



Solid Waste Management

**Municipal Corporation of Greater
Mumbai**

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Current Status of SWM

- **Generation**
- **Segregation and Collection**
- **Transportation**
- **Road sweeping**
- **Treatment and Disposal**

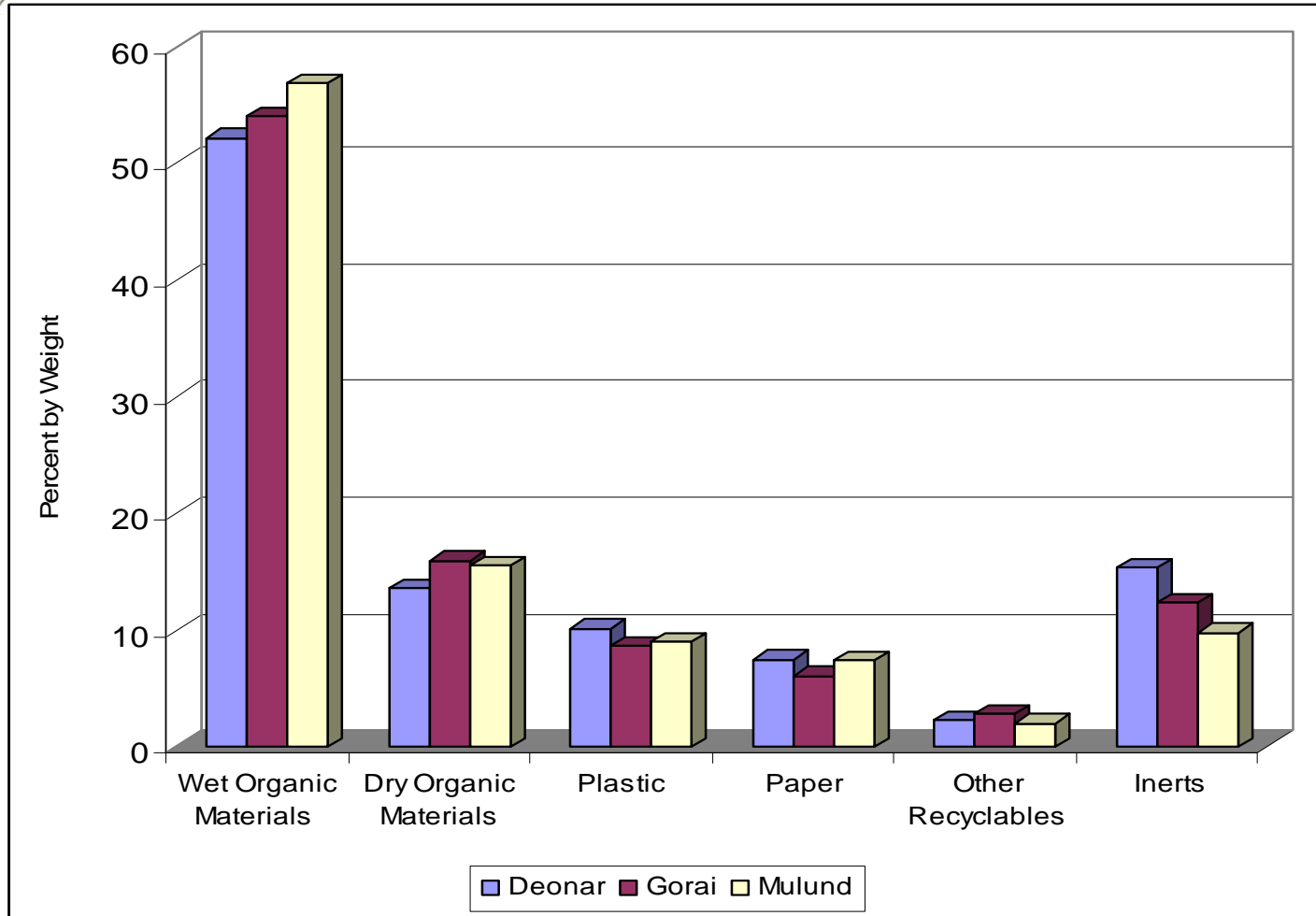


Generation of MSW

- | | |
|-----------------------|-------------|
| • Per capita expected | 450 gm/day |
| • Total SWM generated | 8500 MT/day |
| • Biodegradable waste | 6000 MT |
| • Dry waste | 500 MT |
| • Silt and Debris | 2000 MT |
| • Bio-medical waste | 25 MT |



Aggregate Composition – By Major Material Category Reaching Dumping Grounds





Segregation & Collection

- **House to house collection** **25%**
- **Collection at community bins** **75%**
- **Total community bins** **6223**
- **No. of community bins removed** **3115**
- **About 1050 MT of recyclables are segregated and sold by about 20,000 rag pickers.**
- **Approximate value of recyclables sold is between Rs. 55 to 75 crores per year.**



Type and Number of Collection Bins

Type of Collection Bins/ Temporary Storage	No. of Containers
1 cubic meter	1,471
1.1 cubic meter	429
2.5 cubic meter	103
5.2 cubic meter	433
Sheds	308
Round bins	609
Stationary Compactors	10
Open Dumps	292
Total	3654



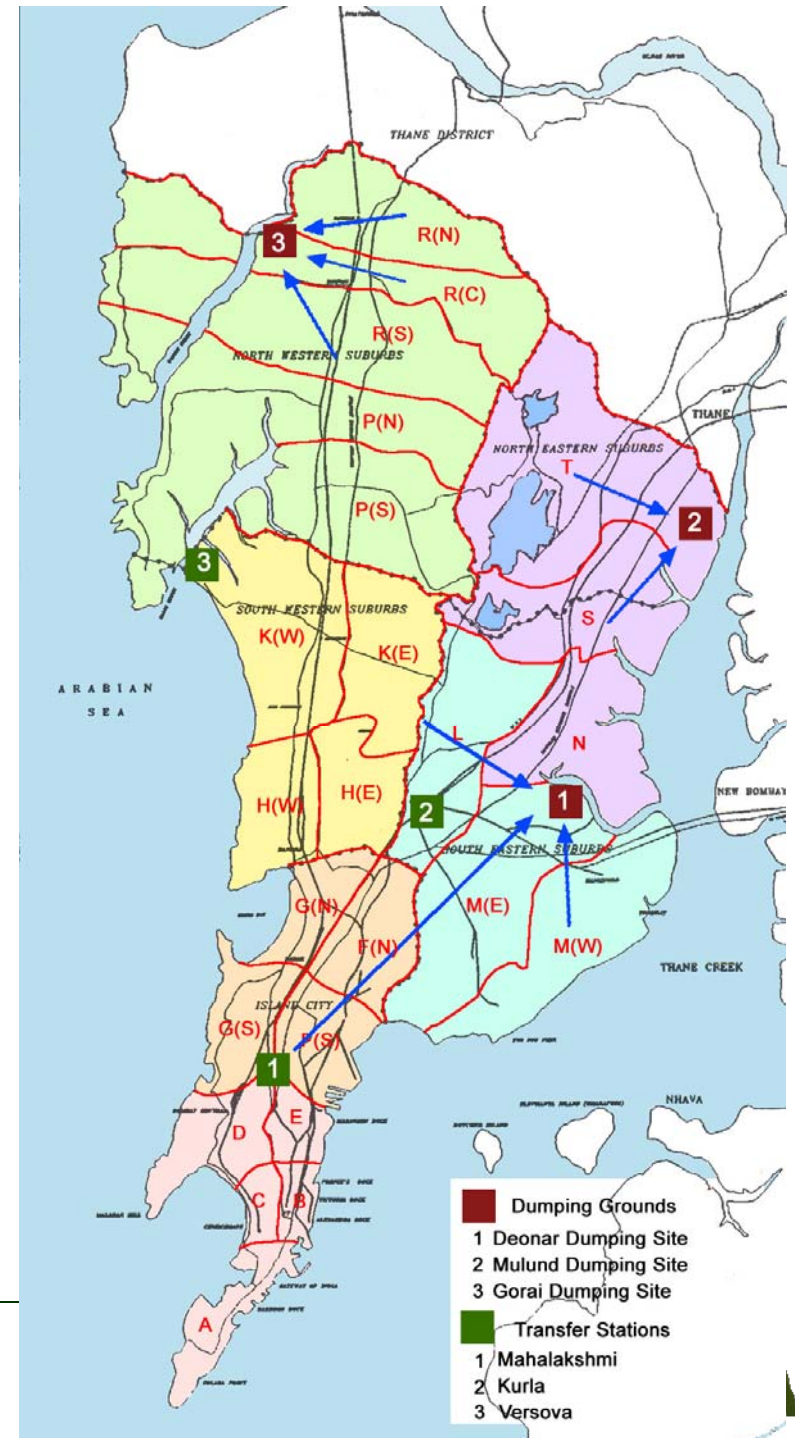
Road Sweeping

- **Street sweeping**
 - City 4000-5000 sq. mtr/pair
 - Suburbs 8000-10000 sq. mtr/pair
- **Time of street sweeping 6.30 am to 1.30pm**
- **Departmental sweeping 1225 km.**
- **Balance through contract/NGO labours**



Transportation of MSW

- Fleet of 296 municipal and 677 private vehicles
- 1350 trips per day
- Municipal staff numbering 5000
- Three transfer stations combined capacity of 600 MT per day





Type and Number of Collection Vehicles

S. No.	Type of Vehicles	Municipal Vehicles	Private Vehicles	Total
1	Compactors (Big)	117	313	430
2	Compactors (small)	-	258	258
3	Skip Vehicles	89		89
4	Small Tipper	-	106	106
5	Tippers	90	-	90
6	JCBs	19	-	19
7	Bull Dozers	20		20
8	Poclain	5	-	5
9	Stationary Compactor	10		10
10	Crawler Dozer	-	2	2



Treatment of MSW

- Treatment at small scale plants (less than 20 MT per day) is done through involvement of ALMs/NGOs.
- Composting and vermi-composting are the primary means of treatment.
- Total treatment capacity is in the range of 100-150 MT.



Disposal of MSW

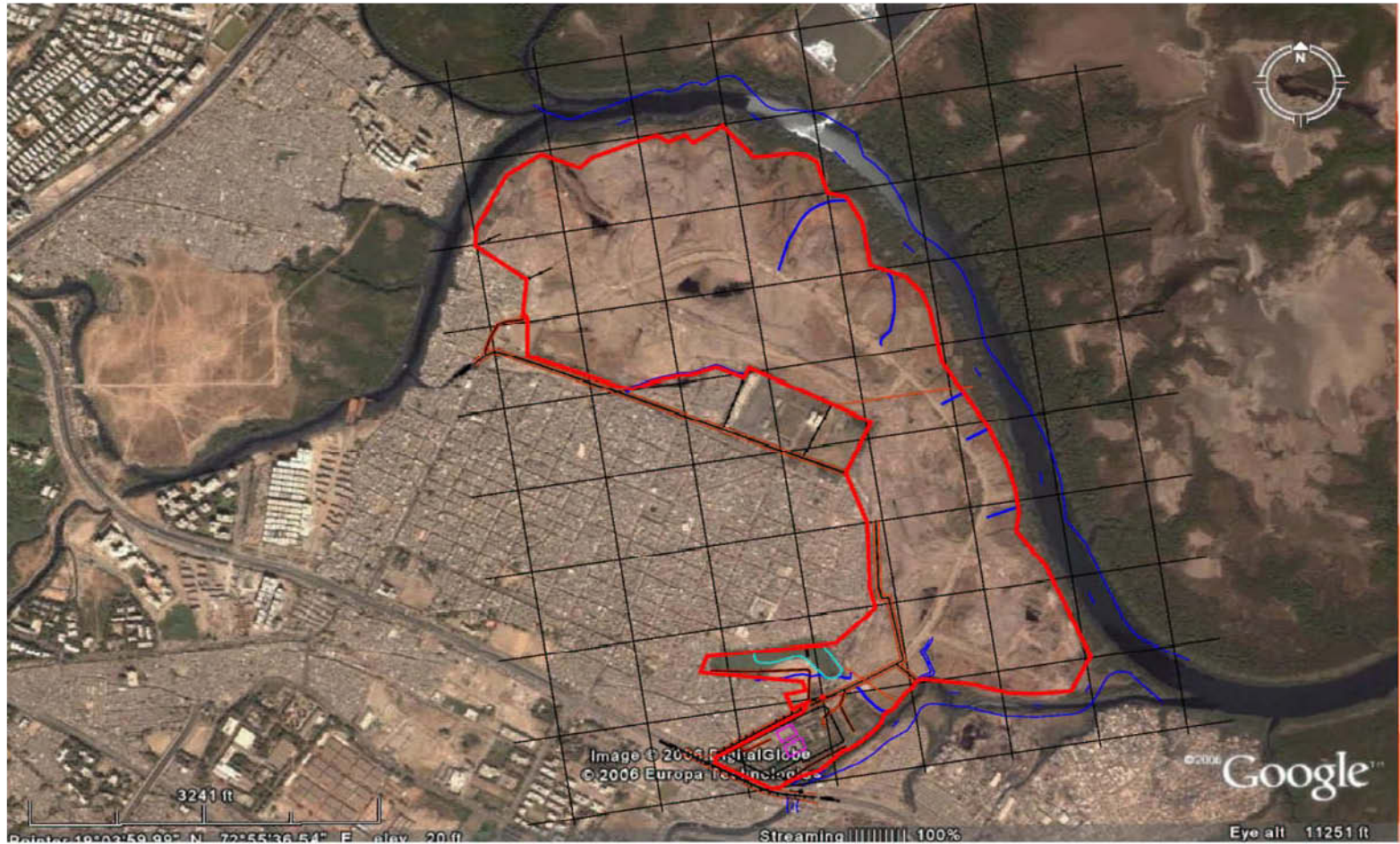
- MSW is disposed at three disposal sites by open dumping**

Name of Site	Operational Since	Total Area (ha)	Height of Waste (m)	Future life (years)
Gorai	1972	25	21	2
Mulund	1968	25	16	2
Deonar	1927	110	18	8

- A green field site of 141ha area at Kanjurmarg has been recently allotted by State Govt.**



Layout of Deonar Disposal Site



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Layout of Gorai Disposal Site



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Layout of Mulund Disposal Site



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New Initiatives Taken by MCGM

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Initiatives Taken....

- Morning rounds by Asstt. Comrs./DMCs and other senior officers increased.
- Daily monitoring of important roads being done.
- Sweeping of important roads being finished before 8 am everyday.
- Action against bird feeders/dog feeders being taken on regular basis. Cases registered with local police stations.
- Action against cow feeders envisaged. Warnings already issued for impending action.
- More NDs/Municipal security personnel deployed for taking strict action.
- All shops and commercial establishments served with warning notices (more than 3 lakhs notices) for using dustbins and maintaining clean premises including front pavements.
- Action being taken on regular basis against unauthorized hoardings.
- Action being taken against spitting, urinating, littering etc. on regular basis.



Initiatives Taken...

- **Outsourcing the following activities:**
 - 30% of the road sweeping through NGO labour;
 - 100% manning and mopping in the afternoon on important roads;
 - More than 60% transportation is outsourced;
 - Mechanised sweeping of highways, orders are placed;
 - 100% Landfill site management under PPP framework.



Byelaws 2006

- **Greater Mumbai Cleanliness and Sanitation Bye-laws, 2006** have been approved by MCGM, which provides for
 - Mandatory segregation at source by households.
 - To facilitate society level segregation, more than 5000 rag pickers have been trained and organised through NGOs.
 - To dissuade citizens from making the streets dirty after these are swept everyday.
 - To stop all types of bird/animal feeding on non-designated public places.
 - To instill a sense of strict discipline amongst citizens, if they expect that Mumbai should be developed into a world class city.



Byelaws 2006 (contd.)

- **Dry waste sorting centers:**
 - Creation of covered areas at the ward level are planned for segregation and recovery of recyclables.
 - These centers to be managed by NGOs who are expected to organize rag pickers, and interface with recycling industries. Instead, NGOs can be given some advertisement rights to cross subsidize their cost.
 - E-waste, latest category of waste, can also be accepted at these centres.



Initiatives taken....

- 9340 litter bins already placed. 3000 more to be placed at strategic locations like bus stops, traffic signals attached to zebra crossings, outside railway stations.
- Enforcement squads formed in each ward for taking daily actions against unauthorised hawking; implementation of Byelaws.
- Outsourcing Bye Laws implementation through pvt security agencies
- Manning and mopping squads on contract basis for high footfall areas.



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Initiatives taken.....

- 15 important roads in the City have been identified as “zero tolerance zones”: one Day Officer appointed for each road.
- Improved implements being deployed like mopping sticks (1000) for picking up litters,
- Small mechanized sweepers being introduced for road sweeping.
- Night sweeping of VIP roads through contract labour.



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Streamlining MSW Storage at Community Bins

- Replacement of community bins is planned with bins of uniform design amenable to mechanical loading and unloading
- Purchase of 6000 bins with lid of 1.1m³ capacity are planned to replace dumping in 'open' and 'refuse sheds', on priority
- These bins are going to be cow and crow proof.



Improved Community Bin



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Improvement of Collection and Transportation

- **Slum Adoption Scheme through CBO participation for improved collection of MSW in slum areas:**
 - CBOs are registered and provided monthly honorarium for waste collection and cleaning the small nallahs and drains
 - CBO's are allowed to collect user charge from beneficiaries (Rs 10 per household per month)
 - Rs. 2500/- per 1000 population is paid by MCGM to CBOs per month (10% adl for hilly area).
 - Rs. 370/- per 1000 population is paid to CBOs per month for implements.
 - Two training programmes : training of 650 office bearers and 760 volunteers of CBOs with the help of UNICEF, Ruia College and United Ways in chronically affected 8 wards.
 - 385 CBOs covering 6.8 million slum population have been registered
 - 100% coverage is aimed at in 2007-08.



Improved transport

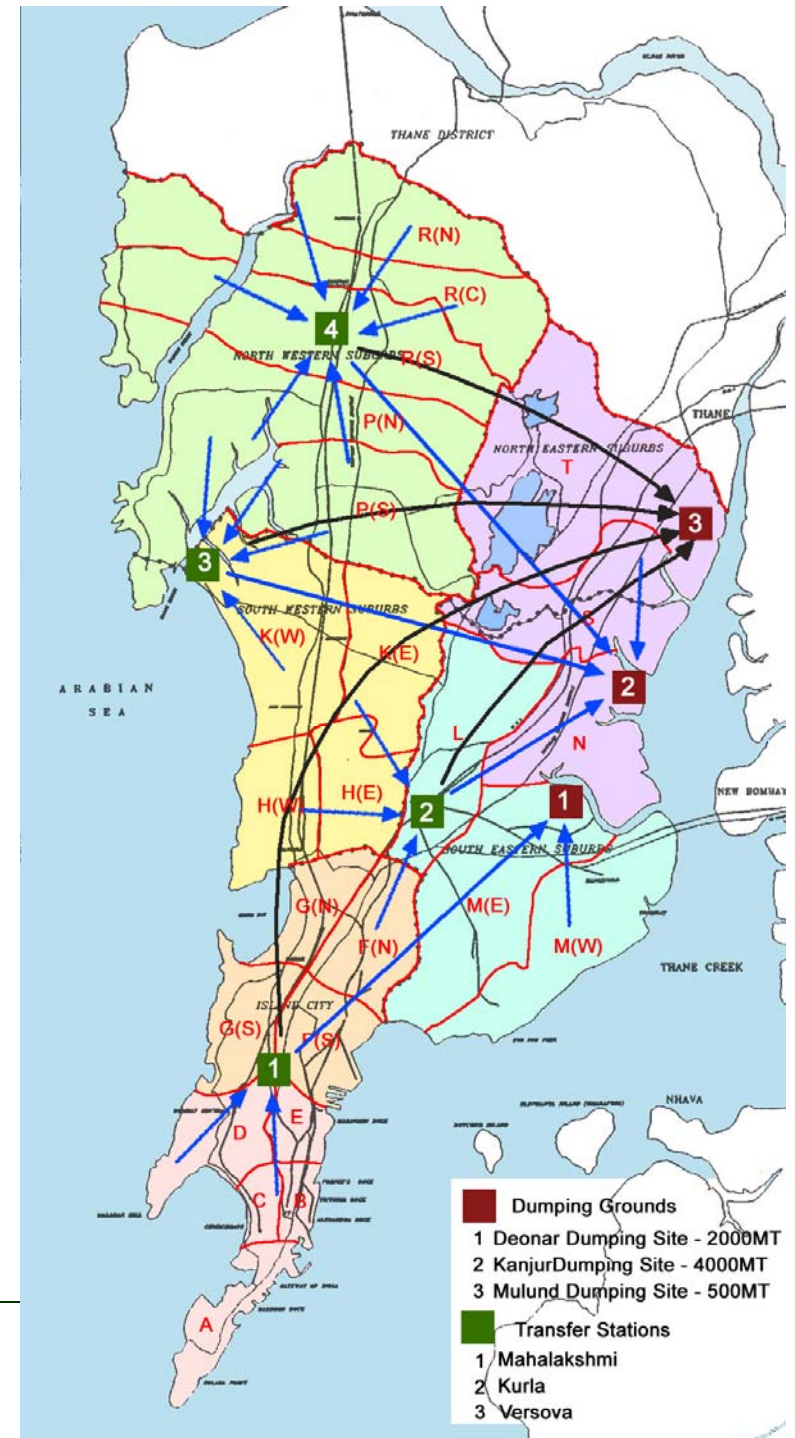


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Improvement in Transportation

- In future Deonar [1] and Kanjur [2] will be main disposal sites
- Haul distances will increase
- Judicious use of transfer stations will be essential
- Proposal is to improve and add new transfer stations





Modernisation of Refuse Transfer Station at Mahalaxmi

- Mahalaxmi Refuse Transfer Station (MRTS) is the oldest Transfer Station located near Mahalaxmi Railway Station, the only transfer station in city area.
- At present, about 580 to 600 dumper placer vehicles and small refuse vehicles are unloaded, collecting refuse, round the clock from collection points in A to G/North wards.
- Earlier, the receipted garbage was transported with the help of 'Bulk Refuse Carriers' up to dumping grounds namely (Deonar & Mulund).
- Due to phasing out these "Bulk Refuse Carriers," as per Hon. High Court's orders, not adhering to latest pollution norms, the load is presently transported with the help of JCB/Dumpers.
- MCGM has decided to modernize the refuse transfer station to be operated on "Build, own & Operate" basis for a period of 10 years. The capacity of the transfer station is 750 MT/day, which can be enhanced to 900 MT/day.



Salient features and advantages

- ❖ Avoid multiple handling of Garbage.
- ❖ Reduce no. of vehicles & no. of trips of garbage transported, thereby reducing transportation cost.
- ❖ Compaction reduces weight of garbage, hence per vehicle capacity increases.
- ❖ Closed Vehicle will prevent flying & spreading of garbage.
- ❖ Unloading time at landfill/ processing plants gets reduced making overall control easy.
- ❖ High level of cleanliness can be maintained with environment friendly standard.
- ❖ The Leachate formed due to compaction is treated in a scientific manner.



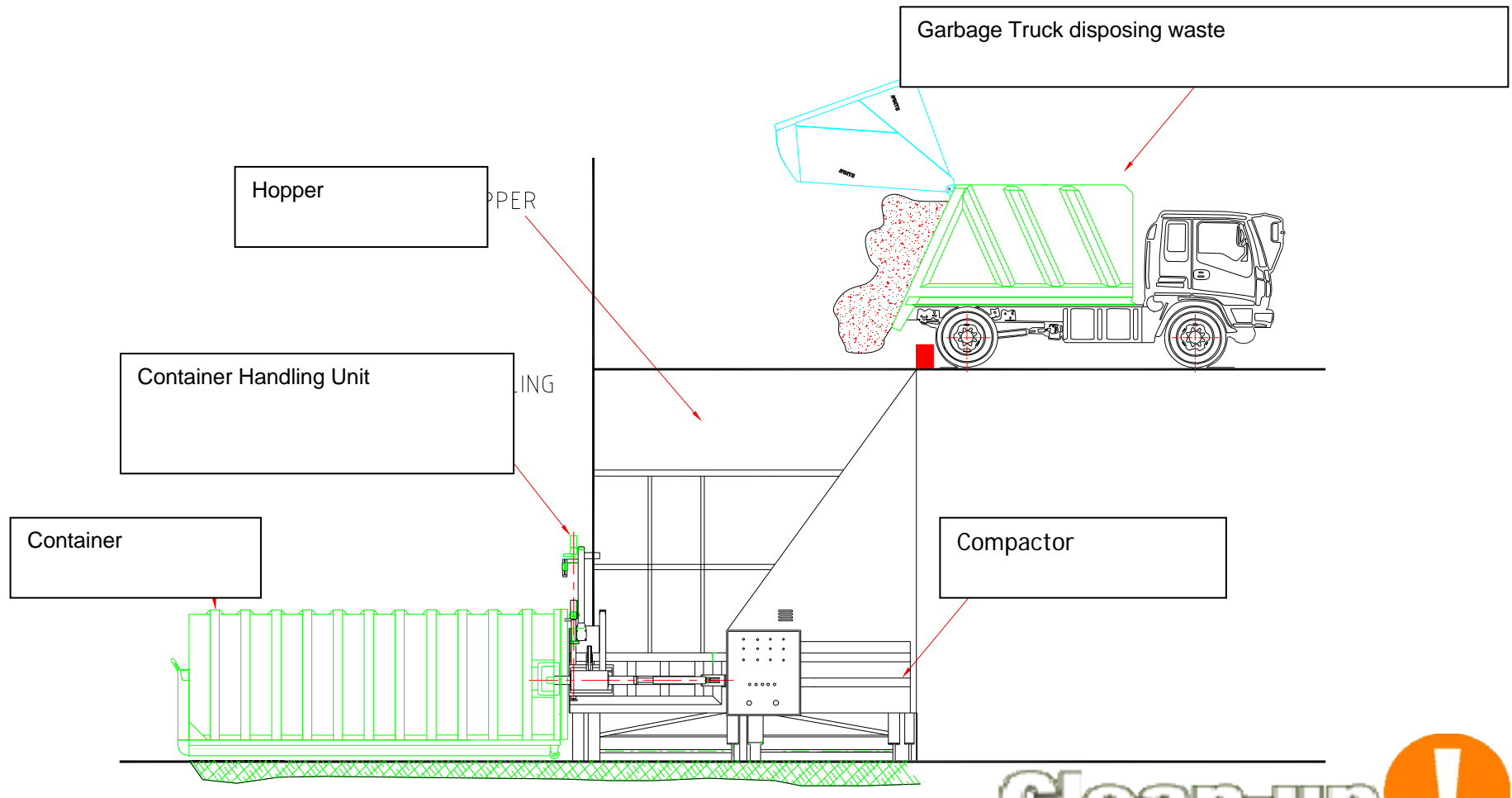
Features of MRTS is as under

Capacity	750 MT/day
No. of Transfer Station Compactors (with Hoppers)	2 Nos + 1 (stand by)
No. of Containers	20 CuM (20 Nos)
No of Hook lift vehicles	15 Nos.
Weigh bridges	2 Nos. (30 ton capacity each)
Leachate treatment	1 no.

The other related infrastructures like sheds for vehicles & containers, water pumping arrangements, drainage system, vehicle washing, office premises, computer room, storage rooms, deodorant spraying on the vehicle etc. The cost is included in B.O.O. cost. The total B.O.O. cost for installation, maintenance & operation for 10 years is Rs. 53.88 crores (approx)



The general view of transfer station process is as under.



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PROCESS FLOW IN TRANSFER STATION

Diagram 1: GENERAL PROCESS CHART

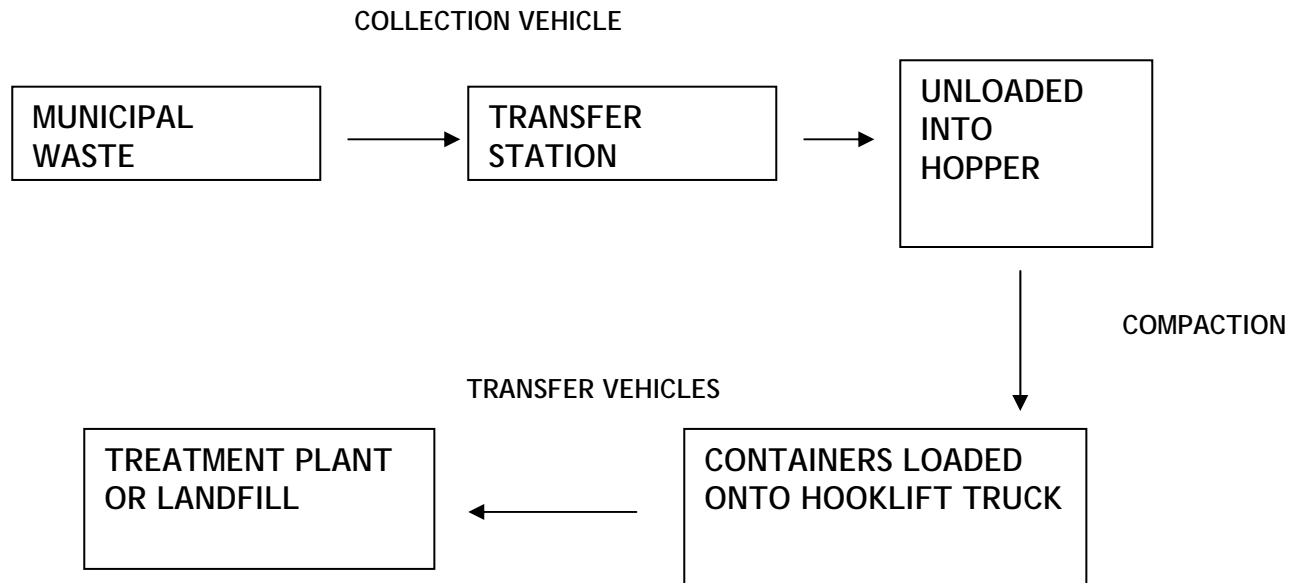
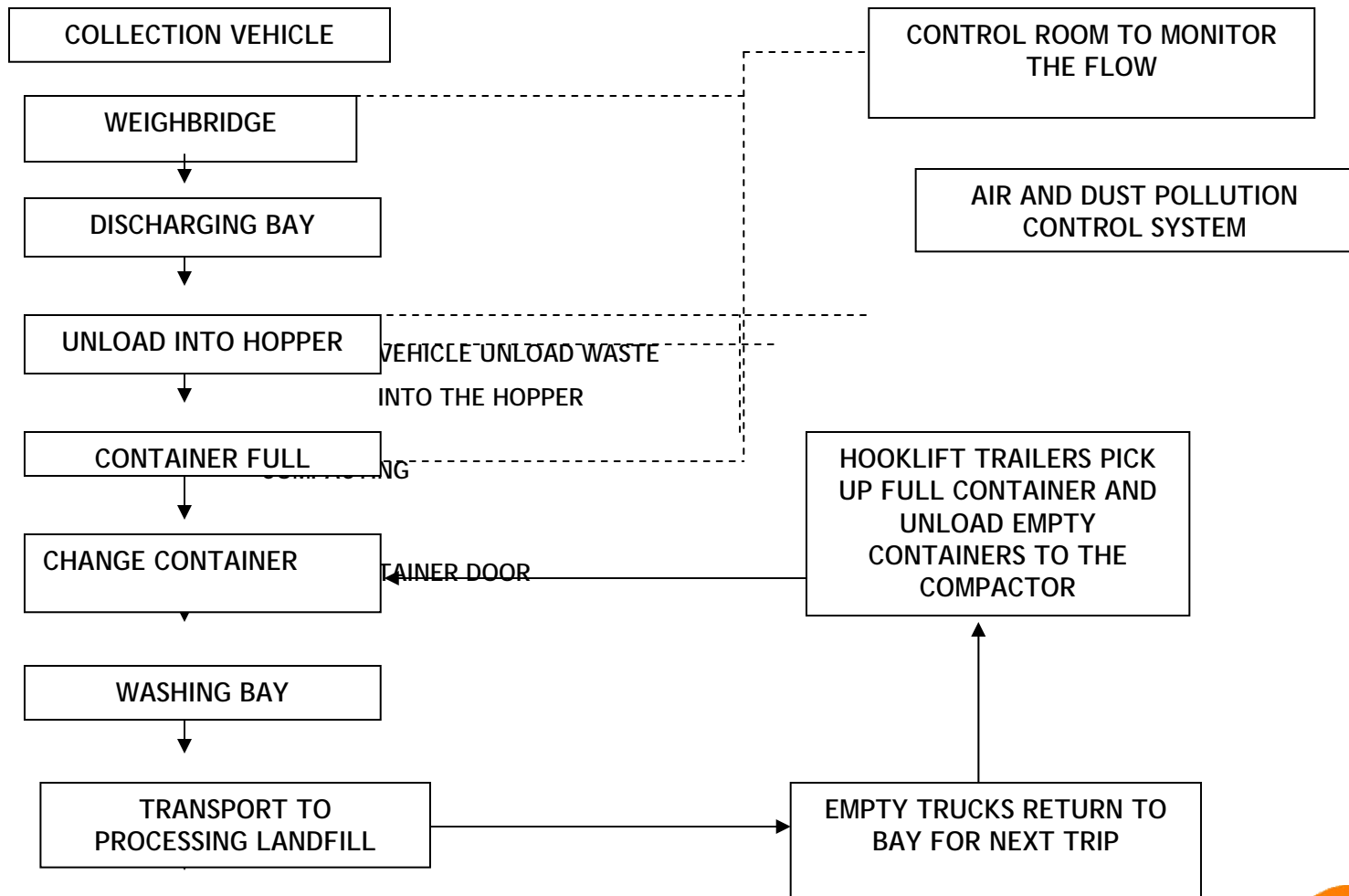




Diagram 2: TRANSFER STATION PROCESS CHART





New Transfer Station (example)



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Transfer Station (example)



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New Transfer Station (example)



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Inside view (Transfer Stn)



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Management Plan for Landfill Sites

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Background

- **Treatment and Disposal are areas of major deficiencies in SWM in Mumbai**
- **A comprehensive solution addressing long term (25 years) need for management of MSW and C&D waste was required.**
- **MCGM awarded a detailed study to IL&FS in July 2005 for development of integrated treatment and disposal plan for Mumbai**



Sampling and Analysis of MSW

- Sampling at 3 dump sites were carried out for 7 consecutive days, round the clock
- Category wise sampling was conducted at the ward levels for a period of four days (inclusive of a weekend) prior to onset of monsoon
- Category wise sampling was conducted at the ward levels for two consecutive days during monsoon
- Conducted Market Waste sampling at Dadar and Crawford market



Critical MSW Characteristics

- **High Organic Content > 50 %**
- **High Moisture – about 50% in dry period, up to 65% in monsoon**
- **Low calorific value (below 1000 K Cal/Kg)**



Technologies considered

- **Aerobic composting**
- **Refuse derived fuel**
- **Bio-methanation**
- **Mass Burn (Incineration)**
- **Gasification/Pyrolysis**
- **Sanitary Landfill (Landfill as Bio-reactor)**
- **Plasma Pyrolysis Vitrification (PPV)**



Technology Evaluation Criteria

Reliability Filter



Proven Technology for Large Scale Application

Proven Internationally requires Caution before adopting for Mumbai

No Proven Track Record

Waste Suitability Filter



Suitability for Mumbai Waste

Can be made suitable by using Auxiliary Fuel

Unsuitable for Mumbai Waste

Environmentally Accepted Filter



Environmentally and Socially Accepted

Environmental Suspect/Does not Meet MSW Rules 2000

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Short listed Technologies

- **Composting**
- **Bio-methanation**
- **Refuse Derived Fuel for special waste**



Projected Population & MSW Generation

Year	Population (Million)	MSW (TPD)
2005	12.8	6100
2010	13.6	7100
2015	14.4	8100
2020	15.3	8900
2025	15.9	9800
2030	16.2	10500



Objective of Landfill Plan

- **Suitable for Mumbai waste characteristics**
- **Cost effective**
- **Takes care of about 6,500 TPD MSW initially and meets the need for 10,500 TPD by 2030.**
- **Meets regulatory requirements.**
- **Integrates use of C&D debris to the extent feasible.**
- **Makes optimal use of available sites.**



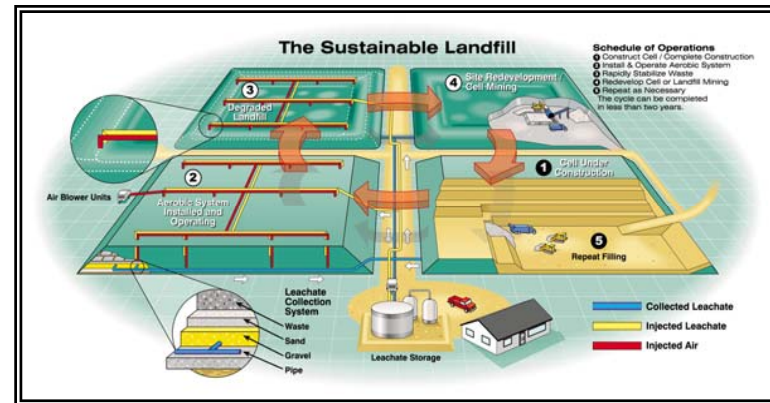
Strategy for Waste Management

Site	Waste Allocation (tons)	Total Area (ha)	Closure Needs (ha)	Available for future (ha)	Waste Processing Technology
Mulund	500	25	13	12	Bio-methanation + SLF
Deonar	1500	132	55	77	Composting + SLF
Kanjur Marg	4500	85	nil	82	Composting +SLF



Proposed Scientific Management of Dumpsites

- **Creation of space for future operation**
 - Shifting of Existing waste
 - Capping
 - Landscaping



Before Shifting



After Shifting and Capping

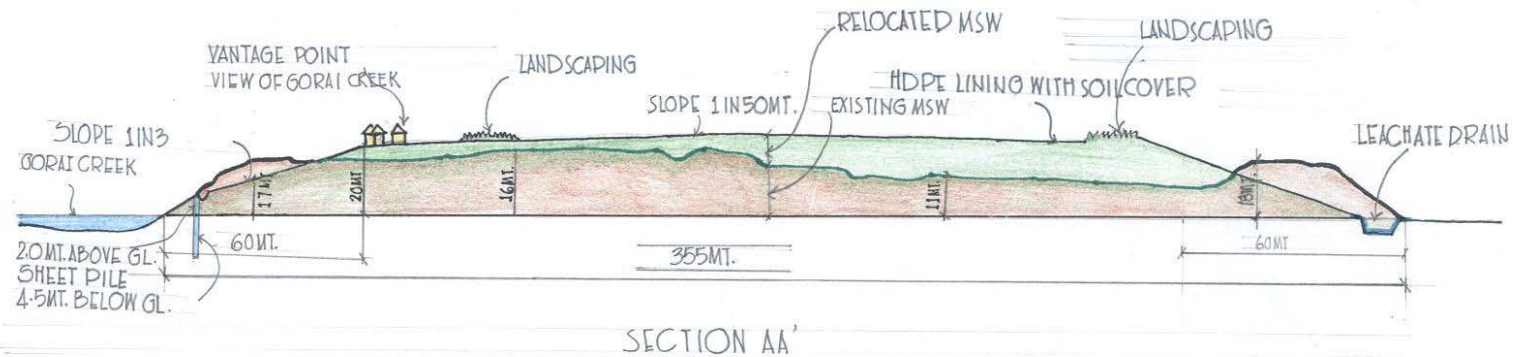


After landfill closure

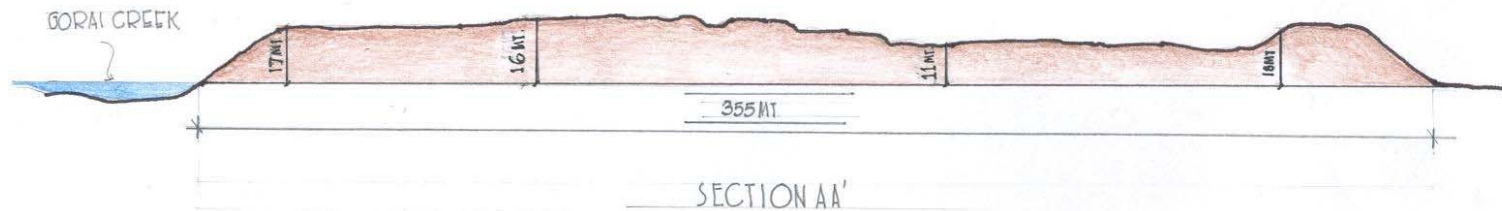
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Site Management Plan for Gorai Cross-section view at section AA'



TYPICAL SECTION - PROFILE AFTER CLOSURE OF THE SITE

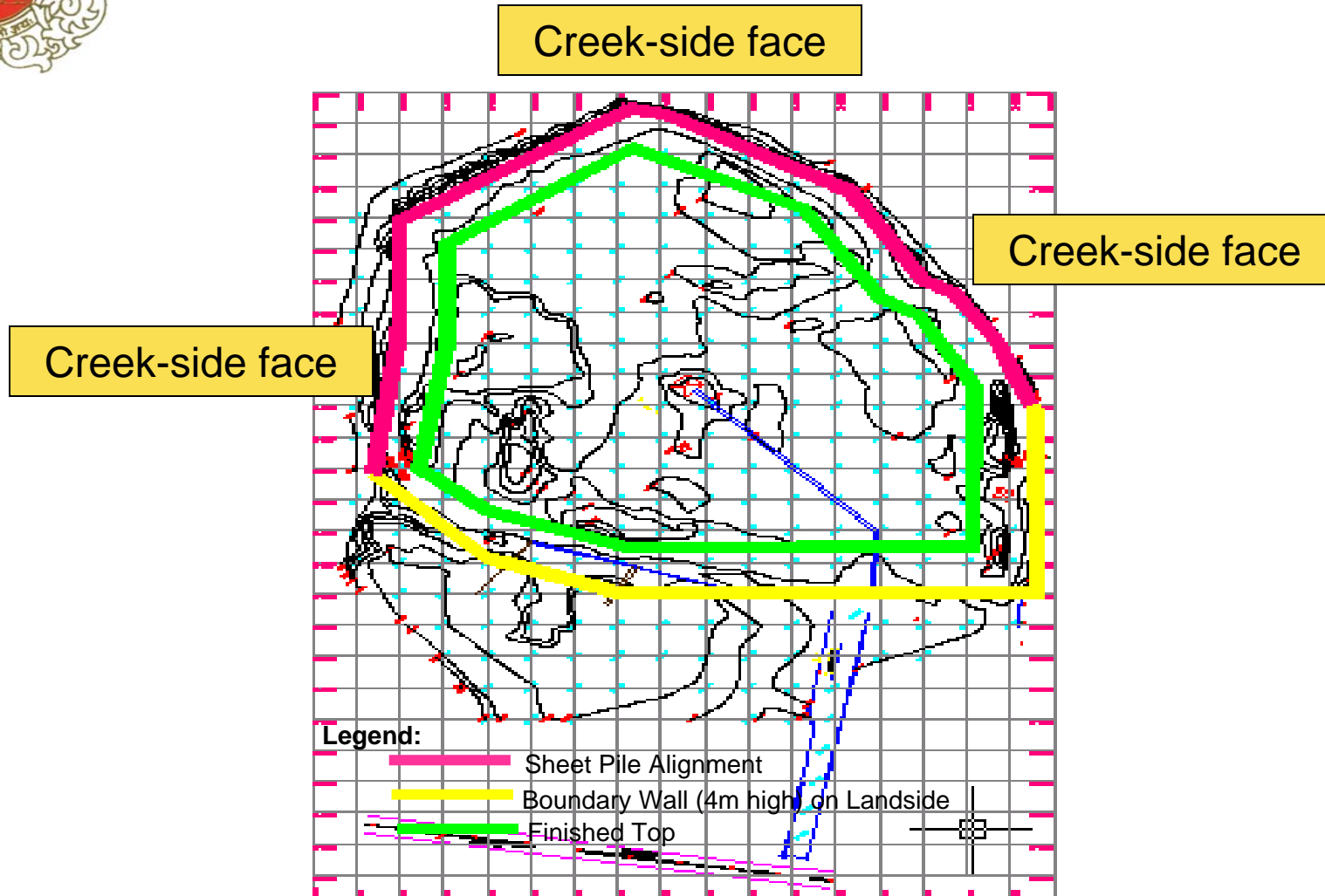


TYPICAL SECTION - EXISTING PROFILE OF DUMP

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Site Management Plan for Gorai Sheet-pile arrangement and finished levels





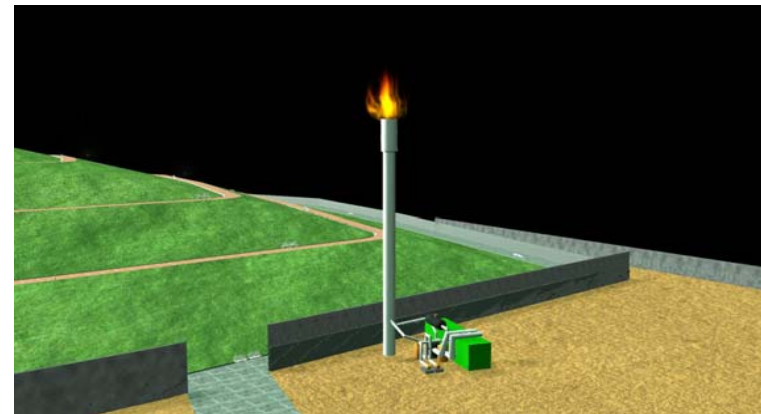
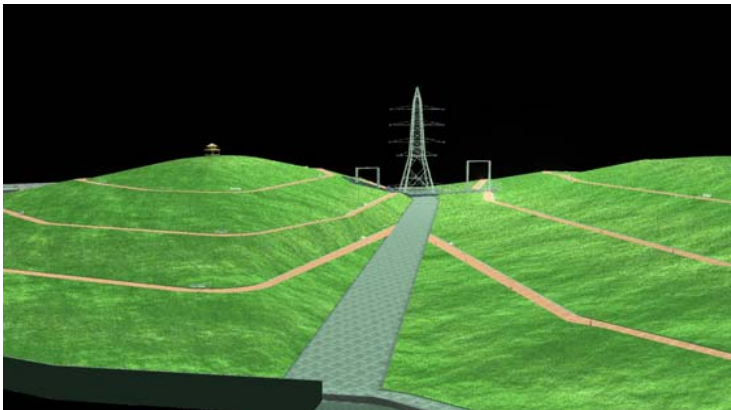
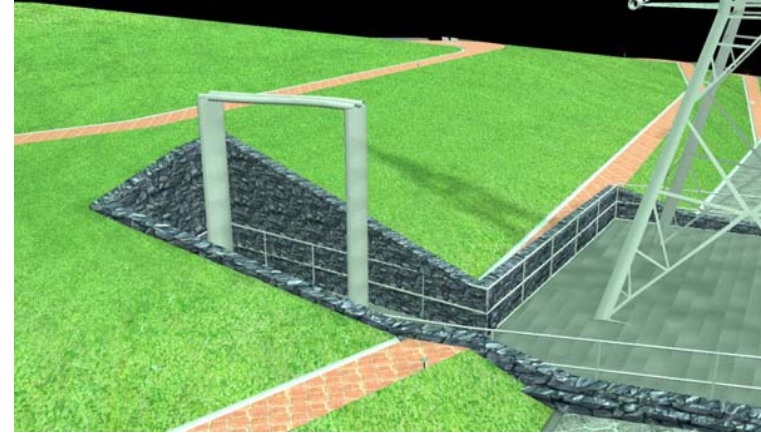
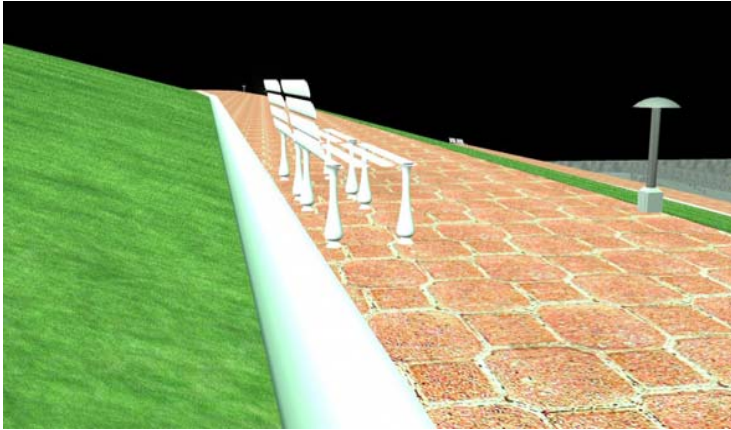
Site Management Plan for Gorai



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Gorai Landfill 3D Plan

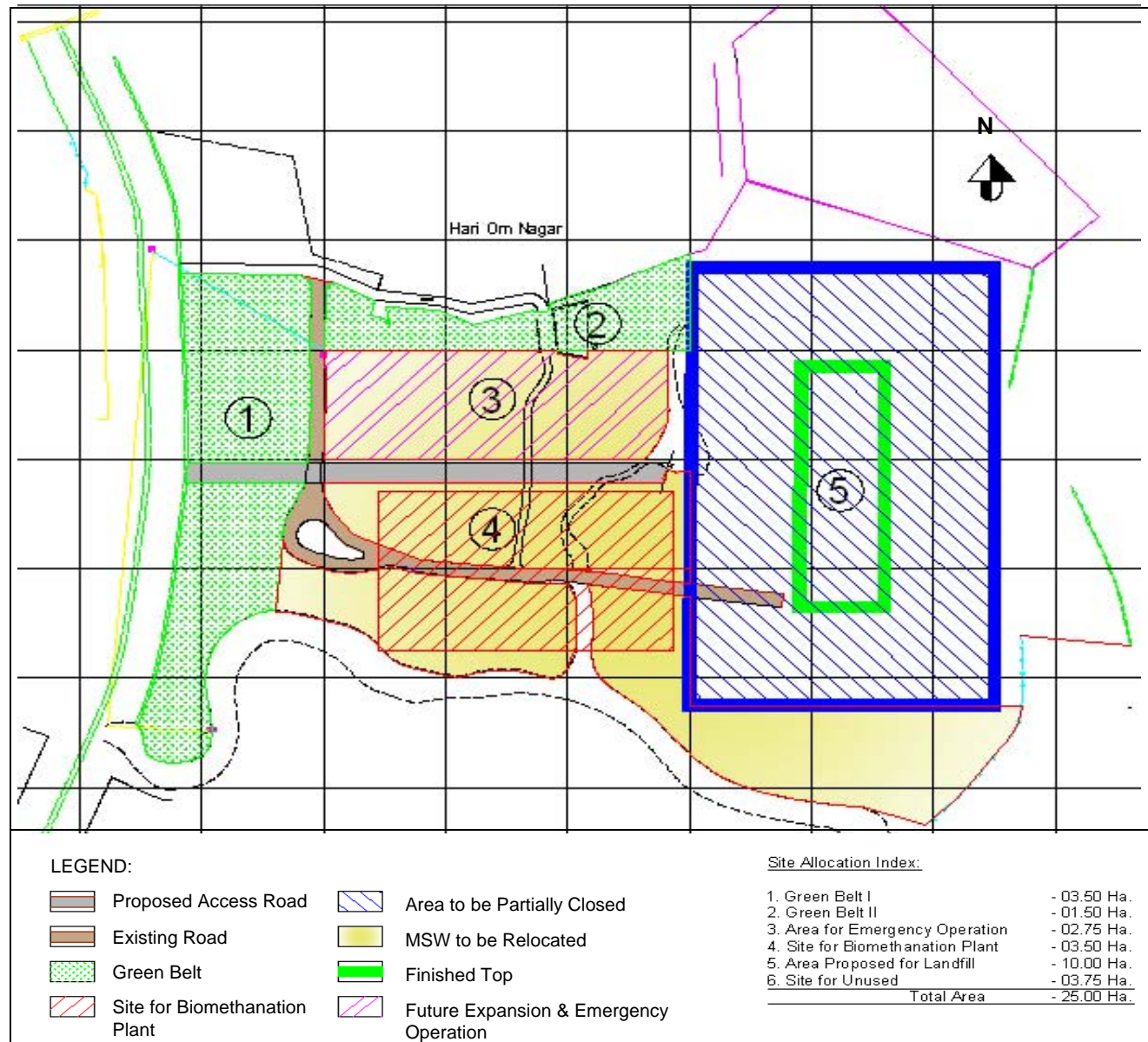


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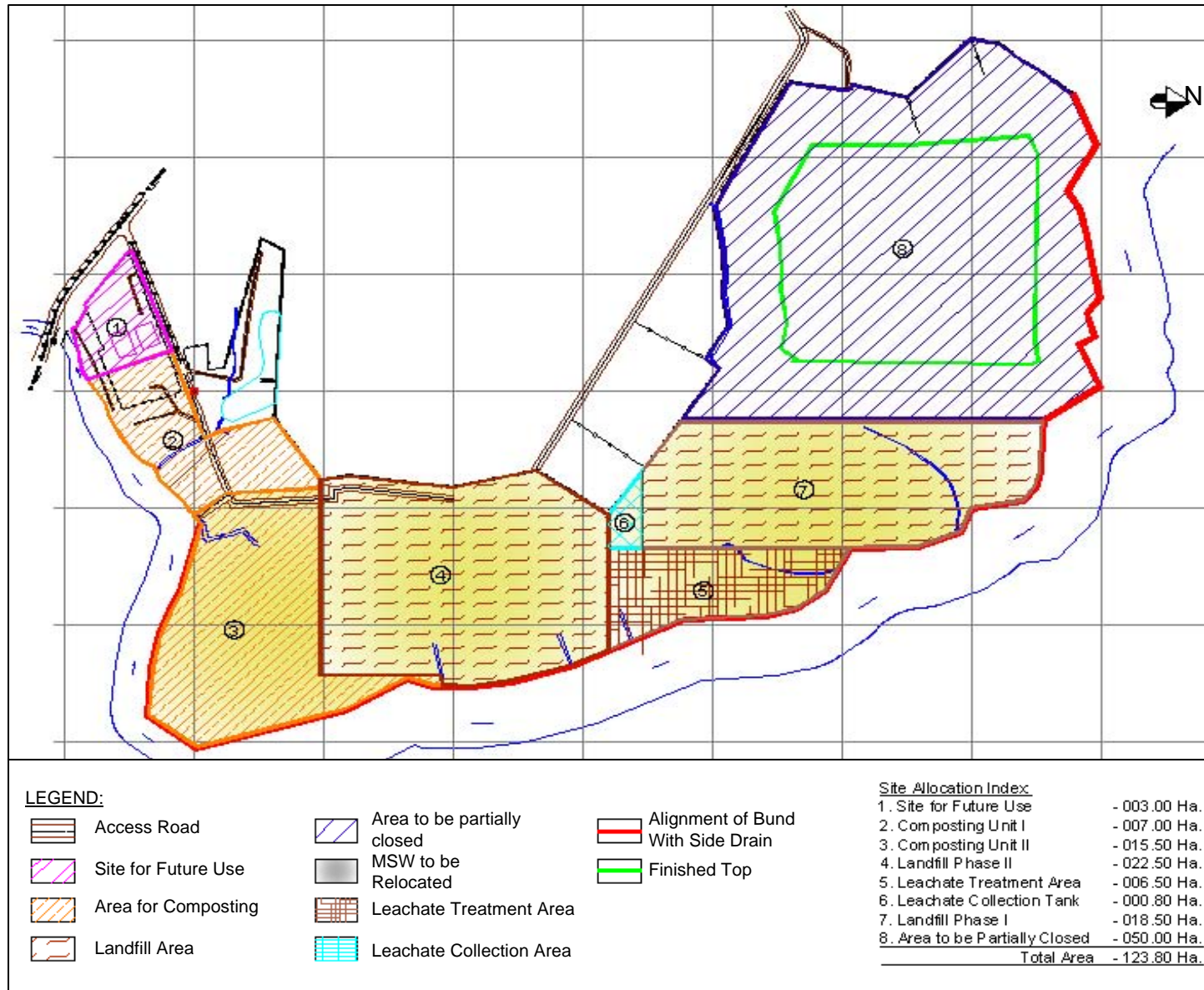
Site Management Plan for Gorai





Management Plan for Mulund Site



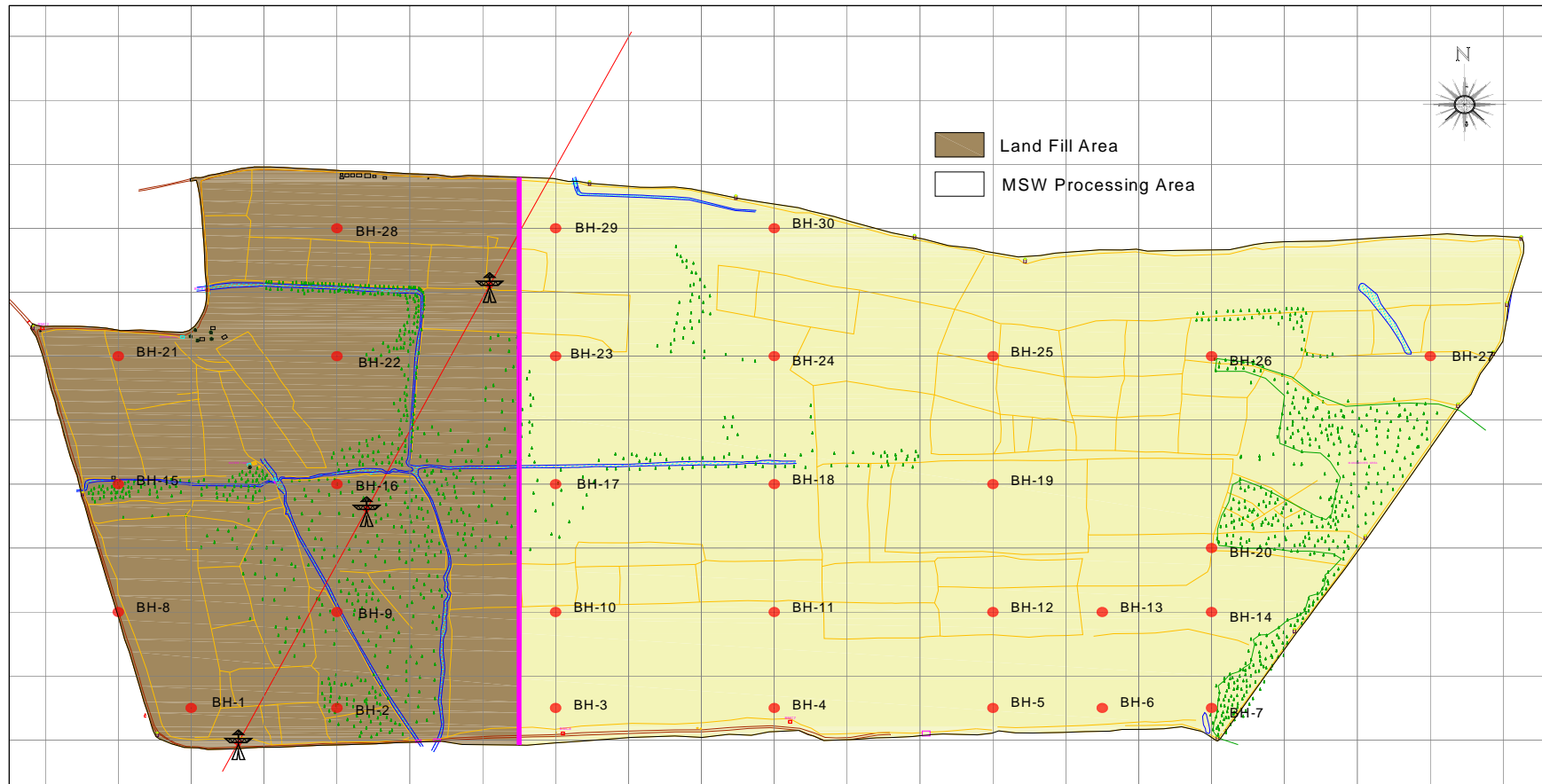


Management Plan for Deonar Site

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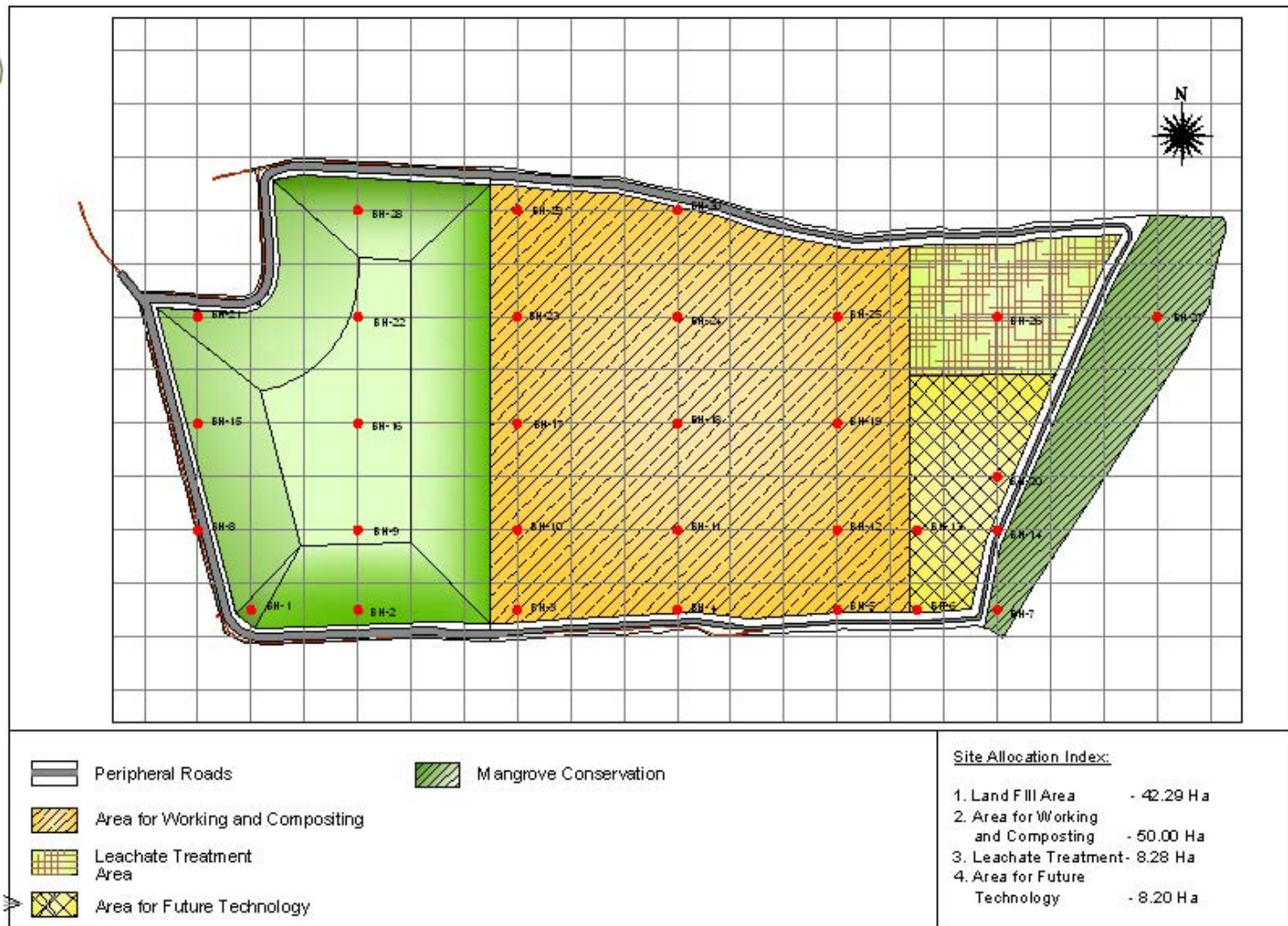
Kanjur Management Plan



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Kanjur Management Plan





Financial Implications for Treatment and Disposal

- **Cost for closure and clearing of existing waste :**
Rs 144 crores
- **Total Investment Requirement over 3 years:**
 - Mulund Rs 79 crs
 - Deonar Rs 58 crs
 - Kanjurmarg Rs 180 crs
 - **Total Rs 319 crs**
- **Average Annual Tipping Fees (80% compost sold)**
 - Mulund Rs 4 crs
 - Deonar Rs 11 crs
 - Kanjurmarg Rs 17 crs
 - **Total Rs 32 crs**
- **Total Project Cost is Rs 495 crores. Project proposal for JNNURM funding already submitted.**



Approach adopted

- **A Public Private Partnership framework for implementing the projects.**
- **Partial closure of the site and clearing of existing waste considered as a separate project for bidding.**
- **An integrated waste management facility would be bid out for each of the sites comprising of waste processing facilities (including for C&D Waste), SLF and closure.**

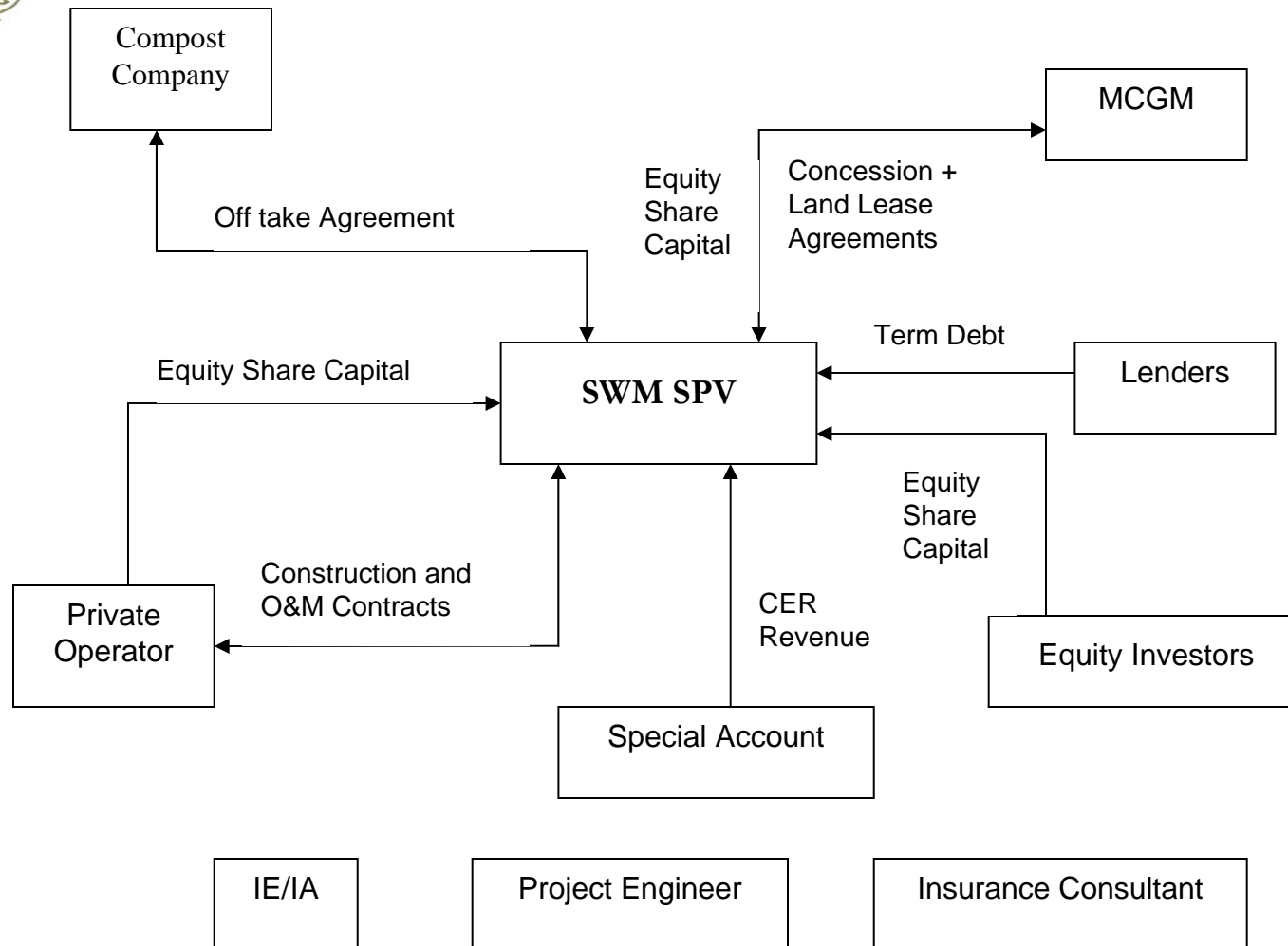


Implementation Strategy

- **A Public Private Partnership structure for implementation**
- **Structuring of Project has attracted both National and International Operators**
 - 10 bidding consortiums pre-qualified
 - Mix of national and international bidders
- **Off-Take agreements**
 - with Fertilizer company for compost
 - with Gas company for methane gas
 - with Power company for power



Typical Project Structure





Cost and Means of Finance

- **Total Project cost: Rs.496 crores**
- **Means of Finance:**
 - Private sector contribution Rs. 254 crores
 - JNNURM Rs. 90 crores
 - (for non-remunerative closure component)
 - MCGM's budgetary resource
 - Carbon credits (to enhance project revenue flows and minimize tipping fee to municipality)
 - Revenue from sale of compost
 - Revenue from sale of methane gas
 - Revenue from sale of power



Tipping Fees

Parameter	Tipping fees required for 15% project IRR Sale of Compost – 100 %		
	Mulund	Deonar	Kanjur
Compost price Rs. 1,800 TPD	Nil	Rs.118/ton	Rs.90/ton

- Operation Period: 15 Years (all sites)
- Cost of operations – 7.5% of base cost (Mulund)
- Terms of debt - 12 years with 2 year Moratorium, Interest – 10% (all sites)
- Cost of landfill operations (Deonar) - 230/ton
- Cost of landfill operations (Kanjur) – 190/ton
- Power tariff - -as stipulated by MERC (Mulund)



Sensitivity Analysis of Tipping Fees

Parameter	Tipping fees required for 15% project IRR		
	Mulund	Deonar	Kanjur
Increase in compost price to Rs. 2,000 TPD	Nil	Rs.65-70/ton	Rs. 40-50/ton
Sale of compost – 80%	Nil	Rs.173-175/ton	Rs. 145-150/ton
Sale of compost – 50%	Rs. 50-60/ton	Rs.260-265/ton	Rs. 230-235/ton



Environmental Benefits

- **On-Site Environmental Benefits**
 - Conservation of CRZ Area
 - Impact on Micro-Climatic Condition
 - Aesthetical Improvement and Control on Smoke, Dust, Vermin and Flying Refuse
- **Off-Site Environmental Benefits**
 - Contribution to Green House Gas Emission Control
 - Improvement in Air Quality in the Neighborhood
 - Improvement in Surface Water Quality



Environmental Benefits

- **Social Benefits**

- Improved Working Conditions for Rag Pickers
- Impact on Economic Opportunities in the Neighborhood
- Reduction in Bird Nuisance to Air Safety



Bidding Strategy

- **Selection of private operator on Build, operate, maintain and transfer basis**
- **Concession period – 25 years**
- **Operators' Responsibilities**
 - Receive, process and dispose off waste received at the site during the concession period
 - Implement the facility within given timeframe and as per desired performance level
 - Mobilize funding for the project
 - Compliant with laws/rules
- **Operators' rights**
 - Rights over revenue from sale of process outputs
 - Partial CDM benefits
- **MCGM's obligations**
 - Make arrangement for delivery of waste at the site
 - Provide land at disposal site on lease during concession period
 - Payment of tipping fees



Pre-qualified bidders

- **SembCorp Env. Mgt. Pvt. Ltd., Singapore with SITA Env. Solns. Australia**
- **IVRCL Infrastructure and Project Ltd, Hyderabad with Enkem**
- **Veolia Environmental Services Asia Pvt Ltd, Chennai**
- **United Phosphorus Limited, Mumbai with End-I Ag Germany**
- **Antony Waste Handling Cell Pvt. Ltd, Mumbai with Modern Asia Environmental Holdings, Thailand**
- **Unity Infraprojects Ltd, Mumbai with Han-je Bio-Tech Energies Pvt Ltd.**
- **SPML, Delhi with SMEC Intl. Pvt Ltd**
- **ILISO/DSW, Durban with Garware**
- **Ambuja Cements Ltd., Mumbai with Eco-Save Systems Pvt.Ltd**
- **EA Infrastructure Operations Pvt. Ltd., Mumbai with AMA Italy, UDC Kuwait**
- **Ramky Enviro Engineers, Hyderabad with City of San Diego**
- **STRABAG-AG, Austria**



Project Features

- **At par with International Best Practices.**
- **Participation of well establish international companies as technical partners**
- **Fully integrated facilities with complete residue management and zero waste discharge**
- **High standards of compaction, daily cover, gas collection and leachate control and treatment**
- **High standards of air quality, water quality, noise and odour control, supported with regular monitoring**
- **Provision for closure compliant to international norms**
- **Effective and complete isolation of the waste from coastal water bodies and Provision of Green Belt**
- **Fully covered waste handling areas to maintain cleanliness and smooth operations during monsoon**



Clean Development Mechanism

- **Potential CDM benefits for closure of dump sites, capture of landfill gas and composting**
- **Approved methodology for estimation of baseline emission**
- **CDM benefits feasible for composting and bio-methanation**
- **Cash benefits for seven years starting from 2008**
- **Prevailing market rate of CERs \$20 and VERs is \$10**
- **CERs can provide a continuous flow of revenue stream increasing commercial viability of the project**
- **By securitizing future CERs, capital cost of the project can be funded**



Benefits To City

- **Professional and scientifically managed disposal of solid waste in key sites in Mumbai.**
- **Environmental and health benefits.**
- **Compliance with MSW 2000 Rules.**
- **Developing public-private partnership.**
- **Sound contractual structure that attracts private capital and management skills.**
- **Long-term sustainable solution.**
- **Role model for other cities.**



Thank you

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