



राष्ट्रीय ग्रामीण विकास एवं
पंचायती राज संस्थान
NATIONAL INSTITUTE OF RURAL
DEVELOPMENT AND PANCHAYATI RAJ
Ministry of Rural Development, Government of India



Standard Operating Procedure for a Swachh Campus

Solid Waste Management



Standard Operating Procedure for a Swachh Campus

Solid Waste Management



**National Institute of Rural Development and
Panchayati Raj**

Rajendranagar, Hyderabad – 500 030

www.nird.org.in

© National Institute of Rural Development and Panchayati Raj

Published in October 2017

Printed at VAISHNAVI LASER GRAPHICS, Barkatpura, Hyderabad,
Tel: 040-27552178

Foreword

Ancient India placed great sense of importance to the environment and the same got embedded in our scriptures and traditions for high standards of hygiene and health. However, the modern civilisation and changing living conditions have created massive piles of solid waste thrown across the places both in rural and urban India. The public Institutions are struggling to keep pace with the Solid Waste Management and satisfactory management can never be achieved without active participation of all the stakeholders. Excessive plastic usage in the country added fuel to the fire, resulting in unimaginable consequences on environment and bio-diversity.

The Hon'ble Prime Minister of India has rightly mainstreamed the need for sanitation and launched Swachh Bharat Campaign. Today we are enjoying independence from the colonial rule owing to the 'Sankalp' of Mahatma Gandhi and other great freedom fighters, who gave the call of 'Quit India' and achieved Swaraj. Sankalp of 'Quit India' resulted in achievement of Swaraj. As we witness 75 years of the great movement of Quit India, the Hon'ble Prime Minister dreams of a New India, an India clean from all dirt and malice and has given a call to all of us to 'Quit Dirt'!

India has thousands of Institutions both public and private with millions of stakeholders either working or using these Institutions across the country. The Institutions being great learning places, should also impart and attempt to bring appropriate behavioural changes among all the stakeholders to practise cleanliness, reduce waste generation, refuse use of materials where not required, recycle and recover usable materials. For achieving this, Institutions themselves have to have a system of scientific management of the solid waste generated within their premises.

NIRD&PR being an apex organisation engaged in capacity building, training and research related to rural development, is deeply engaged in making the dream of our Hon'ble Prime Minister a reality to create Swachh Bharat and achieve 'Quit Dirt'. The team of NIRD&PR converted the campus into 'Clean and Green Campus' by applying various principles of solid waste management and technologies through the process of doing have evolved a Standard Operating Procedure which can be made available to other Institutions. The action research which has resulted in SOP followed the scientific process of Solid Waste Management i.e. the '5 R's namely, 'Refuse, Reuse, Recycle, Recover and Regenerate'.

The Standard Operating Procedure prepared based on practical conversion of the campus into zero waste campus recognises the importance of participation of all the stakeholders to bring behavioural change of in-situ segregation, refusing and reducing the use of plastic and promoting environment friendly goods and processes. Standard Operating Procedure addresses the end-to-end process of handling the waste and conversion to usable products ultimately achieving the objective of transforming waste into wealth.

The adoption of Standard Operating Procedure developed by NIRD&PR can transform every Institution into a Swachh Campus, the environment of which can bring positive behavioural change of millions of stakeholders who can further spread the concept for implementation, thus achieving the dream of Swachh Bharat. NIRD&PR with their expertise can provide guidance / hand-holding for all the willing Institutions to implement the Standard Operating Procedure across the country.

As Mahatma Gandhi said “Cleanliness is next to Godliness”, let us take forward this thought to scientifically manage the solid waste in Institutions, thus, creating Swachh Campus and at the same time wealth by following the Governance of Standard Operating Procedure.



Dr. W. R. Reddy, IAS
Director General, NIRD&PR

CONTENTS

Making of Swachh Campus - Preamble	1
1. General	2
1.1. Purpose	
1.2. Scope	
1.3. Responsibility	
1.4. Summary of the procedure	
2. Survey of Waste Generation	3
3. Planning	4
4. Awareness Generation and Stakeholder Involvement	5
5. Waste Segregation and Collection	7
6. Waste Treatment and Disposal	8
7. Monitoring and Correctives	10
8. Reporting Mechanism	11
9. Human Resources Management in Sanitation Department	12
Annexures	
A. Annexure - 1	13
Sources of Waste	13
B. Annexure - 2	14
Types of Waste and Color of Bins for each category	14
C. Annexure - 3	16
Assessment Forms for Waste Survey	16
D. Annexure – 4	17
a) Task Description for Sanitation Inspector	17
b) Task Description for Team of Sanitation Workers	17
c) Task Description for Residents / Households	18
d) Task Description for Hostel In-charge	19
e) Task Description for the staff in-charge of Biomedical Waste	20
E. Annexure – 5	21
Equipment and Logistical Support for SWM	21
F. Annexure – 6	22
IEC Strategy for Community Preparation for SWM	22
G. Annexure – 7	25
Process for replacing Plastic Bottles and Bags	25
H. Annexure - 8	28

	Kitchen Waste Management (and Kitchen Sanitation)	28
I.	Annexure – 9	30
	Illustrative Schedule on Collection and its Frequency	30
J.	Annexure - 10	31
	Wet Waste Treatment	31
K.	Annexure - 11	33
	Preparation of Sanitary Land II	33
L.	Annexure - 12	34
	Biomedical Waste – Treatment and Disposal	34
M.	Annexure – 13	38
	E-waste Treatment	38
	Prepare Material Recovery Facility (MRF)	38
	Extended Producer Responsibility (EPR)	38

Making of Swachh Campus - Preamble

With increasing incidence of waste generation in all Institutions across the country, an endemic problem of waste disposal / management and absence of an appropriate scientific system in these Institutions has called for a systematic approach to Solid Waste Management (SWM), the process of reducing, reusing/recycling the solid waste to convert it into a valuable resource. Solid Waste and Management is a major problem even in the rural areas wherein a proper process and approach is the need of the hour to convert the waste generated into useful forms, thus, moving towards 'Waste to Wealth'.

National Institute of Rural Development and Panchayati Raj (NIRD&PR), an apex Organisation for rural development policy formulation and capacity building of various stakeholders for sustainable development of the rural population in the country had taken up an action research project for converting their 175 acres campus with about 1000 stakeholders on the Campus, into green and Swachh (clean) Campus during the year 2016-17. The Institution as it existed, was loaded with waste material generated because of its activities and huge quantity of non-degradable waste accumulated within the campus.

While transforming NIRD&PR into Swachh Campus, as part of action research, the research team has documented the steps involved and developed a process map to come up with ideal strategies to convert any campus into Swachh Campus. The outcomes from this action research have been converted into a 'Standard Operating Procedure (SOP)' which will be of use to all the Institutions, both government and private across the country. The SOP if effectively followed, can enable every Institution into 'Swachh Campus' with multifarious benefits and can become a model for all to emulate. The SOP has been explained in the following pages.

.....

Standard Operating Procedure for a Swachh Campus

1. General

1.1. Purpose

The purpose of the Standard Operating Procedure (SOP) for Solid Waste Management (SWM) in Educational/Training Institutions/Organisations, is to provide a practically implementable procedure and direction for scientific management of waste generated, to maintain a clean campus and transform 'waste' into 'wealth'. A swachh campus can create an ideal ecosystem for better learning outcomes and become a model for all to adopt and implement in their respective Institutions/Organisations.

1.2. Scope

The scope of the SOP is for maintaining a 'Swachh Campus' and is for all departments and members of the campus (living, visiting and working, etc.). All employees, contractors, visitors, residents and others must comply with applicable procedures at all times, when present in the campus. The intent of the SOP is to enable create cleanest, hygienic and environment-friendly working and living conditions for everyone on the campus and adopt the principles of SWM that are 'Refuse, Reuse, Recycle, Recover and Regenerate (5R s)' for managing the waste so as to convert it into 'wealth'.

1.3. Responsibility

1.3.1. **Personnel Involved in Waste Management in a Campus:** A sanitation team along with a Team leader or the sanitation in-charge of the campus is the owner of this SOP and is responsible to maintain the campus in accordance with the SOP guidelines and take notice of any changes, if they are made in the guidelines. If there is no full-time team leader, the head of the Institution shall nominate a responsible officer as in-charge Team Leader.

1.3.2. **Managers and Supervisors:** The head of the Institution or the designated authority is responsible for ensuring their staff's compliance and regular auditing with the procedure. To ensure compliance, proper training and education on the concept is to be conducted with the most recent version of the SOP and to review, audit and revise as required.

1.4. Summary of the Procedure

This operating procedure will involve step-by-step guidelines to be followed, starting with the survey of the waste generated to determine the plan to be adopted, sensitisation of all stakeholders for active participation, segregate the waste as per the norms and treatment by ultimately following the principle of 'Refuse, Reuse, Recycle, Recover and Regenerate' to achieve the goal of Swachh Campus.

2. Survey of Waste Generation

- 2.1. **Assess the Sources:** For making any Institution 'Swachh Campus' there is a need to understand the sources of waste, its type and quantum. In order to assess the sources, a systematic observation-cum-survey is to be conducted. List of all possible sources of waste in an Institution, given in Annexure-1 can become a basis for assessing.
 - 2.2. **Type and Quantum of Waste:** The team leader and additional members of the team involved in making the campus 'Swachh Campus' should continuously perambulate / conduct transect walks in the campus for over a period of five days. While doing these transect walks the sources of waste generation in the campus, type and quantum of waste at each source shall be recorded along with the respective stakeholders group.
 - 2.3. **Segregating and Measuring of Waste:** Depending on the sources of waste generation, different teams constituted for the purpose shall assess the type and quantity of the waste being generated from each source by actually segregating and measuring each type of the waste. The list of items under wet, dry, hazardous and e-waste given in Annexure-2 can be used as a guide.
 - 2.4. **Decision for Treatment/Disposal of Waste:** The assigned teams shall segregate and measure the waste from each source continuously for five days. Based on the type and quantity of the waste assessed during the five days, the respective team shall arrive at the total quantity of each type of waste being generated from all the sources in the campus. The quantity of each type of the waste generated from each source will decide the type of treatment / disposal of the waste. Annexure – 3 provides model forms for survey of waste generation.
 - 2.5. **Assess Existing System:** The teams shall also record the existing system of collection, segregation, transport and disposal of the waste.
 - 2.6. **Dumpyards in Campus:** The team in-charge shall also locate the dumpzyard (s) presently being used for disposal of the waste.
-

3. Planning

- 3.1. **Drawing Up a Plan for SWM:** The team leader in consultation with the members identifying the sources of waste, its type and quantity generated along with its present system of disposal, shall draw a 'plan' for scientific SWM.
- 3.1.1. **The Principles of 'Swachh Campus'** are to Refuse, Reuse, Recycle, Recover and Regenerate waste for wealth creation. The plan shall have steps touching upon all the principles with ways and means of achieving the ultimate goal.
- 3.1.2. **The Plan Design:** It shall clearly elucidate the sources, types, quantum of waste, roles and responsibilities, Do's and Don'ts, awareness generation strategy for the entire Institution.
- 3.1.3. **Discussion of Draft Plan with Stakeholders:** An illustrative list of tasks for sanitation workers, sanitation officer, campus residents, hostel in-charge and bio-medical staff in-charge is given in Annexure – 4 with strategies to achieve the 5R's (Refuse - Reuse – Recycle – Recover – Regenerate) on the part of each stakeholder group. The draft plan shall be discussed with all the stakeholders either in groups or as one congregation and the framed up plan shall be adopted. Such adoption by all stakeholders shall ensure their owning up of the plan.
- 3.2. **Training and Redefining the Roles and Responsibilities:** Depending on the quantum of waste, an appropriate sanitation team shall be constituted either by training and redefining the roles and responsibilities of the existing team where additional manpower may be hired if required or outsourcing the activities to an external agency.
- 3.3. **Allocation of Area for Sanitation Workers:** Sanitation team shall be assigned their duties appropriately with definite area, jurisdiction and hierarchical supervision, with prominent exhibition of names and phone numbers of the supervisory team at appropriate places for ready reference for anyone to inform / complain about any aspect of the SWM process.
- 3.4. **Facilities and Logistics to Aid Implementation:** The plan shall also indicate the equipment facilities and logistics support to aid the plan implementation. Indicative list of equipment is given in Annexure –5.
- 3.5. **Detailed Cost Estimate:** Based on the campaign strategy a detailed cost estimate is to be prepared for launching the campaign. Thus, prepared estimate is to be managed through the existing budget and any additional budget, if required has to be provided accordingly.
-

4. Awareness Generation and Stakeholder Involvement

- 4.1. **Stakeholder Identification:** Enabling the 'Swachh Campus' would require effective participation of all the stakeholders. The possible stakeholders are all residents, households, all officials working, all visitors, all students, all maintenance staff and other personnel working for various services in the campus.
- 4.2. **Explaining Roles and Responsibilities of all the Stakeholders:** Head of the Institution shall arrange a meeting of all the stakeholders and explain the performance and the outcomes expected out of the campaign for making the institution a 'Swachh Campus'. While explaining the plan of action, the roles and responsibilities of each stakeholder shall also be narrated. In addition, roles and responsibilities in the form of leaflets will also be distributed in this first meeting.
- 4.3. **IEC Strategy and Awareness:** Depending on the type of stakeholders, appropriate IEC strategy and awareness creation as adopted in the SWM plan shall be implemented. The broad steps will be as follows:
 - 4.3.1. Preparation of IEC material and display, and continuous awareness generation activities for each stakeholder group.
 - 4.3.2. Launching awareness generation activities including road shows, skits, posters, pamphlets, group meetings, and assembly announcements, etc.
 - 4.3.3. Display adequate sign boards at appropriate places across the Institution to prompt action and thereby lead to continuous involvement of all the stakeholders for the plan to be successful. Annexure – 6 provides an illustrative IEC strategy for awareness generation in the community.



Figure 1: School children taking part in IEC activities



Figure 2: School children spreading the message of SWM through street play

4.4. **Regular Discussion on SWM:** It is effective to talk about 'Swachh Campus' at every opportune moment to enable the stakeholders and to generate a sense of pride in the community, for following the principles of SWM and maintaining the cleanliness of the campus

4.5. The activities are to be continued at regular intervals to drive the focus and to keep up the momentum

5. Waste Segregation and Collection

5.1. **Say NO to Plastics:** The first and foremost critical element of success of waste management will begin with the stakeholders to desist usage of non-degradable materials such as plastic covers, plastic bottles and replace them with degradable materials such as cloth bags, jute baskets, reusable bags, reusable glass bottles, etc. The success depends on enabling alternative materials/system to replace plastic. An illustrative process for replacing plastic water bottles and plastic bags is given in Annexure - 7.

5.2. **Segregation is the Way Forward:** Next important element of waste management in any Institution is segregation of the waste at source i.e. primary segregation which will be done at the household level / kitchen of the hostels / the dining halls of the hostels / canteens by putting the waste in the appropriate bins i.e. wet waste in the green bin, recyclable waste in the blue bin and hazardous waste in the red bin. The grouping of the waste into green, blue and red is given in Annexure - 2. Appropriate segregation of the type of waste and collection of the same in separate bins for processing will be crucial. Annexure - 8 provides suggestive guidelines for managing kitchen waste.

5.3. The teams collecting the waste from each source of waste generation shall also ensure that segregation is happening and any violations should be brought to the notice of the stakeholders. The teams collecting the waste shall segregate and collect waste in these three categories and shall be aggregated into similar bigger bins and carry to the waste segregation shed using cycle cart or electrically driven vehicle or other appropriate transport system. Also, till the stakeholders absorb the principles of segregation, special care is to be taken by the collection teams to ensure segregation. A sample schedule of collection frequency is given in Annexure – 9.

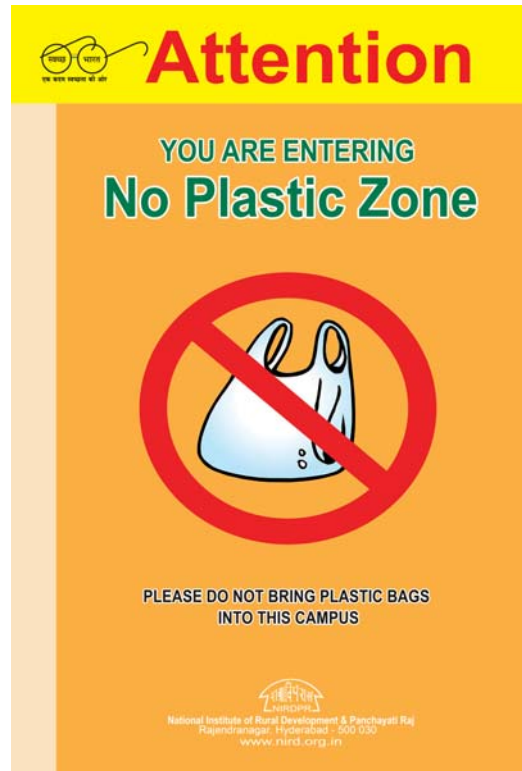


Figure 3: Sample poster for ban on plastic bags

6. Waste Treatment and Disposal

- 6.1. **Handling Wet Waste:** The wet waste aggregated from various sources shall be sent for processing to produce bio-gas through aerobic or anaerobic processes as designated in the plan or sent for composting with appropriate composting techniques. The success of the campaign is decided by effective handling of the wet waste segregation at source, proper collection/aggregation without mixing and its effective treatment. Annexure – 10 guides on each type of wet waste treatment and the campus can adopt the method that suits its needs.
- 6.2. **Handling Dry Waste:** The dry waste collected from each source is taken to processing yard and further segregated into next level for sifting recyclable waste (metals, bottles, plastic, etc.). The segregated dry waste will be sent to recycling units or sold to agencies handling such materials. Post resource recovery level segregation, the residual reject from the dry waste will be sent for incineration in an eco-friendly incinerator. This process, depending on quantum of waste, can be leveraged for generation of electrical energy by use of some simple technologies.
- 6.3. **Handling Hazardous Materials:** After recovering the items that can be recycled / or sold to the recyclers, the residual reject which would mainly consist of hazardous material is to be sent for incineration or to designated scientifically prepared sanitary landfills. The method of preparation of landfills is given in Annexure – 11.



Figure 4: Types of Dry Waste



Figure 5: Types of Hazardous Waste

- 6.4. **Treatment of Biomedical Waste:** Storage of segregated biomedical waste in coloured bags / appropriate containers in the premises to be ensured in a safe, ventilated and secured location before sending to common Biomedical Waste Treatment and Disposal Facility operated by specialists. Few preventive measures during treatment and disposal of biomedical waste is specified in Annexure – 12.

- 6.5. **Treatment of e-Waste:** The discarded e-waste in the campus shall be sent to the 'Material Recovery Facility' (MRF) and stored there until it is sent to specialist e-waste recyclers (Annexure – 13 suggests alternatives for treatment of e-waste).
- 6.6. **Extended Producer Responsibility (EPR):** The hazardous waste/e-waste reaching the segregation shed to be sent back to the suppliers in the buy-back guarantee scheme or Extended Producer Responsibility (EPR), if available.
- 6.7. **Handling Construction Debris:** The construction and demolition waste/debris, should be stored in a designated location within the premises by the concerned contractor, till the waste is handed over to authorised processing facilities of construction and demolition waste/debris. Construction and renovation waste / debris if generated more than 20 tonnes in one-day or 300 tonnes per project in a month, the concerned contractor/department shall prepare a plan for waste segregation and management, and get it approved by the head of the Institution along with building plan and follow the same. Some of the components of the construction debris can also be recycled as aggregates for further construction.
-

7. Monitoring and Correctives

- 7.1. **Weekly Review:** The in-charge sanitation officer along with his/her team must carry out a weekly review to ensure compliance to the SWM plan of the Institution
 - 7.2. **Physical Verification:** Weekly visits to the office spaces, households, segregation sheds and all other parts of the Institution to be carried out for physical verification for any lapses in adherence and for taking up rectification steps
 - 7.3. **Display Contact Numbers of Sanitation Team:** The mobile number of the sanitation in-charge officer is to be clearly mentioned in all key visible areas of the campus and suggestion boxes to be placed at accessible locations for regular feedback from all stakeholders
 - 7.4. **Monthly Meeting:** A monthly meeting to be held with participation of all stakeholders till the SWM plan gets streamlined
 - 7.5. **Plastic should be Refused:** As per the 'Refuse' principle of the Waste Management, all plastic poly bags, bottles should be barred from entering/using on campus. The security personnel at the entrance should be trained to perform regular checks on every individual / vehicle entering the institution for any plastic bags/bottles and detain these plastic bags/ bottles for appropriate disposal
 - 7.6. **Penalisation for Non-Compliance:** Non-compliance in any form from any of the stakeholder should attract penalisation in any format but not limited to fines, public shaming and warnings
 - 7.7. **Maintain least possible Residual Reject:** Measures have to be taken to reduce and maintain this residual reject to be less than 10% of the total waste by adopting appropriate methods of processing the waste
-

8. Reporting Mechanism

- 8.1. **Records have to be maintained** for each type and quantum of waste collected, transported, treated and disposed
- 8.2. **Daily entry has to be made** by each team of sanitation workers in the record placed at a common location



Figure 6: Poster indicating reducing of Residual Reject

- 8.4. **Data on e-Waste and Biomedical Waste:** Special care has to be given while recording the data pertaining to e-waste and biomedical waste which has to be reviewed every alternate day
- 8.5. **Analyse the Residual Reject:** The amount of residual reject that is sent to land II post tertiary segregation to be analysed every month

9. Human Resources Management in Sanitation Department

- 9.1. **Proper training to be given:** The sanitation workers must be trained properly at regular intervals and sensitised in all functions related to sanitation. They should be sensitised to use the protective gear such as hand gloves while collecting the waste
- 9.2. **Rewards and recognition policies** for the sanitation team should be drawn up and implemented to keep up the spirit
- 9.3. **Frequent health check-up** has to be ensured for the HR team as the work done by these workers is hazardous in nature.
- 9.4. **Regular follow up and review** mechanism to be exercised



Figure 7: A sanitation worker on duty

Annexures

Annexure - 1

Sources of Wast

- i. Office Buildings / Blocks
 - ii. Library / Auditorium
 - iii. Training / Conference Halls / Students Classrooms
 - iv. Hostels / Guest Houses
 - v. Dining Halls / Kitchen / Canteen
 - vi. Grocery Room and other Store Rooms
 - vii. Health Centre
 - viii. Playground / Common Areas
 - ix. Household Waste
 - x. School (if any, within the campus)
 - xi. Other buildings
-

Annexure - 2

Types of Waste and Colour of Bins for each category

(a) Wet Waste (Green Colour Bin)	(b) Dry Waste (Blue Colour Bin)	(c) Hazardous Waste (Red Colour Bin)
Vegetable peels	Soap covers / pockets / sachets	Mosquito repellent re II bottles/ Mosquito repellent mats
Fruit peels	Empty shampoo bottles	Expired medicines
Rotten fruits and vegetables	Empty perfume bottles / containers of deodorants / shaving creams	Tablet covers / Syrups bottles
Leftover food	Milk covers	Any medical discard
Used tea / tea bags	Used door mats/doormats	Sanitary napkins
Used coffee ground	Used tooth brush	Children's diapers
Egg shells	Chocolate wrappers	Used condoms
Coconut shells (including tender coconut shell)	Butter wrappers	Used razor / razor blades
Mango kernel and any seed	Used mop cloth	Old batteries
Coconut bre	Ghee / oil pockets / cans	Fused bulbs / tubes / electrical items
Used owers / dry owers	Package / polythene covers / plastic covers	Broken glasses / ceramics
Spoiled spices	Newspapers / cardboards	Empty cans of toilet cleaners
Floor sweeping dust	Cosmetics containers	Expired cosmetics
Meat and Non-veg remains	Styrofoam	Cockroach killers / spray cans
Expired bread, biscuits and other food items	Broken stationery like used pens, pencil sharpener	Old printer cartridge / CDs
Hair	Empty cans of oor cleaners	Rusted iron pieces
Garden shrubs	Chips packets	Used odonil bottles
	Unusable shoes	Old electronic items / parts

(a) Wet Waste (Green Colour Bin)	(b) Dry Waste (Blue Colour Bin)	(c) Hazardous Waste (Red Colour Bin)
	Sachets (of shampoo, creams, etc.)	Pieces of wires, old chargers, old pen drives
	Packaged water bottles	Old paints / old household chemicals / cleaners
	Used tooth paste tubes, etc.	Insecticide sprays / leftovers
	Broken household plastic items / and toys	Toxic rejects
	Metal tins and cans (Ex. Pepsi Coke cans) – Aerosol cans	Cotton/ tissue papers used for medical purpose
	Small tubs like the ones used for yogurt, cheese, jam	
	Pieces of aluminum foils	
	Old brooms Iron pieces	
	Paper napkins, Tetra packs	
	Destroyed old cushions	
	Leather, rexene, rubber	
(d) e-Waste (Red Colour Bin)		
Pen drives	PCs	Modems
Cables / Wires	Laptops	GPS units
Phones	Printers	Hubs
Cordless phones	TVs (cathode ray tubes [CRTs] in televisions)	Thermostat asks
Cell phones	Air coolers	Calculators
Charges	Air-conditioners	Dry cell batteries
Digital cameras	Fridges	Electronic scrap parts
Digital plotters	Freezers	Dehumidifiers
External drives	Fax machines	Fluorescent lamps and tubes
Mouse / Key board such items	Copiers	Incandescent light bulbs
Routers	Digital Thermostats	Smoke detectors
Speakers	CFL tube lights / bulbs	Thermometers
CD/DVDs		

Assessment Forms for Waste Survey

Recording Type and Quantum of Waste Generated from each source

Wet Waste – Kitchen Waste / Dry Waste / Hazardous Waste / E- Waste

Date (WET)	Type of Waste In kgs	Quantity (daily) (Weekly) In kgs	Quantity (Monthly) In kgs	Quantity

.....

a) Task Description for Sanitation Inspector

- Supply uniform, green caps and other protective gear to the workers
- Proper training to be given to sanitation workers on collection and segregation methods, usage of incinerator, segregation shed, chopper / crusher tools, bio-methane plant, etc.
- Make periodical plans for assigning workers for various tasks in waste management
- Make sure that the waste transported by trucks / trailers from one place to another is covered properly and transported
- Arrange with Municipality to send away land fill waste to take to their land fill and sale of recyclable waste
- Oversee the type and form of waste fed into the bio-methane plant/ incinerator, that the garbage is of acceptable type and in acceptable form
- Make sure there is no dumping taking place anywhere in the campus by any sanitation worker or any member of the institution.
- Attend to the complaints brought about by the sanitation workers promptly
- Ensure the workers get their wages on time and recommend for incentives from the sale of recyclable items
- Ensure good health of the workers through periodical health check-ups and ensure their adherence of wearing protective gear while at work.

b) Task Description for Team of Sanitation Workers

- The sanitation workers shall collect waste primarily segregated at the household level and handle contents of each bin based on its colour
- Starting with RED bin, after reaching the Segregation Shed, the sanitation workers feed into the incinerator (combustion chamber) all the diapers, sanitary napkins and such items handed by households wrapped in old newspapers
- Moving onto the Wet waste in GREEN bin, they will do secondary segregation of the wet waste. During secondary segregation, their main job is to ensure that wet waste does not mix up with other type of waste
- Post secondary segregation, the wet waste sent will be to the bio-methane plant. Before the wet waste goes into the bio-methane plant, the workers shall do the necessary chopping, crushing (using the tools installed at the segregation shed) so as to make it fit for feeding into the bio-methane plant. This is the technical arrangement for treating wet waste. While

feeding shredded wet waste into the bio-gas plant, plenty of water must also go along with it. Water used for washing the rice or vegetables can be fed into the bio-gas plant. Wastewater from kitchen can be used, provided that no chemicals are used in washing vessels, and never the wastewater from bathroom

- The workers then do segregation (tertiary segregation) of dry waste. The main task here is sorting various materials like plastics, bottles, papers, cardboards, cosmetic containers and tins separately. Post segregation, these items can be sold to the recyclers and rest to be handed over to municipality for their land fill. This will include other hazardous waste, if any found in this. This covers the BLUE bin.
- For the items picked from the dry waste, a Dry Waste Recovery Centre to store recyclables can be set up in segregation shed. Incinerator should also be part of the Segregation Shed.
- Periodically, it will also be the responsibility of sanitation workers to remove slurry from bio-gas plant and take it to slurry drying bed. When water is drained and it is partly moist, it can be used either as manure, or be added to any type of composting including vermi.
- Sanitation workers shall inform sanitation inspector regarding houses which do not cooperate.

c) Task Description for Residents / Households

The following are responsibilities of households / residents

- Each household shall segregate waste into wet waste (kitchen waste - GREEN) and dry waste (BLUE) and Hazardous Waste (RED) and put in the bin specifically provided for each purpose. This is called primary segregation, which will be the responsibility of the residents. The foundation for success or otherwise of this effort in SWM, absolutely lies at this stage.

Wet Waste (GREEN): Kitchen-refuse such as vegetable peels, fruits, flowers, egg shells, tea leaves, including leftover food, old bread, fish bones, leaves, garden shrubs and others easily degradable items.

Dry Waste (BLUE): plastics, papers, cardboards, shampoo bottles, empty cans/tins/toothpaste tube/ worn out toothbrush/ milk covers, oil covers, glass bottles, pet bottles, broken toys, caps of mineral water bottles, iron pieces, etc.

Hazardous Waste (RED): Under this category items frequently discarded are: (i) used batteries, (ii) children's diapers, (iii) used-napkins (and such items). Other items under this category could include household chemicals / cleaners / fused bulbs / tubes, broken mirror and broken ceramic items, residual paint/ indoor and farm pesticides, grease, spray cans, shoe polish, expired medicines and other pharmaceutical items / syringes, needles, sharps, blades and rusted tins, etc.

Do's and Don'ts during Segregation

- Leftover food items such as fish bones, mutton and chicken bones may be given to cats / dogs, if available at the households. This is a way to deal especially with leftover food at household level. If not, these items may be put under wet waste (Green Waste), which will go into wet waste treatment plant.
- Items such as sanitary pads, children's nappies and condoms shall be wrapped in newspapers before dropping in the Red Bin
- Avoid placing used sanitary pads in plastic bags, they should always be wrapped in a paper / old newspapers
- Avoid placing kitchen waste (Vegetable peels, fruit peels, egg shells, used tea leaves, leftover cooked vegetables / food, etc.) in carry bags and knotting it
- It is the responsibility of each household to give all three baskets to the sanitation workers, who shall empty each basket in separate containers they bring / in partitioned vehicles
- The residents who repeatedly give mixed up waste (dry /wet / hazardous, etc, waste together) shall be trained and penalised if required
- The residents may also call up the Sanitation Inspector for guidance or complaints, if any

d) Task Description for Hostel In-charge

- To ensure no plastic water bottles are provided and water dispensers filled with purified water is made available at all designated locations in the hostel
- Ensure that only reusable plates and cups are used in the campus
- Along with the existing incinerator at the segregation shed, another incinerator can be installed at the girls' hostel. This will be used for incinerating sanitary napkins, children's diapers and paper napkins and oily / butter papers, etc.
- To ensure proper segregation of waste from all sources of waste in hostel (rooms, dining area, kitchen, etc.)
- Recyclable items recovered during segregation shall be kept in the store room available at the segregation shed. If an existing way of disposing them in an acceptable manner is available that is to be continued

e) Task Description for the Staff in-charge of Biomedical Waste

- Make provision within the premises for a safe, ventilated and secured location for handling bio-medical waste and any biomedical waste in the Institution(from health centre, etc.) should be directly transported to this common bio-medical waste treatment facility for appropriate treatment / disposal
- Ensure that there shall be no secondary handling of bio-medical waste, pilferage or inadvertent scattering or spillage by animals
- The staff in-charge of waste collection and storage must be aware of the type of bag or container to be used for the storage of various types of medical waste
- Operate the Incinerator at the Health Centre for disposal of regular medical waste such as used cotton, bandage rolls, etc.
- Use the sterilisation or hydroclaving facility for sterilisation of some of the waste before they are shredded and sent to landfills
- Never mix bio-medical waste along with municipal solid waste or other solid waste
- Immunise all healthcare workers and others, involved in handling of bio-medical waste for protection against diseases including Hepatitis B and Tetanus
- Waste of different types / nature be kept separately for instance sharp surgical blades separate from left over chemicals and tablet strips
- Unauthorised reuse of any bio-medical waste should be prevented and necessary systems and actions have to be placed by the in-charge staff.



Figure 8: Symbol indicating Bio-Hazard which is to displayed on the dustbins carrying Bio-Medical Waste

Equipment and Logistical Support for SWM

- Waste collection carts or vehicles (Number is as required)
 - Uniforms and safety gears for the sanitation workers
 - Waste Segregation shed
 - Facility for treatment of wet waste and other equipment such as rakes, shovel, hand fork, garden fork, trowel, buckets, wheel barrow, watering can, etc.
 - Facility for treatment of dry waste (and the residual reject)
 - Facility for treatment of hazardous waste (such as an incinerator)
 - Storage place for recyclables until they are passed on to recyclers
 - Facility for hand-washing / body washing for the sanitation workers
 - Paper bins to be placed under each table in the campus
 - Waste bins for households (if any) with three different colour bins – Green, Blue and Red
 - Kerb-side (road-side / pavement-side) Drop-off Boxes
 - Door-to-door collection bin and collection vehicle of the sanitation workers
 - At every 100 metres one 'set of bins' to be placed (set of bins indicate Red, Blue and Green bins)
 - Display signs/signage to be placed near every set of bins for easy segregation
-

IEC Strategy for Community Preparation for SWM

(Information, Education and Communication (IEC) Campaign)

All the stakeholders of the Institution are key for the success in solid waste management in the campus. First, it requires inscribing in their minds that the administration is serious about it. Secondly, it should be personally convincing for them to play their part and cooperate and thirdly what they witness should gradually strengthen their trust in the process.

- All stakeholders should be habituated to properly segregate waste into three different categories (Wet / Dry / Hazardous) before handing them over to waste collectors

Information	Education	Communication
(Know what, why and how) Knowledge Awareness Ability	(Self-regulation, Self-correction, Practice, Responsible well-being and civility)	The methods, tools and techniques (media) should be used to pass on information and impact on practice so as to make one behave like an educated person. One can be illiterate but still be 'educated'

Suggestive IEC Activities

- Waste Bins Distribution with Handbills: The Sanitary Inspector shall arrange supplying of three different colour bins to all the residents (if not done already). This must be used as an opportunity to supply a handbill explaining the purpose of three different colour bins and seek residents' cooperation and motivate them (Provide a handbill to all even if the bins are placed before the launch of the campaign).
- Cultural Evening: Cultural evenings with messages on waste management, energy and water conservation to be organised in the campus. At the end of the programme, the head of the Institution shall sum up by asking for the cooperation of residents for conservation of energy and water and for proper management of waste.



Figure 9: Students of BVB participating in an Awareness Drive

3. SMS Alert: An SMS alert may be arranged for alerting residents every morning with a message on 'waste segregation'. This should go on at least for 15 days at the launch of the programme or till the members are accustomed to the process and slowly the frequency of SMS can be reduced.
4. Educating the Users: The sanitation workers shall educate the residents where they mix up waste (without segregating)

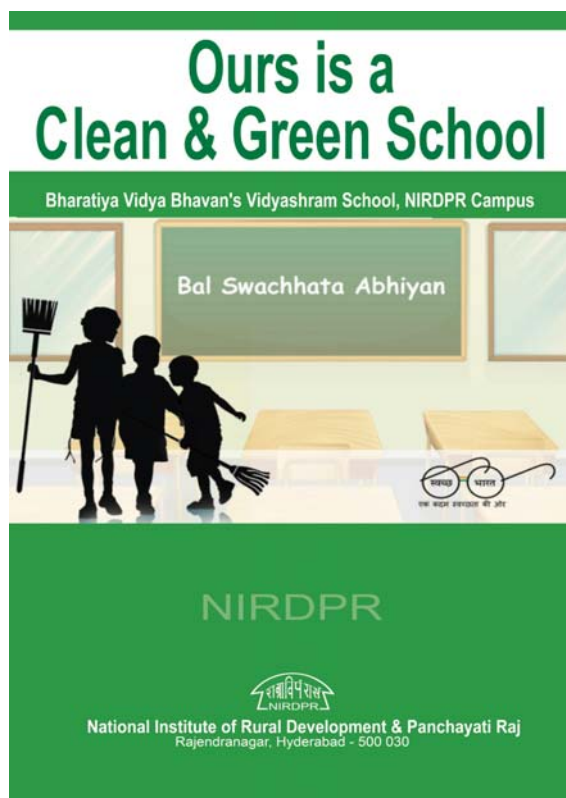


Figure 10: A poster for BVB School to promote Swachhta from young age

5. Educative Inspection: The Sanitation Inspector should regularly inspect/ monitor the work of the sanitation workers and make direct observation on the response of the residents. He can also use that opportunity to educate the residents who are unable to or are unwilling to spend time on segregating.
6. Announcing Prizes and Gifts: The residents in the campus who comply 100 per cent with the solid waste management norms and those who constantly reduce the generation of waste must be identified and recognised which may be done for sanitation workers as well to encourage compliance.

7. Competitions to Encourage Cleanliness: All members in the campus may be encouraged to participate in competitions like rangoli, gardening and beautification of lanes. This will encourage residents to grow kitchen gardens and facilitate in educating growing gardens using waste water. This will contribute to clean and green campus.



Figure 11: Sample image taken at NIRD&PR with well-maintained lawns

Process for Replacing Plastic Bottles and Bags

1. Assess the current usage of plastic bottles and bags through a survey form, observation from the collected waste and general usage across the Institution
2. Initiate by giving a week time for everyone in the Institution to eliminate all their current non-recyclable plastic bottles and bags and not to carry any plastic bottles or bags into the campus
 - 2.1 Arrange collection points at all convenient places to collect discarded bottles and bags
3. Arrange cloth and paper bag counters across the Institution for everyone to purchase if required (The hand-made paper unit in NIRD&PR can be contacted for a counter to be setup)
4. The Principles of 'Refuse' and 'Reuse' to be promoted for eliminating usage of plastic in the Institution
5. All the bags to be scouted at the entrances of the Institution for any possible plastic bags or bottles being brought in which have to be replaced with paper or cloth or jute bags
 - 5.1. The members of the Institution should carry paper/jute/cloth bags while going out for purchase of anything
 - 5.2. Refuse any plastic bags being provided and use your bags to carry everything
 - 5.3. A handmade paper unit maybe setup in the campus which can also function as a stall selling paper bags. The below links provide a detailed project report on setting up a manufacturing and conversion unit of handmade paper and the contact details for handmade paper unit in RTP, NIRD&PR.

http://nird.org.in/nird_docs/rtpprojectreport060917.pdf

<http://www.gandhihandmadepaper.com/>



Figure 12: Handmade Paper Bags from RTP, NIRD&PR

6. Replace plastic bottles and 'use and throw cups' with glass/ceramic bottles and tumblers across in all areas of the utility in the Institution
- 6.1. Promote the idea of 'Reuse' through these bottles and tumblers and 'Refuse' to use any non-biodegradable materials
7. Place these glass/ceramic bottles and tumblers specially in the conference rooms and meeting points and promote their usage at every opportune moment
8. Conduct regular drives across the Institution to make every member entering it aware of the 'No-Plastic' Policy of the Institution
9. Before any new member enters the Institution, all the brochures and entry kit being given to them should consist of these 'Dos and Don'ts' to be followed as part of the 'No-Plastic Policy'
10. To improve the compliance towards this policy, a nominal penalty of \$50 may be imposed for every non-compliance incident

The below Images show a couple of changes before and after implementation of the 'Say No to Plastic Drive' in NIRD&PR

Before Implementation



Figure 13: Use of Plastic Folders in Office

After Implementation



Figure 14: Use of Handmade Paper Folders in Office



Figure 15: Use of Plastic Bottles in Conferences



Figure 16: Use of Glass Bottles in place of Plastic Bottles



Figure 17: Poster for promoting glass cups

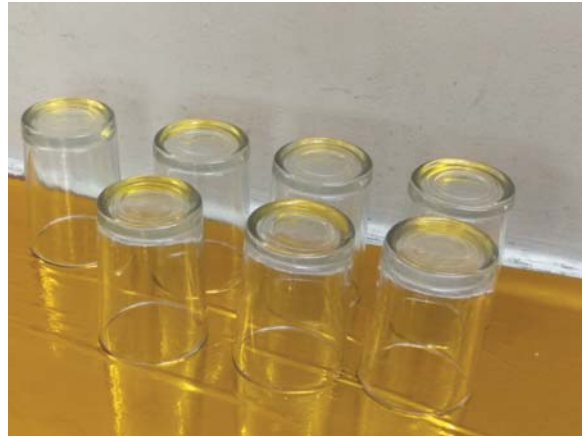


Figure 18: Promoting the use of Glass in place of use and throw cups in NIRD&PR

Kitchen Waste Management (and Kitchen Sanitation)

All areas consisting of kitchen and dining halls, produce waste and store it temporarily before disposal. Waste must not be allowed to accumulate in working areas or the surrounding environment but to be treated in the following way:

- Food waste (i.e. food scraps) is to be kept in sealed containers
- Ensure waste containers are emptied regularly
- Provide an adequate number of bulk waste storage containers with sufficient capacity



Figure 19: Poster indicating components in kitchen waste



Figure 20: Kitchen waste collected after segregation



Figure 21: Segregation of waste in dining area at NIRD&PR



Figure 22: Loading the collected kitchen waste into shredder



Figure 23: Shredded Kitchen waste waiting to be loaded into Bio-gas Plant

- Ensure waste containers are solidly constructed and can be easily cleaned when emptied. Clean (and where necessary sanitise) waste containers regularly
- Ensure gratings are in place to prevent solid matter entering and blocking drainage
- Ensuring local authority trade waste bye-laws are complied with, if any
- Staff to be trained in good hygienic practices when handling waste
- Regular visual inspection should be done to ensure adherence of all above rules
- Observation (e.g. staff dispose of waste appropriately and follow good practices – i.e. washing hands after handling waste, staff responsible for removing waste from food areas and cleaning containers carry out their duties appropriately). This includes observations with regard to pest control as well.

Illustrative Schedule on Collection and its Frequency

Place of Waste Collection	Frequency	Timings
Office Blocks, Computer Center, Library,	Daily	7.30 - 8.30 am
Training / Conference Halls,	Daily	7.30 - 8.30 am
Residential Areas	Daily	7.30 - 8.30 am
Road-side / Walk-ways / Pavements	Daily (as frequently as required)	7.30 am & 6.30 pm (Clear drop-off boxes)
Hostel Kitchen, Dining Halls, Canteen	Not less than twice daily	7.00 AM, 4.00 PM
Other Buildings	Before and after every programme / meeting or as frequently as required	Weekly cleaning to be done

Wet Waste Treatment

Waste especially from kitchen, such as vegetable refuses, food scraps, etc., are called wet waste. They are to be sent for composting using one of the methods such as aerobic or anaerobic methods.

- **Aerobic Method:** Windrow composting, vermi-composting, NADEP composting are some of the popular methods. A list of useful guides that can explain each of these methods is provided in the web links below :
 - o http://nrega.nic.in/Circular_Archive/archive/MGNREGA_manualjuly.pdf
 - o http://www.indiaenvironmentportal.org.in/files/file/Solid_Liquid_Waste_Management.pdf
 - o <http://vikaspedia.in/agriculture/farm-based-enterprises/vermicomposting>
 - o <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=149590>
 - o <http://www.fao.org/docrep/007/y5104e/y5104e07.htm>
 - o <http://www.fao.org/docrep/007/y5104e/y5104e08.htm>
 - o http://unosc1.undp.org/GSSDAcademy/SIE/Docs/Vol4/Nadep_method.pdf



Figure 24: Vermicomposting at RTP, NIRD&PR



Figure 25: Home Composting at NIRD&PR

- **Anaerobic Method:** Methane gas generation from kitchen refuse is one widely known method of anaerobic composting methods. Converting food waste into methane gas (especially from the hostels and dining halls waste) is possible. In addition, the kitchen refuse from staff quarters and hostel dining halls can also be fed into an anaerobic composting plant, which can produce methane for use as cooking gas. Action to set up this plant to be initiated by Sanitation Team. The web links given below provide detailing on the process of setting up a Bio-Gas Plant and organisation which can support in the process :
 - o <http://www.build-a-biogas-plant.com/>
 - o <http://mnre.gov.in/schemes/organic/biogas-2/>
 - o <http://barc.gov.in/publications/nl/2002/200201-02.pdf>
 - o <http://www.biotech-india.org/>



Figure 26: Bio-methane Plant at NIRD&PR

Preparation of Sanitary Landfill

Landfill needs to be scientifically made without affecting the groundwater and the environment. There are certain types of non-bio-degradable wastes that cannot be recycled. They are to be sent to sanitary landfills. The main consideration while planning for a sanitary landfill is prevention of negative impacts on human health and environment. A low-lying site away from human settlement to be selected, a gravel bed is made so as to prevent leaching, if any and not to contaminate the soil nearby or water. After every filling or in periodical intervals a sand cap or clay cap should be put on that, which prevents gases such as methane / carbon dioxide from causing air pollution.

Note: Dump sites and Sanitary Landfills are not to be assumed as same

Bio-medical Waste – Treatment and Disposal

The following are some indicative options for storage, treatment and disposal of Bio-medical Waste

Type of Medical Waste	Type of Bag or Container to be Used	Treatment and Disposal Options
<p>(a) Human Anatomical Waste:</p> <p>Human tissues, organs, body parts and fetus below the viability period (as per the Medical Termination of Pregnancy Act 1971, amended from time to time.)</p>	<p>Yellow coloured non-chlorinated plastic bags</p>	<p>Incineration or Plasma Pyrolysis or Deep Burial.</p> <p>(Plasma Pyrolysis technology is often referred to as Plasma Gasification which converts organic matter into synthesis gas, which can then be used as a renewable fuel to produce clean power)</p>
<p>(b) Animal Anatomical Waste:</p> <p>Experiment animal carcasses, body parts, organs, tissues, including the waste generated from animals used in veterinary hospitals or colleges or animal houses</p>		
<p>(c) Soiled Waste:</p> <p>Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components</p>		<p>Incineration or Plasma Pyrolysis or Deep Burial</p> <p>In absence of above facilities, autoclaving or micro-waving/hydroclaving followed by shredding or mutilation or combination of sterilisation and shredding. Treated waste to be sent for energy recovery</p>
<p>(d) Expired or Discarded Medicines:</p> <p>Pharmaceutical waste like antibiotics, cytotoxic drugs including all items</p>	<p>Yellow coloured non-chlorinated plastic bags or containers</p>	<p>Expired cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1200 ° c or</p>

Type of Medical Waste	Type of Bag or Container to be Used	Treatment and Disposal Options
contaminated with glass or plastic ampoules, vials, etc.		<p>to common bio –medical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at > 1200 °c or encapsulation or plasma pyrolysis at >1200 °c</p> <p>All other discarded medicines shall either sent back to manufacturer or disposed by incineration</p>
<p>(e) Chemical Waste:</p> <p>Chemicals used in production of biological and used or discarded disinfectants</p>	Yellow coloured containers or non-chlorinated plastic bags	Disposed of by incineration or plasma pyrolysis or encapsulation in hazardous waste treatment, storage and disposal facility
<p>(f) Chemical Liquid Waste:</p> <p>Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, silver x-ray film developing liquid, discarded formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house-keeping and disinfecting activities, etc.</p>	Separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste shall be pre-treated before mixing with other waste water. There are discharge norms to be conformed to.
<p>(g) Discarded Linen, Mattresses beddings contaminated with blood or body fluid</p>	Non-chlorinated yellow plastic bags or suitable packing material	<p>Non-chlorinated chemical disinfection followed by incineration or plasma pyrolysis or for energy recovery</p> <p>In absence of above facilities, shredding or mutilation or combination of sterilisation</p>

Type of Medical Waste	Type of Bag or Container to be Used	Treatment and Disposal Options
		and shredding to be done. Treated waste to be sent for energy recovery or incineration or plasma pyrolysis
<p>(h) Clinical Laboratory Waste:</p> <p>Microbiology, Biotechnology and other clinical laboratory waste:</p> <p>Blood bags, laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological residual toxins, dishes and devices used for cultures</p>	Autoclave safe plastic bags or containers	Pre-treat to sterilise with non-chlorinated chemicals on-site as per national aids control organisation or world health organisation guidelines thereafter for incineration
<p>Contaminated Waste (Recyclable)</p> <p>(a) Waste generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and used needle syringes) and vaccutainers with their needles cut) and gloves</p>	Red coloured non-chlorinated plastic bags or containers	<p>Autoclaving or micro-waving/hydroclaving followed by shredding or mutilation or combination of sterilisation and shredding. Treated waste to be sent to registered or authorised recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible</p> <p>Plastic waste should not be sent to land fill sites</p>

Type of Medical Waste	Type of Bag or Container to be Used	Treatment and Disposal Options
<p>Waste Sharps including Metals:</p> <p>Needles, syringes with used needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes used, discarded and contaminated metal sharps</p>	<p>Puncture-proof, leak-proof, temper-proof containers</p>	<p>Autoclaving or dry heat sterilisation followed by shredding or mutilation or encapsulation in metal container or cement concrete: combination of shredding-cum-autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State pollution control boards or pollution control committees) or sanitary land fill or designated concrete waste sharp pit</p>
<p>(a) Glassware:</p> <p>Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic waste</p>	<p>Cardboard boxes with blue coloured marking</p>	<p>Disinfection (by soaking the washed glass waste after cleaning with detergent and sodium hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling</p>

E-waste Treatment

Prepare Material Recovery Facility (MRF)

Each Institution to have one Material Recovery Facility (MRF) where non-compostable office waste can be temporarily stored in order to facilitate segregation, sorting and recovery of recyclables from various components of waste by authorised informal sector of waste pickers, recyclers or any other work force engaged by the Institution for the purpose before the waste is delivered or taken up for its processing or disposal.

Extended Producer Responsibility (EPR)

One way is as mooted by the E-Waste Management Rules – 2016 i.e. Extended Producer Responsibility (EPR). Under EPR, manufacturers of computers and other electronic items should take back end-of-life products. If some producers / manufacturers want to appoint a 'Producer Responsibility Organisation' which on behalf of manufacturers, collect, dismantle and recycle end-of-life products that can be opted. Institution shall use such facility for the disposal of e-waste.
