REPORT OF WASTE MANAGEMENT

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CONTENTS

1. Introduction

What is e-waste?

In the simplest of terms, Electronic Waste – e-waste for short – or Waste Electrical and Electronic Equipment ("WEEE"), includes all types of electronic equipments/ products which have become obsolete or have been discarded due to:

- Advancement in technology
- Changes in fashion, style, status or perception
- Nearing the end of their useful life

The term 'e-waste' is generally understood to refer to any old, obsolete, end-of-life appliances using electricity which have been disposed off by their owners. E-waste thus would include discarded old computers, television sets, refrigerators, radios, telecommunication equipment, laboratory equipment, and other handheld gadgets – basically any electrical or electronic appliance that has reached its end-of-life.

E-waste has been one of the fastest growing waste streams in the world. While e-waste contains valuable materials such as aluminium, copper, gold, palladium and silver, it also contains harmful substances like cadmium, lead and mercury. In the absence of suitable techniques and protective measures, recycling e-waste can result in toxic emissions to the air, water and soil and pose a serious health and environmental hazards.

Electronic Waste: An Alarming Global Phenomenon






Computer Waste – Largest Component of E-Waste in India

Computer waste is the most significant of all e-waste due to the quantity as well as rate at which it is generated. The computer hardware sector has displayed a phenomenal growth in the past few years keeping pace with the rapid growth in the software sector. And given the continuous innovations and technological up gradations that take place in the hardware segment, obsolescence risk remains a key area of concern for companies that have made huge investments in their IT systems.

This obsolescence could be brought about by several factors such as the perception that superior efficiencies could be achieved by investing in superior IT equipment, or due to the poor design of computers that do not facilitate easy upgradability, or due to the steady decline in prices of computers and computer peripherals, making it them more affordable to increasing number of businesses.

The most disturbing aspect of computer waste – or techno-trash, as it is also known - is the rate at which it is accumulates. According to a study by the Manufacturers Association for Information Technology ("MAIT"), together with GTZ, the German Technical Cooperation agency, India generated 330,000 MT of electronic waste in 2007, while an additional 50,000 MT was illegally imported into the country. By 2011, it is estimated that e-waste generated in India would touch 470,000 MT.

E-waste Recycling: The Indian Scenario

Increasing Demand in the Brown Goods/ White Goods Segment
Though organized e-waste recycling is an established industry overseas, it is a phenomenon that is still gaining currency in India.

With the Indian economy having registered a sustained growth rate of eight percentage points-plus in the past, changing economic trends have resulted in a significant rise in the disposable incomes and the rise of an Indian consumer with a greater propensity to spend. This has translated into a massive demand for consumer durables – especially white goods such as television sets, microwave ovens, air-conditioners, cellular phones, etc.

The E-Waste Recycling Industry in India

Scrap-dealers Using Crude and Unsafe Methods to Recycle E-Waste





E-waste Hazards

WEEE equipments are made up of a number of components – some containing toxic substances which can have an adverse impact on human health and the environment if not handled properly. Often these hazards arise due to the improper recycling and disposal processes used.

For instance, Cathode Ray Tubes (CRT) has high content of carcinogens such as lead, barium, phosphor and other heavy metals. When disposed carefully in a controlled environment, they do not pose any serious health or environmental risk. However,

breaking, recycling or disposing off CRTs in an uncontrolled environment without the necessary safety precautions can result in harmful side effects for the workers and release toxins into the air, soil and groundwater.

Another dangerous process is the recycling of components containing hazardous compounds such as halogenated chlorides and bromides used as flame-retardants in plastics, which form persistent dioxins and furans on combustion at low temperatures (600-800 degrees centigrade). Copper, which is present in printed circuit boards and cables act as a catalyst for dioxin formation when flame-retardants are incinerated. The PVC sheathing of wires is highly corrosive when burnt and also induces the formation of toxins.

Land-filling of e-waste, one of the most widely used methods of disposal, is prone to hazards because of leachate which often contains heavy water resources. Mercury, cadmium and lead are among the most toxic leachate. Mercury, for example, will leach when certain electronic devices such as circuit breakers are destroyed. Lead has been found to leach from broken lead-containing glass. In addition, landfills are also prone to uncontrolled fires which can release toxins.

Anatomy of a computer – A storehouse of toxic substances

A computer is a storehouse of several toxic substances. Key components of the computer are broken down by the kabadies, often in a crude and hazardous manner to extract whatever worth that is possible from them. Key items of computer waste that finds their way to scrap dealers are:

Monitors
Scrap dealers least prefers the monitors once they enter the post-consumer phase unless the cathode ray tube (CRT) is in working condition. The recovered CRT is procured by TV mechanics, which in turn use it in portable TV sets.

Circuit boards and motherboards
Circuit boards and motherboards are used to recover working components manually after which the boards are heated to recover thin copper sheets. In some recycling units they are cut into 5-10 mm bits and then they are exported for recovery.

Printers
The most important components recovered from a printer are the motor and the circuit boards.

Hard disks
Hard disks are either resold or broken to recover the steel casing, actuator (magnet),

platter, and circuit board inside. These are sold separately.

Plastics

Nearly 20 per cent of a computer is made up of plastics – primarily Alpha Butadiene Styrene (ABS) used for making CPU and keyboard housings. In recent years, even polycarbonate is used to enhance the aesthetics. ABS plastics are a high quality plastic and harder than most other varieties. Their hardness and the requirement of specialised equipment for their recycling discourage its retrieval. ABS plastics from computer components are separated and sold on weight basis to plastic recyclers. These recyclers collect ABS plastics from various other sources, and after pelletising them, pack them off to Mumbai or Delhi where the pellets are recycled into chairs and trays. According to experts from the Central Institute of Plastics Engineering and Technology (CIPET) there is very little chance of this coming back to the manufacturing stream.

Mechanism Employed for Recovery of Components from Computers		
Computer Component	**Recovered Component**	**Mechanism Employed**
Monitor	Cathode ray tube, circuit board copper, plastics	Dismantled using screw drivers; the broken CRTs are usually dumped at landfills
Hard disk	Steel, aluminium, actuator (magnet), platter, circuit board	Broken using hammers
Circuit board	Capacitor, condenser, gold, copper, chipped board	Gold recovery through acid treatment Copper recovery through heating Crushing of boards by custom-made crushers
Printer	Motor, plastics	Dismantled using screw drivers
Cables and wires	Copper, aluminium	Burning or stripping

Toxic elements of a computer	
Toxic Constituents	**Components of PCs**
Lead and cadmium	Printed circuit boards
Lead oxide and cadmium	Cathode Ray Tubes (CRTs)
Mercury	Switches and flat-screen monitors
Cadmium	Computer batteries
Poly Chlorinated Biphenyls (PCBs)	Capacitors and transformers
Brominated Flame Retardants (BFRs)	Printed circuit boards, plastic casing cable

Poly Vinyl Chloride (PVC)	Cable insulation releases highly toxic dioxins and furans when burned to retrieve copper from the wires.

E-waste management: key challenges in India

While the overall challenges regarding management of e-waste in India are the same faced by other developing economies, the vast geographical diversity and economic disparities between regions often make e-waste management challenges unique in India. A few of the key challenges faced are:

- Rapidly increasing e-waste volumes, both domestically as well as generated through imports. Imports are often disguised as second-hand computer donations towards bridging the digital divide, or as metal scrap
- Limited accuracy in the estimates of the quantity of e-waste generated and recycled
- Low level awareness among consumers about the hazards of incorrect e-waste disposal
- Widespread e-waste recycling in the informal sector using rudimentary techniques such as acid leaching and open air burning resulting in severe environmental damage
- E-waste workers have little or no knowledge of toxins in e-waste and are exposed to serious health hazards, etc.

E-waste Recycling: The Global Scenario

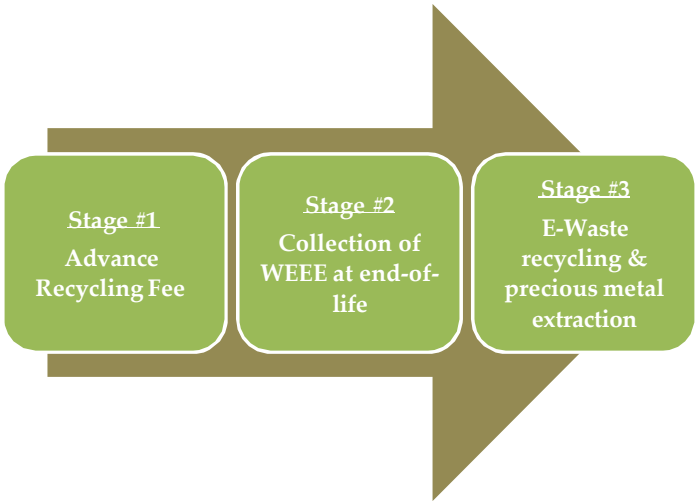
E -waste has been widely recognized as one of the rapidly growing environmental problems of the world. United Nations Environment Programme ("UNEP") estimates that up to 50 million tones of electronic waste is being generated globally on an annual basis, comprising more than 5% of all municipal solid waste. In developed countries, e- waste equals 1% of the total solid waste generation and is expected to grow to 2% by 2010. In the United States alone, it accounts up to 3% of the total municipal waste generation. In the European Union, e-waste is growing three times faster than average annual municipal solid waste generation. It is estimated that the total amount of e- waste generation in EU ranges from 5-7 million tons per annum or about 14-15 kgs per capita, and is expected to grow at a rate of 3% to 5% per year. In developing countries, e-waste accounts for up to 1% of the total municipal solid waste generation. In countries like China and India, though the annual generation per capita is less than 1 kg, it is growing at an exponential pace. Given the above scenario, e-waste recycling has been an activity that has been attracting significant global attention.

An Overview of Key Recycling Legislation

The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal (the "Basel Convention") of 1989 is an international treaty that was designed to reduce movements of hazardous wastes between nations, and specifically to prevent transfer of hazardous waste from developed countries to less developed countries. In the 1990s, some European countries banned the disposal of e- waste in landfills, paving the way for creation of an e-waste processing industry in Europe. In Switzerland the first electronic waste recycling system was implemented in 1991, beginning with refrigerators initially, gradually bringing all other electric and electronic devices into the system. A specific legal framework was introduced in 1998, with the Ordnance on the Return, the Taking Back and the Disposal of Electrical and Electronic Equipment ("ORDEEE") coming into force. The European Union implemented a similar system under the Waste Electrical and Electronic Equipment Directive (2002/96/EC) (the "WEEE Directive"), imposing the responsibility of disposal of waste electrical and electronic equipment on the manufacturers of such equipment. The WEEE Directive has since been transposed in all national laws in all member countries of the European Union. The Restriction of Hazardous Substances Directive ("the RoHS Directive") is another piece of legislation (2002/95/EC) adopted by the European Union to control the hazardous substances in e-waste.

The E-Waste Recycling Life-Cycle

Though individual countries might have their own domestic laws governing specific aspects of e-waste management, the overall mode of execution of an e-waste recycling model in developed countries in current times includes the following three broad stages – collection of Advance Recycling Fee at the point-of-sale of EEE components, disposal of WEEE at dedicated collection points at their end of life and the final recycling/ safe disposal of e-waste by recyclers. This activity flow can be pictorially captured as follows:



Stage #1: The first step in e-waste recycling takes place at the time of buying new

electric or electronic products, when the customers are charged an Advance Recycling Fee (“ARF”, or Advance Disposal Fee, “ADF”) which contributes towards the expense incurred for all processes required for a safe disposal of the article at the end of its life. The amount of ARF is defined by the type of the product and is included in the sales price and is usually stated separately in the invoice. This introduction of ARF enables customers to return retired equipment free of charge at designated collection sites.

Stage #2: The second step in the process is at the time of returning the various end-of- life appliances. Customers are not allowed to dispose off WEEE through other than certain dedicated collection points. Retailers, traders and manufacturers are obliged to take back WEEE free of cost and independent of any purchase for all types of products that they deal in. In other words, if a retailer sells only computers belonging to a certain brand, he would be obliged to take back computers of all brands, but not televisions or refrigerators.

Stage #3: The final stage in the process is the recycling of e-waste material. This broadly involves segregation of e-waste (e.g., into monitors, keyboards, CPUs, etc.), and the dismantling of equipments in order to obtain recyclable material. E-waste is subjected to processes such as crushing, shredding, and magnetic/ eddy current/ air separations in order to segregate recyclable material from the e-waste.

The final step in the recycling process is extraction of precious materials and safe disposal of hazardous waste. After subjecting the e-waste to crushing, shredding, etc. material that contain precious metals such as the printed circuit boards is usually sent to refineries such as Umicore in Belgium, Boliden in Sweden, etc. where it is subjected to refinement and precious materials are extracted. The hazardous components of e-waste are sent to authorised waste treatment and disposal facilities for their safe treatment/ disposal.

Overview of Regulatory Framework

E-waste trade comes under the broad regulatory framework related to environment, foreign trade and local rules & regulations. The following section makes a reference to some of the relevant rules and regulations which facilitate this trade.

Regulations and Their Scope

Electronic waste is being partly covered under the broad regulatory framework related to hazardous waste in India. The Ministry of Environment and Forests, Government of India, is the nodal agency at the central level for policy, planning,

promoting and coordinating the environmental programs. The Environment (Protection) Act 1986, umbrella legislation covers hazardous waste and provides broad guidelines to address it. The policy statement on the abatement of pollution issued by the government of India in 1992 reiterated its commitment towards waste minimization and control of hazardous wastes. India is a signatory to Basel Convention on the control of trans- boundary movement of Hazardous Wastes and Disposal. India ratified and acceded to it in 1992. The ratification of this convention obliges India to address the problem of trans- boundary movement and disposal of dangerous hazardous wastes through international cooperation.

The Ministry of Environment and Forests ("MoEF") has issued the following notifications related to hazardous waste:

1. Hazardous Wastes (Management and Handling) Rules, 1989/ 2000/ 2002
2. MoEF Guidelines for Management and Handling of Hazardous Wastes, 1991
3. Guidelines for Safe Road Transport of Hazardous Chemicals, 1995
4. The Public Liability Act, 1991
5. Batteries (Management and Handling) Rules, 2001
6. The National Environmental Tribunal Act, 1995
7. Bio-Medical Wastes (Management and Handling) Rules, 1998
8. Municipal Solid Wastes Rules, 2000 and 2002
9. The Recycled Plastic Manufacture and Usage (Amendment) Rules 2003

The Hazardous Wastes (Management and Handling) Rules, 1989 were introduced under Sections 6, 8, and 25 of the Environment (Protection) Act of 1986 (referred to as "HWM Rules, 1989"). The HWM Rules, 1989 provide for the control of generation, collection, treatment, transport, import, storage and disposal of wastes listed in the schedule annexed to these rules. The rules are implemented through the various Pollution Control Boards and Pollution Control Committees in the states and union territories. There were a few inherent limitations to the implementation of the HWM Rules, 1989, which led to amendments to these Rules being introduced in 2000, 2002 and 2008, widening the definition of hazardous waste by incorporating e-waste and harmonizing the list of hazardous waste materials with that of the Basel Convention.

Besides these rules, in 1991, the Ministry of Environment and Forests (MoEF), New Delhi issued guidelines for management and handling of hazardous wastes for (a) generators of waste, (b) transport of hazardous waste, and (c) owners/operators of hazardous waste storage, treatment and disposal facilities. These guidelines also established mechanisms for the development of a reporting system for the movement of hazardous waste (the manifest system) and for the first time, established procedures for closure and post-closure requirements for landfills.

In addition to these direct rules dealing with issues of hazardous waste

management, the Government has moved to enact legislation and additional incentives for industries to comply with environmental provisions and bring out market forces into the business of environment. In this vein, the Public Liability Act 1991 was adopted to require industries dealing with hazards to ensure against accidents or damages caused by release of pollutants.

Batteries (Management and Handling) Rules, 2001 apply to every manufacturer, importer, re- conditioner, assembler, dealer, recycler, auctioneer, consumer and bulk consumer involved in manufacture, processing, sale, purchase and use of batteries or components thereof. These rules confer responsibilities on the manufacturer, importer, assembler and re-conditioner; they govern the registration of importers, the customs clearance of imports of new lead acid batteries, procedures for registration/ renewal of registration of recyclers and also the responsibilities of consumer or bulk consumer and responsibilities of auctioneers.

In 1995 publication of guidelines for Safe Road Transport of Hazardous Chemicals that established basic rules for Hazardous Goods Transport and provided for establishment of a Transport Emergency Plan and for provisions on Identification and assessment of Hazards.

The National Environmental Tribunal Act, 1995, provides for expeditious remedies to parties injured by environmental crimes. Legislation on the Community's Right to Know, 1996, has been adopted to provide more access to information regarding potential hazards from industrial operations.

Bio-Medical Wastes (Management and Handling) Rules, 1998, provides a ten category listing of biomedical waste there control of generation, collection, treatment, transport, import, storage and disposal of wastes listed in the schedule annexed to these rules.

Municipal Solid Wastes (Management and Handling) Rules, 2000, provides for collection, segregation, storage, transportation processing and disposal of municipal solid wastes.

The recycled plastic Manufacture and Usage (Amendment) Rules 2003. These rules essentially deal with plastic recycling and products made out of plastic recycling.

2. Role of Educational Institutions in India

Educational institutions are playing important role in a nation's growth and development which starts from maintenance of Different wastes without harming the environment (Chan and Lam, 2018). A clean and healthy environment in an Organization determine effective learning skills and offers a conducive learning environment to the students. Educational institutions are insisted by both Central and State Governments to offer eco-friendly atmosphere to the stakeholders (Rajalakshmi *et al*., 2021). In addition, all the Educational institutions are asked to save the environment for future generations and to resolve the environmental problems (accumulating solid wastes and wastewaters/effluents and their careless disposal, enormous utility of plastics, uneconomical consumption of water, irresponsible in water harvesting and storage procedures, etc.) through Environmental Education. Implementing Swachh Bharath Abhiyan Scheme launched by the Indian Government thro' the Educational institutions plays a major role in terms of giving neat and clean environment to tribal, rural and urban people across the country, besides the regular and conventional activities carried out by Student Force, Nature club, Eco club, Science club, Fine Arts club, Flora and Fauna club, Youth Red cross unit, etc. Seminar, Conference, Workshop, training and awareness programmes on environmental Waste Management awareness programmes may be conducted periodically by the Management and Administrative people of an Organization to the stakeholders.

Waste Management auditing is a systematic method whereby an organization's environmental performance is checked against its environmental strategies and compliances of the Government guidelines. This audit process is definitely useful for the Educational institutions to maintain the campus neatly and can give pure atmosphere to the students and staff members including management people (Vergara and Tchobanoglous, 2012). It is like an official examination of the environmental effects onan organization's campus as per the Government guidelines. The audit report may be useful to improve the organization's campus significantly by following the recommendations and suggestions given in the report. The Waste Management processes are being undertaken by ISO EMS 14001:2015 criteria and the concept of Swachh Bharath Abhiyan under Clean India Mission (Gnanamangai *et al*., 2021).

3. Waste Management and Environment Policy

Waste management and environment policy aims to provide an education and awareness in a clean environment to the stakeholders with regard to environmental compliance. Scope of the policy applies to all employees and students of the Institution/organisation to provide an ecofriendly atmosphere (Ghiani *et al*., 2014). Waste Management Policy dealt with cleanliness of the campus maintained through proper disposal of wastes and steps to be followed to recycle the biodegradable wastes and utilization of eco-friendly supplies to maintain the campus free from hazardous wastes /pollutants (Cardenas and Halman, 2016). The concept of eco-friendly culture is disseminated among the students as well as rural community through various awareness programmes. Head of the Organization, Departmental Heads and Senior Managers/ Management Representatives are responsible for monitoring the "waste management" initiatives of the College / University and maintain a clean campus whileeach and every individuals of the organisation should adhere to the policy.

4. Environment Friendly Campus

As stated earlier, Organization is liable to provide an eco-friendly atmosphere along with waste management facility to all the stakeholders (students and staff members). All non-compostable and single-use disposable plastic items, plastic utensils, plastic straws and stirrers should be avoided. Demonstration/awareness programme on establishing plastic-free environment and utility of organic alternatives for all incoming and current students, staff and faculty should be organised. Reduction of use of papers alternated with e-services, e-circulars, etc. and proper disposal of wastes, recycling and suitable waste management system should be considered to establish environment friendly campus. Environment Friendly Campus is playing an important role in terms of imposing waste management scheme which in turn useful tomaintain the soil health and increased productivity (Sridhar and Adeoye, 2015).

5. Importance of Waste Management Auditing

The Management of the Organization (Auditee) should be exposed their inherentcommitment towards making ecofriendly atmosphere through the Waste Managementand ready to encourage/follow all types of waste management activities. They should promote all kinds of waste management activities such as conduct of environment awareness programmes, usage of segregation bins, avoiding of single use plastics, utility of organic alternatives prior to and after the Waste Management (Suwartha and Sari, 2013). The administrative authorities should formulate 'Waste ManagementPolicies' based on technical report of Waste Management auditing. A clean and healthyenvironment will enhance an effective teaching/learning process and creates a favourable learning clean environment to the scholars. They should create the awareness on the importance of waste management through environmental education among the student members and research scholars. Waste Management is the most effective, ecological approach to manage environmental complications.

Waste Management may be beneficial to the campus in improving the greeneryactivities which in turn useful to save the planet for future generation. It is necessary toconduct Waste Management audit frequently at least once in three years in campus because students and staff members should aware of the Waste Management and its beneficial effects in order to save planet by means of 'Go green concept' which in turnsupport the institution to set environmental models ('icon') for the community. Waste Management is a professional and useful measure for an Organization to determine howand where they are retaining the campus eco-friendly manner (Kaseva and Gupta, 1996). It can also be used to implement the alleviation measures at win-win situation for the stakeholders and the planet. It provides an opportunity to the stakeholders for the development of ownership, personal and social responsibility.

6. Broad Categories of Waste

6.1. Municipal Solid Waste (MSW): It is commonly known as garbage collected by the municipality and/or disposed of at the municipal waste disposal site. Based on the sources of waste generation, it is further categorised into residential, commercial, institutional, and municipal services. MSW include food items, packaging materials, newspapers, clothes, containers, bottles, batteries, and durable goods like furniture, etc., generated by households, offices, hotels, shops, schools, and other institutions (USEPA, 2020). Some fractions of demolition and construction debris, hazardous waste materialssuch as used electric light bulbs, batteries, automotive parts, and a very small quantity of biomedical waste such as discarded medicines and used syringes, are often found incollected municipal solid waste. Once collected, they are sorted and treated for recycling and reuse before their final disposal.

6.2. Biomedical waste: Biomedical waste or hospital waste is the waste created by healthcare activities such as diagnosis, treatment, immunization, or any kind of research activity or in the production or testing of biologicals. It contains hazardous materials such as needles and syringes, chemicals, pharmaceuticals, medical devices, and radioactive materials and infectious materials such as unwanted microbiological cultures and stocks, bandages and soiled dressings, body parts, other human or animal tissue, diagnostic samples, discarded blood, etc.

6.3. Plastic waste: Plastic wastes are the discarded products made of plastic, such as packaging material, carry bags, pouches, etc. whose life is over and are of no use as prescribed in the Plastic Waste Management Rules, 2016. They are recyclable materials. It is necessary to manage plastic waste properly because the accumulation of plastic discarded objects causes adverse effects on wildlife, the marine environment, and human beings. Plastic waste can be easily seen everywhere on land and in oceans,lakes, rivers, ice, and air, which causes damage to humans and the whole environment.

6.4. Electronic waste: Electronic waste, also known as "E-waste," refers to unwanted or useless electronic or electrical products that are non-working, broken, rejected, or have reached the end of their useful life. Some examples of electronic waste are computers, cell phones, tablets, televisions, photocopiers, fax machines, etc. They are dangerous in nature due to toxic chemicals they release and can harm the environment.Although they can be refurbished, reused, or recycled.

6.5. Bio-waste: Bio-waste is biodegradable waste, which consists of mainly organic waste. It includes green waste generated from paper waste, gardens and parks, food andkitchen waste from households, restaurants, and food processing waste from food processing plants. In the landfill directives, it is defined as ‘waste capable of undergoinganaerobic or aerobic decomposition, such as food and garden waste, and paper and cardboard. Bio-waste is a fuel resource that may be used to produce heat and electricity.

6.6. Construction and demolition (C&D) waste: C&D waste comprising of building materials, construction debris and rubble generated during the

redevelopment, construction, repair and demolition of any civil structure. Though it is kept as a separate category, some of the fraction of C&D waste is also found in municipal solid waste. The waste was disposed of at the disposal facilities which contains high proportion of recyclable materials, which are used to make construction materials. The C&D waste may have some hazardous substances which should be disposed of separately.

6.7. Industrial waste: Industrial waste is generated as a result of industrial processes. They are categorized mainly as hazardous waste and non-hazardous waste. Though industrial waste is not considered as municipal solid waste and is not mixed with it, in some places, non-hazardous waste is disposed of with municipal waste. In this case, theindustries arrange for waste transportation to the disposal site and may be responsible for disposal fees. According to the legislation and current practises, the municipality should explicitly define its responsibility for industrial waste management. This wouldassist in the quantity and classification of hazardous and non-hazardous industrial wastes, as well as municipal and non-municipal wastes.

6.7. Food waste: It refers to the decrease in mass (quantitative) or nutritional value (qualitative) of food - edible parts - throughout the supply chain that was intended for human consumption. It also refers to food that gets spilled, spoilt or otherwise lost, or incurs reduction of quality and value during its process in the food supply chain before it reaches its final product stage. It is typically taking place at production, post-harvest, processing, and distribution stages in the food supply chain.

7. Scope of Waste Management Audit

Waste management audit is sought to examine whether the institution / industries / pharmaceutical / hospitals had identified waste as a risk to environment and health, accurately assessed the amount of different kinds of waste being generated in the institution/industries/pharmaceutical/hospitals and drafted a policy on waste management which focused on waste minimisation and waste reduction, as compared to waste disposal, as the more effective ways to manage waste (Rajeshwari *et al*., 2015;Trung and Kumar, 2015). In addition, the waste management audit sought to examine whether all kinds of waste had been covered under legislation for safe disposal and whether agencies had been allocated responsibility and accountability for the management of waste.

8. Benefits of the Waste Management Auditing

There are several benefits on conduct of Waste Management by the Organization which may be definitely useful to improve the campus significantly based on the auditreport. The Waste Management contained methodology followed and both qualitative and quantitative measurements including physical observation of availability of adequate dust bins, usage of personnel protected materials, separate transportation trolley and method of disposal of waste. The waste management scheme is essential toimpose the soil health and increased productivity in an organization (Brunner and Rechberger, 2014). The following are the major benefits of the waste management process.

- Availability of adequate number of user-friendly dust bins as per Guidelines (Red, Yellow, Blue, and Black & Green Bins) in the campus for various wastes' collection, segregation and disposal.
- Maintenance of 'Record Register' for waste disposal and puncture proof containers for sharps / blue bags in the campus.
- Availability and usage of personal protected materials like Gloves, Caps, Masks, Aprons & Gum boots etc. as per the Guidelines in the campus.
- Availability of 1% fresh Sodium hypochlorite or Bleaching Powder solution as per guidelines for maintaining the pest and disease free hygiene environment.
- Proof of Licensed companies signed MoU with the organization for wastescollection and disposal as per the Central and State GoveT. regulation.
- Norms are being followed by the Organization as per the Central and State Government Pollution Control Board.
- Different Forms, Formats, Annual Report, etc. are available for waste collection and mode of transportation.
- Availability of a trained dedicated with skilled personals for waste management in each campus in department / sector wise.
- Checking whether e-wastes, bio (wood) wastes, construction wastes, plastic wastes, hazardous wastes and biomedical wastes mixed at the source of generation.
- Checking whether the waste collected in covered bins and is the bins filled up to more than ¾ th level.
- Checking whether the bins are cleaned with soap and disinfectant regularly and isthe stored waste kept beyond 48- 72 hrs.
- Checking whether the waste transported in closed containers or open bags and are the waste collection bins/Trolleys/wheel barrow used for transporting wastes.
- Checking whether the concept of E-Waste, Plastic Waste, Biomedical waste management is followed in the campus.
- Whether E-Waste management practices included in the purchase policy ofelectronic items and observe the E-waste refurbished and used again in theinstitution.
- Whether the importance waste and their implications on environmental andpersonal hygiene through awareness programmes are conducted for stakeholders.
- Signing MOU with Government and NGOs ensure proper handling of waste materials and reuse of construction and wood wastes in the same campus.

9. About the Organization

The college has its primary mission to prepare outstanding lawyers and legally trained professionals to serve their local. national. and global communities with excellence integrity, and professionalism: and through its service strives to contribute to the development of the law and society career to provide the youth with the best opportunities and environment for higher education and enable them to attain very high levels of academic excellence to inculcate students' moral values and leadership qualities to make them appreciate the need for high ethical standards in personal. social and public life, to create students with social responsibility to reach out the disadvantaged sections of the society through our legal service programs.

Knowledge that will lead to happiness, peace, harmony and prosperity. To empower backward and rural students in legal education and to impart social and legal awareness and to create awakening of their rights and duties thus, making them saviour of law and justice. we believe individual from each stratum of society needs affordable, relevant and quality

Floor	Facilities
Ground floor	Playground, parking for 2 wheeler & 4 wheeler, cricket and football turf, badminton court, water storage facility, washrooms for girls and boys, Principal cabin, Administrative office, Accounts office, Auditorium, Pantry, medical room, reception
First floor	Classrooms, staff room, boys common room, girls common room, NAAC (IQAC) room, girls washrooms, boys washroom.
Second floor	Computer lab, indoor games room
Third floor	Activity room
Fourth floor	Library, e- library
Fifth floor	
Terrace	Water storage & harvesting

10. Procedures followed in Waste Management Audit

Waste Management is a structured process of documenting the credentials in terms of availability of adequate Dust bins, usage of personnel protected materials, separate transportation trolley and method of disposal of waste. it is a kind of a professional tool for assessing the waste management in the campus. Waste Management projects the best environmental practices and initiatives taken in the organisation at the prescribed site of audit that brings added value to the organisation in maintaining the eco-friendly campus to the stakeholders. First step of the audit is ensuring that the organisation has a central role in building the waste management, in order to validate the same.

Waste management is not intended for the self-sustainability of the building alone, it also involves in propagation of the waste management initiatives so as to be adopted by any individuals and organization at a minimum cost. Waste Management has been conducted as per the checklist of QUALITY CARE through the authenticated Professionals for people qualified to investigate and evaluate the campus for validating the best environmental practices. Professional team of ISO Environment Management Audit (14001:2015), Indian Green Building Council Accredited Professionals, Experts of waste management Lead Auditors were selected to conduct the Waste Management process.

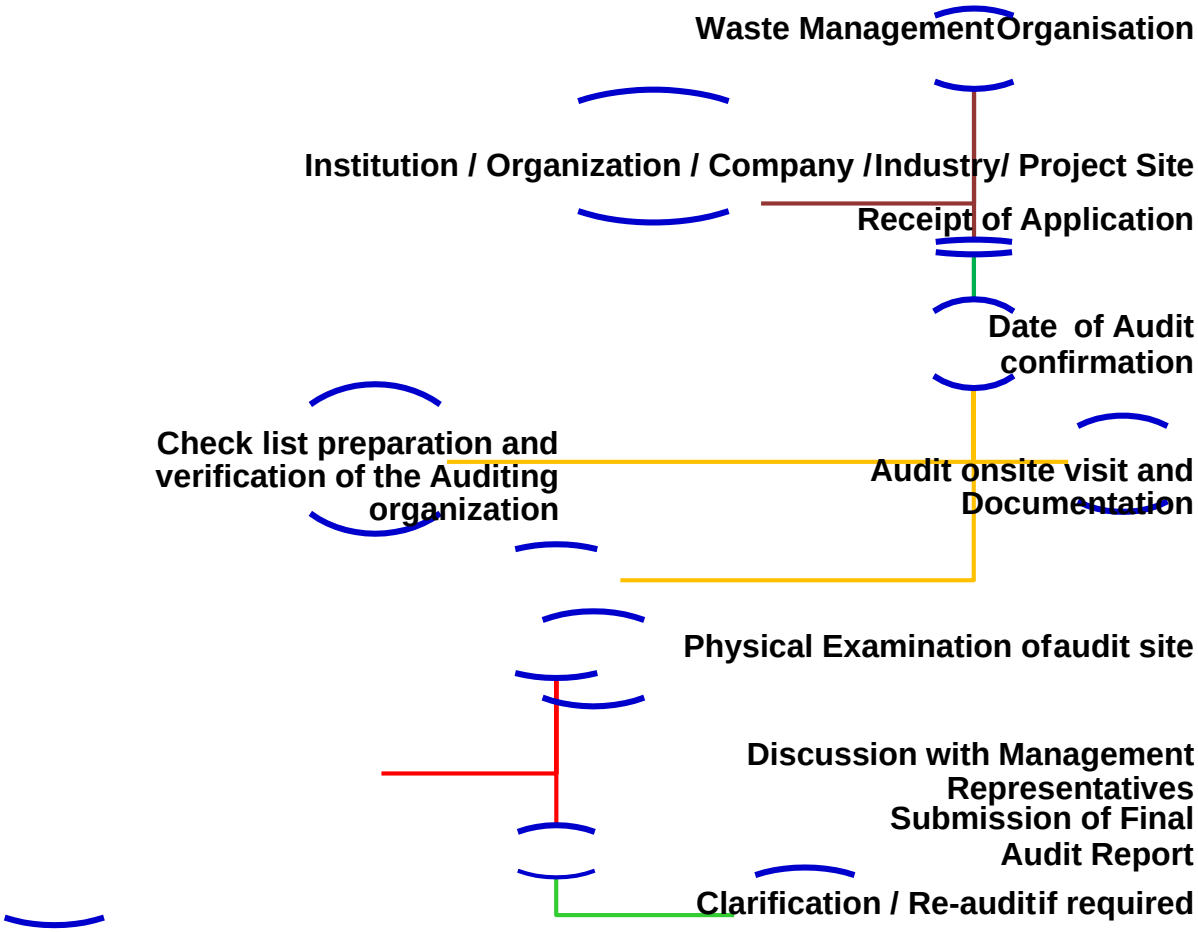
During the audit, Availability of Adequate number of Dust Bins as per Guidelines (Red, Yellow, Blue, and Black & Green Bins) in the campus for various wastes' collection, segregation and disposal, maintenance of 'Record Register' for waste disposal and puncture proof containers for Sharps / Blue Bags in the Campus, Availability and usage of personal protected materials like gloves, Caps, masks, apronsand gum boots etc. as per the guidelines of Tchobanaglous *et al*. (2007), PIB GoI (2016) and Tewari (2021) in the campus, Availability of 1% fresh Sodium hypochlorite or Bleaching Powder solution as per guidelines is checked to assess the personal and hygiene environment. Checking whether e-wastes, wood wastes, construction wastes, plastic wastes, hazardous wastes and biomedical wastes mixed at the source of generation, checking whether the waste collected in covered bins and is the bins filled up to more than ¾ th level are monitored. In addition, checking whether the bins are cleaned with soap and disinfectant regularly and is the stored waste kept beyond 48- 72hrs, checking whether the waste transported in closed containers or open bags and are the waste collection bins/Trolleys/wheel barrow used for transporting wastes are also monitored ring the audit process. Checking whether the E-Waste refurbished and used again in the institution are also done during the audit process as per the protocolof Gnanamangai *et al*. (2021).

Projects, Dissertations and Thesis are the academic effort credentials that alwaysfosters the innovative ideas on thinking and implementation of new innovative approaches towards the waste management. These should be disseminated through presentations and publications in social media, books, magazines and journals so as tospread the innovative ideas and methods to the broad public. These efforts taken by the students and staff members were deliberated while conducting the waste management.Waste management processes are taking place as per the following flow-chart starting from the receipt of application forms from the auditee (organization) and ending upon the submission of final report to the concerned organization (Leal Filho *et al*., 2015). During the audit process, the best environmental practices followed

and new initiatives undertaken in the organisation to reduce the environmental pollution and steps taken for nature conservation that brings added value to the organisation in maintaining the eco-friendly campus with respect to waste management process were assessed (WGBC,2021). In addition, supporting activities of the scholars and staff with regard to "Visionand Mission" of the waste management activities of the Organization is also evaluated.

10.1. Onsite Waste Management Audit activities

Opening meeting is the first step between the audit team and auditee along the Management Representatives where the purpose of the audit, procedures to be adopted for the conduct of the audit, verification of the documents and the time schedules werediscussed, in brief. Followed by opening meeting, onsite inspection will be conducted which is the second step in the audit where the Audit team members visited different sites in the campus and required photographs were taken then and there for preparing the audit report. During the onsite phase of visit, it is vivid how the various facilities made by the NLC to the stakeholders to ensure the waste management in the campus. It is observed how the environment is protected in the campus and by what means an eco-friendly atmosphere is being given to the stakeholders. The assessment reveals the strengths and weaknesses of theAuditee's Management controls and risks associated with their failure in creating waste management facilities. Collecting audit proofs *ie*, data collection and information from the auditee as per the audit protocol were carried out. An exit meeting was conducted to describe the findings of the audit with Management Representatives and staffmembers along with the audit team in brief.



Flow-chart of Waste Management Audit Procedures

10.2. Pre-Audit stage activities

A pre-audit meeting (opening meeting) is conducted with Management and Administrative people along with staff coordinators of waste management audit process, wherein, audit protocol and audit plan were discussed in brief. The purpose ofthis meeting is to provide a chance to emphasize the scope and objectives of the audit and discussions held on the feasibilities associated with the audit (Marrone *et al*., 2018). Pre-audit stage activities are an essential prerequisite for the Waste Management to meet the auditee and to gather information about the campus and required documents were collected directly from the Organization before the start of the audit processes.

10.3. Target Areas of Waste Management Auditing

Waste Management is nothing but a professional tool to assess the waste management activities in the educational institutions and give a value addition to the campus and considered as a resource management process. Waste management processmay be undertaken at frequent intervals and their results can demonstrate improvementor change over time. Eco-campus focuses on the reduction of carbon emissions, water consumption, wastes to landfill and enhance energy use conservation to integrate environmental considerations into all contracts and services considered to have significant environmental impacts (Choy and Karudan, 2016). There are several targetlisted in the waste management process in which a few are taken into consideration as per the Indian scenario is concerned. They are the various sources (source of plastics, wood, e-waste, biomedical, construction and demolition waste and hazardous waste), segregation of waste, storage area of the waste, collection and transport units, processing units and the landfills.

11. Impact of Waste on Health and Environment

Waste represents a threat to the environment and human health if not handled ordisposed of properly. Surface and ground water contamination takes place when wastereach water bodies. Residues from waste can change the water chemistry, which can affect all levels of an ecosystem. The health of animals and humans are affected when they drink the contaminated water. A specific environmental hazard caused by waste isleachate, which is the liquid that forms, as water trickles through contaminated areas leaching out the chemicals. Movement of leachate from landfills, effluent treating plants and waste disposal sites may result in hazardous substances entering surface water, ground water or soil. Waste contaminates soil and can harm plants when they take up contaminants from their roots. Eating plants or animals that have accumulated soil contaminants can adversely affect the health of humans and animals. Emissions from incinerators or other waste burning devices and landfills can cause air contamination. Incinerators routinely emit dioxins, furans and polychlorinated by-phenyls, which are deadly toxins, causing cancer and endocrine system damage. Landfills are a big sourceof release of greenhouse gases, which are generated when organic waste decomposes

in landfills. E-waste contains a mix of toxic substances such as lead and cadmium in circuit boards; lead oxide and cadmium in monitor cathode ray tubes; mercury in switches and flat screen monitors; cadmium in computer batteries; polyvinyl chloride in cable insulation that release highly toxic dioxins and furans when burned to retrieve copper from the wires. Thus, improper handling of waste has consequences both on theenvironment as well as on the health of the people.

12. Management of Wastes

Waste management can be simply defined as the collection, transport, recoveryand disposal of waste together with monitoring and regulation of the waste managementprocess. Waste prevention means measures aiming at the reduction of the quantity and harmfulness for the environment of diverse waste streams. Prevention is the most desirable waste management option as it eliminates the need for handling, transporting,recycling or disposal of waste. It provides the highest level of environmental protectionby optimising the use of resources and by removing a potential source of pollution. The most popular types of waste management are

Recycling, Incineration, Landfill, Biological Reprocessing and Animal feed. According to United Nations Environment Programme (UNEP), waste management includes both the components of prevention and disposal of waste. Rather than regarding 'waste' as a homogenous mass that shouldbe buried, they argued that it was made up of different materials that should be treateddifferently i.e. some should not be produced, some should be reused, some recycled orcomposted, some should be burnt and others buried. According to this hierarchy, the priority of any country should be to extract the maximum practical benefits from products and prevent and minimize the waste that is generated. Thus, strategies for waste disposal should focus on waste prevention and minimization through 7R's - Recycle, refuse, Reduce, Reuse, Repair, Re-gift and Recover.

Incineration is the disposal of waste materials by means of burning. The power produced by burning waste materials to produce heat, energy or steam. One of the drawbacks of this disposal process is that it can be a source of air pollution. Landfills includes the collection, transportation, disposal and burying of waste in designated property. Landfill sites are a significant cause of health and environmental problems that concern many communities. The gas from theses landfills is often incredibly dangerous. Chemical waste materials, such as kitchen waste and paper goods, can be reused after a procedure called biological reprocessing which is another popular system amongst the varied types of waste management. Multiple physiological systems, including recycling and biomass gasification, are used in biological reprocessing. Composting is a normal biological mechanism that is carried out under control conditions. One of the ends of the stock is natural gas, which is used to produce heat and electricity. Biological reprocessing is commonly used for the disposal of industrialwaste. Food waste can be preserved by manure and livestock feed and this is also one of the ecological types of waste management methods.

The three types of waste management based on the nature are (i) Solid Waste Management, (2) LiquidWaste Management and (3) Biomedical Waste Management. The term solid wasterefers to all discarded and thrown away solid and semi-solid wastes arising from human and animal activities. These may be classified as municipal wastes, industrial waste, and hazardous waste. Theuse and throw culture of advanced societies has led to a tremendous increase in the generation of solid waste. To overcome the major causes of solid waste,we have to practice the rules of no littering
zone, separate the dry waste and wet waste and dump it into the municipal vans, avoid usage of plastic, etc. liquid waste management is the practice followed to remove or prevent the discharge of pollutants to the drain system or to watercourses as a result of the creation, collection, and disposal of non-hazardous liquid materials.

To overcome the problem of liquid waste, we should stop dumping the oilcontainers on the ships, which disturb marine life, stop washing animals across the rivers, etc. Process of treating Liquid Waste by the Management includes (i) Primary treatment: Screening, grit removal, and sedimentation (settling), (ii) Secondary or biological treatment: Biological processes and additional settling and (iii) Tertiary or advanced treatment: Not all sewage
treatment plant requires tertiary (advanced) treatment. Biological wastes are generated during the diagnosis, testing, treatment, research, or production of biological products for humans or animals. Major sources of biomedical waste are hospitals, blood banks, labs, etc. Process of treating Biomedical Waste Management includes (i) Incineration,
(ii) Autoclaves, (iii) Mechanical / Chemical Disinfection, (iv) Microwave, (v) Irradiation and (vi) Vitrification. Waste management involves a process wherebywastes are collected, transported, and disposed of in the best possible way of limiting or eliminating the harmful effect of wastes. This aspect of environmental managementis as important as other public amenities or infrastructures without which the life of a contemporary man would be extremely difficult.

13. Observations of Waste Management

During the waste management audit processes, how the organization is managing the various waste materials like e-wastes, wood wastes, construction wastes, plastic wastes, hazardous wastes and biomedical wastes in the campus effectively without harming the environment. It is ensured that a proper storage of the wastes as per their classification, characterization, mode of treatment and disposal and analysis of disposal and recycling process of wastes as per the guidelines of MPCB, CPCB & DPCC are carried out.

13.1. Qualitative Measurements of Waste Management

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Adequate number of Dust Bins as per Guidelines (Red, Yellow, Blue, and Black & Green Bins) are made available in the campus for various wastes, collection, segregation and disposal.	√		
2.	Record Register for waste disposal and Puncture proof Containers for Sharps / Blue Bags are made available inthe campus	√		
3.	Mutilators (Needle / syringe cutters) and calibrated weighing machines for biomedical wastes collection*		√	
4.	Personal protected materials like Gloves, Caps, Masks, Aprons & Gum boots etc. used are adequately madeavailable as per the Guidelines in the campus.	√		
5.	Around 1% fresh Sodium hypochlorite or Bleaching Powder solution is made available as per guidelines*			√
6.	Mercury Spill Management, kit, Post Exposure Prophylaxis Kit and Blood spill Management kit are available*			√
7.	Proof of Licensed Companies signed MoU with the Organization for wastes collection as per the Govt.regulation	√		
8.	Norms are being followed by the Organization as per the Central and State Government Pollution Control Board	√		
9.	Different Forms, Formats, Annual Report, etc. are available for waste collection and mode of transportation	√		
10.	Availability of a trained dedicated with skilled personals for waste management.	√		
11.	Is the waste segregated at the site of generation? If not, where are they segregated?		√	

12.	Is the infectious waste and non infectious waste mixed at the source of generation?*			√
13.	Is e-wastes, wood wastes, construction wastes, plastic wastes, hazardous wastes and biomedical wastes mixed atthe source of generation?			√
14.	Is the waste covered in covered bins? and Is the bins filled up to more than ¾ th level ?	√		
15.	Is the bins cleaned with soap and disinfectant regularly and bins are overfilled? And is the stored waste keptbeyond 48-72 hrs?*			√
16.	Is the waste transported in closed containers or open bags?and Are the waste collection bins/Trolleys/wheel barrow used for transporting wastes?	√		
17.	Is the personal protective gears like mask and gloves used while collecting the wastes from the site of deposition?	√		
18.	Whether the concept of E-Waste management is followed in the campus?	√		
19.	Has a Management Representative, E-Waste Specialist, Laboratory Staff been assigned?	√		
20.	Whether E-Waste management practices included in the purchase policy of electronic items?	√		
21.	Whether an authorised refurbrisher appointed to manage the E-waste	√		
22.	Are the E-Waste refurbished and used again in the Institution?		√	
23.	Whether the importance waste and their implications onenvironmental and personal hygiene through awareness programmes are conducted for stakeholders?	√		
24.	Signing MOU with Government and NGOs ensure proper handling of waste materials	√		
25.	Whether construction and wood wastes are subjected to reuse them in the same organization campus?	√		
26.	Whether plastic wastes are burnt inside the campus? Any air pollution due to plastic materials burning takes place ?		√	
27.	Projects and dissertation works, scholarly publication onvarious wastes and their management carried out by staff members and students	√		
28.	Whether hazardous wastes are properly discarded in which acids, solvents and salts are disposed after dilutingwith water and poured after buried in the soil	√		

29.	Have programmes for the achievement of plastic free area objectives and targets been established and implementedas on today? Any display board is made in the campus?	√		
30.	Are recycling of plastic polymers promoted in the campus among the stakeholders?	√		
31.	Wood waste are collected and recycled properly and they used for fuel and degradation / green manuring purposes?	√		
32.	Residual wastes are properly disposed in the campus after burring the soil with proper dilution with water	√		

* Applicable for Hospitals/Labs/Pharmaceutical Industrial sectors

13.2. Plastic Waste Management

Plastics fuelled scientific and technological innovations due to their flexibility, durability, water resistance, and affordability. The most extensively used techniques of plastic waste management across the globe are mechanical recycling, incineration and landfilling. Recycling of plastic is considered as environmental friendly and the most effective way of plastic waste management. The other method of plastic waste management is incineration. The non recyclable plastic waste irrespective of segregation, cross contamination, additives and impurities are burned through incinerators. Landfilling is another method of plastic waste management. But unsanitary landfill or dumping of waste leads to tremendous space constraints, leaching of harmful chemicals and can also result in open surface fire in dumps, often resulting in the release of harmful air pollutants like dioxins and furans.Waste management audit conducted at NLC is ensured the methodology adopted to reduce the use of plastics among the stakeholders. The institute is collecting plastic items periodically and subjected to proper segregation into recyclable and non-recyclable wastes in appropriate colour coded and labelled bins. After segregation of plastic wastes, they are given to the Mumbai Municipal Corporation for its further disposal and recycling processes as per the Centraland State Government policies. The College Campus has taken sufficient attempts not to use single use plastics in the campus and 'say no to plastics' in places like canteen, hostel dining halls, seminar halls, corridors, etc. to the students, parents and public. The Management insisted the people use eco-friendly bags made from organic materials likeplant fibres which are easily decomposable in nature. These efforts are very much essential to keep the environment neat and clean to conserve nature.

13.3. Construction and Demolition (C&D) Waste Management

The waste comprising of building materials, bris and rubble resulting from construction, re-modelling, repair and demolition of any civil structure. According to Technology Information, Forecasting and Assessment Council's (TIFAC), highest waste generation comes from demolition and construction of buildings. The typical composition of Indian C&D wastes are concrete, soil, sand, gravel, bricks, wood, asphalt and metal. Recycling of C&D wastes is important as it helps to reduce the dependence on natural resources and eliminates adverse environmental impacts. Recycling of C&D wastes has the additional advantage of controlling the quantum of C&D wastes destined for disposal at landfills besides reducing transportation costs. Thelist of reuse and salvage materials include appliances, bathroom fixtures, bricks, blocks,masonry stone, structural steel, cabinets, carpeting, ceiling tiles, timber and timber based boards, door and window frames and shutters, flooring tiles, stone tiles/platforms, insulation, landscaping materials, lighting fixtures, metal framing including for partitions and ceiling, panelling, pipes, antique mouldings, accessories and hardware offurniture, PVC water tanks, roofing sheets used for garages, outdoor areas, fabric of tensile structures etc. Waste management audit conducted at the Campus is ensured theC&D wastes properly reused in the campus. C&D waste

management activities such assegregation, reuse and recycling are properly done without harming the environment. The College has performed the estimation of the amount and type of recyclable and non-recyclable waste materials that are expected to be generated on site. Listed all expected quantities of each type of waste and recycled into aggregates which are effectively used in the construction of pillars and pathways.

13.4. Bio wastes Management

Bio wastes are originated from plants animals and food wastes which also affectthe environment to a greater extend. Depending on the biowastes quality, it can be recycled or reused for energy production. Plant wastes can be reused as a building material, recycled into mulch for landscaping, pulp for paper production, and used as a fuel. The rising cost of waste material disposal and a growing environmental consciousness also contribute to the increasing importance of waste wood recycling. The reason for recycling waste wood is world approaching closer to global warming and reduce their global footprints. S.A Engineering Campus (Autonomous) is at the initial to collect the various biowastes across the campus and recycle them properly without harming the environment. Recycles biowastes are reused for plant cultivation as manuring.

Segregation of Waste at the source of generation by using different coloured dustbin observed inside the Campus.

13.5. Hazardous Wastes

Hazardous-waste management, the collection, treatment, and disposal of waste material that, when improperly handled, can cause substantial harm to human health and safety or to the environment. Hazardous wastes can take the form of solids, liquids,sludges, or contained gases, and they are generated primarily by chemical production, manufacturing, and other industrial activities. They may cause damage during inadequate storage, transportation, treatment, or disposal operations. Improper hazardous-waste storage or disposal frequently contaminates surface water and groundwater supplies as harmful water pollution and can also be a source of dangerous land pollution.

NLC Campus, has taken pioneering efforts to dispose the hazardous waste properly that are generated from various Department laboratories. The Campus did notdispose the chemical wastes in regular trash or in the drainage system. Acids, solvents,salts, reagents and cancer-causing substances (carcinogens) will cause cancer to the stakeholders those who doing research and/or experiments. Acids and Reagents are carefully mixed with 2 to 5 gallons of water and diluted solution poured slowly down the sink followed by flushing with large quantum of water without splashes. Most chemical wastes must be disposed of safely without affecting the environment, soil health and water quality as per the directions of World Hazardous Waste Programme. The Management has a certain protocol to dispose waste as well as expiry chemicals properly. But there are some proper records for disposing of acids, reagents, carcinogenic and hazardous chemicals as per the rule of Central and State Pollution Control Board. The usage of chemicals has been recorded very low inside the campus.

13.6. Electronic Waste

Electronic waste, as known as e-waste, is generated when any electronic or electrical equipment becomes unfit for the intended use or if it has crossed its expiry date. E-waste posses the huge risk to humans, animals, and the environment. E-waste typically consists of plastics, metals, cathode ray tubes (CRTs), printed cables, circuit boards, and so on. The presence of toxic substances like liquid crystal, lithium, mercury, nickel, selenium, polychlorinated biphenyls (PCBs), arsenic, barium, brominates flameretardants, cadmium, chrome, cobalt, copper, and lead makes it very hazardous, in casee-waste get dismantled and processed in a crude manner with the rudimentary techniques. The computers, mainframes, servers, monitors, printers, scanners, compact discs (CDs), copiers, calculators, battery cells, cellular phones, fax machines, transceivers, TVs, medical apparatus, iPods, refrigerators, washing machines, and air conditioners are examples of e-waste when they become unfit for its use. If these electronic items are discarded with other household garbage, the toxics pose a threat toboth health and vital components of the ecosystem.

According to E-Waste Management Rules, 2016 (Ministry of Environment, Forest and Climate Change, Government of India), electronic waste or e-waste includesold and non-functional electrical and electronic appliances. As per the Rules, the producer of the electrical and electronic equipment shall be responsible to collect and channelize the e-wastes generated under the criteria Extended Producer Responsibility.In compliance to the E-Waste Management Rules, 2016, Government of India, e-wastematerials were collected from the NLC campus arebeing segregated and then sold to Authorised Agencies which are approved by the Pollution Control Board (PCB) for handling e-waste. Segregation of e-waste helps in proper management of e-wastes are segregated from other waste and collected in red coloured bin. Due to this e-waste activity disposal, the e-waste pollution is significantly reduced in the Campus.

Segregation of E – Waste observed at NLC.

Counselling Centre and Hygienic maintenance at NLC.

13.7. Solid Waste Management

The term, solid waste control refers to the method of accumulating and treating solid wastes by following eco- friendly methods. It also offers solutions for recycling objects that do not belong to garbage. In the solid waste management, the wastes are accrued from different parts and are disposed of based on degradability materials like paper and non-degradability materials like glasses, plastics and metals. Integrated Solid Waste Management (ISWM) is an activity that promotes reduction of waste, recycling, composting, and disposal besides offering methods/solution to manage stable wastes in the context of protect all living organismsin the ecosystem. As per Solid Waste Management Rules, 2016 (Ministry of Environment, Forest and Climate Change, Government of India), solid waste refers to solid or semi-solid wastes generated from domestic, commercial, institutional, catering, and markets and other non-residential wastes (street sweepings, silt removed or collected from surface drains, horticulture/agriculture and dairy waste, bio-medical waste excluding industrial waste, and e-waste, battery/radio-active waste). According to the rules, the local authorities are responsible to collect, treat and dispose the solid wastes. The 'Central Board of Solid Waste Management' is the monitoring authority and is responsible for granting authorization to local bodies for processing and disposalof solid waste.

Table 1. Wastes Management Strategies in is NLC.

S.No	Kinds of Wastes	Collection (kg/year)	Collection frequency	Name of the Agency
1.	Plastic wastes	100-200	Monthly	Mumbai Municipal Corporation
2.	Construction and demolition wastes	Quantity is not known	Weekly	Utilized by the Campus premises itself
3.	Biowastes	300-500	Daily	Recycled in the Campus premises itself as manuring
4.	E-wastes	100-200	Yearly	Mumbai Municipal Corporation
5.	Hazardous wastes	Quantity is not known	Weekly	Mumbai Municipal Corporation

The Campus has a very good solid waste recycling unit which operates a few vehicles to collect wastes using compostable bags across the campus. Both degradableand non-degradable items are being collected from different Department laboratories, canteens, cafeteria, stationary shops and hostels every day and dumped in the place which is subsequently segregated based on the nature of degradability. The segregated items are neatly packed in eco-friendly covers and subjected to degradation without harming the environment. In addition, dust bins are kept in different places across the campus to provide a dust free atmosphere to the stakeholders. The dust bins are labelledproperly for the indication of degradable and non-degradable items. These bio composts are utilized for cultivation of plants in the campus and enhance the health of soils and population density of beneficial microorganisms to a greater extend.

13.8. Biogas plant facility

A biogas plant is the structure where it is produced by fermenting biomass (cow dung and plant waste products). This is done by developing methane-containing fuel that is usually present in energy crops like corn, or waste substances (manure or organicfood waste). The fermentation residue left over from the substrates at the end of fermentation can be used as fertilizer. Biogas is produced by the microbial/bacterial decomposition of the substrate under anaerobic situations. This is implemented by pumping the substrate into the fermenters. The substrate is stored beneath anaerobic conditions and is periodically shifted *via* agitators to avoid the formation of surface scum and sinking layers which allows the biogas to rise greater effortlessly. Installing biogas in educational institutions and industries help in the waste management process,as the wastes accumulated in canteen, hostels, mess and restaurants can be used for biogas plant, which in turn can be used for cooking. This fulfils two purposes simultaneously by energy saving and waste management. The Campus is in the initial development process for setting up biogas plant in the campus.

13.9. Vermicompost, Organic and Green manures

Natural or eco-friendly methods should be used to grow plants vigorously in the campus which could reducethe environmental pollution. Use of biofertilizers, organic manures (cow dung, vermicompost and plant wastes and litters) and green manures to grow healthy plants in the medicinal plant garden, kitchen garden and terrace garden should be ensured to keep the campus organic. The plant waste such as fallen leaves, stems, fruits, nuts, seeds and other plant parts should be used to make green manures. A concrete or ground level green manure production unit and vermicomposting units will help to convert all the plant and animal-based wastes into green/organic manures. This will be a healthy way of solid litter waste management in the campus. Minimal use of chemical fertilizers aspart of integrated nutrient management system is acceptable but nil use of chemical fertilizers is highly appreciable and also helps to keep the campus more of an organic ecosystem. The soil, air, water and sunlight are the four major natural resources any campus gets. Proper use and conservation of these resources are mandatory in Waste Management sites. Biofertilizers such as Nitrogen fixing bacteria, Potassium andPhosphorus solubilizing bacteria, Potassium mobilizing fungi (VAM), farmyard manure, dried cow dung manure, vermicompost manures and biofungicides

and biopesticides are extensively used in Campus to cultivate plants. Agrochemicals, chemical fertilizers, pesticides and fungicides are not used. These practices are very well appreciated because air, water and soil pollution due to use of agrochemicals is eradicated which in turn to improve the soil health significantly. The College is at the initial stage of Composting system

13.10. Napkin disposal facility

Menstrual Hygiene Management (MHM) is an indispensable part of the Swachh Bharath Mission Guidelines (SBM-G) for adolescent girls and ladies. As in step with MHM hints, 'Safe disposal' method making sure that the process of destruction of used and dirty materials is performed without human touch and with minimum environmental pollutants and 'Unsafe disposal' method throwing used material into ponds, rivers, or inside the fields exposes others inside the vicinity to decaying material and must be averted. Some of the unsafe practices of napkins include throwing them unwrapped into fields and rooftops, wrapping them in paper/ plastic bags and throwing them outdoors or in dustbins, burying them for de-composting, throwing them in latrine / toilets, burning it. These unsafe practices are to be avoided and rather health practices can be adopted. The Campus Management is implementing the safe practices ofdisposing of napkins using small scale incinerators in ladies' hostels. Incinerator's facility and disposal structures in the proper directions and other social stigmas connected to menstruation influences the sanitary waste disposal conduct of women within the campus is very much appreciated. The Management is taking care of adolescent girls and ladies significantly in their personal hygiene.

13.11. Environmental Education on Waste Management

An environmental study is the learning principle of the ecosystem and how it will expand sustainable techniques to defend the surroundings. It enables people to develop an understanding of the environment in which we live and helps to overcome tough environmental troubles affecting nature. In addition, the physical aspects of the environment should be studied, it also emphasizes the need to conserve biodiversity and undertake an extra sustainable way of life and make use of sources in a responsible manner. To create attention amongst today's generation on pressing environmental troubles, the University Grants Commission (UGC) in India has made it mandatory for the Universities and Autonomous Colleges to introduce a course in 'Environmental studies' and teach to the students about the ecosystem, pollution and problems associated with the environment. Environmental education refers to structured efforts to deliver how natural environments function, how human beings can manage to protectthe ecosystems in sustained manner. It is a multi-disciplinary field integrating Biology(Botany and Zoology), Chemistry, Physics, Ecology, Environmental Science & Engineering, Earth Science, Atmospheric Science, Mathematics, and Geography. These subjects may be useful to convey the importance of ecosystem, ecology and environment to the students and scholars.

14. Action Plan and Suggestions for Waste Reduction in the Organization

Preparing one's own waste reduction action plan allows one to rethink procedures toproduce less waste or redesign processes and hence boost efficiency. There are eightsteps to be taken by the Organization as per the following:

Step 1: Review the site waste audit report and ensure 3R's actions to be followed

Review site Waste Audit Report and gather information about the 3R's actions that are currently in place, such as waste reduction strategies, quantity of current wasteReduction, Reuse, Recycling, and analysis of operating costs after following 3R's.

Step 2: Using the 3Rs, identify major waste reduction opportunities

Examining the materials that make up a substantial part of the waste produced isa key aspect in identifying 3R's potential for waste reduction. Consider the cost of waste disposal, the potential for source separation, the potential to reduce, reuse, or recycle, the complexity of handling, and current and potential regulatory requirements.

Step 3: Determine waste reduction after identifying potential areas

Possible impacts of other priorities on the 3R's should be investigated when developing a waste reduction action plan in which review the costs and benefits of eachwaste reduction opportunity. Be aware of anticipated landfill closures, increased tipping fees, or other factors that may affect the disposal of waste and ensure the availability ofon-site storage space and storage space with adequate fire safety should be considered.

Step 4: Figure out why waste is produced?

When evaluating waste reduction possibilities, the Organization should start by asking, "Why is this material being used?". It may reveal the possibilities for reducing,reusing, or recycling the waste significantly. There are some questions such as 1) wherewaste can be eliminated during the operations by reducing the use of specific materialsor procedures, 2) where other materials that can be reused or recycled can be used, 3) where it is possible to utilise disposable materials and 4) where can we put controls in place to limit waste production during the operations?

Step 5: Evaluate impact of material purchasing practices on waste reduction

Material purchasing procedures involve a lot of waste reduction possibilities. Actions to change the materials used to manufacture the products or provide very good services which may involve discussions with suppliers. Replacing non-recyclable materials with reusable or recyclable materials gives economic benefits and greater waste diversion.

Step 6: Achievable waste reduction action plan

A waste reduction action plan is a compilation of the identified waste reduction opportunities and the actions intended to be taken in reducing waste. At this stage, realistic waste reduction targets should be set. Excessive over-targeting could have negative effects on employee attitudes and confidence in future work plans. The work plan focuses on the wastes for which reduction measures, actions and objectives have been specified. The format enables us to identify activities on specific waste materials as well as the total amount of waste reduced, reused, and recycled.

Step 7: Identify the waste reduction, reuse, and recycling opportunities

The following are some opportunities to improve the management of waste products:

a) Reduce Waste

Employees at campus facility may already be employing a variety of waste-reduction techniques. Some disposable products may have already been replaced with reusable products in the facility. Use fewer disposable supplies and equipment that weuse. Focus on strengthening purchasing rules in administrative departments to reduce the amount of incoming packaging.

b) Minimize Paper Usage

Avoiding the waste of paper by implementing double-sided printing and photocopies. E-mail memos and reports to staff or clients instead of providing hard copies. Encourage staff to save digital copies of documents instead of printing them. Remove names from mailing lists if magazines or catalogues are no longer needed.

c) Bulk Purchasing

To get volume discounts, look into buying in bulk. Bulk purchases frequently come with less packaging than items purchased individually.

d) Disposable / Reusable / Eco-friendly Packaging

Request loose products rather than individually packed ones when purchasing supplies. Instead of using disposable tape dispensers, use permanent tape dispensers. Request that the package be "taken back" by the vendor or it should be reusable or eco-friendly.

e) Cafeteria Waste

Single-serve condiment containers should be avoided. Customers that bring theirown coffee/travel mug should receive a discount. To cut down on waste, go over the menus again, focusing on portion sizes. Start a "litter less lunch" campaign to encourage employee or students to bring lunches in reusable containers. Napkin dispensers mighthelp to avoid using too many napkins.

f) Washrooms

Replace disposable hand towel dispensers with hand dryers where possible.

g) Manufacturing Technology

Where possible, adopt newer production technologies that reduce material usage. Due to older technology, make sure that process start-up and/or cut-off tolerances aren't exorbitant. To avoid waste, improve process controls.

h) Reuse Equipment

Reusable things can be donated or sold. The organisations are typically interested in equipment and supplies that are no longer needed.

i) Donate Left Over or Unused Food

Donations of consumable fresh foods and out-of-date packaged foods are welcomed by many food banks. To determine if it can assist in this way, contact the local social organisations.

j) Recycle Waste

Many recyclable materials, such as corrugated cardboard, office paper, newspaper, glass, aluminium, steel, plastic products, and food waste, have markets.

Asthe markets grow, more items may be added to the recycling list.

k) Use of Recyclable Materials

Look for ways to include recycled materials in products development. The success of recycling is dependent on stable material markets. It can also contribute to the environment by buying products containing recycled materials.

l) Internal Recycling

Recycle the own products' materials. Where feasible, introduce processes to support internal recycling of waste materials.

m) Employee Training on Source Separation

Make sure that the segregation in different types of waste materials at source oforigination. All personnel should be trained in source-separation techniques and given enough well-labelled containers and storage facilities to collect recyclable material.

n) Organic and Inorganic Wastes

Examine the options for composting and look into composting organic materials like food waste, leaves and yard trash, and paper towels with private operators or the local Government sectors.

o) Internet or Business Directory

Find recycling companies in the Organization campus area by using a local business directory or by doing a search on the internet.

Step 8: Recommendations for Sustainable Waste Management

- A proper step may be taken to minimize the environmental degradation by means of developing 'Sanitation and hygiene policy', 'Waste management policy', 'Green campus and Environment policy', 'Energy policy' and 'Purchase policy' in collaboration with Governmental and Non-Governmental Organizations.
- Helpline numbers for waste collection may be made available in the Campus which may be useful for door-to-door collection of wastes thus avoiding improper disposalby individuals.
- The concept of eco-friendly culture and sensitize the students to minimize theuse of plastics, non-biodegradable materials and exploitation of natural resources which pose the environmental hazards may be carried out.
- Waste disposal management for both dry and wet wastes should be proper in which from collection to disposal of the waste, together with monitoring and regulation ofthe same may be undertaken. Attempts may be made to segregate the wastes and to convert organic wastes into fertilizing material through recycling and composting processes which may be used for vegetation purpose.
- Students may be taken to some industrial areas including the waste management sites to teach about the recycling of wastewaters, solid wastes, natural ecosystem,

pollution-free environment and environmental education.

15. Best Practices on Waste Management Initiatives followed in the Organization

1. The Campus has taken green and environmental protection initiatives in a substantial manner by means of creating solid waste management, wastewater treatment, sanitation, and natural vegetation in the campus without harming the environment.

2. Various kinds of degradable and non-degradable wastes such as plastics, construction & demolition, biowastes, hazardous, electronic, biomedical, solid & liquid wastes, organic & inorganic wastes are segregated properly and subjected recycle and/or given to Mumbai Municipal Corporation for their further processing.

3. The Management is also taking efforts in establishing vermicompost, organic and green manures facilities, identification of waste reduction reuse, and recycling opportunities, origination of wastes, use of disposable / reusable / eco-friendly packaging materials in the campus in a big way.

4. The Organization is created massive facilities for solid waste management and wastewater treatment to purify the wastewaters to manage both solid wastes and wastewaters effectively without harming the environment.

5. The dust bins and eco-friendly trashes are kept in different places across the campusto provide a dust free atmosphere to the stakeholders which are labelled properly for the indication of degradable and non-degradable items.

6. The management has created a very good campus ecosystem for making a coexisting and sustainable environment which includes natural and planted vegetation supporting a rich biodiversity of flora and fauna.

7. 'Eco Club' and 'Nature Club' along with Units are functioning well and conducting a large number of awareness programmes related to nature conservation and environmental protection.

8. Swachh Bharath Abhiyan and National service schemes are implemented effectively towards sanitation, solid waste management and refining drinking waterquality to promote cleanliness to rural and tribal people across the city.

Follow 3 R : Reduce , Reuse and Recycle
Reduce Buy less and use less. Purchase recycled papers. Use softcopy instead of hard copy Purchase environmentally friendly office supplies. Choose to purchase items with less packaging. Double-side printing and photocopying. Use one-sided printed paper instead of throwing in trash. Set printer to print double sided as a default setting.

Print notices on half-sheets.
Use emails instead of faxes.
Post newsletters online.
Avoid printing out emails.
Host paper-free meetings by setting the agenda on the board.
Use fewer paper towels in the washroom or replace them with electric hand dryer.
Use refillable soap dispenser in washroom
Encourage waste-free lunches.
Reduce the use of tetra-packs by using refillable containers.
In the dining area replace the paper napkins with the cloth napkins.

Purchase condiments, sweeteners, salt, and pepper in bulk.
Use dispensers instead of individually packaged servings.

Reuse

Replace disposable items with reusable items and learn to share or donateto avoid the landfill.
Reuse the other side of used paper.
Use reusable coffee cups and water bottles.
Stock cafeteria with reusable or biodegradable plates, cups, and cutlery.
Donate uneaten lunch items to a “share a lunch” program.
Donate used computers, eyeglasses, cell phones, clothes, textbooks, andother items.
Host a clothing swap/sale/collection.
Host a schoolyard/garage sale-type fundraiser.

Recycle

Divert garbage by recycling items such as paper, glass, plastics, cans, tetra packs, and cardboard.
Recycle special items such as batteries, electronics, cell phones, and computers.
Compost organic waste.
Limit contamination of recycled items by ensuring they are clean.
Recycle ink and toner products.
Ensure correct disposal methods are used for chemicals.

17. Conclusion

NLCis a well-established Institute in India in terms of academic and social activities. The Management is taking enormous efforts continuously in providing an eco-friendly atmosphere to the students, research scholars, parents and staff members. It is observedthat the green and environmental protection initiatives are substantial by means of creating solid waste management, wastewater treatment, sanitation, and natural vegetation in the campus without harming the environment. Various kinds of degradable and non-degradable wastes such as plastics, construction & demolition, biowastes, hazardous, electronic, biomedical, solid & liquid wastes, organic & inorganic wastes are segregated properly and subjected recycle and/or given to Mumbai Municipal Corporation for their further processing. The Management is also taking efforts in establishing vermicompost, organic and green manures facilities, identification of waste reduction reuse, and recycling opportunities, origination of wastes, use ofdisposable / reusable / eco-friendly packaging materials in the campus in a big way. The College has 'solid waste management and wastewater treatment facility to recycle the solid wastes and wastewaters; respectively. The campus ecosystem is supported a rich biodiversity of flora and fauna which is making a sustainable environment and eco-friendly campus due to effective waste management implantation policy. Waste management audit is carried out to provide an indication on how the environmental organization system is working towards the noble cause of environmental protection and nature conservation. To conclude the waste management audit report, the Collegeis an eco-friendly campus and providing very good amicable atmosphere to thestakeholders.

18. Acknowledgement

Quality Care Alliance is grateful to the Management and Principal of NLC, for providing necessary facilities and co-operation extends during the conduct of 'Waste Management audit'. This helped us in making the audit a magnificent success. Further, we hope that waste management audit report may be highly useful tomaintain the pollution free campus which will be helpful for future generations.

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ANNEXURE - CERTIFICATE OF RECYCLING & DISPOSAL

Recycling & Disposal of Waste

GreenGlobe RECYCLING

SAVE THE EARTH

Certificate of Waste Management

ISO 9001(QMS) & ISO 14001(EMS) Certified.

Certificate No. : QC-WM-22-23/62

Date: 15-04-2023

This is to certify that

NALANDA LAW COLLEGE

Gorai 2, Borivali west, Mumbai – 400091. Maharashtra

has successfully undergone the "Waste Management Audit" during the period of Feb to April 2023 under our supervision and the efforts taken by the management and the faculty towards the green campus initiatives.

We appreciate your effort in contributing to a green Environment

Green Regards,

AUTHORISED SIGNATORY

Quality Associates & Consultant

qualitycare.in@gmail.com I QEHS

QEHS Consultant

QUALITY CARE ALLIANCE

QUALITY I ENVIRONMENT I SAFETY I ENERGY CONSULTANTS

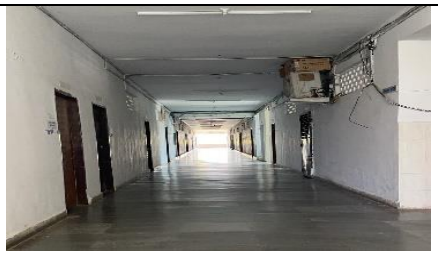
MUMBAI I PUNE I KOLHAPUR I NASHIK I NAGPUR I AMARAVATI

ISO

SHAHU SHIKSAHN SANSTHA'S (PANDHARPUR)
NALANDA LAW COLLEGE
MUMBAI
400 092.

I/C PRINCIPAL
Nalanda Law College
Borivali (west),
Mumbai - 400 091

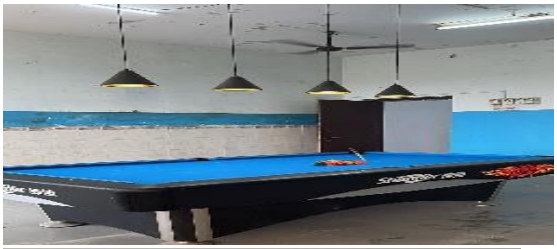
CAMPUS PHOTOS

Photographs of Physical facilities			
Sr. No	**Description**	**Geotag Photo**	**floor**
	Corridors - 1		**Ground floor**
	Corridors - 2		**First floor**
	Corridors - 3		**Second floor**
	Corridors - 4		**Third floor**
	Corridors - 5		**Fourth floor**

	Medical room		
	Pantry		

Geotag Photographs of Physical facilities		
Sr. No	**Description**	**Geotag Photo**
	Girls washroom	
	Girls washroom	

	Boys washroom	
	Boys washroom	

Geotag Photographs of Physical facilities			
SR NO	**DESCRIPTION**	**GEOTAG PHOTO**	**Floor**
	Indoor Games	 	**Second floor**
	Activity Room		**Third floor**
	Yoga Centre		**Ground floor**

*

*******END OF THE AUDIT REPORT*******

THANKS!!!

SHAHU SHIKSAHI SANSTHA'S (PANDHARPURI) NALANDA LAW COLLEGE MUMBAI 400 092.

Think GREEN

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Borivali (west),
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RECYCLE

HELP MAKE A GREEN DIFFERENCE!

Recycle:

- Cardboard
- Office Paper
- Newspaper
- Aluminum Cans
- Metal Cans
- Plastic Beverage Bottle

Do Not Recycle:

- Styrofoam products
- Plastic bags and wraps
- Disposable coffee cups
- Hazardous waste
- Clothing and textiles
- Food waste

Recycling is an easy and effective way to help protect our planet. By recycling materials like paper, glass, and plastic, we can reduce the amount of waste that ends up in landfills and conserve natural resources.

Learn more at
www.companyname.com