municipal waste with certain conditions. Umiam Lake is approximately 3.0 km from proposed disposal site. Umiam Lake is a "potential Ramsar site". It is not officially a Ramsar designated Wetland; however the site design and environmental mitigation measures seeks to avoid impacts to surface water quality of the surrounding area.

167. Government of Meghalaya may likely to establish SIPMIU with the supporting staff at an early date. SIPMIU is to be headed by a Programme/Project Director supported by technical and other staff and the same may be established within the State level Executing Agency (SLEA). SLEA may be a state department responsible for executing the part of the loan approved for ADB assistance for the state. MOUD is the executing Agency at the National level, while in the state it is either the Finance department or the Urban Development Department.

168. All components in the solid waste management sub-project effectively avoid encroachment / direct impact onto environmentally sensitive locations or protected area networks within Shillong. To minimize environmental impacts associated with construction of new infrastructure facilities, the site selection for these components has been done carefully. It is to be noted that as per the statutory requirements of Government of India (Environmental Impact Assessment Notification, September, 2006), and as per the ADB guidelines, 2003, the proposed improvements do not warrant an EIA as none of the project components are: (i) likely to have significant adverse environmental impacts and (ii) located within designated environmental sensitive or protected areas. However, the development of the landfill site and the composting facility shall require an authorization from the Meghalaya State Pollution Control Board.

169. The significance of the environmental impacts shall be more due to the construction related impacts than any impacts associated with areas of rich environmental sensitivity. It is to be noted that the resultant potential impacts from these proposals can be offset through provision of proven mitigation measures during the design and adoption of good engineering practices during construction and implementation. While no further detailed EIA shall be required for the proposed components, the addressal of the following key provisions have been included in the ToR for the environmental specialist of the DSC:

- Site Management Plan to address impacts during construction;
- Waste Management Plan to address disposal of wastes generated during construction;
- Occupational Safety Plan to address occupational hazard during construction and operation;
- Sludge Management & Disposal Plan to address sludge handling and management during operation of the STP;

- Lechate Management & Disposal Plan to address lechate management and disposal plans during operation of the Landfill Site; and

- Natural Habitat Management Plan to address issues relating to conservation of natural habitats during construction and operation phases.

170. The effective implementation of the same shall be ensured through the building up of capacity towards environmental management within the PMU supplemented with the technical expertise of an Environmental Specialist as part of the DSC. Further, the monitoring plans shall provide adequate opportunities towards course correction to address any residual impacts during construction or operation stages.

171. The Design consideration will take care of surface and ground water pollution from leachate coming from sanitary landfill sites or methane gas produced from decomposition of solid wastes. The Design consideration will take care of temporary silt runoff due to construction.

172. Adequate institutional and financial capabilities for the management of the landfill operation will be provided to avoid hazards to public health.

173. The loss of deep-rooted vegetation (e.g. tress) from the project will be compensated with at least two times of tree plantation at suitable locations

VIII. CONCLUSION

174. The proposed components should proceed through to design and implementation, subject to mitigation measures and monitoring programs identified in the IEE, which will be updated and detailed during detailed design stage, and based on above recommendations. It may be emphasized that, owing to: (i) scale of activity, (ii) location of the proposed sub-project component, and (iii) 'no environmental sensitivity' of the sub-projects, none of the components required to go through the process of EIA. It may be emphasized that the present IEE, which identifies potential impacts and suggests appropriate mitigation measures, is sufficient enough to safeguard the environment. There are no significant adverse impacts, which are irreversible or may lead to considerable loss/destruction of environment, envisaged. Proven mitigation measures exist to minimize/mitigate the same. Hence, no further study such as an EIA is required.

ANNEXURE 1: NOTIFICATION & SCHEDULES

Municipal Solid Wastes (Management and Handling)

Ministry of Environment and Forests

Notification

New Delhi, the 25th September, 2000

S.O. 908(E).- Whereas the draft of the Municipal Solid Wastes (Management and Handling) Rules, 1999 were published under the notification of the Government of India in the Ministry of Environment and Forests number S.O. 783(E), dated, the 27th September, 1999 in the Gazette of India, Part II, Section 3, Sub-section (ii) of the same date inviting objections and suggestions from the persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which the copies of the Gazette containing the said notification are made available to the public;

And whereas copies of the said Gazette were made available to the public on the 5th October, 1999;

And whereas the objections and suggestions received from the public in respect of the said draft rules have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by section 3, 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules to regulate the management and handling of the municipal solid wastes, namely:-

1. Short title and commencement.--

1. These rules may be called the Municipal Solid Wastes (Management and Handling) Rules, 2000.

2. Save as otherwise provided in these rules, they shall come into force on the date of their publication in the Official Gazette.

2. Application -- These rules shall apply to every municipal authority responsible for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes.

3. Responsibility of municipal authority

1. Every municipal authority shall, within the territorial area of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.

2. The municipal authority or an operator of a facility shall make an application in **Form-I,** for grant of authorization for setting up waste processing and disposal facility including landfills from the State Board or the Committee in order to comply with the implementation programme laid down in **Schedule I**.

3. The municipal authority shall comply with these rules as per the implementation schedule laid down in **Schedule I.**

4. The municipal authority shall furnish its annual report in Form-II,-

a. to the Secretary-incharge of the Department of Urban Development of the concerned State or as the case may be of the Union territory, in case of a metropolitan city; or

b. to the District Magistrate or the Deputy Commissioner concerned in case of all other towns and cities,

with a copy to the State Board or the Committee on or before the 30th day of June every year.

5. Responsibility of the State Government and the Union territory Administrations .--

(1) The Secretary-incharge of the Department of Urban Development of the concerned State or the Union territory, as the case may be, shall have the overall responsibility for the enforcement of the provisions of these rules in the metropolitan cities.

(2) The District Magistrate or the Deputy Commissioner of the concerned district shall have the overall responsibility for the enforcement of the provisions of these rules within the territorial limits of their jurisdiction.

6. Responsibility of the Central Pollution Control Board and the State Board or the Committees

1. The State Board or the Committee shall monitor the compliance of the standards regarding ground water, ambient air, leachate quality and the compost quality including incineration standards as specified under **Schedules II, III** and **IV**.

2. The State Board or the Committee, after the receipt of application from the municipal authority or the operator of a facility in **Form I,** for grant of authorization for setting up waste processing and disposal facility including landfills, shall examine the proposal taking into consideration the views of other agencies like the State Urban Development Department, the Town and Country Planning Department, Air Port or Air Base Authority, the Ground Water Board or any such other agency prior to issuing the authorization.

3. The State Board or the Committee shall issue the authorization in **Form-III** to the municipal authority or an operator of a facility within forty-five days stipulating compliance criteria and standards as specified in **Schedules II, III** and **IV** including such other conditions, as may be necessary.

4. The authorization shall be valid for a given period and after the validity is over, a fresh authorization shall be required.

5. The Central Pollution Control Board shall co-ordinate with the State Boards and the Committees with particular reference to implementation and review of standards and guidelines and compilation of monitoring data.

7. Management of municipal solid wastes

1. Any municipal solid waste generated in a city or a town, shall be managed and handled in accordance with the compliance criteria and the procedure laid down in **Schedule-II**.

2. The waste processing and disposal facilities to be set up by the municipal authority on their own or through an operator of a facility shall meet the specifications and standards as specified in **Schedules III** and **IV.**

8. Annual Reports

1. The State Boards and the Committees shall prepare and submit to the Central Pollution Control Board an annual report with regard to the implementation of these rules by the 15th of September every year in **Form-IV**.

2. The Central Pollution Control Board shall prepare the consolidated annual review report on management of municipal solid wastes and forward it to the Central Government alongwith its recommendations before the 15th of December every year.

9. Accident Reporting

When an accident occurs at any municipal solid wastes collection, segregation, storage, processing, treatment and dispoosal facility or landfill site or during the transportation of such wastes, the municipal authority shall forthwith report the accident in **Form-V** to the Secretary in-charge of the Urban Development Department in metropolitan cities, and to District Collector or Deputy Commissioner in all other cases.

Schedule I

[see rules4(2) and (3)]

Implementation Schedule

Serial No.	Compliance Criteria	Schedule
1.	Setting up of waste processing and disposal facilities	By 31.12.2003 or earlier
2.	Monitoring the performance of waste processing and disposal facilities	Once in six months
3.	Improvement of existing landfill sites as per provisions of these rules	By 31.12.2001 or earlier
4.	Identification of landfill sites for future use and making site (s) ready for operation	By 31.12.2002 or earlier

Schedule -II

[see rules 6(1) and (3), 7(1)]

Management of Municipal Solid Wastes

S. No	Parameters	Compliance criteria
1.	**Collection of municipal solid wastes**	1. Littering of municipal solid waste shall be prohibited in cities, towns and in urban areas notified by the State Governments. To prohibit littering and facilitate compliance, the following steps shall be taken by the municipal authority, namely :- i. Organising house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and scheduling by using bell ringing of musical vehicle (without exceeding permissible noise levels); ii. Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and commercial areas; iii. Wastes from slaughter houses, meat and fish markets, fruits and vegetable markets, which are biodegradable in nature, shall be managed to make use of such wastes; iv. Bio-medical wastes and industrial wastes shall not be mixed with municipal solid wastes and such wastes shall follow the rules separately specified for the purpose; v. Collected waste from residential and other areas shall be transferred to community bin by hand-driven containerised carts or other small vehicles; vi. Horticlutural and construction or demolition wastes or debris shall be separately collected and disposed off following proper norms. Similarly, wastes generated at dairies shall be regulated in accordance with the State laws; vii. Waste (garbage, dry leaves) shall not be burnt; viii. Stray animals shall not be allowed to move around waste storage facilities or at any other place in the city or town and shall be managed in accordance with the State laws. 2. The municipal authority shall notify waste collection schedule and the likely method to be adopted for public benefit in a city or town. 3. It shall be the responsibility of generator of wastes to avoid littering and ensure delivery of wastes in accordance with the collection and segregation system to be notified by the municipal authority as per para 1(2) of this Schedule.
2.	**Segregation of municipal solid wastes**	In order to encourage the citizens, municipal authority shall organise awareness programmes for segregation of wastes and shall promote recycling or reuse of segregated materials. The municipal authority shall undertake phased programme to ensure community participation in waste segregation. For this purpose, regular meetings at quarterly intervals shall be arranged by the municipal authorities with representatives of local resident welfare associations and non-governmental organizations.

3.	**Storage of municipal solid wastes**	Municipal authorities shall establish and maintain storage facilities in such a manner as they do not create unhygienic and insanitary conditions around it. Following criteria shall be taken into account while establishing and maintaining storage facilities, namely :- i. Storage facilities shall be created and established by taking into account quantities of waste generation in a given area and the population densities. A storage facility shall be so placed that it is accessible to users; ii. Storage facilities to be set up by municipal authorities or any other agency shall be so designed that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user-friendly; iii. Storage facilities or 'bins' shall have 'easy to operate' design for handling, transfer and transportation of waste. Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black; iv. Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers.
4.	**Transportation of municipal solid wastes**	Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The following criteria shall be met, namely:- i. The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing; ii. Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided.
5.	**Processing of municipal solid wastes**	Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill. Following criteria shall be adopted, namely:- (i) The biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes. It shall be ensured that compost or any other end product shall comply with standards as specified in Schedule-IV; ii. Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can also be used for processing wastes in specific cases. Municipal authority or the operator of a facility wishing to use other state-of-the-art technologies shall approach the Central Pollution Control Board to get the standards laid down before applying for grant of authorisation.
6.	**Disposal of municipal solid wastes**	Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till

		installation of alternate facilities, land-filling shall be done following proper norms. Landfill sites shall meet the specifications as given in Schedule – III.

Schedule III

[see rules 6(1) and (3), 7(2)]

Specifications for Landfill Sites

Site Selection

1. In areas falling under the jurisdiction of 'Development Authorities' it shall be the responsibility of such Development Authorities to identify the landfill sites and hand over the sites to the concerned municipal authority for development, operation and maintenance. Elsewhere, this responsibility shall lie with the concerned municipal authority.

2. Selection of landfill sites shall be based on examination of environmental issues. The Department of Urban Development of the State or the Union territory shall co-ordinate with the concerned organisations for obtaining the necessary approvals and clearances.

3. The landfill site shall be planned and designed with proper documentation of a phased construction plan as well as a closure plan.

4. The landfill sites shall be selected to make use of nearby wastes processing facility. Otherwise, wastes processing facility shall be planned as an integral part of the landfill site.

5. The existing landfill sites which continue to be used for more than five years, shall be improved in accordance of the specifications given in this Schedule.

6. Biomedical wastes shall be disposed off in accordance with the Bio-medical Wastes (Management and Handling) Rules, 1998 and hazardous wastes shall be managed in accordance with the Hazardous Wastes (Management and Handling) Rules, 1989, as amended from time to time.

7. The landfill site shall be large enough to last for 20-25 years.

8. The landfill site shall be away from habitation clusters, forest areas, water bodies monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.

9. A buffer zone of no-development shall be maintained around landfill site and shall be incorporated in the Town Planning Department's land-use plans.

10. Landfill site shall be away from airport including airbase. Necessary approval of airport or airbase authorities prior to the setting up of the landfill site shall be obtained in cases where the site is to be located within 20 km of an airport or airbase.

Facilities at the Site

11. Landfill site shall be fenced or hedged and provided with proper gate to monitor incoming vehicles or other modes of transportation.

12. The landfill site shall be well protected to prevent entry of unauthorised persons and stray animals.

13. Approach and other internal roads for free movement of vehicles and other machinery shall exist at the landfill site.

14. The landfill site shall have wastes inspection facility to monitor wastes brought in for landfill, office facility for record keeping and shelter for keeping equipment and machinery including pollution monitoring equipments.

15. Provisions like weigh bridge to measure quantity of waste brought at landfill site, fire protection equipments and other facilities as may be required shall be provided.

16. Utilities such as drinking water (preferably bathing facilities for workers) and lighting arrangements for easy landfill operations when carried out in night hours shall be provided.

17. Safety provisions including health inspections of workers at landfill site shall be periodically made.

Specifications for land filling

18. Wastes subjected to land filling shall be compacted in thin layers using landfill compactors to achieve high density of the wastes. In high rainfall areas where heavy compactors cannot be used alternative measures shall be adopted.

19. Wastes shall be covered immediately or at the end of each working day with minimum 10 cm of soil, inert debris or construction material till such time waste processing facilities for composting or recycling or energy recovery are set up as per Schedule I.

20. Prior to the commencement of monsoon season, an intermediate cover of 40-65 cm thickness of soil shall be placed on the landfill with proper compaction and grading to prevent infiltration during monsoon. Proper drainage berms shall be constructed to divert run-off away from the active cell of the landfill.

21. After completion of landfill, a final cover shall be designed to minimize infiltration and erosion. The final cover shall meet the following specifications, namely :--

a. The final cover shall have a barrier soil layer comprising of 60 cms of clay or amended soil with permeability coefficient less that 1 x 10^{-7} cm/sec.

b. On top of the barrier soil layer there shall be a drainage layer of 15 cm.

c. On top of the drainage layer there shall be a vegetative layer of 45 cm to support natural plant growth and to minimize erosion.

Pollution prevention

22. In order to prevent pollution problems from landfill operations, the following provisions shall be made, namely:-

a. Diversion of storm water drains to minimize leachate generation and prevent pollution of surface water and also for avoiding flooding and creation of marshy conditions;

b. Construction of a non-permeable lining system at the base and walls of waste disposal area. For landfill receiving residues of waste processing facilities or mixed waste or waste having contamination of hazardous materials (such as aerosols, bleaches, polishes, batteries, waste oils, paint products and pesticides) minimum liner specifications shall be a composite barrier having 1.5 mm high density polyethylene (HDPE) geomembrane, or equivalent, overlying 90 cm of soil (clay or amended soil) having permeability coefficient not greater than 1 x 10^{-7} cm/sec. The highest level of water table shall be at least two meter below the base of clay or amended soil barrier layer;

c. Provisions for management of leachates collection and treatment shall be made. The treated leachates shall meet the standards specified in Schedule- IV;

d. Prevention of run-off from landfill area entering any stream, river, lake or pond.

Water Quality Monitoring

23. Before establishing any landfill site, baseline data of ground water quality in the area shall be collected and kept in record for future reference. The ground water quality within 50 metres of the periphery of landfill site shall be periodically monitored to ensure that the ground water is not contaminated beyond acceptable limit as decided by the Ground Water Board or the State Board or the Committee. Such monitoring shall be carried out to cover different seasons in a year that is, summer, monsoon and post-monsoon period.

24. Usage of groundwater in and around landfill sites for any purpose (including drinking and irrigation) is to be considered after ensuring its quality. The following specifications for drinking water quality shall apply for monitoring purpose, namely :-

S.No.	Parameters	IS 10500: 1991 Desirable limit (mg/l except for pH)
1.	Arsenic	0.05
2.	Cadmium	0.01
3	Chromium	0.05
4.	Copper	0.05
5.	Cyanide	0.05
6.	Lead	0.05
7.	Mercury	0.001
8.	Nickel	-
9.	Nitrate as NO_3	45.0
10	PH	6.5-8.5
11.	Iron	0.3

S.No.	Parameters	IS 10500: 1991 Desirable limit (mg/l except for pH)
12.	Total hardness (as $CaCO_3$)	300.0
13.	Chlorides	250
14.	Dissolved solids	500
15.	Phenolic compounds (as C_6H_5OH)	0.001
16.	Zinc	5.0
17.	Sulphate (as SO_4)	200

Ambient Air Quality Monitoring

25. Installation of landfill gas control system including gas collection system shall be made at landfill site to minimize odour generation, prevent off-site migration of gases and to protect vegetation planted on the rehabilitated landfill surface.

26. The concentration of methane gas generated at landfill site shall not exceed 25 per cent of the lower explosive limit (LEL).

27. The landfill gas from the collection facility at a landfill site shall be utilized for either direct thermal applications or power generation, as per viability. Otherwise, landfill gas shall be burnt (flared) and shall not be allowed to directly escape to the atmosphere or for illegal tapping. Passive venting shall be allowed if its utiliztion or flaring is not possible.

28. Ambient air quality at the landfill site and at the vicinity shall be monitored to meet the following specified standards, namely :-

S.No.	Parameters	Acceptable levels
(i)	Sulphur dioxide	120 □□□. □□□□□□□
(ii)	Suspended Particulate Matter	500 □□□. □□□□□□□
(iii)	Methane	Not to exceed 25 per cent of the lower explosive limit (equivalent to 650 mg/m^3)
(iv)	Ammonia daily average	
	(Sample duration 24 hrs)	0.4 mg/m^3 (400 □□□..
(v)	Carbon monoxide	1 hour average : 2 mg/m^3 8 hour average : 1 mg/m^3

29. The ambient air quality monitoring shall be carried out by the concerned authority as per the following schedule, namely:-

(a) Six times in a year for cities having population of more than fifty lakhs;

(b) Four times in a year for cities having population between ten and fifty lakhs;

(c) Two times in a year for town or cities having population between one and ten lakhs.

Plantation at Landfill Site

30. A vegetative cover shall be provided over the completed site in accordance with the and following specifications, namely:-

(a) Selection of locally adopted non-edible perennial plants that are resistant to drought and extreme temperatures shall be allowed to grow;

(b) The plants grown be such that their roots do not penetrate more than 30 cms. This condition shall apply till the landfill is stabilised;

(c) Selected plants shall have ability to thrive on low-nutrient soil with minimum nutrient addition;

(d) Plantation to be made in sufficient density to minimize soil erosion.

Closure of Landfill Site and Post-care

31. The post-closure care of landfill site shall be conducted for at least fifteen years and long term monitoring or care plan shall consist of the following, namely :-

(a) Maintaining the integrity and effectiveness of final cover, making repairs and preventing run-on and run-off from eroding or otherwise damaging the final cover;

(b) Monitoring leachate collection system in accordance with the requirement;

(c) Monitoring of ground water in accordance with requirements and maintaining ground water quality;

(d) Maintaining and operating the landfill gas collection system to meet the standards.

32. Use of closed landfill sites after fifteen years of post-closure monitoring can be considered for human settlement or otherwise only after ensuring that gaseous and leachate analysis comply with the specified standards.

Special provisions for hilly areas

33. Cities and towns located on hills shall have location-specific methods evolved for final disposal of solid wastes by the municipal authority with the approval of the concerned State Board or the Committee. The municipal authority shall set up processing facilities for utilization of biodegradable organic wastes. The inert and non-biodegradable waste shall be used for building roads or filling-up of appropriate areas on hills. Because of constraints in finding adequate land in hilly areas, wastes not suitable for road-laying or filling up shall be disposed of in specially designed landfills.

Schedule IV

[see rules 6(1) and (3), 7(2)]

Standards for Composting, Treated Leachates and Incineration

1. The waste processing or disposal facilities shall include composting, incineration, pelletisation, energy recovery or any other facility based on state-of-the-art technology duly approved by the Central Pollution Control Board

2. In case of engagement of private agency by the municipal authority, a specific agreement between the municipal authority and the private agency shall be made particularly, for supply of solid waste and other relevant terms and conditions.

3. In order to prevent pollution problems from compost plant and other processing facilities, the following shall be complied with, namely :-

   i. The incoming wastes at site shall be maintained prior to further processing. To the extent possible, the waste storage area should be covered. If, such storage is done in an open area, it shall be provided with impermeable base with facility for collection of leachate and surface water run-off into lined drains leading to a leachate treatment and disposal facility;

   ii. Necessary precautions shall be taken to minimise nuisance of odour, flies, rodents, bird menace and fire hazard;

   iii. In case of breakdown or maintenance of plant, waste intake shall be stopped and arrangements be worked out for diversion of wastes to the landfill site;

   iv. Pre-process and post-process rejects shall be removed from the processing facility on regular basis and shall not be allowed to pile at the site. Recyclables shall be routed through appropriate vendors. The non-recyclables shall be sent for well designed landfill site(s).

   v. In case of compost plant, the windrow area shall be provided with impermeable base. Such a base shall be made of concrete or compacted clay, 50 cm thick, having permeability coefficient less than 10^{-7} cm/sec. The base shall be provided with 1 to 2 per cent slope and circled by lined drains for collection of leachate or surface run-off;

   vi. Ambient air quality monitoring shall be regularly carried out particularly for checking odour nuisance at down-wind direction on the boundary of processing plant.

Ambient air quality monitoring shall be regularly carried out particularly for checking odour nuisance at down-wind directi

Parameters	**Concentration not to exceed * (mg/kg dry basis , except pH value and C/N ratio)**
Arsenic	10.00
Cadmium	5.00
Chromium	50.00

Copper	300.00
Lead	100.00
Mercury	0.15
Nickel	50.00
Zinc	1000.00
C/N ratio	20-40
PH	5.5-8.5

* Compost (final product) exceeding the above stated concentration limits shall not be used for food crops. However, it may be utilized for purposes other than growing food crops.

4. The disposal of treated leachates shall follow the following standards, namely:-

S.No	Parameter	Standards (Mode of Disposal)		
		Inland surface water	**Public sewers**	**Land disposal**
1.	Suspended solids, mg/l, max	100	600	200
2.	Dissolved solids (inorganic) mg/l, max.	2100	2100	2100
3	PH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Ammonical nitrogen (as N), mg/l, max.	50	50	-
5	Total Kjeldahl nitrogen (as N), mg/l, max.	100	-	-
6	Biochemical oxygen demand (3 days at 27^0 C) max.(mg/l)	30	350	100
7	Chemical oxygen demand, mg/l, max.	250	-	-
8	Arsenic (as As), mg/l, max	0.2	0.2	0.2
9	Mercury (as Hg), mg/l, max	0.01	0.01	-
10	Lead (as Pb), mg/l, max	0.1	1.0	-
11	Cadmium (as Cd), mg/l, max	2.0	1.0	-

12	Total Chromium (as Cr), mg/l, max.	2.0	2.0	-
13	Copper (as Cu), mg/l, max.	3.0	3.0	-
14	Zinc (as Zn), mg/l, max.	5.0	15	-
15	Nickel (as Ni), mg/l, max	3.0	3.0	-
16	Cyanide (as CN), mg/l, max.	0.2	2.0	0.2
17	Chloride (as Cl), mg/l, max.	1000	1000	600
18	Fluoride (as F), mg/l, max	2.0	1.5	-
19	Phenolic compounds (as C_6H_5OH) mg/l, max.	1.0	5.0	-

Note : While discharging treated leachates into inland surface waters, quantity of leachates being discharged and the quantity of dilution water available in the receiving water body shall be given due consideration.

The incinerators shall meet the following operating and emission standards, namely:-

A. Operating Standards

(1) The combustion efficiency (CE) shall be at least 99.00%.

(2) The combustion efficiency is computed as follows :

$$C.E. = \frac{\%CO_2}{\%CO_2 + \%CO} \times 100$$

1. Emission Standards

Parameters	Concentration mg/Nm^3 at (12% CO_2 correction)
(1) Particulate matter	150
(2) Nitrogen Oxides	450
(3) HCl	50

(4) Minimum stack height shall be 30 metres above ground.

(5) Volatile organic compounds in ash shall not be more than 0.01%.

Note:

1. Suitably designed pollution control devices shall be installed or retrofitted with the incinerator to achieve the above emission limits, if necessary.

2. astes to be incinerated shall not be chemically treated with any chlorinated disinfectants
3. Chlorinated plastics shall not be incinerated.
4. Toxic metals in incineration ash shall be limited within the regulatory quantities as specified in the Hazardous Wastes (Management and Handling) Rules, 1989 as amended from time to time.
5. Only low sulphur fuel like l.d.o., l.s.h.s or Diesel shall be used as fuel in the incinerator.

Form –I

[see rules 4(2) & 6(2)]

Application for obtaining authorization

To,
The Member Secretary

1.	Name of the municipal authority/Name of the agency appointed by the municipal authority	:	
2.	Correspondence address Telephone No. Fax No.	:	
3.	Nodal Officer & designation(Officer authorised by the municipal authority or agency responsible for operation of processing or disposal facility)	:	
4.	Authorization applied for (Please tick mark)	:	(a) Setting up & operation of waste processing facility (b)Setting up & operation of disposal facility
5.	Detailed proposal of waste processing/disposal facility (to be attached) to include	:	
5.1	**Processing of Waste** i. Location of site ii. Name of waste processing technology iii. Details of processing technology iv. Quanitty of waste to be processed per day v. Site clearance (from local authority) vi. Details of agreement between municipal authority and operating agency vii. Utilization programme for waste processed (Product utilization) viii. Methodology for disposal of waste processing rejects (quantity and quality) ix. Measures to be taken for prevention and control of environmental pollution x. Investment on Project and expected returns xi. Measures to be taken for safety of workers working in the plant	:	
5.2	**Disposal of Waste** i. Number of sites indentified ii. Layout maps of site iii. Quantity of waste to be disposed per day iv. Nature and composition of waste	:	

	v. Details of methodology or criteria followed for site selection vi. Details of existing site under operation vii. Methodology and operational details of landfilling viii. Measures taken to check enviornmental pollution		

Date	Signature of Nodal Officer

Form - II

[See rule 4(4)]

Format of Annual Report to be submitted by the Municipal Authority

i. Name of City/Town:……

ii. Population ……

iii. Name of municipal body:…… and Address
……
……

Telephone No. : ……

Fax : ……

iv. Name of Incharge dealing with municipal solid wastes ……
…… with designation
……

1. Quantity and composition of solid wastes

(i) Total quantity of wastes generated per day

(ii) Total quantity of wastes collected per day

(iii)Total quantity of wastes processed for :

a. Composting: ……
b. Vermiculture: ……
c. Pellets: ……
d. Others, if any, please specify ……

(iv) Total quantity of waste disposed by landfilling:
……

a. no. of landfill sites used : ……
b. Area used: ……
c. Whether Weigh bridge facilities available : Yes/No

a. Whether area is fenced : Yes/No

a. Lighting facility on site : Yes/No

(f) Whether equipment like Bulldozer, Compacters etc.available. (Please specify) :---------- ---------- ----------

a. Total Manpower available on site: ----------

a. Whether covering is done on daily basis : Yes/No

i. Whether covering material is used and whether it is adequately available : ---------- ----------

a. Provisions for gas venting provided : Available (Yes/No) /Not available

a. Provision for leachate collection : Provisions made/ Provisions not made

2. Storage facilities

(i) Area covered for collection of wastes	:	----------
(ii) no. of houses covered	:	----------
(iii) Whether house-to-house collection is practiced (if yes, whether done by Municipality or through Private Agency or Non-Governmental Organisation)	:	----------
(iv) Bins	:	----------
		Specifications Existing Proposed
		(Shape & Size) Numbers for future
		----------
a. RCC Bins (Capacity)	:	
b. Trolleys (Capacity)	:	
c. Containers (Capacity)	:	
d. Dumper Placers	:	
e. Others, please specify	:	
(v)Whether all bins/collection spots are attended for daily lifting of garbage	:	Yes/No
(vi)Whether lifting of garbage from dustbins is manual or mechanical i.e. for example by using of front-end	:	Manual/Loader/Others, please specify

loaders (Please tick mark)

3. Transportation

	Existing number	Actually Required/Proposed
(i) Truck :		
(ii) Truck-Tipper :		
(iii) Tractor-Trailer :		
(iv) Refuse-collector :		
(v) Dumper-placers :		
(vi) Animal Cart :		
(vii) Tricycle :		
(viii) Others (please specify) :		

4. Whether any proposal has been made to improve solid wastes management practices

5. Are any efforts made to call for private firms etc. to attempt for processing of waste utilising technologies like :

	Waste Utilisation Technology	Proposals	Steps taken (Quantity to be processed)
i.	Composting :		
ii.	Vermiculture :		
iii.	Pelletisation :		
iv.	Others if any, Please specify :		

6. What provisions are available and how these are implemented to check unhygienic operations of :

i. Dairy related activities :

ii. Slaughter houses and unauthorised slaughtering :

iii. Malba (cnstruction debris) lifting :

iv. Encroachment in Parks, Footpaths etc. :

7. How many slums are identified and whether these are provided with sanitation facilities :

8. **Are municipal magistrates appointed for Taking penal action :** Yes/No

[If yes, how many cases registered & settled during last three years (give year-wise details)]

9. **Hospital waste management**

i. How many Hospitals/Clinics under the control of the Corporation:

ii. What methods are followed for disposal of bio-medical wastes ?:

iii. Do you have any proposal for setting up of common treatment facility for disposal of bio-medical wastes :

iv. How many private Nursing Homes, Clinics etc. are operating in the city/town and what steps have been taken to check disposal of their wastes :

Signature of Municipal Commissioner

Dated :

Form –III

[See-rule 6(2)]

Format for Issue of Authorisation

File No.: _____

Date:_____

To,

_____
_____
_____

Ref: Your application number _____dt. _____

The _____State Pollution Control Board/Pollution Control Committee after examining the proposal hereby authorises_____having their administrative office at _____to set up and operate waste processing/waste disposal facility at_____on the terms and conditions (including the standards to comply) attached to this authorization letter.

1. The validity of this authorization is till_____. After the validity, renewal of authorization is to be sought.
2. The _____State Pollution Control Board/Pollution Control Committees may, at any time, revoke any of the conditions applicable under the authorization and shall communicate the same in writing.
3. Any violation of the provision of the Municipal Solid Wastes (Managemeant and Handling) Rules, 2000 will attract the penal provision of the Environment (Protection) Act, 1986 (29 of1986).

(Member Secretary)

State Pollution Control Board/
Pollution Control Committee

Date :
Place :

Form - IV

[see rule 8(1)]

Format of Annual Review Report to be submitted by the State Pollution Control Board/Committees to the Central Pollution Control Board

To,
The Chairman,
Central Pollution Control Board,
(Ministry of Environment and Forests)
Government of India,
'Parivesh Bhawan', East Arjun Nagar,
DELHI- 110 0032.

1.	Name of the State/Union territory	:	
2.	Name & address of the State Pollution Control	:	
3.	Board/Pollution Control Committee Number of municipal authorities responsible for management of municipal solid wastes in the State/Union territory under these rules	:	
4.	A Summary Statement on progress made by municipal authorities in respect of implementation of Schedule I [rule 4(3)]	:	Please attach as Annexure-I
5.	A Summary Statement on progress made by municipal authorities in respect of implementation of Schedule II [rules 6(1) and (3), 7(1)]	:	Please attach as Annexure-II
6.	A Summary Statement on progress made by municipal authorities in respect of implementation of Schedule III [rules 6(1) and (3), 7(2)]	:	Please attach as Annexure-III
7.	A summary statement on progress made by municipal authorities in respect of implementation of Schedule IV [rules 6(1) and (3), 7(2)]		Please attach as Annexure-IV

Date: _____	Chairman or the Member Secretary
Place : _____	State Pollution Control Board/
	Pollution Control Committee

Form - V

[see rule 9]

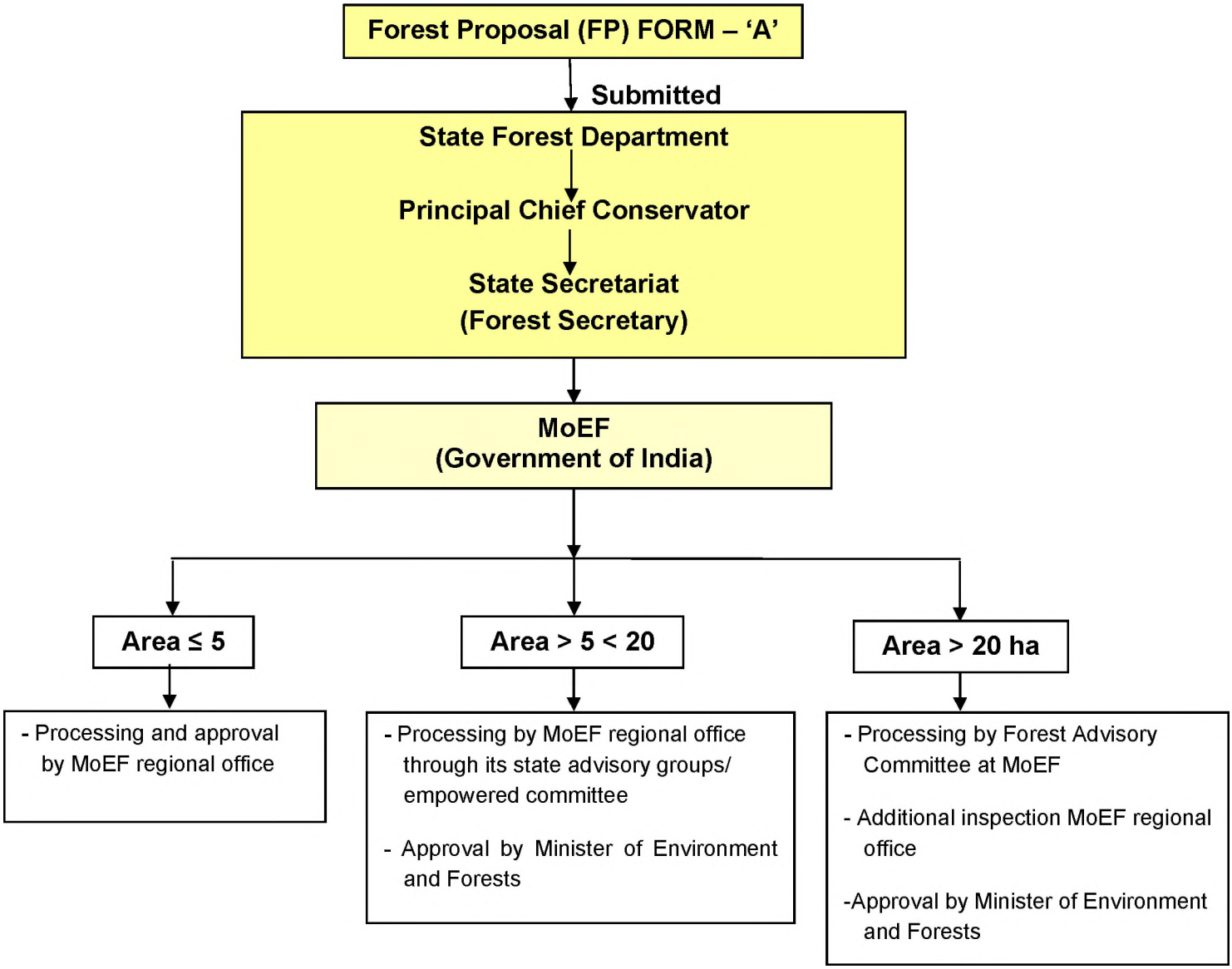
Accident reporting

1.	Date and time of accident	:	
2.	Sequence of events leading to accident	:	
3.	The waste involved in accident	:	
4.	Assessment of the effects of the accidents on human health and the environment	:	
5.	Emergency measures taken	:	
6.	Steps taken to alleviate the effects of accidents	:	
7.	Steps taken to prevent the recurrence of such an accident	:	

Date : ……	Signature : ……
Place : ……	Designation : ……

V. Rajagopalan, Jt. Secy.
[F.No.17-2/95-HSMD]

ANNEXURE 2: FOREST CLEARANCE APPROVAL PROCESS



ANNEXURE 3: FORM 1 – APPLICATION FOR CONSENT FOR EMISSION/CONTINUATION OF EMISSION UNDER SECTION 21 OF THE AIR ACT.

398 **Price Rs. 100/-**

(To be submitted in Triplicate)

FORM - 1

(To be submitted in triplicate)

APPLICATION FOR CONSENT FOR EMISSION/ CONTINUATION OF EMISSION UNDER SECTION 21 OF THE AIR ACT.

(See Rule 4)

From Date .....

.....

.....

.....

.....

To

The Member Secretary,
Meghalaya State Pollution Control Board,
'ARDEN', Motinagar, SHILLONG 793014

Sir

I*.....occupier of the industrial plant **.....hereby apply for consent under section 21 of the Air (Prevention and Control of Pollution) Act 1981 for a Period upto of ..... (not exceeding three years) to operate the above mentioned industrial plant, detail pertaining to it being given in the Annexure and the accompaniments submitted at part of this application.

2. I declare that the information furnished in this application, annexure, accompaniments and appendixes, if any, are correct and true to the best of my knowledge and belief.

3. I hereby agree to inform the Board within 15 days of any change in the particulars in respect of the occupier/or authorised agent.

4. I hereby submit that in case of a change either of the point or the quality or emission or its quantity, a fresh application for consent shall be made and until such consent is granted no change shall be made.

5. I hereby agree to submit to the Board application for renewal of consent six months in advance of the date of expiry of the consented period if the operation of the industrial plant is to be continued thereafter.

6. An amount of Rs. ..... (Rupees .....) as the consent fee for this application has been remitted in the office of the Board *vide* Receipt No. ..... Dated ..... an authenticated copy of which is attached as proof of payment.

1

7. I undertake to furnish any other information called for by the Board within such times as specified by the Board.

Yours faithfully,

Occupier's signature .....

Name .....

Address .....

Note : * Here enter the name and address of the occupier who, in relation to any factory or the premises, is the person who has control over the affairs of the factory or the premises and where the said affairs are entrusted to a managing agent, such agent shall be deemed to the occupier of the factory or the premises.
** Here enter the name and address of the industrial plant.

Accompaniments :

i) Index / Site plan
ii) Topographical map
iii) Detailed layout of different process and point, of emissions and position of stacks & chimneys.
iv) Process flow sheet
v) Emission analysis report
vi) Ambient air quality report, if available
vii) Details of air pollution control devices provided or proposed to be provided.
viii) Copy of the receipt for the consent fee.

ANNEXURE TO FORM - I

Chimney { Existing / New / Altered

NOTE : (i) Form I in set of three is obtainable from the office of the Meghalaya State Pollution Control Board, Shillong on payment of Rs. 100 (Rupees one hundred only) in cash or by Money Order.

(ii) Read the explanatory note at the end of the application form carefully before filling the form.

(iii) While filling this Annexure, the applicant (occupier) shall mark 'not applicable' against items which are not pertaining to this Industrial plant and no space shall be left blank.

(iv) Any applicant knowingly giving incorrect information or suppressing any information pertaining thereto shall be liable to be punished under the Act.

2

1) *a)* Full name of the occupier
b) Designation
c) Postal address
d) Telegraphic address
e) Telex / Fax No.
f) Telephone No.

2) Full name & address of the Industry & its registered office.

3) Name/s, designation/s and postal address of authorised agent/agents.

4) *a.* Type of industry (with reference to the schedule of the Act)
b. Category of Industry, small scale/medium scale/large scale.
c. Capital investment (with year of investment)

5) Month and year in which the plant : was actually put into commission or is proposed to be put into commission

6) Location of the Industrial plant.
a. Revenue Survey No.
b. Area in Hectares
c. Village
d. Taluk
e. District
f. Panchayat/Municipality/ Corporation.

7) *a.* State whether the Industry premises has been declared a prohibited area. Yes/No
b. If yes, state the name of authority making the declaration & furnish a certified copy of the declaration order.

8. *a.* State whether the Industry is working round the year or seasonal
b. If seasonal, state the period From ..... to .....

9. *a.* Number of persons attending in the premises/ the factory per day.....
b. Number of persons residing in the premises .....

10. List of individual plants in the Industry.

11. *a.* List of materials used in process (other than fuels)

3

Sl. No.	Name of material	Process where used	Consumption in tonnes/day

A Process flow diagram must be attached showing the entry and exit points of all raw materials, intermediate products, by-products and products Label process and control equipments and give process description.

b. Details of fuel consumption.

Fuel identification/commercial name	Coal	Oil	Wood	Gas	Others
a) Daily consumption in tonnes					
b) Where used					
c) Calorific value					
d) Ash content percent					
e) Sulphur content percent					
f) Others (specify)					

List of products and by-products.

Sl. No.	Name	Quantity in tonnes/day

12) *a)* Indicate the present use of the land within 5 Km radius, :

i) Human settlements of more than 1000 population (Specify population and distance from the plants) :

.....

.....

ii) Commercial .....

iii) Industrial .....

iv) Fisheries .....

4

v) Hills / mountains/sanctuary/National Parks .....

vi) Ancient monuments .....

vii) Worship centres .....

viii) Others .....

b) Climatological and metrological details (if available)

i) Climate condition & the site .....

(eg. arid, semi-arid etc)

ii) Rainfall, yearly average, range .....

iii) Temperature, seasonal changes .....

iv) Speed and direction of wind .....

v) Humidity, solar radiation .....

13. a) Details of furnaces :

Ref. No. of chimney in layout plant through which emission take place	Type of furnace	Fuel used, quantity of fuel, tonne/day	Operation & Loading

b) Details of boilers :

Ref. No. of chimney in layout plant through which emission take place	Type of fuel used	boiler	Quantity fuel tonne/ day.	Steam pressure	Capacity	Operation and loading

5

14. *a)* Details of chimney :

Ref. No. of Chimney in lay-out plan	Nature of Construction	Height in m above ground level	Height in m above roof level	Inside shape circle, square etc.	Inside dimension in m diameter size etc. (specify)	Qnty. m3/hour	Exit Gas Temperature 0^{c} C^{0}	Exit Gas Velocity m/sec

b) Chimney emission :

Ref of chimney in lay-out Plan	Source of emission	Analysis of gas* mg/m3			
		Oxides of S C N	Hydrocarbons	Particulars	Others

c) Any other emission :

Source/Outlet	Quantity m3/hr.	Temperature °C	Analysis of gas* mg/m3			
			Oxides of S C N	Hydrocarbons	Particulars	Others

d) Particulate analysis (if available Identification refering to 14(b) (c)

	size distribution %	
	50/m/10/m/5/m/3/m/1/m	Chemical composition

* *(i)* Attach copy of laboratory report
(ii) Specify the parameters.

6

15. Laboratory facilities for air emission analysis Existing / Proposed

16. Quantity of air handled by ventilation equipments, specifying the number and size of equipments installed or to be installed.

17. Detailed of emission sampling facilities available :

Identification of emission	Sampling, points ladder platforms etc., available	Remarks

18. Details of Air pollution control system with specifications and drawings.

(a) Existing (b) Proposed

19. (a) Capital investment for air pollution control and year of investment

Existing

Proposed

(b) Annual recurring expenditure for air pollution control.

Existing

Proposed

20. Number and date of consent, if any under the water (Prevention and control of pollution)

Act, 1974 (Central Act 6 of 1984).....

21. Other relevent information, if any

Occupier's signature .....

Name .....

Address .....

7

Explanatory Note — For filling in Form I and the Annexure

The notes given only for those items for which explanation is considered desirable. If the space is not sufficient for filling in any item, the details may be given in separate sheets of paper.

Item No. 7. The amount payable as consent fee is specified in *Appendix II* of the Air (Prevention and Control of Pollution) Rules 1988. The amount may be remitted in cash or as demand draft drawn in favour of the Member Secretary Payable at Shillong.

ANNEXURE TO FORM

'Chimney' : Includes any structure with an opening or outlet through which any air pollutant may be emitted.

'Existing' : Means that which is in operation at the time of applying for the consent.

'New' : Means that which will be brought into operation in future.

'Altered' : Means that which has been modified due to change in quantity and/or quality of emission, arrangement and / or point of emission etc.

Item No. 3 : Here give the name's, designation's and addresses of the persons authorised to receive, on behalf of the occupier the 'notice' of intention to have sample 'anlysed' served as per section 26 of the Act. .....

Item No. 4. a. Here state the type of Industry, with reference to the schedule of the Act.

Item No. 4. b. The Industries are categorised on the basis of the capital investment as follows.

Large scale Industry. More than 2 crore rupees; medium scale industry : 20 lakhs to 2 Crore rupees; small scale Industry : Less than 20 lakhs rupees.

Item No. 14. : Analysis of the flue gas emission, process emission and particulates should be done for each stack emission. Whenever stacks are not provided, the shop floor specific pollutant concentration should be reported. Chemical analysis of the particulate matter in the emission is to be done for organic content, metals, non-metals, silicates, radio-active substances etc.

Item No. 16 : Here state the total quantity of ventilation air handled by equipments such as roof extractors, evaporative coolers etc.

Item No. 18 : Here give detailed specifications (including efficiency) of the air pollution control system used or proposed to be used. Also furnish the lay out of the control systems with dimensions.

8

The accompanying form in triplicate to be submitted to –

Member-Secretary,
Meghalaya Pollution Control Board, Shillong

0335

EXPLANATORY NOTE FOR FILLING FORM 'A' AND THE ANNEXURE

The notes are given only for those items for which explanation is considered desirable. Other items are self-explanatory.

FORM A

(1) Here mention the names of the declared Area.

(2) Here mention the name of the owner of the land/premises if other than the applicant industry or factory. If the land (premises belong to the factory / industry), say self.

(3) Here mention the case as to which the consent is sought for.

(4) Here mention the local name of the river/stream tidal waters/sea, as may be applicable.

ANNEXURE TO FORM 'A' –

Outlet	means the arrangement for discharge of the effluent for which the consent is sought for.
Discharging	means the effluent going out of the outlet.
Existing	means that which is in operation at the time of applying for the consent.
New	means that which will be brought into operation in future.
Altered	means that which has been modified due to changes in quantity and / or quality of discharge arrangement and/or point of discharge etc.
Item 1	Here give the name of the person who is authorised by the Institution/Industry/factory/ local body etc., to transact their legal business.
Item 2	Here give the registered name of the institution/factory/Industry etc. under which the business is carried out.
Item 5	Here state the concerned institution such as M.I.D.C., C.L.D.C.O. etc. under whose administrative control the factory/Industry etc. set up.
Item 6	Applicable to only those area which are prohibited areas such as the Ordinance Factories, Mint etc.
Item 13 (B)	State the method of measurement of hourly/daily maximum quantity of effluents i.e., by flow meters, venturi meters, V notch, Sump measurements, or approximately estimated etc.
Item 16 (A)	If the effluent is treated, give separately the method of treatment and flow diagram of the treatment process.
Item 16 (B)	Here mention 'Yes' if any other authority such as the local body, M.I.D.C., or State Department has already approved the discharge of effluent either with or without treatment, at the time of establishment of factory/Industry.
Item 19	Here give the quantity of effluent of different types such as domestic, industrial or mixed etc. proposed to be or is let into stream/river, lands, lakes, sea etc. as may be applicable.
Item 22 (a)	Analysis to be furnished shall cover as many parameters as are expected to be found to the effluent. If some of the parameters are not expected to be found, say not applicable. If some of the parameters other than those listed under items are expected, the same may be mentioned at the end. The analysis report shall be separately furnished for domestic, industrial and combined effluents.
Item 22 (b)	Here toxicity means the which is established by bio-assay studies on fish as per procedure given in the standard methods.
Item 24	This item is meant to cover such highly Polluting substances which do not ordinarily find way in the effluents, but are required to be handled in the premises and which may, by accident, join the effluent in large quantities.

1

Price Rs. 100/-

(To be submitted in Triplicate)

FORM 'A'

APPLICATION FOR CONSENT FOR DISCHARGE UNDER SECTION 25/26 OF THE WATER ACT., 1974

Application for consent for discharge in (1) .....

.....

Area which is a "Water Pollution Prevention Area" .....

From : Date

.....

.....

.....

To,

The Member-Secretary
Meghalaya Pollution Control Board, Shillong.

Sir,

I / We hereby apply for CONSENT under the Water (Prevention & Pollution) Act. 1974 to make discharge for land / premises owned by (2) .....

.....

(3) (a) Sullage / Sewage via drains outfall sewers / treatment works

(b) Trade effluent via drains / outfall sewer / treatment works.

(c) Solid wastes into (4) —

(i) Stream ..... River

OR

(ii) On land for irrigation, bearing Survey No. ..... adjoining at a distance of ..... stream / river.

OR

(iii) Lake pond adjoining / at a discharge of ..... Stream/River

OR

(iv) Directly on land for open percolation into subterrianian strata of Survey No. ..... adjoining at a distance of ..... Stream/River

OR

(v). Tidal waters / estuarine waters known as .....

2. The Annexure, appendices, other particulars and plans in triplicate are attached herewith.

3. I / We further declare that the information furnished in the Annexure / Appendices, and plans is correct to the best of my / our knowledge.

4. I / We hereby submit that in case of change either of the point or the quantity or its quality a fresh application for CONSENT shall be made and until such CONSENT is granted, no change shall be made.

P.T.O.

3

5. I/ We hereby agree to submit to the Board, an application for renewal of CONSENT four month in advance fo the date of expiry of the consented period for outlet/discharge, if to be continued thereafter.
6. I / We undertake to furnish any other information within one month of its being called by the Board.

Yours faithfully,

Signature .....

Name of Applicant .....

.....

Address of applicant .....

.....

.....

Accompaniments :

- ❒ Details of Land (Revenue Survey number, Area, Location, etc.) including land documents, topographical map and site plan.
- ❒ Detailed Project Reports.
- ❒ Layout Plan of factory/premises showing water supply lines, storm drains, sewers for domestic and trade effluent, treatment plant and disposal facilities, etc.
- ❒ Detail of effluent treatment plant and disposal facilities, etc. including specifications and drawings along with flowsheet.
- ❒ Details of outlets and receiving course/land/well.
- ❒ Description of the manufacturing process with process flowsheet.
- ❒ Licenses and Certificates (SWA approval, Trading License, Mining License, NOC from Forest, NOC from Local Headman, etc.
- ❒ Consent Fee.
- ❒ Other relevant documents.

(Note - Strike out entries not relevent)

4

ANNEXURE TO FORM - A

Outlet / Discharge Existing / New / Altered

Note :- Any applicant knowingly giving incorrect information or suppressing any information pertaining thereto shall be liable to punishment under the Act.

While filling this Annexure the Applicant not concerned with any of the items shall state "Not concerned" against the relevant one.

1.	Full Name of Applicant with address	.... (Tel. No.) .....
2.	Full Name of land/premises/institute/factory/ industry/Local Body with address	.... (Tel. No.) .....
3.	Give revenue / city survey No. of land/premises for which the application is make stating District, Taluka and Villages.	District ..... Taluka ..... Town ..... Village ..... City Survey No. ..... Area in Hectares ..... Revenue Survey No. ..... Area in Hectares .....
4.	State month & year in which the land/premises/ Institute/factory/industry/was actually put into commission, or in proposed to be put into commission, or the month and year from which the local body is functioning.	
5.	State the Civil/Military Defence/Industrial Estate etc, under whose administrative jurisdiction the application's land/premises is situated	Collectorate ..... Corporation ..... Municipality ..... Village Panchayat/Cantonment ..... Defence Department ..... State Government ..... Prohibited Area .....

5

6. (a) State whether land/Premises/factory/industry has been declared as prohibited area.

(b) I yes, state the name of the authority and furnished a certified copy of the order under which the area has been declared as prohibited area.

7. Is the industry/factory for which application is made closed on Sunday/holiday. Yes/No

8. State working seasons per year for the industry/ factory. Full Year

From To
From To
From To
From To
Every year

9. *(a)* Number of workers attending the factory

Shift No. 1	Shift No. 2	Shift No. 3
Hrs.	Hrs.	Hrs.

(b) Number of workers residing in this premises

10. *(For Local bodies only)*

(a) Present Population

(b) Population covered under regular sewerage facilities .....

(c) Population covered by conservency latrines

(d) Population having septic tanks/pits/privy facilities.

11. Give the list of raw materials such as metals, alloys, chemicals, oils, fuels, etc. used per month in Metric Tonnes :-

Sr. No.	Name of material	Quantity in MT per month
1.		
2.		
3.		
4.		
5.		
6.		

6

(b) Give the list of Names of Products and by Products manufactured per month in MT

Serial No.	Name of Product	Quantity in MT per month

12. State daily quantity of water in litres utilised -

USES			
Domestic	Industrial	Agriculture	Other

13. (A) State the hourly maximum and daily maximum quantity of effluent arising from land which the application is made :

Premises for In Litres

	Hourly Maximum	Daily Maximum
(a) Domestic		
(b) Industrial		
(c) Agriculture		
(d) Other use		
(e) Total quantity of effluent		

(B) State how measurements for rate and quantity are carried out .....

14. State whether strom water drains are kept separate from Industrial/Domestic effluent drains. Yes / No

15. (a) Is domestic effluent allowed to get mixed in industrial effluent ? Yes / No

(b) If yes, state the ratio Domestic / Industrial

16. (a) Describe, if any, treatment for industrial or domestic effluent or one for combined effluent is made ? Yes / No
If yes, state the process of treatment in brief *(separately)*.

(b) Is the quality of effluent emanating either without or after treatment approved by any authority. Yes / No

(c) If approved, furnish the authority (Two certified copies to be served)

17. Is there any provision for disposal of

	Already made	Proposed to be made
(a) Domestic effluent in public underground water	Yes / No	Yes / No
(b) Industrial effluent in public underground water	Yes / No	Yes / No
(c) Give the name of public authority owing the sewer	Yes / No	Yes / No

7

18. Is there any provision for disposal of

	Already made	Proposed to be made
(a) Domestic effluent over land for irrigation	Yes / No	Yes / No
(b) Industrial effluent over land for irrigation	Yes / No	Yes / No
(c) Domestic effluent in the underground strata	Yes / No	Yes / No
(d) State the area of land used for (a) above in hectares		
(e) State the area of land used of (b) above in hectares		

19. (a) Give quantitative disposal of effluent in litres per day for the places mentioned below :–

	Domestic	Industrial	Mixed
(i) Stream / River			
(ii) On lands for irrigation			
(iii) On lands for percolation			
(iv) Lake/Pond			
(b) If disposed into Stream/River, State			
(i) Ratio of volume effluent to receiving water at the point of discharge during the driest & the monsoon periods.			
(iii) Maximum safe carrying capacity of Stream/River			

20. Is there any provision for equalizing or holding Lagoons for tanks to store the effluent during unfavourable stream or tidal conditions :-

	Already made	Proposed to be made
(i) Domestic effluent		
(ii) Industrial effluent		
(iii) Combined effluent		

21. Is sufficient land available/can be made available in case of disposal of pumping effluent or land will have to be considered ? Yes / No

8

21. (a) Give details of composition of Domestic/Industrial/Combined effluents in respect of the following :-

Effluent	before	treatment	Effluent	after	treatment
At Max. Dis.	At Min. Dis.	At Ave. Dis.	At Max. Dis.	At Min. Dis.	At Ave. Dis.
(1)	(2)	(3)	(1)	(2)	(3)

(i) PH
(ii) Colour - Units
(iii) Temperature °C
(iv) Suspend solids
  (a) Total mg/1.
  (b) Fixed mg/1.
  (c) Volatile mg/1.
(v) Dissolved solids.
  (a) Total mg/1.
  (b) Fixed mg/1.
  (c) Volatile mg/1.
(vi) Total Volatile solids mg/1
(vii) (a) Ammoniacal Nitrogen mg/1.
  (b) Free Ammonia as NH_3.
(viii) Nitrates (mg/1) N.
(ix) Dissolved Oxygen mg/1.
(x) B. O. D. 5, days 20°C mg/1.
(xi) C. O. D. mg/1.
(xii) Oil and Greases mg/1.
(xiii) Chloride, (as *Cl*), mg/1
(xiv) Phosphates (P), mg/1.
(xv) Phenolic compounds, (as Phenol), mg/1.
(xvi) Cyanides (as CN) mg/1.
(xvii) Sulphates (as SO_4) mg/1.
(xviii) Sulphades (as S), mg/1.
(xix) Sulphites (as SO_3), mg/1.
(xx) Insecticides mg/1.
(xxi) Total residual chlorine (as Cl_2) mg/1.
(xxii) Flouride (as F.), mg/1.
(xxiii) Boron (as B.) mg/1.
(xiv) Arsenic (as As) mg/1.
(xxv) Barium (as Ba.), mg/1.
(xxvi) Percent Sodium
(xxvii) Cadium (as Cd.) mg/1.
(xxviii) Copper (as Cu.), mg/1.
(xxix) Lead (as Pb.), mg/1.
(xxx) Chromium :-
  (a) as Cr. mg/1.
  (b) Hexa valency (as Cr.), mg/1.

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(xxxi) Mercury (as Hg.), mg/1.
(xxxii) Nickel (as Ni.), mg/1.
(xxxiii) Selenium (as Se.), mg/1.
(xxxiv) Silver (as Ag.), mg/1.
(xxxv) Zinc (as Zn.), mg/1.
(xxxvi) (a) Iron (as Fe.), Maganese (as Mr.), mg/1.
(b) any other Metals, mg/1.
(xxxvii) Carbon Chloroform Extracts.
(xxxviii) (a) Pesticides (mg/1) (name)
(b) Herbicides (mg/1) (name)
(xxxix) Coliform organisms.
MPN. per 100ml. (monthly average)
(xE) Bioassay for Toxic constituents'
TL. 50 (96 hours).

Note :- *(i) Furnish a copy of the analysis report or representative samples carried out by a competent laboratory.*

(ii) Methods of determination as approved by the Board will be followed for determination of above mentioned parameters.

22. (b) Is the effluent toxic — Yes / No
(c) State if the industrial effluent is having — Yes / No
(i) Unpleasent smell — Yes / No
(ii) Irritating and / or harmful — Yes / No
(iii) Corrosive — Yes / No
(d) Is there any sudden change of temperature exceeding 10°C at any time.

23. (a) Are facilities available with the applicant for carrying out the following tests of the waste

Water	Existing	Proposed
(i) Physical	Yes / No	Yes / No
(ii) Chemical	Yes / No	Yes / No
(iii) Bacteriological	Yes / No	Yes / No
(iv) Toxicological	Yes / No	Yes / No

(b) If yes, details of equipment.

24. Has the Land/Premises, etc. for which application is made, open ?

Highly polluting matter.
Toxic Organic Inorganic Microbiogical

25. State details for solid wastes

	Description	Quality Method of Collection	Method of disposal
Seasonal waste, spillage			
Rejected Materials.			

Signature .....

Name and Address of the applicant

on behalf of .....

.....

Name and address of the firm .....

.....

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ANNEXURE 4: NOTIFICATION: FORESTS & ENVIRONMENT DEPARTMENT

GOVERNMENT OF MEGHALAYA
FORESTS & ENVIRIONMENT DEPARTMENT

NOTIFICATION

FOR. 76/99/16 Dated Shillong the 25th February 2000.

The Governor of Meghalaya is pleased to extend the lease granted to the Shillong Municipality by the Government of Assam, vide their order No. 2391-G-S-8 dated 19-05-1938, for 18 acres of land in Riat Khwan Forest Compartment No. 4 for the purpose of trenching ground of Municipal waste, and which has been in perpetual use till date for the said purpose, on the following conditions :

1) That the lease is regularised and extended for the period from 1956 to 2026 (Seventy years).
2) That the Shillong Municipality will pay Land Rent of Rs. 90/- per annum, which may be revised by the Government of Meghalaya, at any point of time.
3) That the area shall be used exclusively for dumping of garbage and management of waste.
4) That out of this allocated area, 11 acres can be used for setting of aerobic compost plant which will help in disposal of accumulated waste.
5) That the Municipality will construct an internal fire line to isolate the adjoining forests.
6) That the Municipality will demarcate the area by constructing proper fencing.
7) That the Municipality will not sublet the project plant or sub-lease the area allocated to any other organisation or individual.
8) That the Municipality will not fell or damage any tree standing in area.
9) That the Municipality shall not pose any further encumberance on the forest due to establishment and or running of the project.
10) That the Municipality and its staff shall observe the rules and acts applicable to the forests in Meghalaya.

Principal Secretary
Forests & Environment Department

FOR. 76/99/16-A **Dated Shillong the 25th February 2000.**

Copy Forwarded To

1. The Principal Chief Conservator of Forests, Meghalaya Shillong for his information and necessary action
2. The Chief Executive Officer, Shillong Municipal Board for his information and necessary action
3. The Chief Conservator of Forests (Territorial) / Conservator of Forests (Territorial) Khasi & Jaintia Hills / Divisional Forest Officer (Territorial) Khasi Hills Division for their information and necessary action.

By Orders etc.

Under Secretary to the Government of Meghalaya
Forests & Environment Department

LAND POSSESSION CERTIFICATE

This is to certify that an area of 18 acres in the Riat Khwan Reserve Forest, Compartment No. 4 has been allotted to the Shillong Municipality on lease for the period 1938 - 2026. The Municipality is allowed to implement the solid waste management scheme on 11 acres out of this holding without sub-letting or sub leasing it to any other private agency.

Principal Secretary
Forests & Environment Department

ANNEXURE 5: REA CHECK LIST OF SOLID WASTE MANAGEMENT

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area?		X	The proposed land fill area is 5.2503 Acres (Plot No-1).
• Densely populated?		X	
• Heavy with development activities?		X	
• Adjacent to or within any environmentally sensitive areas?		X	
• Cultural heritage site		X	
• Protected Area/ Reserve Forest	X		Plot No-1 is the part of Compartment no-4 of Riat Khwan Reserve Forest (It includes Plot No-1, Plot No-2 and Plot-3). The Government of Meghalaya Forest & Environment Department has extended the lease from 1938 to 2026 under letter no. FOR 76/99/16 dated 25th February 2000 to the Shillong Municipality for 18 Acres of land in Riat Khwan Forest Compartment No-4 for the purpose of trenching ground of Municipal waste.
• Wetland		X	Umiam Lake is approximately 3.0 km from proposed disposal site. Umiam Lake is a "potential Ramsar site". It is not officially a Ramsar designated Wetland; however project design will mitigate any impacts to water quality affecting the lake.
• Mangrove		X	
• Estuarine		X	
• Buffer zone of protected area		X	
• Special area for protecting biodiversity		X	
• Bay		X	
B. Potential Environmental Impacts Will the Project cause…			
• Impacts associated with transport of wastes to the disposal site or treatment facility		X	
• impairment of historical/cultural monuments/areas and loss/damageto these sites?		X	
• degradation of aesthetic and property		X	

Screening Questions	Yes	No	Remarks
value loss?			
• nuisance to neighboring areas due to foul odor and influx of insects, rodents, etc.?		X	
• dislocation or involuntary resettlement of people		X	
• public health hazards from odor, smoke from fire, and diseases transmitted by flies, insects, birds and rats?		X	
• deterioration of water quality as a result of contamination of receiving waters by leacheate from land disposal system?		X	The Design consideration will take care of surface water pollution from leachate generation.
• contamination of ground and/or surface water by leachate from land disposal system?		X	The Design consideration will take care of surface water pollution from leachate generation.
• land use conflicts?		X	
• pollution of surface and ground water from leachate coming from sanitary landfill sites or methane gas produced from decomposition of solid wastes in the absence of air, which could enter the aquifer or escape through soil fissures at places far from the landfill site?		X	The Design consideration will take care of surface and ground water pollution from leachate coming from sanitary landfill sites or methane gas produced from decomposition of solid wastes.
• inadequate buffer zone around landfill site to alleviate nuisances?		X	
• social conflicts between construction workers from other areas and community workers?		X	No impact will take place, as habitation is not available near site.
• road blocking and/or increased traffic during construction of facilities?		X	
• noise and dust from construction activities?	X		Temporary noise and dust from construction activities will generate, regular sprinkling of water will minimise the dust pollution.
• temporary silt runoff due to construction?		X	The Design consideration will take care of temporary silt runoff due to construction.
• hazards to public health due to inadequate management of landfill site caused by inadequate institutional and financial capabilities for the management of the landfill operation?		X	Adequate institutional and financial capabilities for the management of the landfill operation will be provided to avoid hazards to public health.
• emission of potentially toxic volatile organics from land disposal site?		X	The Design consideration will take care of emission of potentially toxic volatile organics from land disposal site.
• surface and ground water pollution from leach ate and methane gas migration?		X	The Design consideration will take care of surface and ground water pollution

Screening Questions	Yes	No	Remarks
			from leachate and methane gas migration.
• loss of deep-rooted vegetation (e.g. tress) from landfill gas?		X	The loss of deep-rooted vegetation (e.g. tress) from landfill gas will be compensated with at least two times of tree plantation at suitable locations.
• explosion of toxic response from accumulated landfill gas in buildings?		X	The Design consideration will take care of explosion of toxic response from accumulated landfill gas in buildings.
• contamination of air quality from incineration?		X	The Design consideration will take care of contamination of air quality from incineration
• public health hazards from odor, smoke from fire, and diseases transmitted by flies, rodents, insects and birds, etc.?		X	The landfill is located sufficient distance from inhabitants. The sanitary operations of the landfill will improve health conditions of the public.
• health and safety hazards to workers from toxic gases and hazardous materials in the site?		X	The Design consideration will take care of health and safety hazards to workers from toxic gases and hazardous materials in the site.

	should be categorized as an A project.
X	**should be categorized as a B project**
	should be categorized as a B Project in an environmentally sensitive area
	should be categorized as a C project
	should be categorized as an A/B Project because (give reason)
	requires additional information for classification

ANNEXURE 6: PHOTOGRAPHS OF EXISTING SOLID WASTE DISPOSAL SITE

Project Implementation and Urban Management Improvement in the North Eastern Region – Package A

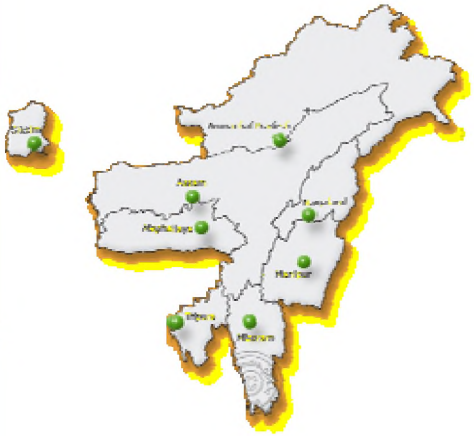
Draft Final DPR-Greater Shillong Planning Area

Asian Development Bank TA 4779 - IND

Volume VII

Community Assessment Report

March, 2009



SMEC INDIA

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ACRONYMS

ADB	Asian Development Bank
BPL	Below Poverty Line
CBO	Community Based Organization
CC	Construction Committee
CHC	Community Health Centre
DPR	Detailed Project Report
FGD	Focus Group Discussion
GSPA	Greater Shillong Planning Area
HIG	High Income Group
IEC	Information, Education & Communication
IND	India
INR	Indian Rupees
SMB	Shillong Municipal Board
LADF	Local Area Development Fund
LDC	Local Development Committee
LIG	Low Income Group
MLA	Member of Legislative Assembly
NDC	Neighbourhood Development Committee
NER	North Eastern Region
NERCCDIP	North Eastern Region Capital City Development Investment Program
NERUDP	North Eastern Region Urban Development Plan
NGO	Non Government Organisation
NH	National Highway
O&M	Operation & Maintenance
PHC	Primary Health Centre
PHED	Public Health & Engineering Department
PPTA	Project Preparatory Technical Assistance
PWD	Public Works Department
SHC	State Health Centre
SHG	Self Help Group
TA	Technical Assistance
TB	Tuberculosis
TW	Transect Walk
UDH	Urban Development & Housing
UDD	Urban Development Department
ULB	Urban Local Bodies

1 INTRODUCTION

1.1 BACKGROUND

ADB through implementation of various developmental projects realises that there is start up delays in the project implementation that affect the project course adversely. It strongly feels that there is a need to strengthen the management and institutional capacity of the state and ULBs prior to loan effectiveness. Timely introduction of financial and governance reform measures and timely initiation of associated institutional reforms have been recognised as crucial in ensuring success and sustenance of the project.

TA for this project focuses on strengthening of management and institutional capabilities, and improves overall readiness of states for project implementation under NERCCDIP and NERUDP-II.

In this context, there is a general agreement that the community participation is a necessity to achieve higher program delivery and its effectiveness. Therefore, a strong emphasis is placed on processes to strengthen community participation along with urban local bodies as well as other community based organisations. In view of this, the project has a significant emphasis on how to achieve greater community participation in project delivery and empower community in the overall framework of institutional capacity building.

1.2 THE CONCEPT OF COMMUNITIZATION

It is now universally recognised that community participation is a key for the success of the projects. The experience however indicates that there has been a passive attitude towards the community participation in project management and implementation. Participation apart, more often than not stakeholders are not even informed about the project.

Communitization therefore has become a key word which highlights that the community remains at a centre stage in projects during its entire course- design to implementation, monitoring and evaluation. This will ensure a sense of ownership and belonging for project and its activities leading to higher project outcomes.

1.3 SHILLONG - THE CAPITAL CITY OF MEGHALAYA

The State of Meghalaya attained the statehood status on the 21st January, 1972 with city of Shillong as the Capital. It is a small State which is situated to the south- east of Assam. It is bounded on the north by Goalpara, Kamrup, Nagoan and Karbi Anglong districts of Assam State, and on the east by the Districts of Cachar and North Cachar Hills, also of the State of Assam. On the south and west lies Bangladesh.

Shillong is the state capital of Meghalaya, one of the smallest states of India, and also the district headquarter of East Khasi Hills District - one of the seven districts of the state. The East Khasi Hills district forms a central part of Meghalaya and occupies an area of 2,748 Sq Km. It has Ri-Bhoi District on the north, Karbi Anglong District on the northeast, Jaintia Hills district on the east, Bangladesh on the south and West Khasi Hills district on the west as boundaries. The District is mostly hilly with deep gorges and ravines on the southern portion. The District's population, according to the 2001 Census Report, was 660,994. The district is divided into 7 community development blocks viz. Mawphlang; Mylliem; Mawryngkneng, Pynursla, Mawkynrew, Mawsynram and Shella Bholagng.

Shillong often referred as the Scotland of the East, derived its name from the 'U Blei Shyllong' the presiding deity of Shillong peak. It is located at 25°34′N 91°53′E25.57°N

91.88°E. The city lies in the centre of the plateau and is surrounded by hills, three of which are revered in Khasi tradition: Lum Sohpetbneng, Lum Diengiei and Lum Shillong. Due to its latitude and high elevation Shillong has a sub-tropical climate with mild summers and chilly to cold winters. Shillong is subject to vagaries of the monsoon. The monsoons arrive in June and it rains almost until the end of August. October-November and March-April are the best months to visit Shillong.

Shillong is connected to Guwahati by an excellent National Highway-40 and it takes 3 to 4 Hours to cover the distance of 103 Kms. Further, the National Highway-44 connects Shillong to Silchar in Assam, Aizawl in Mizoram and Agartala in Tripura. Day and night bus services are available from Shillong to all major towns of Meghalaya and also other capitals and important towns of Assam and North Eastern States. Helicopter Services are also available from Shillong to Tura and Guwahati. This is one of the few hill stations with motorable roads all around. Shillong has no rail lines. There is a small airport at Umroi, around 30 km from Shillong; most flights into Umroi are only on certain days of the week. The nearest major airport and railway station is at Guwahati

According to the census of 2001, the population in Shillong is around 232,876, where males and females constitute 50 per cent each of the population. Khasis make up the majority of the population though the percentage of Khasi people in the city continues to fall as a result of the large number of migrants from other Indian states. All the other northeast Indian tribes are represented here as well as significant numbers of Bengali, Nepali, Assamese, Biharis and Marwaris making it a fairly cosmopolitan city.

Christianity is the dominant religion in the city. Protestants make up three-fourth of the population of Shillong and Catholics make up the remaining one-fourth. A sizable proportion of the population follows Khasi religion. Other religions found in India are also represented in significant numbers in the city.

Common Languages spoken are Khasi, Garo, English, Assamese and Hindi.

The state has an average annual rainfall of as high as 1200 cm in some areas. Meghalaya is the wettest state of India. The Shillong area, with the highest elevations, experiences generally low temperatures. The maximum temperature in this region rarely goes beyond 28 degrees, whereas winters temperatures of sub-zero degrees are common. The town of Cherrapunji in the Khasi Hills south of capital Shillong holds the world record for most rain in a calendar month, while the village of Mawsynram, near town of Cherrapunji, holds the distinction of seeing the heaviest yearly rains.

Shillong has steadily grown in size and significance in its own traditional way from a small village as it used to be when it was made the new civil station of the Khasi and Jaintia Hills in 1864 by the British. It remained the summer capital of Eastern Bengal and Assam for many years. In 1874, on the formation of Assam as a Chief Commissioner's Province, it was chosen as the headquarters of the new administration because of its convenient location between the Brahmaputra and Surma Valley and more so because the climate of Shillong was much cooler than tropical India. Shillong remained the capital of undivided Assam until the creation of the new state of Meghalaya on January 21, 1972 when Shillong became the capital of Meghalaya and Assam moved its capital to Dispur.

The GSPA has a total area of 173.87 sq.kms. It comprises two distinct areas viz., SUA and rural area. The SUA consists of (a) Shillong Municipal Board Area (SMB) Area and 6 urban centers such as Shillong Cantonment, Mawlai, Pynthorumkhrah, Nongthymmai and Madanriting. The remaining Rural Area comprises 32 rural settlements. Therefore, GSPA, with its total population of 312539 accounts for 78% of the total urban population of Meghalaya. *(ADB TA 4348)*

As of 2001 Census of India, Mawlai had a population of 38,241. Males constitute around 48 per cent of the population and females around 52 per cent. Mawlai has an average literacy rate of 73 per cent. Occupational profiles of the population in the region indicate that entering into government jobs is most preferred, followed by business and construction labour.

1.4 COMMUNITY INVOLVEMENT IN MEGHALAYA – SHILLONG

The involvement of community members in the development work within the community had already existed among the tribal communities of Meghalaya. Community groups in the name of *dorbars* had been there that took care of community well being and management of community infrastructures. The *dorbar* system had been created on the choice and wishes of the people of Meghalaya, and the people feel comfortable to be a part of the system. The working approach isn't at all that formal in nature. It is as clannish as is the living style. The idea of formalizing the community involvement approach in the state's development programs has been thought of and as a result Autonomous District Council (ADC) was established in Meghalaya. The purpose of creating District Council was to protect the tribal people with their cultural heritage as well as their socioeconomic life and living. But on the contrary, the committee responsible for setting up such bodies failed to understand the sentiment of the local chiefs and as a result the conflict between District Council, i.e. the functionaries of District Council and the Chiefs started. Consequently, the District Council does not get sufficient cooperation from the chiefs although the chiefs have been given magisterial powers to function with limited capacity. But the chiefs feel that their major powers have been snatched away and they are not at all involved in development programs of government. There is a need of developing a 'well coordinated mechanism' that will help in maintaining a balance between the traditionally existing social institutions and the modern vision of formalization approach, and that the durbars and District Councils will be able to work in tandem.

The *dorbar* rules and regulations have been framed by the people through consensus. The Chiefs are just titular heads who enjoy some tributes according to the desire of the local people. Hence, they are just custodians.

The *dorbar* laws are framed by the people through consensus primarily to control all community land, clan land, forest land or sacred lands.

The forest area in Khasi hills vary from 60 per cent to 88 per cent of the total geographical area (FSI 2003). The forests in the region are owned both by the Forest Department and the community/individuals. The state forest department owns only 4 per cent of the total forest area, and categorised as Reserved Forest Area. And more than 90 per cent of the forest areas are owned by community/individuals and is regulated by laws made by District Council. The *dorbar* heads do rule but only with the community consensus. With the divergent perceptions of durbars and ADC on who controls the forest resources, preservation of forest wealth has become a 'no-man's land'. Consequently there is indiscriminate usage and visible erosion of the forest wealth which may have significant bearing on natural resources. Although the vast majority is under the control of community this seems to have no impact in containing depletion of the forest wealth.

In this context there is a need for well designed awareness programs for both - the *Dorbars* and District Councils.

The traditional system of governance involving *dorbars* continues to play a major role in the upkeep of the city. The *dorbar* laws framed by the people through consensus primarily to

control all community land issues, but they also settle all petty crimes. "These traditional *dorbars* provide commendable voluntary service by settling disputes and litigations at their level, take up civic problems-- of streetlights, footpaths, community halls and water--with the local administration. But whenever a common problem for all the *dorbars* arises-- say for example municipal elections, communal unrest, public distribution system or the use of plastics – the matter is taken to the Federation. The Federation organises activities to raise awareness in the localities to keep these streams and springs clean.

2 SCOPE

Scope of the assessment study is as follows:

- An assessment of the *Beneficiaries* to assess their awareness and interest in participation and involvement in the development project efforts
- An assessment of the *Service Providers* to explore their requirements for the preparation of community awareness plan, a consultation program and a disclosure plan
- An assessment of the existing level and requirements of NGOs/CBOs/TIs

3 OBJECTIVE

The prime objective is to ascertain the level of awareness, interest level and the extent of community participation and involvement in the urban infrastructure development project - implementation and management.

4 APPROACH

The study comprises of three components:

- The first component involves undertaking a series of meetings & discussions with concerned authorities.
  - State government departments.
  - Development Authority and other Urban Local Bodies
  - Locally based NGOs/CBOs/Traditional Institutions
- The component two was focused on gathering the relevant secondary data
- The third component was discussion-consultation with the local communities in general and the affected people in particular in Shillong city.

5 METHODOLOGY

The source of information collection for the preparation of action plans, consultation programs, disclosure plan, preparation of IEC materials, and identification of NGOs/CBOs/TIs was as follows:

- Information from Primary Sources
- Collection of additional Information from Secondary Sources

INFORMATION FROM PRIMARY SOURCES

Information from primary sources was gathered through consultation with the concerned government departments, discussion with local NGOs/CBOs/Traditional Institutions and through a community assessment survey with the community in general, local women folks and women's group, and with the local youths and other local youth's bodies.

5.1 MEETINGS WITH GOVT. OFFICIALS

Meetings & discussions with concerned government departments were held. Departments covered were Urban Development Department (the nodal department), Public Health & Engineering Department, Public Relations Department, Social Welfare Department, Meetings were also held with Shillong Municipal Board.

5.2 MEETINGS WITH NGOS

Meetings were held with the locally based NGOs, a few others were contacted through e-mails. A questionnaire was prepared for the NGOs that intended to assess, along with meeting-discussion, the nature and level of the NGOs, their requirement for capacity building programs and their knowledge vis a vis awareness program for the community. The outcome will also help in preparing a database of Meghalaya/Shillong NGOs/CBOs/ SHGs/TIs to contribute effectively in urban infrastructure development projects implementation and management. The key question areas are presented below:

The key question areas

Background
- History
- Mission & Vision
- Status

Organization Profile
- Employee profile
- Infrastructure profile
- Donors associated with

Networking
- With whom
- Process
- Willingness & ability

Activity
- Scope of other activities
- Technical skill
- Operation approach

Relationship
- With government
- With community
- With NGOs/CBOs/SHGs/TIs

Section I Assessment of their working system
- Expertise in development sector
- Experience particularly in the area of urban infrastructure development

- Training and capacity building requirement

Section II Assessment of their awareness of the community
- General community awareness
- Community development programs
- Community motivation & mobilization

Section III Assessment of IEC requirement
- IEC material preparation
- Community requirement of IEC
- Capacity development program for IEC

5.3 COMMUNITY ASSESSMENT SURVEY

The Community Assessment Survey was carried out using a semi-structured Questionnaire to the individual owners or anyone willing to contribute in the assessment study. A Focus Group Discussion (FGD) within the community and a Transect Walk (TW) in the project area was also carried out to gather information on socio-economic background of the community, their awareness and willingness to participate and get involved in the urban infrastructure development projects. As part of the Assessment Survey a three level analytical exercise was conducted with a range of people who expressed reluctance and/or difficulty in participating and remain involved in the development project implementation and management.

Data was collected from the seven sample project sites (Table 1.1). For management purposes, the data set was divided into 3 thematic areas that comprised of *(i) socio-economic assessment, (ii) community awareness assessment and (iii) community involvement/ participation assessment.*

5.3.1 SAMPLING

The survey sites have been identified from the Project Preparatory Technical Assistance (PPTA), prepared by the earlier consultant (Ref ADB TA 4348 & 4678). The sites for present survey were selected based on the technical and social impact assessment done earlier and as prioritized by the concerned state governments and agreed by ADB Task Managers.

Further, the survey areas were sampled using the city map provided by the divisions and suggestions from the nodal department. The sampling was further refined with a view to have the sample representing heterogeneous population of those directly affected and of those with indirect impact. The social survey will be conducted in the locations shown in Table 1.1

TABLE 1.1 SURVEY LOCATIONS

State/City	Location	Groups	Time
Meghalaya - SHILLONG **Sector** Solid Waste	Mawlai-Nongkwar, Mawlai-Nonglum, Police Bazar, Laitumkhrah area, Lachumiere area, Upland Road, Upper Nongthymmai	House holders, Women's Group, Youth Bodies, Property owners	17 – 19 Nov '08 Individual interview – 1 to 1½ hrs Group Interview – 3 to 4 hrs

5.3.2 SCOPE OF THE SURVEY

- Assessment of existing social economic status & possible community participation/ involvement in project implementation and management
- Assessment of community awareness requirement
- Preparation of an appropriate awareness action plan

5.3.3 OBJECTIVE OF THE SURVEY

The prime objective is to assess the community awareness level and their IEC requirement so as to prepare and motivate them for effective participation and involvement in the development project's implementation and management.

5.3.4 CHARACTERISTIC OF SAMPLE

Participants were drawn from the population residing in and around the project location. This helped to assess the direct as well as indirect impact of the project outcome and the consequential impact on their desire to participate and get involved in various city infrastructure development project interventions.

The participants included men & women from the locality, the community heads, local MLAs, ward officials, and others willing to comment and suggest. Women groups and Youth Bodies from the community were separately quizzed as well.

Particular care was taken to see that there was appropriate representation of the community. Sampling characteristic was as heterogeneous as possible. The vocal and interested members though got the priority; the non-vocal/subdued members of the community were not left behind.

5.3.5 TOOLS USED

An initial field visit was undertaken to get familiarised with the social setting and community characteristics. A questionnaire outline was prepared and tested in the field. The idea behind pre-testing was to see the relevance and appropriateness of the questionnaire. A final version of the questionnaire was prepared.

5.3.5.1 QUESTIONNAIRES

Based on the specialist's requirements, the questionnaire was organised into three sections:

Section A Socio-economic Considerations

Section B Community awareness Assessment

Section C Community IEC Requirement

These sections were further divided into 15 (1+10+3+1) sub-sections - one initial sub-section on Socio-economic Assessment, 10 sub sections on Infrastructure Sectors, 3 sub sections on Community and a final sub section on Awareness & IEC Evaluation. These sub-sections are presented below:

Sub-section I Socio-economic Assessment

Sub-section II Electricity Connection

Sub-section III Water Supply

Sub-section IV Sewerage System

Sub-section V Drainage System

Sub-section VI Health and Sanitation

Sub-section VII Solid Waste Management

Sub-section VIII Road

Sub-section IX Transportation

Sub-section X Market Improvement

Sub-section XI Slum Improvement

Sub-section XII Community Assessment

Sub-section XIII Gender Assessment

Sub-section XIV Youth Assessment

Sub-section XV Awareness and IEC Requirement

The questionnaire was pre-tested at Guwahati project locations. The feedback and responses were taken care of and the questionnaire sections were modified and finalized.

KEY QUESTION AREAS

Socio-economic Assessment
- Population Structure, Density of Population and Household
- Division of Labour
- Decision Making

Land Issue
- Land Ownership
- Land Holding
- Land Inheritance and Transfer
- Land Pricing and Selling-buying

Education Scenario
- Literacy Percentage
- School Enrolment
- Facilities in School

Employment Status
- Employed-unemployed Percentage
- Type of jobs Involved in
- Average Monthly Income
- Labour Assessment

Infrastructure Improvement ▪ Available Amenities ▪ Access to Amenities ▪ Quality of Service Delivery ▪ O&M of Amenities
Health Issues ▪ Service Availability ▪ Life Expectancy ▪ Common Illnesses
Sanitation ▪ In-house Toilet ▪ Community/Public Toilet ▪ Sanitary Habits
Transportation ▪ Availability ▪ Accessibility ▪ Reliability of Service ▪ Scope of Improvement
Assessment of Identified Project Sectors ▪ Water Supply ▪ Sewerage System ▪ Drainage System ▪ Roads ▪ Solid Waste Management ▪ Market Improvement ▪ Slum Improvement
Other Sector Assessment – Present Status and Future Prospect ▪ Tourism ▪ Art & Handicraft ▪ Handloom & Textile ▪ Local Produce & Products
Awareness, Involvement and Affordability Assessment ▪ Community Assessment ▪ Gender Assessment ▪ Youth Assessment
IEC Material Assessment ▪ Awareness Programs ▪ Level of IEC Requirement ▪ Suitability of IEC

5.3.5.2 SURVEY PROCESS

A three tier exercise was carried out (whenever required) where the surveyor acted only as the catalyst and motivated community to respond. In tier I, the community indicated their knowledge and responsiveness for participating and contributing in the development projects. In tier II, community indicated problems and inhibitions they have/feel in involving themselves in development programs, they also identified set of

causes that led to such problems and inhibitions. And finally in tier III, solution to allay such problems and inhibitions were worked out. The tiers with major question areas are presented below:

Tier I Awareness among the community groups on participation and involvement in the development projects Tier II Community posed and indicated problems that hampered their participation and involvement in the project activities Tier III Discussion with community groups led to derivation of few strategic actions

5.3.5.3 Focus Group Discussion

A Focus Group Discussion (FGD) at the community level was also carried out. The same questionnaire format was used as the baseline for FGD.

5.3.5.4 Transect Walk Process

Transect walk (TW) was undertaken to observe and visualise the existing scenario and a possible impact of the project outcome. TW was also utilized to discuss and gather the positive-negative impacts assessment from the community perception.

The quality of information was ascertained by maintaining the reliability and validity of the emerging views and responses from the surveys. To maintain the quality, there was cross questioning and cross checking of responses from questionnaire to FGD to TW.

5.4 Collection of Additional Information from Secondary Sources

Relevant census data, documents and other information were gathered from different government departments.

6 Outcome from Meeting-Discussion with Government Departments, NGOs/ CBOs/TIs and Survey Result Analysis

6.1 Community Assessment

Characteristic Features: Mawlai is one of the townships outside the Municipal limit of Shillong, and it has around 15 localities. The locality has partially scattered habitation, they are somewhat congested in the core areas, primarily due to hilly terrain. The hilly terrain, although not steep, allows habitation only in the limited areas. The area is around 3-4 kms away from the main Shillong city. The area does not fall within the municipal area, and hence the waste collection is managed by the community themselves. Door to door waste collection has been recently introduced in some of the sub localities; others manage by either burning or throwing the garbage down the hill. The door to door collection system seems to be well accepted by the community of the Mawlai locality. Even in poor families, the system seemed to be well accepted. The area has very few small shops catering to the daily requirements; otherwise they have to come to Police Bazaar or Bara Bazaar in the main city. Even for educational institutions and health services one has to come to the main city. Hiring taxi or the shared taxis are the only mode of transport to travel from main city to Mawlai.

Mawlai locality is around 1½ kms away from the dumping site. The location of the dumping site is at the hill top, covering an area of approximately 6 acres. The site is surrounded by land area on 2½ sides and rest faces the deep gorge. The site is adjacent

to the NH and forest land down the gorge that often carries the filth from dumping ground, particularly during the monsoon. The gorge downwards gets connected to the Umium Lake – thus polluting the lake. Although the lake is 8kms away, the downwards slope of the gorge carry everything into the lake. The site does not have any provisions for waste treatment; neither there is any infrastructure facility for the people working there.

- ✓ *There needs to be a complete refurbishment of the dumping site*
- ✓ *Provisions for drinking water facility, toilet complex and uniform set at the site are necessary.*
- ✓ *There is an urgent need for well organised waste management system*

Population Composition: Shillong has a population of 260,000 (Population of Meghalaya is 23,18,822, according to 2001 census). East Khasi Hills district is the highest populated district, and Shillong primarily being the capital city with more facilities and opportunities attract people from other parts of Meghalaya as well as other states of India and hence is highest populated city. Out of State's total urban population of 452612 persons, as per 2001 Census, the SUA has a population of 267662 which represents nearly 59% of the State's urban population. Out of a total urban population of East Khasi Hills district which is 277967, nearly 97% are residing in SUA. The total study area(GSPA) population is 331373, which is 1.4% of the state and 50.1% of East Khasi Hills District which consists of 7 urban centres and 32 villages as per the Master Plan of Shillong 1991-2011.There had been a tremendous growth in population during 1971-81 with 42.3 per cent growth, but then there is a decline in 1981-91 with 27.9 per cent and further decline in 1991-01 with only 19.8 per cent growth. A similar trend was observed when data of GSPA was considered, that showed 39.6 per cent in 1971-81, 24.8per cent in 1981-91 and 22.2 per cent in 1991-01. (*Census of India 2001 and The State of Environment of Shillong City- A Report - MSPCB*).

TABLE 1.2A AREA, POPULATION, DENSITY AND DECENNIAL GROWTH OF POPULATION OF SHILLONG 2001 CENSUS

	Area in sq km	Population	Density per sq km	Decennial Growth Rate %
Meghalaya	22429	22306069	103	30.65
East Khasi Hill	2748	660923	241	22.88

Source: Statistical Handbook of Meghalaya 2006

The population density of Shillong is 10538 when the Shillong urban agglomeration is considered (comprising of Shillong Municipality, Shillong Cantonment, Nongthymmai, Mawlai, Madanrting, Pynthorumkhrah, Nongmynsong) and 1904 when GSPA was considered (that covers SUA and villages).

TABLE 1.2B AREA, POPULATION, DENSITY OF SHILLONG BY LOCALITIES 2001 CENSUS

Urban Components	Area in sq. kms.	Population 2001	Density/sq. kms
Shillong Municipality	10.36	132867	12825
Shillong Cantonment	1.84	12396	6737
Nongthymmai	2.93	34292	11703
Mawlai	6.14	38303	6238
Madanrting	2.02	16318	8078
Pynthorumkhrah	2.11	22115	10481
Nongmynsong	2.00	11371	5686
SUA	**25.40**	**267662**	**10538**
Villages	149	63711	428

Urban Components	Area in sq. kms.	Population 2001	Density/sq. kms
GSPA	174	331373	1904

Source: (JNNURM Shillong CDP Preparation Report - *Census of India 2001 and The State of Environment of Shillong City- A Report - MSPCB*).

The sex ratio of the state was found to be 972, which is much above the National Average. The district indicated the ratio to be 981 and the city population constitute around 50 per cent males and 50 per cent females.

The sex-ratio as per Census figures of 1991 and 2001 of the urban component is as follows:

TABLE 1.3: DISTRICT WISE SEX RATIO

Urban Component	1991	2001
Shillong Municipality	889	1010
Shillong Cantonment	666	748
Mawlai	1066	1066
Pynthorumkhrah	NA	933
Nongthymmai	NA	933
Nongmynsong	968	1008
Madanrting	968	967

Source: Master plan, 1991-2011, and Census Report of 2001

It is evident from the above that the sex ratio in SUA registered a significant increase in Shillong as well as other constituent units.

The district has around 77.49 per cent of tribal population whereas only 0.35 per cent belongs to the scheduled caste population. Khasis make up the majority of the population though the percentage of Khasi people in the city continues to fall as a result of the large number of migrants from other Indian states. All the other northeast Indian tribes are represented here as well as significant numbers of Bengali, Nepali, Assamese, Biharis and Marwaris making it a fairly cosmopolitan city. Christianity is the dominant religion in the city. Protestants make up three-fourth of the population of Shillong and Catholics make up the remaining one-fourth. A sizable proportion of the population follows the original Khasi religion. Other religions found in India are also represented in significant numbers in the city.

- ✓ *The region has domination of Khasi tribes, the IEC preparation needs to be in Khasi language other than English and Hindi.*
- ✓ *The city has a significant percentage of population from outside the state and hence representation of other communities in the IEC materials will have better impact on the community.*

INCIDENCE OF POVERTY

The population below poverty line constitutes 49 per cent of population It is said that "Meghalaya is a case of *Poverty in the midst of Plenty",* the growth seems to have benefited the urban areas while the rural population has remained largely untouched due to lack of commercial orientation of the indigenous entrepreneurship within tribal communities. The apex planning body under the Government of India estimated the percentage of population below poverty line in Meghalaya to be nearly one-third the total population of the state in 2000, and the incidence of poverty in rural areas at about 55 per cent is almost double the percentage of poverty in the urban areas.

Meghalaya Chief Minister in one of his speeches mentioned that around 49 per cent of the state's population is below poverty line and about an equal percentage of educated youth are unemployed. "The figure of poverty and unemployment in the state is disheartening." He attributed the dismal state of economy and scenario of unemployment to "resource and infrastructure constraints." Roy said to overcome the present situation; the state must accelerate investment in infrastructure.

East Khasi Hills district has a record of 50,997 families under BPL out of a total of 1,09,115 families, indicating the district of having 46.74 per cent of BPL families, whereas East Garo Hills district has 55.94 per cent of BPL families, the highest when compared with other districts of Meghalaya.

Among various income groups, more than 81.9% of the Below Poverty Line (BPL) population and 90.6% of the Marginally Poor (MP) population were born within the State where as the Middle Income Groups (MIG) and High Income Groups (HIG) showed the maximum tendency of coming to the city from other parts of Meghalaya to settle down (9.9% and 6.9% respectively). This explains the fact that economic opportunities are more in comparison to rest of the state. Apart from that the city assumes importance for administrative activities. Also it is seen that the highest percentage of people coming from outside the state and settling within the town are mainly the MP. (ADB TA 4348-City Report)

- ✓ *It is evident from the BPL data and indicated by the community that poverty level in the region is quite high, and the problem of unemployment is equally grave. And as there are not many job opportunities available in the city, people from the poor families work as waste collectors or at the dumping site collecting sellable wastes, in a very unhygienic working condition.*
- ✓ *Well being of this category of the working group should be government's concern. Some measures have to be devised to ensure their wellness.*
- ✓ *Their involvement in the systematic (door to door) waste collection system will improve their economic status.*

Tenancy & Migration: Shillong being the state capital has better opportunities and provisions for better living and hence the increase in in-migration. It was pointed out that people come to Shillong from villages, other nearby underdeveloped towns, and from neighbouring states of Bihar, Assam, West Bengal and other north-eastern states. People from Bangladesh also have settled in Shillong. Community indicated that the dominant reason for migration was employment opportunities in the city where local habitants are not capable enough. The business community in Shillong is primarily from Bihar and Rajasthan, followed by educated mass from Bengal and other parts of India. Majority of in-migrants indicated poverty and lack of opportunities in their own state that forced them to move out. They live as tenants and expect the owner to take care of any form of maintenance.

- ✓ *The knowledge of community involvement and participation is yet to invade the thought flow of the locals. A different level of awareness program is required for the group.*
- ✓ *It appeared to be a jerk for some to contribute in the state/city development programs.*
- ✓ *There was a class difference in understanding the need for community involvement in the development initiatives.*

Building Structure: The building structures in Shillong clearly show the income class difference. Those who could pay have big concrete structures and others have wooden structures with corrugated galvanised iron (CGI) sheet roofs. Due to hilly terrain and very

high rainfall of about 1200 cm the lower income groups have building structures more often as semi-concrete with a CGI or other temporary materials sheet roof. Unlike Kohima and Aizawl migrants in Shillong are better off and do posses well constructed concrete buildings. But the migrant population and particularly those living as tenants wanted the owners to take the entire responsibility of maintenance and management. This is what had actually been happening so far. Contribution from the tenants is a new thought.

- ✓ *There was a distinct class difference among those who agreed and those who didn't to pay for community infrastructure development and its maintenance. It seemed difficult with the poor community, due to the genuine reason of being poor, but it didn't seem impossible.*
- ✓ *A community motivation/mobilization mechanism has to be developed.*
- ✓ *An effective awareness program will yield better result.*

Livestock: Among the tribal communities and so with the people of Meghalaya in Shillong the tradition of keeping domestic animals for ones livelihood and family status is maintained well. The tradition continues among the people of lower economic strata for the dire reason of maintaining livelihood. The issue with them is now space crunch in the city for keeping and maintaining the livestock. Possession of domestic animals no more determines the family wealth and status. The common livestock found in Shillong are cattle, goat, sheep, pigs, flows and ducks. Piggery is the most commonly found livestock among the urban poor, followed by poultry. Interestingly pigs are used for managing household waste.

- ✓ *Due to lack of space and money, many open piggery and poultry in their houses, this is a major concern from health point of view.*
- ✓ *Owners of piggery and poultry should be involved in awareness programs concerning health & hygiene.*
- ✓ *Segregation of wastes particularly at the poultry and piggery needs to start.*

Land Issue: A major part of the area falling in the project jurisdiction is privately owned residential area. Around 90 per cent of the area land is used for residential purpose. There is neither inter or intra tribal domination over land possession, nor there is any tribal group rivalry. In Shillong though major residential areas are now privately owned, there are areas still under community hold, and settlements on these are determined by the community authorities, the *Dorbar Hima* or *Dorbar Shong,* by the *Syiem* who is the chief of a tribe and *Rangbah Shong* the headman who is elected by voice of vote of the villagers. The position of community head is still valued by others in the community.

Traditionally among the north-eastern tribal community the land belonged to the community, and that the community represented a particular clan. As the members were from same clan the sense of affinity and belongingness was very high. The community together worked for management and maintenance of the community and its resources. The community like other tribal regions also have a community head, whose authority is the supreme. But the style of functioning is not at all autocratic; it works on the general consensus. Among the Meghalaya tribes the traditional community groups are referred as *Dorbars.* The *dorbar* heads are referred as *Syiem* (the chief ruling a set of localities) and *Rangbah Shong* (the chief ruling one locality). Their assessments and judgements are considered to be the final verdict. Apart from this the role of ADCs are quite significant in the land management in Meghalaya. ADCs are institutions formally recognised and given specific powers for land administration under Sixth Schedule of the Constitution of India.

Land had been a major source of economic well being of the community. Around 75 per cent of the state's population is involved in the agriculture sector. The widely prevalent agricultural practice has been shifting cultivation known as *jhum* in the region but a marked transition from shifting to settled cultivation is observed throughout the state. While

ecological hazards created by *jhum* cultivation and its economic non – viability provide external pressure to abandon the practice, increasing population pressure, reduction in *jhum* cycle and overall socio – economic transformation have created internal pressure against it. Consequently, the prevailing trend is towards a clear shift from shifting to permanent cultivation.

The two broad categories of land based on the ownership pattern in the Khasi Hills are (i) *Ri Raid* and (ii) *Ri Kynti*. The *Ri Raid* or community land is allocated by the village headman/council/chief to the individuals for use without the right of ownership. The land could be forest or non-forest land and are given for constructing a dwelling or for cultivation or other economic purposes without paying any tax or money. Traditionally if a person keeps such a land but does not use it for three consecutive years, the land is taken back and given to others in the community. Other land types that fall under this are land given to priest for religious purposes, for water and pasture, village forests etc. But over the years people working on such lands have started claiming the land ownership that resulted in privatization of the community land. The *Ri Kynti* or private land is further classified as inherited land and acquired land. The ancestral land if not divided are by tradition given to the youngest daughter of the family. In Khasi-Jaintia set up the maternal uncles are the decisions making authorities in use and management of the land. When the ancestral land is not divided over many generations and keeps passing down automatically then it acquires the status of *Ri Kur* – clan land. The self acquired land remains as a property solely for the person who purchased it. When it passes on to the children, it becomes ancestral property for them. (C Kumar)

The forest areas in Khasi Hills vary from 60 – 88 per cent of total geographical area. (FSI 2003) The forests in the region are owned by both the State's Forest department and by Community/Individuals. The state department owns only 4 per cent of the total forest area. The forests owned by them are classified as reserved and protected forests regulated by laws and acts similar to other states in India. The second category of forests (more than 90% of total forest area,) owned by community/individuals, is regulated by the laws made by the District Councils. The United *Khasi Jaintia Hills* Autonomous District (management and control of forest) Act, 1958 provides a broad classification of forests under the control of District Councils (KHAD 1995). The main types of forests as classified by them are:

- Law Ri- Kyunti (Private Forest): these forests belong to an individual or clan or joint clans, which are grown or inherited by them.
- Law-Ri-Sumar (Private forest): These forests belong to an individual clan or a joint clan, and are grown or inherited on village or common raid land.
- Law-Lyngdoh, Law Kyntang, Law-Niam (Sacred Groves): These forests are set aside for religious purposes and are managed by the Lyngdoh (a religious head) or other person to whom the religious ceremonies for the particular locality are entrusted.
- Law Adong and Law Shnong: These are village forests reserved by the villagers themselves for conserving water, soil and plants etc. for the use of villages and are managed by the 'Sordar' or headman with the village dorbar.
- Protected Forests: these are forests declared protected by the District Councils for the growth of trees for the benefit of local inhabitants under the district council act 1958.
- Green Blocks: These forests belong to an individual family or clan or joint clan and grow on Raid lands and are protected for aesthetic beauty and the water supply of the town of shillong and its suburbs.
- Raid Forests: These forests are looks by the head of the Raid and are under the management of the local administrative heads.
- Unclassed forests: These are mostly private forests over which local village

institutions retain control. They are mostly on the hills and are used by local inhabitants for jhum cultivation.

The Land tenure system and hence the forest management system in Meghalaya is mainly regulated by the traditional socio-political institutions of the tribal groups.

Donating land for community development purposes is not something very new in the north-eastern region and thus in Meghalaya-Shillong is no exception. People give away part of land willingly provided they along with the Syiem/Headman are convinced that something really constructive is coming up and is going to contribute significantly for the welfare of the community. For the private land acquisition, a suitable compensation is worked out, which involves the owner, community head and the district authority. Community land acquisition does not look for any compensation; an informal agreement is enough to finalize the deal.

Land encroachment is not a major issue in the region. There have been stray cases which were amicably settled. Neither, encroachment had been a major problem, nor it had led to any major consequences. Community could not really give an assessed market value of the land in possession. For many, even the land value assessment is done having community and the community heads involved.

Community really did not feel that there would be a hike in the land value with the project intervention. The project site – the dumping ground is around 1½-2 kms away and any improvement of the site may not really contribute in beautifying the locality; anyhow the effort to improve dumping site was welcomed. Except the ward officials who belonged to the locality, no one else from the community knew about the upcoming projects and hence no possibility of land development in anticipation of the project efforts.

- ✓ *This is in flow with the tribal culture where community bond is very strong. There is a strong dependency need within the community structure. Though it was mentioned that modern living is over powering the community feeling, the concern now is more e individualistic. The land issues are still concern of the community in total.*
- ✓ *The Syiem and/or Rangbah Shong the community heads hold a key position in any form of community land settlements*
- ✓ *Any form of improvement of the dumping ground is beyond any ones expectation and knowledge and hence hike in land value of the nearby locality could not be assessed.*
- ✓ *There has to be a very effective information dissemination system reaching the community.*

Education: Shillong city has an average literacy rate of 80 per cent, which is higher than the national average of 59.5 per cent. The city male literacy was found to be 83 per cent and female literacy to be 78 per cent. The census data of 2001 indicated East Khasi Hills district literacy to be 76.1 per cent, where male literacy was indicated as 77.3 per cent and female literacy to be 74.8 per cent. The literacy percentage of Shillong city as well as the district is much higher than the national and the state average.

TABLE 1.4: TOTAL POPULATION, LITERATE POPULATION (MALE/FEMALE) AND LITERACY RATE IN EAST KHASI HILLS 2001 CENSUS

Total Population	Literate Population			Literacy Rate %		
	Person	Male	Female	Person	Male	Female
660923	415160	212637	202523	76.07	77.28	74.84

Source: Census of India 2001

TABLE 1.5: DISTRICT WISE LITERACY IN MEGHALAYA, 2001

State/Districts	Literacy Percentage		
	Total	Males	Females
Meghalaya	63.31	66.14	60.41
West Garo Hills	51.03	57.51	44.51
East Garo Hills	61.70	67.39	55.74
South Garo Hills	55.82	62.60	48.61
West Khasi Hills	65.64	67.02	64.21
East Khasi Hills	76.98	78.12	75.82
Jaintia Hills	53.00	50.52	55.54
Ri Bhoi	66.07	69.22	62.67
All India	59.50	-	-

Source: Census of India 2001

The East Khasi Hills district has highest percentage of literates when compared with other districts. It was observed in community discussion that *Khasi* tribes are most forward looking and progressive minded than *Jaintia* and *Garos*. The fact that Shillong is the capital city having high concentration of Khasi tribes in the region, results in high literacy percentage. The district has 1 University, 21 Colleges, 2 Industrial Training Institutes, 779 Primary Schools, 169 Middle Schools, 120 High Schools and 5 Higher Secondary Schools.

Community members did agree that there is direct relationship between education and human development. And that education other than certificate and degree courses has lots to offer. They expressed that present generation is smarter because they have access to better education facilities and opportunities. Community indicated that from Mawlai locality all children go to schools. Even the lower income category helps their children to complete at least the primary level if unable to pay for entire school education. Not many move out of the state for higher studies.

- ✓ Provisions of drinking water and proper toilet facilities in educational institutions need attention.
- ✓ Awareness programs (like waste management) should start from school age itself.
- ✓ State infrastructure protection and care can be taught in schools

Employment: The Census 2001 data indicates total workers to be 256562, where main workers numbered 219190 and marginal workers 37372. It is indeed alarming to note the number of non-workers to be almost double (404361) than those of workers.

Community members indicated that most of the commercial setups are based in the city, and also that the government departments and other offices are located in the main city area. The reason for majority preferring government jobs, despite being not so lucrative, was job security and old age pension. This defence mechanism plays a vital role in influencing preference for working in government offices. This probably contributes to the high population density of the Shillong city.

A majority of population were involved in business; from having big hotel and restaurants to small street side vendors. Many from the lower economic background involve themselves in local handloom and handicraft sector. A sizeable proportion of workforce enters into daily wage labour market. Labours comprise of construction labours, porters and domestic helpers, construction labours are mainly from outside Meghalaya, and the local inhabitants prefer working as domestic helpers. More men preferred trade and commerce sector, followed by government jobs. Community expressed this to be a recent trend. More women

preferred the service sector and a significant percentage of youth population looked for self employment. Most of the NGOs are owned by youth of Shillong.

- ✓ *The work category did have its impact on the awareness level for urban infrastructure development project efforts, but the impact was not so severe on their affordability to contribute in money, kinds or labour in the project efforts.*
- ✓ *Community looks for more employment opportunities within the state.*
- ✓ *Community expressed training and skill development program to improve the handloom and handicraft sector.*

Labour Assessment: Community informed that although the labour demand is met locally, people involved are primarily from the neighbouring states who have settled in Shillong. Labours who belong to Meghalya comprise around 5-10 per cent and the rest make up the migrant labours from neighbouring states. Thus the construction cost more often have to include the labour delivery cost. There is always a requirement of labours from the neighbouring states. Women prefer small business or as domestic helpers. Not many look for working at the construction sites.

It was reported that there is no wage differentiation among men-women labours. Both are paid same wages for the same amount or nature of work. Community members did indicate that local labours do not have sufficient skill to work efficiently, they do need to improve their knowledge and working skill.

- ✓ *Skill development program will benefit the labours in their economic growth.*
- ✓ *It will also open more opportunities for the local labours.*

Establishments and other amenities: On asking about establishments and amenities available in the project locations, and the possible impact of project efforts on these, the community appeared to be totally unaware. Community members could vaguely present what amenities were present, but didn't know to what extent the project effort will have positive or negative impact on these. Many of them did not have the correct information of existence or non-existence of the amenities. Community was not aware of the positive – negative changes.

- ✓ Community and/or community representatives should be involved in the project effort impact analysis.
- ✓ Community needs to be informed about the positive-negative changes that take place after any infrastructure development program is undertaken.

6.2 INFRASTRUCTURE AVAILABILITY

Electricity Connection – Community reported 100 per cent electrification of the inhabited areas. There were no cases reported of having illegal electricity connection. Connection charges depend on the distance covered from the main pole to the house. It is approximately Rs. 1500 to Rs. 2000 as capital cost for connection charges. Electricity charges are metered and around Rs. 200 to 1000 are estimated to be the minimum average monthly expenditure. Service delivery was reported to be satisfactory. Line faults and connection problems were attended without much delay by the Meghalaya State Electricity Board. Thus the cost incurred on O&M was not really high. Some minimum maintenance was required for repairing fuses and changing bulbs that cost Rs. 100-200 a month. The problem lay primarily on hours of supply and reliability of supply. The supply particularly in summer was erratic when load shedding was at its peak.

The working condition of street lights had been very poor with no regularised maintenance; the community took charge of providing the street lights. The houses near the roads within

the locality provide street lights from their house connections. As a matter of fact community did emphasise requirement of street lights and in their good working conditions in the localities. There was no theft or damage reported of street light accessories by the community, but it was reported that maintenance of these is often neglected. Community members actually took charge of O&M of street lights and assured that once provided, they will maintain them.

- ✓ *There was no grudge on the service delivery for electricity connections in houses and other establishments.*
- ✓ *Issue of street lights needed attention.*
- ✓ *Community needs more information on how O&M is possible through them.*
- ✓ *The idea of community affordability for O&M of such infrastructure wasn't readily acceptable, but was neither rooted out.*

Water supply system – Majority of population have tap water connection; other available water sources are river, lakes and water tankers. The state though has heavy rainfall, spring water sources seem to be disappearing. One is able to see spring sources only after the monsoon for a short period. The capital city Shillong is often left with water crisis. During the lean period the most reliable source of water for drinking, cooking and irrigation is taken from the harvested rainwater. Otherwise water tankers are used. To ease out the water crisis, the Government of Meghalaya has decided to launch "Meghalaya Water Harvesting Mission". Some localities do have community wells as well. The lake and the river water as indicated by the community cannot be used because of its high pollutant level.

The city water supply system is managed by PHED, SMB through its Water Works department, and community institutions like *Dorbars.* Water from the government source - PHED is often insufficient and one has to go for private tankers. For those who do not have PHED connections is either taken care by the SMB or Dorbars. Unlike Kohima and Aizawl, Shillong does not provide private connection lines. But the water is collected from community sources with the permission of *dorbar* heads. In Shillong the water sources if at all exist, are owned by the community. Many in the community, who do not have PHED connection, buy drinking water but use the natural spring water or community well for other purposes. Metering is not there and no water tax is paid, one has to pay only the connection charges. The connection charges depend on the water connection distance to be covered and hence it varies from Rs 1000 – 2000 and sometimes more. O&M of the PHED connection is done by the department; similarly SMB-WWD and *dorbars* manage and maintain their sources and the supply system. The PHED water supply is twice a day for two hours in most of the localities – and hence the water scarcity and greater dependence on other sources.

Community could not clearly comment on the quality of water, few said it is just fine because it is through PHED and few mentioned 'it is probably ok'. Majority of households boil the water before use. No one really mentioned of using water filters. There seemed no illegal water connections but leakage was a serious problem in the area, at distribution and at consumer level both. Water leakage is a severe problem in Shillong mainly because the ill maintained old pipelines. The other factor being the hilly terrain where the pipelines have to go through lot many turns and curves and also more often have to be on the upper surface of the ground, making it more open to easy wear-tear and damage. Community demanded more responsible attitude of the department regarding improving the water supply system.

Community seemed satisfied regarding the service provided by the department in managing and maintaining the repair works, though some indicated that the repair activity stretches too long hampering in smooth movement in the locality.

Community was aware of the alternative water source through rain water harvesting. They were willing to contribute in money, kinds and labour if that finally becomes their own asset. As water scarcity was a major issue any alternative measure to improve the situation will be appreciated, but then this has to be the responsibility of the government to provide with the source. The O&M of the same can be handled by the community.

- ✓ *Attention has to be paid for protection of water sources.*
- ✓ *Water storage facilities like ponds, tanks, check dams etc. need to be improved.*
- ✓ *Community needs awareness on right water use and its quality maintenance.*
- ✓ *Community agreed to take the responsibility of O&M of water sources and supply system. They need training and capacity development for the same.*
- ✓ Community will be ready to pay more with improved service delivery.
- ✓ SGS from the government which will have partial contribution from the community will ease the economic burden of the community, particularly in developing water harvesting system

Sewerage system – There is no sewerage system in any part of the city. In its absence alternative arrangements are soak-pits, septic tank or directly into the drains. A majority of people have soak pits; those who can afford have septic tanks and spend around Rs. 2000 to 3000 in getting it cleaned once in 3 - 4 years. Still many have connections directly into the drain.

When asked about possible connection and user charges and community responsibility for O&M of a well developed sewerage system, the community willingness though did not come immediately; they insisted on government departments to be solely responsible for developing an effective sewerage system. Some mentioned that even cleaning of the soak pits/septic should be the responsibility of government. But with elaborate discussions and indication for providing better services and other additional benefits the possibility of community contribution did start finding a place.

Drainage – The city drains and streams are severely polluted, leading to health risks and undesirable environmental conditions for the habitants of the city and surrounding areas. The two major drainage channels the Umkhrah and Umshyrpi rivers guide the city drainage system. Heavy rainfall and poorly maintained drainage leads to flooding in the areas. Many localities are not connected to drains and hence the waste flows down the hills into the streams, lakes and rivers, further contaminating them with city wastes. The hilly nature of the city has many natural open drains more often thin and narrow alongside the hill downwards. Many times these drains get naturally connected to the spring water source and pollute the water. As the drain flow is down the hill, the expectation is everything will flow down wards and hence there is no system of cleaning drains. During monsoon often there is overflow of drain wastes due to clogging.

Community did not express willingness for any form of contribution in constructing and/or repairing the drains, but assured that once constructed by the government the community will take the responsibility of maintaining it along with the concerned department.

- ✓ *Community feels that government is solely responsible for O&M of sewerage as well as drainage system.*
- ✓ *Community's involvement in O&M of the community infrastructures like sewerage and drainage was absolutely new and beyond imagination. Further discussions on the issue could put in their mind the necessity and there-in the benefits of their involvement in O&M of such infrastructures.*
- ✓ *There needs to be extensive awareness program for community participation, involvement and particularly affordability in O&M of community infrastructures.*

Health & Sanitation – The community seemed satisfied with the health services provided in the city area. They expressed satisfaction vis a vis the physical and working conditions of the establishments and facilities provided there in. Health facilities established are presented in the table below.

TABLE 1.6: NUMBERS OF HOSPITALS, DISPENSARIES, P.H.CS./C.H.C./S.H.C./ SUB-CENTERS IN MEGHALAYA

Facilities	In Numbers
Hospitals	4
Dispensaries	5
Community Health Centres	5
Primary Health Centres	21
Sub-centres	70
Veterinary Hospital	1
Dispensaries	13
Aid Centres	14
A I Centres	1
Stockmen Centre	5
Total	139

Source: Statistical Abstract Meghalaya 2006

The community expressed satisfaction over the health services being provided. Community mentioned the need for improvement in health services, particularly mentioning about specialists requirement. During serious illnesses people prefer moving to other big cities in India which have far better facilities.

No yearly epidemic was reported by the community. There had been no major outbreak that had taken a serious toll of lives in Meghalaya-Shillong. Still some common illnesses mentioned were diarrhoea, dysentery, typhoid, jaundice, cancer and TB. Community members could not really remember if there was any health department program for the community.

- ✓ *Community contribution not so much in money but in kinds and labour was possible to improve the health services.*
- ✓ *Community was prepared to monitor the health services being provided to them and ready to report of any misconduct.*
- ✓ *Community agreed to monitor and evaluate the health program, but needed some training and capacity development program.*

Around 90 per cent of houses had in house toilet facilities. Some have water connections within the toilet and others have to carry bucket inside. There is a system of using common toilets, i.e. few families together have one toilet and the O&M of the same is done by them together. As there is no sewerage system, the toilet drain is connected either to the soak pit or septic tank, or else it opens directly into the drains.

All schools had toilets but not all had water connections or any other provision for hand washing. Most of the school toilets need to be renovated. School children require extensive awareness program concerning hygiene and sanitation.

City has few public toilets maintained by the SMB. The condition of these toilets is indeed poor and need extensive renovation and made 'user friendly'. Public toilet use and its O&M have to be meticulously monitored. Community agreed to the requirement of more public

toilets rather than community owned toilets, and the public toilets will be maintained by the poor unemployed in the locality.

- ✓ *The community also needs extensive awareness program on hygiene and sanitation issues.*
- ✓ *Community also needs awareness and motivation for using pay & use public toilets.*
- ✓ *Catching and influencing the young tender minds will have significant impact on hygiene and sanitation related awareness program.*
- ✓ *Community preferred public toilets at strategic locations rather than community owned toilets*. And for the LIGs, a small grant scheme may be introduced for in house facility.
- ✓ *Whoever may own the public toilets – UD or SMB, any private setup, its operation and maintenance may finally be given to individuals who are unemployed and belong to poor family background.*
- ✓ *Community workshops have to be organised to introduce the concepts like communitization, pay and use etc. and present success stories of community driven project efforts.*

Solid Waste Management – There are two distinct areas; one falls under the jurisdiction of SMB and are not in the power and ambit of the Autonomous District Councils (ADCs) and GSPA. Outside the SMB and within the GSPA, the ADC and the Dorbar Shnongs play an important role in providing civic services.

The city at present has both the system of waste collection – door to door collection as well as provisions of community bins. The door to door collection is quite a recent way of SWM in the city, and is prevalent in both within and outside SMB but limited to a few localities areas. Mawlai-Nonglum is one example. Here the waste collection has been assigned to a contractor. The contractor has few labours – the waste collectors who carry a hand pulled wagon in the locality, moving from door to door and collecting the waste. Wherever not possible, he waits at a location blow his whistle to indicate his arrival. The householder dump their garbage in the wagon, which once filled is transferred to another bigger vehicle to be taken to the dumping site. The collection is done twice or thrice a week. The collection system is managed through community collection that varies from Rs. 30 to 20 and for those who genuinely cannot pay the workable amount has been reduced to Rs 10 to 5 every month. From the collection the drivers are paid an approximate amount of Rs 2500/- , Rs. 1500/- to the helpers, the uniform set including rain coats, gum boots, masks and gloves are maintained. Some localities have assigned the job to private contractors, and few others are managed by the NGOs, local youths and *dorbars.*

The SMB areas have community bins. Localities deposit garbage in the community bins, and at certain interval the SMB refuse vehicle collects the wastes from the fixed concrete bins, which involves manual and multi-handling of wastes and from door to door collection in some areas. The wastes thus collected are then transported to the disposal site through uncovered refuse vehicles, which result in waste spillage and environmental pollution. The collected wastes are then disposed off at the designated dumping area at Mawlai. The area is about 8 kms away from the city. The SMB area has regular waste collection. There is regular street sweeping done as well. It was informed that only 40-45 per cent of the total 143 metric ton per day (mtpd) of waste generated is collected.

It was also reported that since these refuse vehicles have no parking and garage facility and no maintenance (cleaning etc.) that result in frequent bear-tear and hence higher operation and maintenance cost for the vehicles - a burden on the department budget.

Segregation of generated waste is not in practice neither at the household level nor at any other establishments. There is no separate collection system prevailing for any of the waste types that may be bio-degradable or non-biodegradable. For household to commercial - biomedical - industrial – construction to any type there is one single collection and dumping system. However the segregation is followed at the disposal site at Mawlai at a distance of about 8km from the city. The site has been operational since 1938. Observation at the site revealed: (i) crude dumping and burning of wastes at the site deteriorates the surrounding environment and public health (ii) no arrangements has been made to arrest the leachate and surface runoff generated during monsoon which ultimately get mixed with Umiam Lake, 2-3 km away from the disposal site and (iii) health impact to rag pickers involved in segregating recyclables from the biodegradable portions in the disposal site.

The city had very few community bins, and those too were often full to the brim. As a result garbage splattered around the bin as well. In places where there were no community bins, any open area was used for garbage dumping. The city streets near habitation generally had all type of garbage littered or else piled up in a corner. Garbage mixed up with open drain filth emanate foul odour. Some congested sloppy areas had no space available to construct a community bin. Over congested localities neither could allow collection even by using hand trolleys. As a result the wastes were often thrown at random places.

In localities with community bins, people generally had the tendency of throwing garbage near the bin - not always into the bin. If no bin was kept, garbage was thrown down the hill or into the drain. The cold weather, polluted streets with littered garbage and bad smell forces locals to constantly spit here - there. Locals also have a tendency of eating *paan* (beetle leaf) and chew tobacco – reason to spit at random. Vendors selling tit bits do not carry or station a bin wherever they stand and hence the wastes are thrown that spread on ground.

- ✓ *Frequent waste collection (daily or alternate days) is limited to selected areas of the city;*
- ✓ *There should be citywide solid waste management action plan.*
- ✓ *Community preferred the door to door collection system. The HIG indicated preference for collection at the household level.*
- ✓ *Community readily agreed to pay the service charges, the amount varied according to the payee's capacity.*
- ✓ *Once the waste collection is systematised, segregation and treatment will be thought of recycling and reusing will be much later to come in practice.*
- ✓ *Low awareness level has been noticed among the communities regarding the ill effects of SWM*
- ✓ *Door to door collection with minimum contribution provided self sustainable economic benefit.*
- ✓ *Waste collection is restricted along the main motorable roads only*
- ✓ *Technically devised and properly maintained refuse vehicles and proper parking area at the dumping site.*

Waste picker's profile: People involved in waste picking are young kids most often in the age group of 5 -12 years old and women from very poor family. They are generally from the lower strata of society. They pick up metal and sometimes plastics waste from the dumping ground and sell them at the *kabari* shops (shops that buy and sell recyclable wastes) and earn their daily livelihood.

These children get busy at the dumping ground collecting sellable wastes bare foot and bare handed. These children fall sick very often and more often they neglect going for treatment for want of money.

Others working as waste collectors, as street sweepers and handling wastes at the site also are from very poor economic background. They are largely illiterate and do not have any social security. While at work, having no knowledge and understanding of handling wastes and its consequences, they become easy prey to ill health. Unaware of the consequences they do not at all use gloves, gum boots and masks. Even loading and unloading is done without using the uniform set. They are not convinced to use them even if provided.

- ✓ *Rehabilitation of waste pickers below 18 years of age.*
- ✓ *Provision of uniform and other necessary equipments to be provided at the dumping site. And its use to be made mandatory.*
- ✓ *Beautification of the dumping site, with proper boundaries having paintings and instructions on the walls.*
- ✓ *A toilet facility with bathroom to be provided at a suitable location in the dumping area.*
- ✓ *Social security measure from the government for people working at dumping sites.*
- ✓ *Regular medical checkups to be provided to them.*
- ✓ *Extensive awareness program on handling wastes and use of uniforms etc.*
- ✓ *Health insurance to be made mandatory for them and the expenditure to be borne by the government.*

Roads – Shillong being the capital city, localities seem to be well connected by roads. The entire city has asphalt road. Few localities do have earth roads and some have temporary roads. And few inner locality roads are made up of concrete. The city main roads are well maintained, but the roads inside the locality particularly on the slopes or partially sloppy area the maintenance is not up to the level. The roads are maintained by PWD. The service delivery for road maintenance is prompt; the community seemed satisfied with the conditions and maintenance services. Shillong has prolonged heavy monsoon. During this time the chocked drains and flooded roads worsen the road conditions.

The increase in city population and in the number of vehicles this is the ever increasing traffic jams particularly in the wee hours. Due to the hilly topography and non availability of land areas neither the roads can be widened, nor street signals cannot be used, thus it has to be manually handled. The traffic management was reported to be somewhat organised. As the terrain permits wherever possible footpaths have been constructed and are well used.

Community contribution for managing inside colony roads was a new thought. Community members did not vehemently disagree with the proposal but wasn't sure how that can be done. Few members did indicate that due to low economic status, one may not be able to contribute money for community development and that too for road etc. But simultaneously others indicated community fund can be gathered; may not be for road construction but for maintaining the inside locality roads.

- ✓ *They need clarity on what can be the community contribution; it may not necessarily be in money but contributing in labour as well.*
- ✓ *Community partially agreed on the suggestion of Small Grant Scheme from government departments together with community contribution for infrastructure maintenance.*
- ✓ *While constructing road, roadside decorations also should be taken care of, and community expressed willingness to take care of the maintenance of roadside decorations within the locality.*

Transportation – There are transport facilities for the public in the form of State Transport Services as well as Private Services. Both government and private buses are plying in and

outside the city areas. Other than the bus services, there are local and reserved taxi and auto services. The vehicles' condition may not be excellent, but reasonably ok. The routing of vehicles seems suiting the community, particularly with the shared taxis, as they can be stopped wherever required. There are no designated stoppages; vehicles can stop at any point. Except for certain junctions where random stopping is prohibited. Traffic seemed more disciplined as far as parking was concerned. The traffic police plays an effective role in maintaining the traffic discipline. One has to pay a penalty if vehicle is not parked properly and this is strictly followed. The public services are reliable and dependable. The fare seemed acceptable to the community. There was no issue of domination of private services over the public transport system.

Community never witnessed nor realised that they could also manage the traffic system by taking initiative to organize the traffic flow (when authorities not available), having community oriented awareness programs on safe driving and proper parking, particularly in and around the community and so on.

- ✓ *Community required awareness regarding traffic rules and regulations.*
- ✓ *It is important to improve the conditions of locally plying buses and other public transport vehicles.*
- ✓ *Community did not express keenness for having special services or reservations for women, aged and disabled. Locals do take care of that already.*

Market Area Development – The city has two prominent market places – Police Bazaar and Bara Bazaar, otherwise there are many small shops all over the city primarily supplying the daily items. These markets do have all variety of goods from daily use items to variety of agricultural and even forest products – handicraft and hand woven items to sophisticate electronic goods. Availability of hospital instruments and raw materials for construction work is an issue, and is brought from outside the state thereby making it costlier. Raw materials for various industries are supplied from Dimapur, Guwahati, and partly from Kolkata and Mumbai. Workshops in the city get the spare parts and other equipments from Dimapur, Kolkata, Delhi and Mumbai and Guwahati.

People from the higher income strata do look for quality products apart from affordable pricing. And sometimes pricing is not a major issue for them and they do get things from outside the state. The middle income category often has to compromise on either the quality or the pricing, whereas for people of lower income strata, the availability rather than quality is a matter of concern.

Provisions like drinking water facility and commercial waste collections are available, the toilet facility and fire protection measures are absolutely lacking. Availability of a delivery man or helper was individual shop specific, not all provided the service or had the facility. Markets in Shillong are spread over an area, not clustered in one single complex. Other than these two market types the locality based shops are scattered with limited provisions. There are no big shopping complexes or malls in the city.

Community – the shop owners expressed willingness to contribute towards maintenance charges for the market area. The idea of having provisions of water, toilet, systematic waste collection system, fire protection measures, helpers in the market locations was appreciated and found acceptable by many.

There are no formal set up shop owners union or committee as such, it is mostly under the community institutions such as d*orbars*. For instance the Bara Bazaar area is maintained by the Syiem representing the area. Any issue involving in that market place is handled by him

- ✓ *The areas should have provisions of drinking water, toilets, waste management, minimum health facility, fire protection, delivery man/helpers.*
- ✓ *Involving unemployed poor youths from the locality as helpers in the market areas will improve their economic level.*
- ✓ *Community i.e. the shop owners agreed to contribute for maintenance and management of the market areas with such provisions.*

Slum Area Development – Shillong city has 14 localities with 19 notified slum areas. This covers Laitumkhrah, Nongrimbah Road, Lumshora, Nogrimaw, Demseiniong, Lummawrie Umshyrpi, Chinapatty, Nongshiliang, Mission Pdengshnong, Upper Jail Road, Mawlai Nongmali, Forest Colony, Wahingdoh, Raitsamthiah Mission Compound, Wahthapbroo, Lower Mawprem, Upper Mawprem, Naspatighari, Mawprem, Laban, West Lumparing, Riat Laban, Madan Laban, Shillong Cantonment and Pynthomukhrah. Around 22 per cent of the population in Shillong comprise of slums (78929 persons) and the BPL population residing in the slum areas accounts for 34.9% of the total BPL population.

TABLE 1.7 : DISTRIBUTION OF SLUMS (2001)

Ward Number	Locality	Notified Slums	Slum Population	Share of Slum Population (%)
1	Laitumkhrah, Nongrimbah Road, Lumshora, Nogrimaw, Demseiniong	2	7321	9.3
4	Lummawrie	1	5782	7.3
6	Umshyrpi, Chinapatty, Nongshiliang, Mission Pdengshnong	2	8917	11.3
10	Upper Jail Road	1	2500	3.2
11	**Mawlai Nongmali & Forest Colony**	**1**	**1227**	**1.6**
13	Wahingdoh and Raitsamthiah	1	599	0.8
17	Mission Compound and Wahthapbroo	1	1169	1.5
19	Lower Mawprem	1	6238	7.9
20	Upper Mawprem	1	3088	3.9
21	Naspatighari, Mawprem	1	1300	1.6
24	Laban West	1	6238	7.9
27	Lumparing, Riat Laban, and Madan Laban	2	14730	18.7
	Shillong Cantonment	2	6636	8.4
	Pynthomukhrah (Census Town)	2	13184	16.7
	Total	**19**	**78929**	**100**

Source: Shillong Municipal Board, 2005 from ADB TA 4348

The slum settlements in Shillong are either located on the steep slopes, normally the rejected locations for habitation or near the commercial hubs of the city where ample labor jobs are available. Slums in Shillong were found more often on the community lands rather than government lands, which normally has been the slum location.

Community stressed the need for improving the infrastructure in slum areas. For them waste management was not a priority area, electricity and water were the major concern. Slum dwellers looked for grants from government for slum area improvement. For them community contribution would be next to impossible. Further discussion on the issue, presenting a few success stories where community had contributed and extracting

information from them on their weaknesses for liquor, paan, cigarette etc. and highlighting that it is possible to save one rupee a day provided they miss one bottle/paan/cigarette etc. every day and put the money in community contribution, the possibility of community contribution did find a place.

- ✓ *Slum community need extensive awareness program on waste management.*
- ✓ *Awareness regarding connection between waste management and health.*
- ✓ *Community needed motivation to live better life and improve living standards.*
- ✓ *Awareness of various development schemes, particularly schemes for poverty alleviation.*
- ✓ *Presentation of success stories involving community contribution*
- ✓ *Community required more information and awareness on their possible involvement in urban infrastructure development projects.*

Other Sector Assessment - Urban infrastructure development has direct impact on other sectors as well. This impact is further extended on the community's livelihood associated with it. Lack of quality infrastructure, like electricity, drinking water, drainage and sewerage, health facilities and sanitation measures, city waste management, roads and transport coupled with insufficient market with bad quality products discourage tourist inflow. The city has splendid panoramic view. Staring from Shillong peak, tourists enjoys number of waterfalls, lakes and other peaks. The major tourist attractions in and around Shillong are Ward's Lake and Botanical Garden, Butterfly Museum, Meghalaya State Museum, Lady Hydari Park, Elephant Falls, Spread Eagle Falls, Bishop & Beadon Falls, Golf Course, Cathedral Church, Mawsmai Cave, Mot Trop, Mawjymbuin Caves, Symper Peak, Shillong Viewpoint, Mih-Um-Spring Lawbah, Sohra, Laitkynsew Viewpoint and many other.

Shillong being a tourist place, a large proportion of workforce is absorbed in Hotel industry and Transport etc. it is mainly a service centre for entire state and rural area. The handicraft industry is not well developed and promoted in the city. It can also act as a major contributor to the economy as the number of tourists is very high and proper marketing can lead to high sales and hence high profits to the city. Bamboo is one such natural wealth, which is available in abundance and has multipurpose usage. It is used as food product, for furniture, for big & small handicrafts and as construction material. Inadequate city infrastructure thus has negative impact on the city and simultaneously on state's economic well-being.

Community wanted information, knowledge, and skill improvement training programs to contribute effectively in improving tourism in areas like local art and handicrafts, local handloom and textile, production and marketing of local produce and products.

- ✓ *There is an urgent need to develop state/city infrastructure*
- ✓ *Promotion of tourism wealth needs attention*
- ✓ *IEC for tourist population should also be prepared*
- ✓ *Promoting and developing industrial sector, planning for skill development and other training programs*
- ✓ *Awareness on government aides and small grant schemes for small scale industry development*
- ✓ *Awareness and skill development program for local habitants for developing and improving the said sectors*

6.3 GENDER ASSESSMENT

The state follows a matrilineal tradition. The women have the social status as the head of the family and custodian of all family property and traditions. However, the women retain only the social status of being the head of the households; in all the other aspects they are subordinate to the men of the households. Although the Khasis have a matrilineal society,

this however, does not mean that the women also manage the property. The male members (uncle – mother's brother and brothers) of the family take all decisions with respect to the management of the property. It is therefore a patriarchal society, where traditionally men have the upper hand in taking all family decisions. At the society level too, women have little role to play. The Khasis have the *dorbar* system for carrying out administration of their villages. Under each of these *dorbars*, there is a women's group locally known as the *Sengkynthai*. These undertake the women's affairs in the village. However, these too are subordinate to the *dorbars* that comprise only of the male members of the community. Women cannot head a *dorbar* in the Khasi tribal set up. Women in Shillong have a long-standing demand of setting up a State Women's Commission to handle the growing problems of women in the city.

Women today in Shillong are otherwise forward looking and seek opportunities for higher education, though only few look for educational and occupational opportunities outside the state. They prefer working in government offices, followed by teaching profession. Few others, for sheer economic need, open small business – selling vegetables, food items, handicraft products. Women are positioned highly in tribal society, and thus there is no discrimination either socially or in any other form – educationally or professionally. Sex ratio in the city was quite low in 1991 at 892 females per 1000 males. However, between 1991-2001, the figure has increased to 1009 females per 1000 males. An increase in the sex ratio in Shillong is primarily the result of economic forces rather than the social forces. There are no major health issues concerning women. The facilities serve all without any bias. Property is generally in the name of men folk in the family. Women otherwise are aware of and do have bank accounts and fix deposits in their name. There is no social security scheme from the government for women, what is available are the development schemes for women by the state government. As women are equally valued in society, there are no social problems such as atrocities against women. Anyhow women are aware of their rights and have equal access to law & justice.

Women seemed to be more pragmatic in their thoughts regarding the issue of community involvement in the urban infrastructure development programs. And sounded quite enthusiastic to act and motivate others in the community for community project contributions.

Apart from SHGs, there are women oriented NGOs and CBOs, that work primarily for women upliftment and welfare, few examples IMPULSE, NEEDS, ACTs and many more. The SHGs are functioning quite well by involving themselves in self sustainable efforts.

- ✓ *Community needs more clarity regarding the present project and knowledge on how can they contribute*
- ✓ *Women seem to be more acceptable on the issue of community affordability.*
- ✓ *Women's group demanded additional small grant schemes, awareness regarding what other activities they can take up.*
- ✓ Awareness generation and training are important components for all women in the city.
- ✓ They especially gave importance to awareness generation with respect to women & hygiene.
- ✓ *Women demanded improved water supply system and public toilet facilities.*

6.4 YOUTH ASSESSMENT

The city of Shillong to many is the 'rock music capital of India. This has been the contribution of youths in Shillong. Many international and Indian rock groups visit Shillong every year. Shillong itself has produced a many legends in rock music which are greatly recognized all over India. Some of Shillong's own popular rock groups are Soul mates,

Revel Soul, Great Society, King Apple, Snow White, Colors, Midnight Garden Factor and so on.

The dynamic, enthusiastic and optimistic trend among the Shillong youths is encouraging. Characteristically they are forward looking and look for availing opportunities for improving the living standards. As the tradition has taught them, they have strong community cohesiveness. Community indicated that youths today are slowly drifting away from traditional norms and ethos.

They feel that the state lacks in adequate employment opportunities, and hence look for a chance to move out and 'achieve the best'. They feel if the state's employment sector is improved, not many will opt to move out of the state. Low job opportunities in the state have led to the unemployment problem and backwardness of the region. They agreed with certainty that unemployment and youth's vulnerability to crime and corruption are directly proportional to each other. And as there is no social security from the government for these youths, there are more chances of their susceptibility to negative elements of the society.

A significant youth population in the state are involved in self employment. They readily want to involve themselves in community development projects/programs. Involving community in development initiatives in itself is a recent venture and therefore involving youths is also a new phenomenon. It was further observed that the recently started NGOs and CBOs (more of NGOs) are initiatives of the local youths.

- ✓ *They expressed desperation to avail better opportunities to live a better life*
- ✓ *They wanted more information & awareness on self employment opportunities*
- ✓ *They also expressed interest for gaining more knowledge and understanding of NGO roles through workshops, seminars and training programs.*
- ✓ *Youth groups needed more clarity regarding the present project and information on how they can contribute*
- ✓ *Youth seemed to be more easily getting convinced regarding user charges and pay & use facilities*
- ✓ *They suggested their involvement in IEC campaigns through music and otherwise.*

6.5 COMMUNITY ASSESSMENT

Community bond is very strong among the tribes of Meghalaya, a distinctive feature of the tribal communities. People readily help each other in time of need. The district data of 2001 indicated that East Khasi Hill has 93 per cent of Khasis, and 3.30 per cent of Garos, whereas only 1.22 per cent are other tribes. Shillong being part of East Khasi Hills district have a high concentration of Khasi tribes.

The Khasis are matrilineal which means that their descendants are along the line of the mother. A boy or a girl born of a Khasi mother, belongs to the family of the mother. The property is inherited by the youngest daughter or Ka Khatduh'. In the Khasi society, the women look after the home and hearth, the father finds the means to support the family, and the maternal uncle settles all social and religious matters. In the conservative Jaintia non-Christian families, however, the father only visits the family in the night and is not responsible for the maintenance of the family. While in the Garo society, the parents have an option to select any daughter as heiress or Nokna.

There are primarily two levels of community group hierarchy, *Dorbar Hima* and *Dorbar Shnong.* The *Dorbar Hima* or the State Assembly is presided by *SYIEM* who is the chief of a tribe who rules a HIMA or a number of villages or areas. Syiem can be elected only from the Syiems' family or its legitimate branch. The electoral council consists of Council members and other Heads of Clans. The functions of Syiem include: construction and

maintenance of roads, bridges, water sources and sanitation, establishment of and maintenance of markets and collection of dues, welfare works and community services, judicial powers to settle petty disputes/cases, to organize cultural festivals. Altogether there are fifteen 'Syiems' by fifteen clans. The 'Syiems' are only titular heads. Actually the 'myntries' (ministers) play the decisive role through democratic process under the 'Syiem', the presiding officer.

Each Village or Area has a *Shnong* headed by a *Rangbah Shnong* (Headman) who is elected by voice vote of the villagers. Other members are elected in a similar manner. Term of office vary from Dorbar to Dorber. It enjoys no legal or constitutional status. The *Dorbar Shnongs* are responsible for looking after law and order, maintaining the common properties of the village and ensuring the delivery of urban services which is done in cooperation with the SMB and related State Government departments. In many urban areas, the *Dorbar Shnongs* works with the Governmental agencies and NGOs' in providing services like water supply, electricity, roads and foot paths schools and dealing with anti social elements. It also implements SJSRY.

The Khasi tribes were reported to be more progressive minded. Majority of them do have good education and employment sector. A subtle domination is there, but no significant inter tribal conflicts have been reported.

Except at the ward official level not many from the community really knew about the forthcoming project efforts. Majority did not have any knowledge about any aspect of the project. Community members could mention about some development projects in with which they have worked, but could not clearly mention about the main project, funding agency for the program, what actually was the project content, why they were being involved and so on.

It was conveyed that the community involvement was not often direct and was through the *dorbar* to the ward officials. To make it more clear, community members posed problems to the *dorbar heads, and the durbars carried it* to the departments. In the process sometimes they used their own judgement in identifying and prioritizing the need, and let their self interest influence the judgement. As a result the community problems sometimes persisted.

Not many, but very few from the community knew about the communitization approach being imbibed by the government departments. But they were not very clear about the real meaning of 'communitisation of project efforts'. Community well understood 'individual or family ownership', for them 'community ownership' was a new concept, and beyond comprehension. Community also wanted clarity on how could they contribute in the urban sector development programs.

Community awareness about development issues in general was low with the people in lower income category, people otherwise knew about the development efforts that the government had been undertaking. They knew about the *Right to Information (RTI) Act* and generally about rights and duties of Indian citizens.

Community members, mainly from HIGs and youths do sit together to spend some leisure time talking about city development efforts. There is not much knowledge sharing among the family members. Neither family nor schools and other institutions discuss/carry awareness programs. The community could not report of witnessing any such development programs.

Community members, though very few, mainly the ward officials and their associates knew about the ADB Project initiatives of improving water supply, solid waste management and improving approach road to the dumping ground. Interestingly many knew this to be the

state government's effort and did not know or were interested to know the source of funding.

TABLE 1.8 : COMMUNITY PRIORITIZATION OF URBAN INFRASTRUCTURE DEVELOPMENT

Sectors	Men	Women	Youths	HIGs	LIGs
Water supply	1	1	4	1	1
Electricity system	13	9	14	14	5
Sewerage system	6	7	9	4	9
Drainage system	5	6	8	3	8
Landslips	15	15	15	15	15
Health issues	12	8	7	10	6
General sanitation	3	4	10	9	7
Public toilets	7	2	6	11	3
Solid waste management	2	3	1	2	4
Environment protection	11	14	5	5	10
Roads	14	13	13	13	14
Transport system	8	5	11	12	13
Building regulations	4	11	2	6	11
Market improvement	9	10	3	8	12
Slum area development	10	12	12	7	2

The community from all sections prioritised improving the water supply system. Youths put high priority to city solid waste management. Electricity was least in priority list except for the lower in groups, probably because majority of them lived in slum areas that lacked basic amenities and hence they prioritised slum area development as well. Requirement of well maintained public toilets were indicated by many along with improving general sanitation. Improving city drainage and sewerage system was highlighted by many; this will also contribute in city sanitation and protect the environment. Health issue was a priority area particularly for the lower income group – not being able to live a good standard life, youths – being more prone to drug addiction & smoking, and women – involved in more work and less care. Youths prioritised market area development as well.

The community never had undergone any training in skill development program to make any technical contribution in the project activities. Anyhow they expressed willingness to learn and acquire more knowledge and participate or involve themselves more constructively in the development project initiatives.

Following consultations and discussions community seemed to understand the value of their participation with active involvement and positive contribution in the state development programs. But insisted that there should to be total government effort in community infrastructure development with adequate service delivery; community may then take up the responsibility of maintaining and managing the same.

VOLUNTARY ORGANIZATIONS

Traditionally tribal societies have manifested a strong community bond which resulted in strong community groups. Shillong is no exception to this trend. These groups have been very active in performing community tasks of welfare and infrastructure development. The community group called *Dorbar* is the example. They have been actively involved in construction and maintenance of roads, bridges, water sources and sanitation; establishment of and maintenance of markets and collection of dues; welfare works and community services; judicial powers to settle petty disputes/cases; to organize cultural festivals within the community area.

While community groups are traditionally strong, the emergence of NGO's/CBO's is a new phenomenon. These are involved more in efforts to address day to day issues rather than in development tasks. Some NGOs recently have embarked on health programs, women's welfare, and rural development.

Therefore if a role for these organisations is carved out for urban infrastructure development projects, there will be strong need for capacity building without which all efforts will be futile.

- ✓ *For any community development initiatives the involvement and consultation with the Syiem and/or Rangbah Shnong is inevitable.*
- ✓ *There is no requirement of creating community based groups; traditionally they have been there, with a community head.*
- ✓ *Community wanted information on how they can participate and get involved in the programs.*
- ✓ *They require clarity on community affordability and that affordability is not always in money, it can also be in service and/or kinds.*
- ✓ *The concept and usage of communitization and few other terminologies have to be made clearly understood by the community members.*
- ✓ *Community needs technical knowledge awareness on actual activities, for instance wanting to know how metering would work in given circumstances.*
- ✓ *Some members indicated training needs in construction work so that skilled labours become available locally (within community).*
- ✓ *Community members indicated willingness to participate and be involved in community development programs, if there are monetary contributions from the government under small grant schemes, where community monetary contribution would be only ¼ and 1/3 for other well-off localities.*
- ✓ *Community expressed willingness for contributing in infrastructure maintenance, rather than its construction.*

6.6 IEC Assessment and Requirement

IEC requirement in the present context is two-fold. First, it is to create awareness among the community for participating and involving themselves in the development projects to let it run successfully, and second, it is community awareness regarding the urban infrastructure facilities - on making infrastructures available and then ably maintaining and managing them.

There have been instances where development efforts have taken place but not many seem to be aware of it, and sometimes the identified projects show a failure due to miss-identification and/or miss-prioritization. Not having clear information about the effort, one does not get to enjoy the benefits. Further many live with the attitude of getting involved with the activities that solely concern them ignoring those which are relevant to community and society and thus tend to miss many opportunities. For instance at the state/city/community level, the development activity is decided evaluating its need and benefits for majority, hence involvement of everyone reduces the possibility of inappropriate need assessment, and builds the social pressures for quick implementation and successful completion.

The success of a project initiative is not limited to its one time construction and initial level of participation and involvement. The post construction period is equally important. There has to be follow up studies to assess if the activities and participation is still continuing.

Community awareness regarding infrastructure availability and consciousness of managing and maintaining it also has a bearing on community participation and involvement in the

development projects. It is also an important factor to determine the project's success. Infrastructure once constructed, but not being used indicates failure of the effort. And to rightfully use one needs to have it accepted, and maintain well for long lasting use. To accept, to use and to maintain – it is important to be aware of its requirement, its usage and how to maintain it.

The IEC materials for community involvement in development projects should thus underline project's main components followed by minor details, rationale for the project, description of the project activity, its clientele and beneficiaries, location, budget, required community contribution, possible outcome, future benefits, success stories from same effort elsewhere.

Community witnessed limited awareness activities in select areas. They reported witnessing awareness programs and IEC materials mainly in health sector, concerning HIV/AIDS, immunization, prenatal-post natal care, sanitation covering hand washing and keeping drinking water safe, identifying health problems like TB and breast cancer and so on. Some have also seen posters campaigning for electricity and water saving. Many have witnessed awareness drive for improving literacy. No one has as such heard or seen IEC campaign for managing and maintaining urban community infrastructures.

It was reported that community benefited most from literacy campaigns and health awareness programs. There had been visible changes in thoughts and understanding among the community members regarding the issues. Community was very familiar with campaigns through posters, wall paintings/wall posters, and short documentary films and advertisements on TV. According to them, the most influential IEC material/s would be presentation through posters. An IEC to be effective, its location was equally important as was its colour and sound effect. From the wide range of IEC material options presented to the community, the preferences are presented in Table 1.9

TABLE 1.9: PREFERENCE FOR IEC MATERIALS

Materials	Men	Women	Children	Youths	HIG	LIG	Unaware
Booklets	2	5	12	11	3	14	-
Leaflets	3	6	16	12	4	15	-
Posters	1	3	3	1	2	1	-
Street plays	19	15	14	13	15	17	-
Role playing	-	-	-	-	-	-	✓
Drama	18	16	6	7	18	16	-
Quiz programs	14	12	1	17	14	10	-
Films/Videos	9	8	7	6	5	2	-
Books/gazettes	17	19	20	20	19	21	-
Calendar	10	4	8	7	6	3	-
Flip charts	-	-	-	-	-	-	✓
Media presentation	5	1	2	8	1	4	-
Game play	21	21	13	21	21	12	
Guidelines	-	-	-	-	-	-	✓
Advertisements	6	2	9	16	7	5	-
Painting competition	4	17	4	2	16	11	-
Information sheet	11	7	15	9	8	18	-
Magazines	7	13	10	10	13	6	-
Manuals	-	-	-	-	-	-	✓
Models	-	-	-	-	-	-	✓
News letters	12	14	21	14	9	20	-
Picture sets	20	20	11	19	20	13	-

Materials	Men	Women	Children	Youths	HIG	LIG	Unaware
Song-CD/tapes	13	10	17	5	10	7	-
Word of mouth	15	9	18	15	11	8	-
Tool kits	16	18	19	3	17	19	
School activities	8	11	5	4	12	9	-
Any other	-	-	-	-	-	-	-

The choice of poster was unanimously selected to be the most preferred option for IEC use. Books and poster were preferred by men & women both but not so much by the children and youths. More visual depictions with sound effects like film/videos, media presentation, and advertisements were next preferred as they catch attention very easily. Children and youths preferred more of theatrical presentation of the issues. Booklets, leaflet, information sheets was preferred options for men, women and HIGs. Women opted for more leisure time visuals. LIGs preferred mediums that were available to them easily. Children and youths preferred more school oriented medium of communication, and more playful items, with quiz, paintings, drama etc. There wasn't much difference among preferences of HIGs and LIGs, except that HIGs preferred more readable items that were at the same time easily available. People in Shillong weren't really aware of role playing, flip charts, guidelines, manuals and models.

Effective information generation and communication is important to make the IEC effort worthwhile. The message to be conveyed should reach the stakeholders. Apart from carrying out IEC drive with only the community and only at the location, a futuristic approach be imbibed, that is to say it should also intend to sensitize others who may not be directly concerned at that very moment but do have the impacting power. Thus IEC usage in the schools from the beginning, influencing young minds at a tender age, when they are 'learning to learn' will have more definite effect than otherwise. Similarly, IEC for the tourists in the tourist information brochures and pamphlets and at the information centres will be easy to carry and communicate.

- ✓ *IEC is required for creating awareness among the community members for agreeing to participate and remain involved in the development project efforts*
- ✓ *IEC preparation needs to be appropriate and acceptable, it should be community friendly*
- ✓ *The impact of IEC materials should be intermittently assessed.*
- ✓ *Use preaching of spiritual/religious leaders along with olden days fables to support IEC messages.*
- ✓ *The CICs have to be introduced /modified and their functioning monitored.*
- ✓ *IEC exposure for the infrastructure development programs should start right as early as school age.*

KEY FINDINGS

- ❖ While community has a tradition of strong bond, this has not been translated for participation in development efforts.
- ❖ Need for community participation needs to be contextualised and internalised, it should not be imposed upon them.
- ❖ Community requires effective motivation and mobilization in order to prepare them to participate and remain involved in the infrastructure development initiatives as a active partners.
- ❖ Community needs extensive awareness programs to manage and maintain community infrastructures in a way that feel that it belongs to them.

- Community contribution may be difficult but not impossible. Community will be ready to contribute provided the service delivery improves and they feel this change.
- Community needs exposure in the use of a variety of IEC materials as a tool for community participation.
- An assessment of IEC usage and its effectiveness has to be undertaken so that it remains meaningful.
- Systematically effective monitoring of IEC material impact on management and maintenance of infrastructures is needed.
- There are already existing traditional community groups working for the development of their community and these needs to be harmonised.
- They need to be trained in handling the development programs in more systematic manner
- Local NGOs/CBOs/TIs need exposure and capacity building programs.